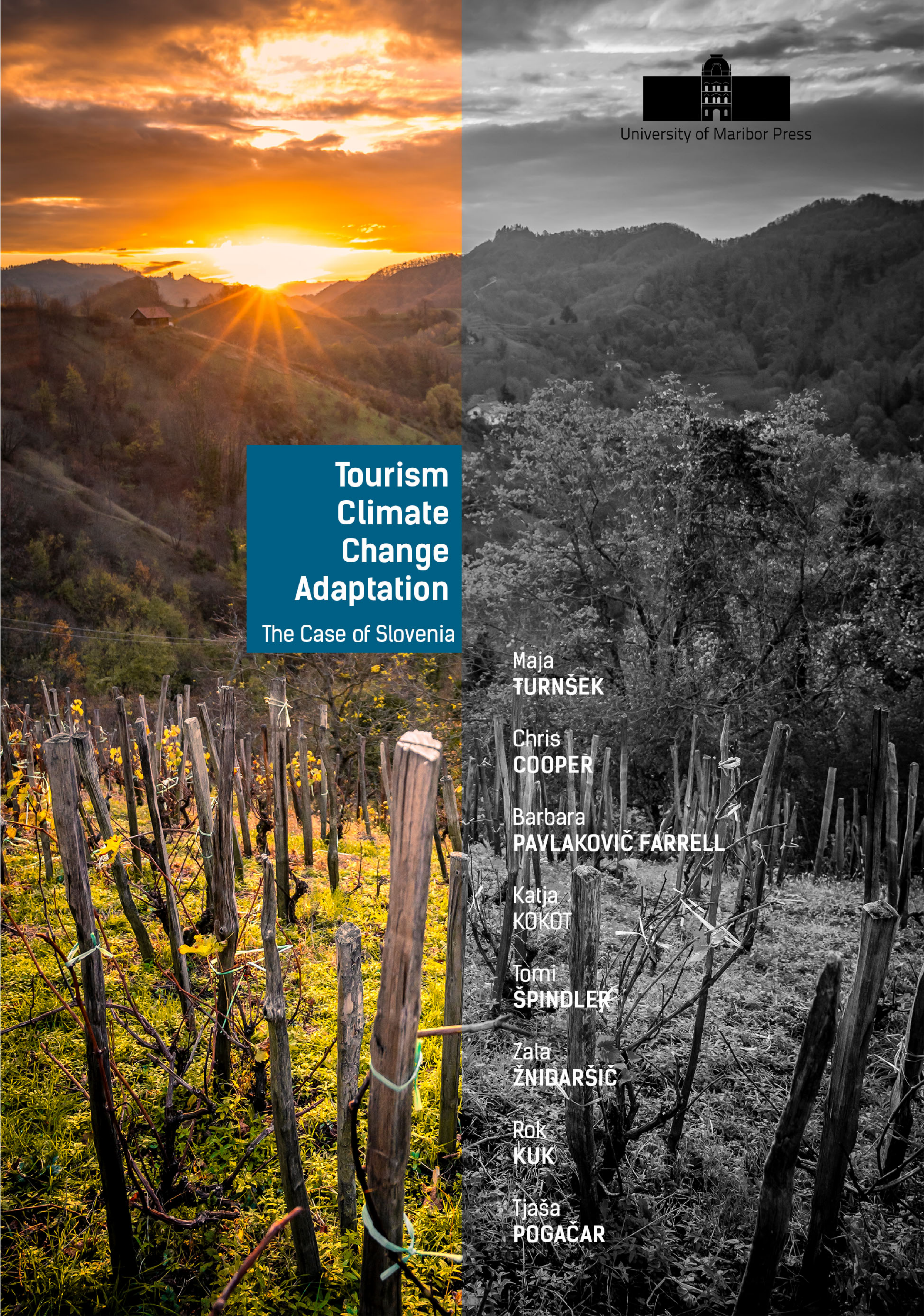

University of Maribor Press

Tourism Climate Change Adaptation

The Case of Slovenia

Maja TURNŠEK

Chris COOPER

Barbara PAVLAKOVIČ FARRELL

Katja KOKOT

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Zala ŽNIDARŠIČ

Rok KUK

Tjaša POGAČAR

University of Maribor

Faculty of Tourism

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Rok Kuk
Tjaša Pogačar

December 2024

Title Tourism Climate Change Adaptation

Subtitle The Case of Slovenia

Authors Maja Turnšek
(University of Maribor, Faculty of Tourism)

Chris Cooper
(Leeds Beckett University)

Barbara Pavlakovič Farrell
(University of Maribor, Faculty of Tourism)

Katja Kokot
(University of Maribor, Faculty of Tourism)

Tomi Špindler
(University of Maribor, Faculty of Tourism)

Zala Žnidaršič
(University of Ljubljana, Biotechnical Faculty)

Rok Kuk
(University of Ljubljana, Biotechnical Faculty)

Tjaša Pogačar
(University of Ljubljana, Biotechnical Faculty)

Review Iva Slivar
(Juraj Dobrila University of Pula, Faculty of Economics and Tourism »dr. M. Mirković«)

Tea Golja
(Juraj Dobrila University of Pula, Faculty of Economics and Tourism »dr. M. Mirković«)

Language editing Hana Kuhar
(University of Maribor, Faculty of Tourism)

Technical editor Jan Perša
(University of Maribor, University Press)

Cover designer Jan Perša
(University of Maribor, University Press)

Cover graphic Gradišče, Zgornji Leskovec, Slovenia, foto: Rene Šešerko, 2023

Graphic material Sources are own unless otherwise noted. Turnšek, Cooper, Pavlakovič, Kokot, Špindler, Žnidaršič, Kuk, Pogačar (authors), 2024.

Published by *Založnik* **University of Maribor**
University Press
Slomškov trg 15, 2000 Maribor, Slovenia
https://press.um.si, zalozba@um.si

Issued by **University of Maribor**
Izdajatelj **Faculty of Tourism**
Cesta prvih borcev 36, 8250 Brežice, Slovenia
http://ft.um.si, ft@um.si

Edition 1st

Publication type E-book

Published Maribor, Slovenia, December 2024

Available at http://press.um.si/index.php/ump/catalog/book/6ft24

Project name: Podnebne sprmembe in trajnostni razvoj slovenskega turizma

Project number: V7-2128

Project financier Slovenian Reswarch and Innovation Agency and Republic of Slovenia, Ministry of the Economy, Tourism and Sport

Slovenian Research and Innovation Agency

REPUBLIC OF SLOVENIA
MINISTRY OF THE ECONOMY, TOURISM AND SPORT

This book was prepared with financial support of Ministry for Economic Development and Technology of Republic of Slovenia and Slovenian Research Agency.

CIP - Kataložni zapis o publikaciji
Univerzitetna knjižnica Maribor

338.484:551.583

TOURISM climate change adaptation [Elektronski vir] : the case of Slovenia / authors Maja Turnšek … [et al.]. - 1st ed. – E-knjiga. – Maribor : University of Maribor, University Press, 2024

Način dostopa (URL): http://press.um.si/index.php/ump/catalog/book/6ft24
ISBN 978-961-286-926-7 (PDF)
doi: 10.18690/um.ft.6.2024
COBISS.SI-ID 214483715

ISBN 978-961-286-926-7 (pdf)

DOI https://doi.org/10.18690/um.ft.6.2024

Price Free copy

For publisher Prof. Dr. Zdravko Kačič
Rector of University of Maribor

Attribution Turnšek, M., Cooper, C., Pavlakovič Farrell, B., Kokot, K., Špindler, T., Žnidaršič, Z., Kuk, R., Pogačar, T. (2024). *Tourism Climate Change Adaptation: The Case of Slovenia*. University of Maribor, University Press. doi: 10.18690/um.ft.6.2024

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List of Abbreviations

UN	United Nations
IPCC	Intergovernmental Panel on Climate Change
GWL	global warming level
UNEP	United Nations Environment Programme
TCI	tourism climate index
HCI	Holiday climate index
RCP	Representative Concentration Pathway
EEA	Euopean Environmental Agency
ARSO	Slovenian Environment Agency
CDS	Climate data store
UNWTO	

1 Introduction

Climate change: A global public problem

The present research aims at analysing climate change impacts on Slovenian tourism to provide appropriate climate change adaptation recommendations for tourism stakeholders. But before we focus on tourism, we need to highlight our own lens through which we view climate change: as a deeply concerning global public problem, one in which tourism cannot be thought of outside the questions of global justice and global care for people and the environment.

In 2022 the latest, sixth, report of the United Nations Intergovernmental Panel on Climate Change (IPCC, 2022) was published. The report includes thousands of pages, but in a nutshell its conclusions can be distilled to one main point: *"The cumulative scientific evidence is unequivocal: Climate change is a threat to human well-being and planetary health. Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all. (very high confidence)"* (IPCC, 2022, p. 33).

If we focus on Europe, the report concludes that warming in Europe will continue to rise faster than the global mean, widening risk disparities across Europe in the 21st century (high confidence). Largely negative impacts are projected for southern regions (e.g., increased cooling needs and water demand, losses in agricultural production and water scarcity) and some short-term benefits are anticipated in the north (e.g., increased crop yields and forest growth). Four key risks have been identified for Europe, with most becoming more severe at +2°C global warming levels (GWL) compared with +1.5°C GWL in scenarios with low to medium adaptation (high confidence). From +3°C GWL and even with high adaptation, severe risks remain for many sectors in Europe (high confidence).

The four key risks identified by IPCC for Europe are:

1. mortality and morbidity of people and ecosystems disruptions due to heat (KR1: heat);
2. loss in agricultural production due to combined heat and droughts (KR2: agriculture);
3. water scarcity across sectors (KR3: water scarcity); and
4. impacts of floods on people, economies and infrastructure (KR4: flooding).

The projection of overall climate hazard risk to critical infrastructures in Europe (Forzieri et al., 2018 in (IPCC, 2022, p. 1854) under the SRES A1B scenario (medium of the SRES scenarios) shows that by the 2080s all of the four analysed sectors of society (energy, transport, social and industrial) are projected to see extreme increases in billions of EUR per year, primarily due to heatwaves, droughts, river floods, windstorms but also wildfires and coastal floods.

Although biodiversity is not identified as its own sector, its importance is more than emphasised by the latest IPCC report, naming biodiversity loss as the twin challenge of climate change. Compared to earlier IPCC assessments, the 6th report claims to have made the greatest leap in recognizing the interactions of human societies, climate, and biodiversity/ecosystems, and integrates knowledge more strongly across the natural, ecological, social, and economic sciences than earlier IPCC assessments. Acc, *"These interactions are the basis of emerging risks from climate change, ecosystem degradation and biodiversity loss and, at the same time, offer opportunities for the future."* (IPCC, 2022).

Climate change is thus a global and highly complex challenge, one that requires unprecedented levels of global governance in all sectors and a formation of the global public (Turnšek, 2011). The problem thus, which in the classic political writings such as John Dewey's falls under the description of an inherently public problem. Dewey's thoughts were triggered by World War I, in which the *"extensive,* *enduring, intricate and serious indirect consequences of a conjoint activity of a comparatively few persons traverse the globe"* (Dewey 1927/1954, 128). Dewey defines the public nature of problems based on the consequences of human acts upon others: the public consists of all those who are affected by the indirect consequences of transactions to such an extent that it is deemed necessary to have those consequences systematically taken care for (Dewey 1927/1954, 15–16). The indirect consequences of human transactions are those which affect people who are not directly involved in these transactions. An issue is judged as a public problem when its potential consequences are perceived as: (a) extensive: when its consequences affect large numbers of people, (b) enduring: its consequences are far-reaching in time, and (c) serious: an issue is public when the extent of injuries or benefits the potential consequences may bring are high (Dewey 1927/1954, 64-67, 126-128).

At the same time, global climate change is an inherently unjust global problem – we can see its inherent unjust nature in both climate change mitigation and climate change adaptation. First, at the level of climate change mitigation, the future actions necessarily involve and depend on the global concerted efforts while at the same time its impacts are extremely disproportionally affecting those populations whose countries have historically contributed the least to greenhouse gas emissions. Second, there is an inherent unjust nature at the level of climate change adaptation – not only are the impacts and future risks disproportionally and unjustly dispersed globally, but the adaptation also itself can be much more regionally, nationally and even locally limited with the wealthiest countries having the most leeway.

In Slovenia, a country representing only 0,5% of European Union (EU) population (or 0,025% of global population), the current general discourse reflecting the two unjust natures of global climate change is pointing out that the country is too small to have an effect on climate change mitigation. So the hopes are put in adaptation since this is the area where the country could be more self-reliant. The argument is that Slovenia necessarily depends on the global governance with regards to climate change mitigation and thus implicitly or directly stating that since the country is so small, there is not much Slovenia can do regarding mitigation success. Climate change adaptation on the other hand is the area where Slovenia can have "its future in its own hands"[1]. The two aspects are, however, highly interconnected, and

[1] The point was emphasized for example at the recent public consultation "Climate change: how do we adapt at the local level?" (Dolinar, 2022).

without global cooperation amongst countries, the adaptation cannot be successful since it in the first place depends on the extent of mitigation that the world is able to introduce. For Slovenia, such a transnational direction of policy comes primarily from its membership in European Union.

In 2021 the European Commission published the "Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change" strategy (EC, 2021), which is one of the main results of the current European Green Deal policy (EC, 2019) – a direction which amongst other guides the post-COVID-19 €723.8 billion worth Recovery and Resilience Facility (EC, 2022b) funding programme whereby climate mainstreaming is aimed to be the norm. The European Green Deal sets clear and measurable goal on climate change mitigation: "no net emissions of greenhouse gases in 2050", with an addition: "where economic growth is decoupled from resource use". With regards to climate change adaptation, the goal is less measurable: "to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts. At the same time, this transition must be just and inclusive".

Although Slovenia has a long tradition of environmental concern (reflected amongst other in the high proportion of protected areas), we can argue here that the current climate change action of the country is to a large extent driven by the concerted efforts of the European Green New Deal. The recent Resolution on the Long-Term Climate Strategy of Slovenia 2050 is for example specifically adopted (in 2021) for the implementation of the Regulation (EU) 2018/1999 of the European Parliament and of the Council on the management of the Energy Union and climate measures and sets the goal to achieve net zero emissions by 2050. The vision as stated in the resolution is translated bellow:

"In 2050, Slovenia will be a climate-neutral and climate-change-resistant society based on sustainable development. It will handle energy and natural resources efficiently, while at the same time maintaining a high level of competitiveness of the low-carbon circular economy. The society will be based on preserved nature, circular economy, renewable and low-carbon energy sources, sustainable mobility and locally produced healthy food. It will be adapted and resistant to the effects of climate change. Slovenia will be a society in which the quality and safety of life will be high, and it will also take advantage of opportunities in the conditions of a changed climate. The transition to a climate-neutral society will be inclusive, and the principles of climate justice will be taken into account. The costs and benefits of the transition will be distributed fairly, as even the most vulnerable population

groups will be able to implement mitigation and adaptation measures." ((ReDPS50, 2021), emphasis on climate change adaptation added).

With regards to climate change adaptation the national vision thus recognises its importance and sees it not only as a threat but also as including potential opportunities – a view, as we will see throughout this monography, is highly important for the question of adaptation of Slovenian tourism to climate change.

Tourism and types of climate change impacts

One of the first highly influential texts on tourism and climate change is the common WTO & UNEP report (Scott et al., 2008) which identified four broad categories of climate change impacts that could affect tourism destinations, their competitiveness and sustainability:

- **direct climate change impacts:** including geographic and seasonal redistribution of climate resources for tourism, and changes in operating costs (heating-cooling degree days, insurance premiums),
- **indirect environmental change impacts:** including climate induced-environmental changes such as water shortages, biodiversity loss, decline of landscape aesthetic, increase in vector-borne disease, damage to infrastructure,
- **impacts of mitigation policies on tourist mobility:** including changes in tourist flow due to increased prices; alterations to aviation routes; changes in the proportions of short-haul and long-haul flights, and
- **indirect societal change impacts:** including the consequences of the broader impacts of climate change on societies, such as changes in economic growth, development patterns, social-political stability and personal safety in some regions. These will have 'knock-on' effects on operations, employment and security issues in tourism and related sectors.

In this research we are limited to the empirical analysis of climate data that show the past trends and future projections of the direct climate change impacts on Slovenian tourism. In the discussion of these impacts, we theoretically address both the indirect environmental change impacts and the impacts of the mitigation policies on tourist mobility. The indirect societal change impacts are however unfortunately beyond the scope of this research. Yet we recognise that these impacts are potentially the most important impacts since they are the "game-changers" that "pull the rug underneath our feet" by negating our assumptions - primarily the assumption that the societal development in Slovenia will continue on its current path. And as we are seeing with both COVID-19 and the war in Ukraine, the world is a fragile place, growing more and more fragile with climate change. It is therefore highly important to openly stress that the most important limitation of this research is the exclusion of indirect societal change impacts of climate change on Slovenian tourism and that the overall analysis is made on the assumption that tourism in Europe will continue to be a highly sought-for activity in a relatively peaceful society.

From a macroeconomic standpoint, tourism is considered to be one of the most vulnerable industries to climate change because of its singular dependence on climate resources. However, there is no empirical evidence to show whether or not tourism is actually more vulnerable and less resilient to climate change. The tourism industry, albeit more vulnerable, appears to also be more resilient to climate change compared to other sectors of the economy (Dogru, Marchio, Bulut, & Suess, 2019).

Vulnerability to climate change is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, the sensitivity and adaptive capacity of that system. Adaptation to climate change refers to the adjustment in natural or human systems in response to actual or expected climate change stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007). Tourism is one of the rare industries identified both by IPCC (2007, 2022) facing not only negative effects but also some positive economic effects in regions that have benefited from lower energy demand as well as comparative advantages in agricultural markets and tourism.

A destination's climate change vulnerability depends on exposure to climate change (which varies spatially in terms of the negative, or positive, impacts of warming and precipitation), the sensitivity of the tourism system, and the adaptive capacity of the destination to cope with change (Čavlek, Cooper, Krajinović, Srnec, & Zaninović, 2019). As one of the latest climate change adaptation guides for Mediterranean tourism (eco-union, 2019) stresses, the excessive development in tourist destinations, such as the construction of hotel complexes, ski resorts and transport infrastructure, has generated significant environmental impacts. The intensity of infrastructure development increases the degree of exposure and sensitivity to the impacts of climate change, such as water scarcity, flooding and other climate events (eco-union, 2019). Because tourism is characterized by extensive spatial interconnectedness, transboundary climate change risks across competing destinations will subsequently have important implications for regional market dynamics and destination competitiveness (Scott & Gössling, 2022).

The most important recent initiative in tourism and climate change is The Glasgow Declaration: Climate Action in Tourism (UNEP, 2021b). Its signatories support the global commitment to achieve a 50% emissions reduction in tourism operations by 2030 and to reach Net Zero emissions as soon as possible before 2050. To achieve these overarching goals, signatories are expected to publish a climate action plan, or to update an existing plan by integrating climate action elements or aligning its targets with those in the Glasgow Declaration. While the proposed actions focus predominantly on climate change mitigation, some specifically address climate change adaptation (see Figure 1).

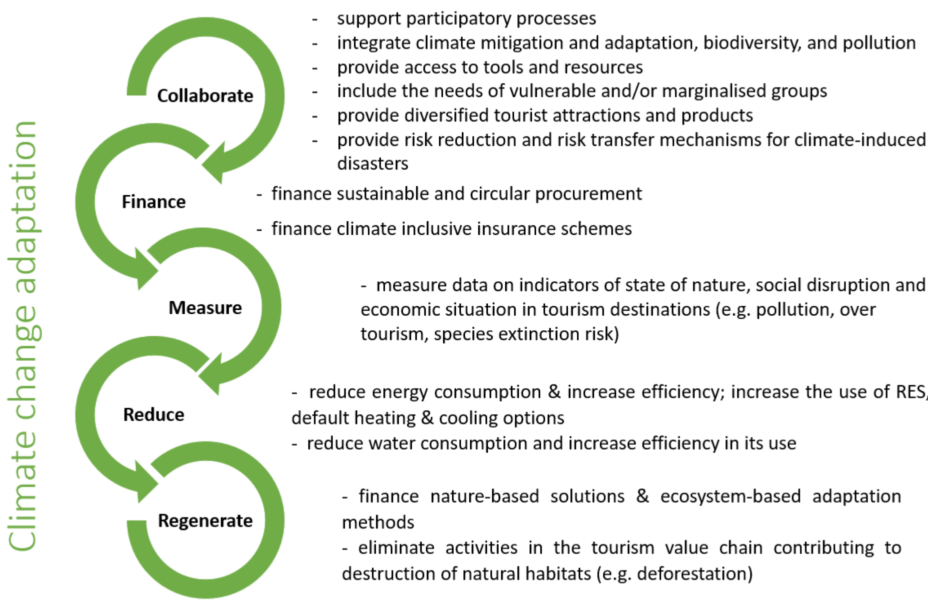

Figure 1: Glasgow Declaration Climate Action in Tourism: Recommended Actions for Climate Change Adaptation

Source: own formatting based on UNEP (2021b)

However, according to the first results of the Global Survey on Climate Action in Tourism (Pilgreen, 2022) the adaptive capacity amongst approximately 1100 of survey respondents is largely lacking and tourism organisations do not routinely review their climate objectives or assess present and future risks. Most of the current adaptations in tourism are technical (e.g. water harvesting and energy efficiency) and organisational policy related adaptations (e.g. changing organisational strategies).

Slovenian tourism and climate change impacts research: State of the art

Slovenian tourism has been included in several cross-country comparative analyses providing a global or an European overview of projected climate change impacts. Already in 2006 Amelung & Viner (2006) projected a deterioration of tourism climatic conditions in the summer and an improvement in the spring and autumn for Slovenia.

In Scott & Gössling's (2019) analysis of the global tourism vulnerability to climate change on a range of 27 indicators Slovenia's tourism fell amongst the least vulnerable (see Figure 2), positioning it with other Western countries.

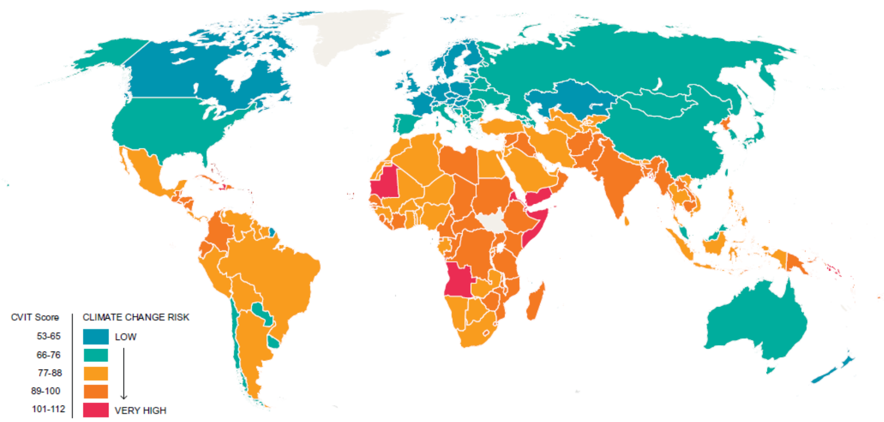

Figure 2: Global distribution of Climate Change Vulnerability Index for Tourism (CVIT)
Source: Scott, Hall, & Gössling (2019,p. 56)

Such global comparison is highly important for the overall picture of the extremely uneven spread of the global climate change impacts, that reflect in all sectors, including tourism. It is a strong argument with regards to the responsibilities the rich industrialised countries have in the aim for a just transition, whereby Slovenian tourism should not be exempt from such concerns, especially since in some respects, as we will see in our report, it is projected to even benefit from climate change.

On the other hand, even if Slovenian (and we must add here European) tourism is projected to fair much better compared to some other parts of the world, there is still a need for a detailed analysis of projected impacts at the national and even smaller-scale level in order to strategically build adaptation policies of Slovenian tourism and its interconnection with other sectors: biodiversity protection, transport, energy and food production.

We can identify two separate phases of Slovenian research on climate change impacts on tourism. The first started about 20 years ago with two main figures: Lučka Kajfež Bogataj and Dušan Plut. Lučka Kajfež Bogataj is renowned climatologist who has long been a member of IPCC and one of the vice chairs of IPCC Working Group II Impacts, Adaptation and Vulnerability (Golobič, Gulič, Kajfež Bogataj, Mladenovič, & Praper, 2008; Kajfež Bogataj, 2009; Kajfež Bogataj et al., 2014). She was also the joint recipient of the Nobel Peace Prize in 2007 for the IPCC's efforts on climate change. She is the only Slovenian in recent history to receive the award, giving her important credibility and we argue here that receiving the award helped to bring awareness on climate change in Slovenian public discourse (one of the authors of this report remembers starting to be interested in the issue of climate change as a young girl due to Lučka Kajfež Bogataj's vocal presence in the media at the time). The second main figure of the first wave of research on climate change and tourism is the critical geographer Dušan Plut (Lampič, Mrak, & Plut, 2011; Plut, 2007, 2014), calling for the green sustainable development of Slovenian society, including tourism. Both have at the time warned regarding especially two climate change impacts on Slovenian tourism: the diminishing snow cover and its impact on the winter tourism in Slovenian Alps, and the rising sea level and its impact on Slovenian coastal tourism.

In 2007 the issue received so much attention that a special consultation was organised by the National Council of the Republic of Slovenia which is the representative body for social, economic, professional and local interests composed of representatives of labour and social interests, and representatives of local interests (territorial interests). Together with several tourism governance stakeholders and academia, the consultation resulted in an edited collection of speeches and short papers published by the National Council of the Republic of Slovenia and the Tourism Association of Slovenia (Faletič & Černe, 2007) including works of Kajfež Bogataj (Kajfež Bogataj, 2007) and Plut (Plut, 2007). The collection warned primarily of diminishing snow cover, the need for water management in the Istria region, and increase of sea level. Winter tourism received most attention (Sever, 2007; Žerjav, 2007), with the authors primarily stressing the need for technical snowmaking. At the same time positive benefits of projected increase of warm days were stressed and consequently the benefits for primarily water-based tourism (Juriničič, 2007; Kajfež Bogataj, 2007; Kovač, 2007; Plut, 2007). Kovač (2007, p. 34) hypothesed that tourism might highly likely be one of the industries characterised as the more important "winners of climate change".

In 2014, Kajfež Bogataj and her team prepared a document for the Ministry of Environment of the Republic of Slovenia providing an overview of climate change hazards for Slovenia. The identified hazards important also for tourism were:

- a strong impact on water resources and water supply that is projected to cause problems with the supply of drinking water in the summer,
- a rise in temperature and the increase in the frequency and duration of heat waves, that are likely to lead to changed energy consumption (a greatly increased need for cooling in summer and a slightly reduced need for heating in winter) and an increase in the need for green areas in cities,
- possible changes in tourism flows that may cause disruptions in the industry and increase operating costs, and
- increased frequency and intensity of extreme weather phenomena may increase damage to infrastructure and threaten the stability of the insurance system, with needed adaptation in construction and spatial planning (e.g. planning outside flood zones) (Kajfež Bogataj et al., 2014).

The Slovenian Environment Agency (ARSO) has been and continues to be the most vocal and authoritative figure in warning on climate change, including tourism (Bergant et al., 2010; Cegnar, 2007, 2015; Percic, Cegnar, & Hojs, 2020). Additionally, the last decade has seen a rise of activities of several non-governmental organisations, amongst which especially CIPRA International and Umanotera stand out in their research activities that aim at dissemination also in the world of tourism (Haubner, 2022; Karba, Sonnenschein, & Gnezda, 2021; Umanotera, 2022).

Ever since its inception in 2014 the Green Scheme of Slovenian Tourism, a national certification scheme intended to boost sustainability of Slovenian tourism, included criteria with regards to climate change adaptation. Currently the two areas of criteria are: (a) asking whether the certified destination or tourism provider includes climate change adaptation measures in any of their strategic documents, and (b) what measures do they include with regards to informing the destinations' tourism stakeholders on climate change.

These combined activities of what we call "the first wave" of research on tourism and climate change in Slovenia resulted in heightened awareness in some of the destinations – especially Kranjska Gora, whose representative was also speaking at the 2007 consultation (Žerjav, 2007). They were amongst the first to include climate change adaptation in their strategy (Kovačič, 2015) and has actively worked on transforming from winter destination into a year-long destination, and even researched on bio-climatic conditions of the area as a potential climatic health resort (Cegnar, 2015). Currently, Kranjska Gora has more tourists in the summer than in the winter (STO, 2021b).

However, for more than a decade, the issue of tourism in relation to climate change adaptation received only little attention from policy makers. The past Strategy for the Sustainable growth of Slovenian Tourism for 2017–2021 (STO, 2017), although striving for sustainability, never directly addressed climate change. The focus of Slovenian tourism started to shift only recently with the European Green Deal (EC, 2019) and the EU's direction into climate mainstreaming in its financing – starting what we term here the second phase of research on tourism and climate change in Slovenia.

Since 2019 we could see an increase in climate change adaptation public awareness events, for example by (Čenčur Curk, 2019) who points to the role of drought on diminishing water resources and lack of freshwater for tourism purposes, the negative effect of higher summer temperatures for tourism activities and the effects of increased winter temperature on ski tourism. An important recent change was made especially with the EU Recovery and Resilience Facility, where Slovenia had to commit that at least 40% of the funds from this Facility will be used for green and climate friendly transformation of society.

Climate change was put back on the radar of Slovenian tourism policy via three recent measures:

1. a joint public call for tourism climate change mitigation and adaptation research made by Ministry of Economic Development and Technology and Slovenian research Agency (financing this report amongst other project activities of the hereby presented project, most importantly: developing a model of Slovenian tourism carbon footprint and analysis of the Slovenian tourism climate change mitigation state of the art and proposed future measures);
2. use of the EU Recovery and Resilience Facility public funding to support tourism post-pandemic growth via financial support in accommodation infrastructure investments (69.000.000,00 EUR) whereby the investors could receive up to 75% cofounding and 50% of the investment needed to be spent on energy efficiency of accommodations (MGRT, 2022a); and
3. including climate change in the newest national tourism strategy, whereby the issue of tourism adaptation to climate change remained limited to stressing that this research project is financed and that it will lead to a model of Slovenian tourism climate change adaptation (MGRT, 2022b).

Co-funding of the hereby presented research is thus the first of the three recent activities of the Ministry of Economic development and Technology of the Republic of Slovenia with regards to climate change adaptation of Slovenian tourism. Our aim is to provide a detailed analysis of projected climate change impacts on Slovenian tourism with recommendations for future necessary climate change adaptation on four levels: the tourists, the tourism providers, local and macro-reginal destinations, and finally national level. For that we turn first to the overview of similar research in countries that share Slovenia's climate conditions.

Literature review: Tourism and climate change impacts in South & Central Europe

If we focus on research in Europe, three climate zones are of prime importance for Slovenia: the Mediterranean, the Alps (Boreal South & Continental) and the Pannonian. Slovenia occupies parts of the Alps, the Dinarides, the Pannonian plane and the Mediterranean coast. The southwest of the country exhibits submediterranean climate which is characterised by dry and hot summers with frequent heat waves, and mild winters. Central Slovenia has subcontinental climate or moderate climate of hilly region with relatively cold winters, warm summers, and large amounts of precipitation, except for Prekmurje (Pannonian plane) which is much dryer (Pucer & Štrumbelj, 2018). The climates correspond well with the four strategically identified macro destinations of Slovenian tourism (see Figure 3).

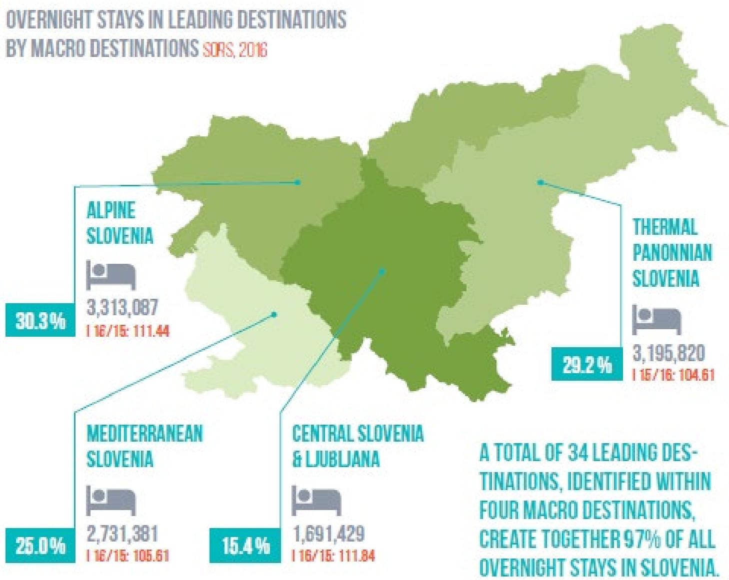

Figure 3: Four macro destinations of Slovenian tourism as first defined by the national tourism strategy 2017-2021 (STO, 2017)

Source: STO (2017, p. 17)

Regarding tourism in Europe the 6th IPCC report emphasizes that both snow-cover duration and snow depth in the Alps has decreased since the 1960s. Due to reduced snow availability and hotter summers, damages are projected for the European tourism industry, with larger losses in Southern Europe (high confidence) but also some smaller gains in the rest of Europe (IPCC, 2022) p. 1852).

Previous research has shown projected prolongation of the seasons for outdoor tourism for all three climate zones in Slovenia's neighbouring countries: Croatia (Čavlek et al., 2019), Austria (Rudel, Matzarakis, & Koch, 2007), and Hungary (Kovács & Király, 2021). We turn to research on climate change and tourism in each of these European areas in the next sections.

Climate change and tourism in the Mediterranean basin

Twenty years ago, in 2003 the UNWTO held its 1st International Conference on Climate Change and Tourism in Djerba, Tunisia, resulting in the Djerba Declaration essentially urging tourism stakeholders to take action on both climate change adaptation and mitigation (UNWTO, 2003). The projections for the Mediterranean basis were: 0.3-0.7 °C temperature rise per decade, increase in heat index, increase in number of days with maximum daily temperature over 40 °C, decrease (15%) in summer rainfoall, increase in desertification, increase in winter rainfall, increase in erosion and runoff, increased risk of forest fires, flash floods, water resources pressures and vulnerability of coastal areas and infrastructure to sea level rise (Todd, 2003).

According to Amelung & Viner's projections made already in 2006, we should be currently living at the times of major changes – they projected that the Mediterranean changes from being a region with very good or excellent summer conditions up to the 2020s into being a region with only good or acceptable conditions or even marginal conditions in 2080s within the worst-case projected scenario. Their results show that northern Europe will have a more attractive climate while the Mediterranean will likely become too hot in the summer and a more pleasant destination in spring and autumn (Amelung & Viner, 2006). The recent data on hottest summers in European history in 2022 seem to confirm these projections made 17 years ago.

At the same time Nicholls (2006) warned that environmental impacts of climate change will have serious implications for the future planning and development of tourism attractions in the Mediterranean region, including the potential need for the construction of new and improved sea defences, and new regulations and/or incentives regarding coastal setbacks and the use of traditional building designs and materials in order to minimize rising energy costs. The supply of water is also likely to become an increasingly contentious issue in the Mediterranean, particularly between local residents and the providers of tourism attractions such as golf courses and swimming pools, and many providers will likely face a rise in the cost of insurance due to the increasing frequency and severity of extreme weather events (Nicholls, 2006).

While the early projections were based primarily on the direct climate data, such as for example projections of temperature change, soon a more nuanced and thus complex approach was developed via combining both climate data and tourists' preferences for specific climate conditions for different activities. Originally, the approaches understood here under the broad umbrella of tourism climate conditions indexes, such as the holiday climate index (HCI) and tourism climate index (TCI) (Scott, Rutty, Amelung, & Tang, 2016) were developed to analyse the appropriateness of climate conditions at certain destinations. For example, Morgan et al. (2000) improved the so-called beach climatic index based on questionnaire surveys amongst Mediterranean tourists to establish the preferences of north European beach users for thermal sensation and bathing water temperature, plus priority levels for other climate attributes. Then they compared these to the climate data at Mediterranean destinations and concluded that many of the Mediterranean destinations were 20 years ago already too hot at the peak of the season in July and August (Morgan et al., 2000).

Only later did we witness the applications of the climate indices approach to the question of how to form future projections with regards to climate change impacts for tourism. Using the TCI Bafaluy et al. (2014) projected suitability for various outdoor activities for the Bay of Palma, Spain where the summer is already too hot for most outdoor activities to be performed during the whole day (except for the water-based activities) – this is projected to remain the same, however, other seasons are projected to become friendlier. For Croatian island of Lošinj, the TCI projections were thus made also on the intra-daily basis according to the season (Čavlek et al., 2019). In general, throughout the year, the results showed a decrease of unacceptable conditions and an increase of acceptable and ideal conditions for Lošinj. Examining annual data, the mornings showed an improvement of climate conditions for all activities. However, analysing on a monthly scale, there are differences between activities. For typical marine activities (3S – sun, sea and sand, motor boating, and sailing) more favourable climate conditions are visible for all months during the warm period of the year in the morning as well as in the afternoon. On the other hand, for all other analysed outdoor activities (cycling, cultural tourism, hiking, golf, and football), there is an increase in ideal conditions for all months in the morning, while in the afternoon, there is an increase of ideal conditions for spring and autumn but a decrease or very small change during the summer (Čavlek et al., 2019). The answer of the Mediterranean destinations to the increasing heat as the most problematic impact of climate change has thus primarily been in the form of intraday adaptation and prolongation of the season. However, more research and a broader view of adaptation possibilites is needed for Slovenian Mediterranean tourism.

Climate change and tourism in the Alps

Areas at high altitudes are being strongly modified by climate change. The impact of climate change on European Alpine winter tourism has been extensively analysed, showing decreased snow cover, melting of permafrost, and glacier retreat (Bausch, 2019; Malasevska, Haugom, Hinterhuber, Lien, & Mydland, 2020; Pröbstl-Haider, Haider, Wirth, & Beardmore, 2015; Salim, Ravanel, Bourdeau, & Deline, 2021; Vij, Biesbroek, Adler, & Muccione, 2021)

In the Alps, the total surface area of glaciers decreased by half between 1900 and 2012, and there has been a considerable acceleration of this phenomenon since the 1990s. Concurrently, periglacial environments in the Alps, which are mainly characterized by frost action and permafrost are tending to warm up and degrade resulting in an increase in the frequency and volume of rockfalls. Thus, conditions for summer mountaineering in the Alps tend to deteriorate year by year. This leads to an increase in the danger and technical difficulty of due to a growing number of detrimental geomorphological processes. As a result, good periods for mountaineering tend to be more unpredictable in summer and have shifted towards spring, autumn and even winter for some routes. As such, high mountain activities do not benefit from the positive effects of climate change on summer nature-based tourism (Mourey, Perrin-Malterre, & Ravanel, 2020).

Based on the data on entries to urban outdoor recreation facilities in Switzerland (mostly water based) and climate change projections until 2030 Finger & Lehmann (2012) conclude that near future climate change characterized by temperature increases and reduced precipitation levels in late summer will have a positive effect on the number of outdoor recreation visitors. While the expected increase of the annual number of visitors ranges from 9 to 19%, increases of >30% are expected for August and September (Finger & Lehmann, 2012).

For Austria, thermal comfortable conditions are projected to increase up to approximately 10 days (but the trends are ambiguous - urban areas show no trend). In the annual course the thermal suitability for recreation and leisure is extended into the late autumn (Rudel et al., 2007). Rudel et al. (2007) predict that in southeast of Austria more than 40 days with heat stress will occur, and in generally the heat stress periods will extend. Also, the days with sultry conditions are projected to increase nearly in the same manner. However, Austrian areas with an elevation above 1000 m are projected not to be affected. Furthermore, the number of days with no or little precipitation are expected to increase, days with foggy conditions to decline accordingly while on the other hand days with significant precipitation are projected to increase.

Pröbstl-Haider et al. (2015) identify three potential positive effects of climate change on summer tourism in Austria: (a) increased number of visitors due to the negative effects of climate change in the Mediterranean, (b) increased lake tourism due to inreased temepratures and more sunshine, and (c) increased mountain hiking and mountaineering due to more days with sunshine. Their survey amongst German tourists showed that the attractiveness of an increasing number of sunshine days depends on visitors' motivation and desired activities. While the relaxation-oriented segment reacted positively to more sunshine days, the activity and sports-oriented segment as well as the nature-oriented segment were less attracted by this change. The number of sunshine days had little influence on destination choice.

In a recent large-scale study Pröbstl-Haider et al. (2021) project that for many activities in Austria, climate change will lead to a prolongation of the season, which is an advantage for destinations focusing on hiking, biking, swimming, water sports, air sports and golf. However, it can be shown that climate-induced phenomena will have a strong impact on many of these activities, such as climbing and alpine touring, fishing, golf, and water and air sports. Here, the impacts may even lead to a change of destination or activity (Pröbstl-Haider, Hoedl, Ginner, & Borgwardt, 2021). While Austrian data are of prime importance also for large extent of Slovenia (especially the Alpine macro destination), more research is needed, especially since, as we will see bellow, Slovenian climate is becoming more similar to climate in Hungary.

Climate change and tourism in the Pannonian Basin

According to EEA (see Figure 4) the climate in Slovenia has shifted from primarily Continental to primarily Pannonian in the past decade.

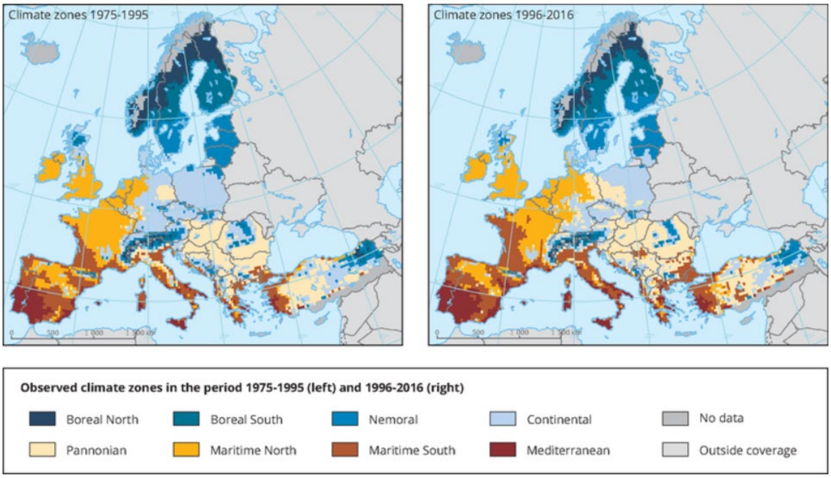

Figure 4: Observed climate zones in the period 1975-1995 (left) and 1996-2016 (right)
Source: (EEA, 2019)

While the Alps and the Mediterranean received intensive research attention with regards to climate change impacts on tourism, the Pannonian plane received much less focus. One exception is the study of the TCI projections for tourism in Hungary by Kovács and Király (2021) who conclude that the annual course of the present and future conditions for tourism is bimodal in all cases, that is, the most favourable circumstances are found in spring and autumn, while in the summer period, a decline in climate potential is observed (Kovács & Király, 2021). They continue, that the improvement of climate conditions in spring and autumn has the potential to extend the outdoor tourist season, which is a key element of adaptation to the altered conditions. The means of diversifying the tourism economy can be the development of different outdoor and partly indoor services usable in extended periods. The authors stress that in Hungary, cultural and gastronomic festivals, health tourism (especially the development of tourism-based medical services) or strengthening business and conference tourism can be feasible directions for future climate change adaptation. The unfavourable tendency shown in summer, which is mainly due to the increasing frequency of warm (or hot) days and extreme events, may encourage tourism operators to develop non-weather and non-climate sensitive products. Themed walks, theme or leisure parks, visitor centres, indoor event spaces, indoor baths, spas or water parks can be effective solutions for this purpose. In each case, the infrastructure for hosting the tourists (accommodation, hospitality) should be adapted in space and time to the altered demand (Kovács & Király, 2021).

Research approach

This research includes cooperation of climatologists and tourism scholars, analysing the climate data and discussing the climate impacts from the perspective of the need for sustainable development of Slovenian tourism, paying specific attention to the relationship between the climate change adaptation and potential threats it may bring to the necessary goals needed for the imperative to decrease of the carbon footprint of Slovenian tourism.

The climate data used in this research is collected from both the national (ARSO) and European climate services (Copernicus Climate Data Store, CDS). The EU climate adaptation strategy (EC, 2021) aims to improve knowledge and develop effective and inclusive governance mechanisms and so called »EU scientific lighthouses« with specific emphasis on Copernicus CDS and the European Marine Observation and data Network (EMODnet) with the aim for these bases to continue to increase data usability in climate change adaptation, for example via European Environment Agency's information platform Climate ADAPT. This project is amongst the first in Slovenia to take advantage of the relatively new Copernicus CDS of providing a set of bioclimatic indicators assessing whether weather or climate conditions are suitable for touristic activities. These indicators are tailored for different kinds of touristic activities. Currently, Copernicus provides data on The Holiday Climate Index (HCI) which is focused on urban tourism, while the Climate Index for Tourism (CIT) is focused on beach tourism. In the future it is planned that also The Climate Suitability for Tourism Apps will be published soon (Copernicus, 2022a).

Ljubljana Tourism is the first (and currently still only) published case of the usefulness of the HCI for local destination management at the Copernicus website for Europe overall (Copernicus, 2022c). However, the discussion with Ljubljana Tourism (personal communication, 19 September 2022) shows that they did not include the data in their strategy and that they would benefit from help in interpretation of the data and specific recommendations that could be made based on the data – the gap that is intended to be filled with this report both for Ljubljana and other Slovenian destinations.

The hereby presented analysis of climate change impacts and future hazards for Slovenian tourism is first based on determining the tourism activities selected for the analysis. This selection then guides the selection of climate data, such as the CIT and HCI, and snow cover duration. We selected the activities and formed the overall structure of this book on the basis of the 10 lead tourism products as identified by the national Strategy for sustainable growth of tourism 2017-2021 (STO, 2017, see Figure 5).

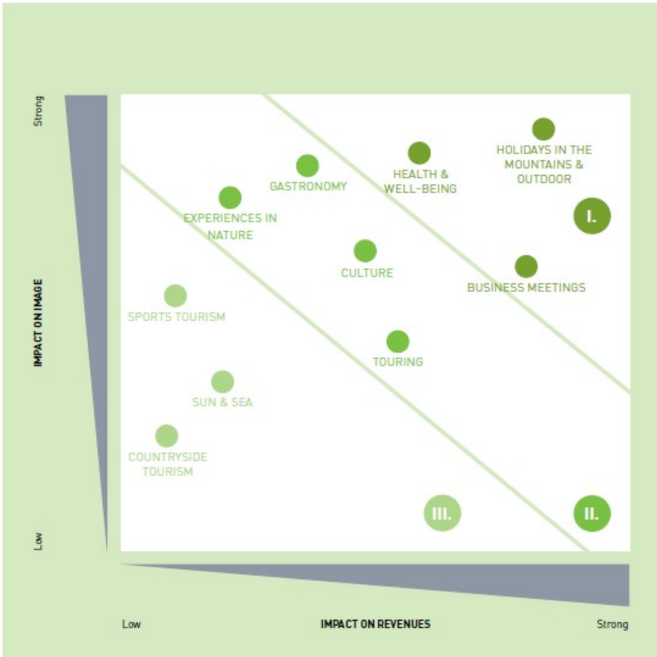

Figure 5: The most important products in terms of their impact on revenues and image divided into three groups with regards to their relevance
Source: STO (2017, p. 23)

The analysis was made before the new Strategy of Slovenian Tourism 2022–2028 (MGRT, 2022b) was published. However, the new strategy builds on the previous strategy and has upgraded the typology of 10 leading products into just 4 leading products: three were the same as already identified in previous strategy: 1. outdoor activities in nature, 2. health and wellbeing, and 3. meetings, incentives, conferences and exhibitions (MICE). The new strategy added the fourth lead product: 4. culture and historical towns. Other products were reinterpreted as horizontal or interconnecting products (gastronomy, experiences in nature, culture and historical towns and touring), or as niche products. Our analysis of projected climate change impacts is thus in line also with this new typology of Slovenian tourism products, whereby we:

– cover health and wellbeing and sun & sea tourism in a common chapter due to their dependency on water-based activities and thus similar climate conditions for outdoor water-based activities,
– cover MICE tourism and culture and historical towns within the chapter on urban tourism due to their similar climate conditions and importance of urban and building infrastructure, and
– divide holidays in the mountains and outdoor activities into winter and summer activities due to the very different climate conditions they require in each of the two seasons.

Taking into account the ideal climate conditions necessary for each type of tourism activity the analysis of climate change impacts and projections of future hazards as presented in this monography follows the stated categorisation:

Chapter 4: Health, wellness, beach and other water-related tourism:

– health & well-being,
– sun & sea,
– sports tourism (for water based sports).

Chapter 5: Urban and cultural tourism and MICE tourism:

– business meetings & events,
– culture,
– touring (for urban activities).

Chapter 6: Winter outdoor tourism:

– holidays in the mountains and outdoors,
– experiences in nature,
– sports tourism,
– countryside tourism,
– touring (for outdoor activities).

Chapter 7: Summer outdoor tourism:

- holidays in the mountains and outdoors,
- experiences in nature,
- sports tourism,
- countryside tourism,
- touring (for outdoor activities).

Climate change projections and past data are thus analysed and interpreted for each of the selected four areas of tourism activities in Slovenia, covering different climate data and including interpretations specific for these activities.

Each of the chapters includes proposed adaptation measures for the specific analysed type of tourism at the individual, organisational, local destination and national level. Adaptive capacity namely varies within the tourism subsectors. According to Scott et al. (2008) tourists have the greatest adaptive capacity (depending on three key resources; money, knowledge and time) with relative freedom to avoid destinations impacted by climate change or shifting the timing of travel to avoid unfavourable climate conditions. Large tour operators, who do not own the infrastructure, are in a better position to adapt to changes at destinations because they can respond to clients demands and provide information to influence clients' travel choices. Suppliers of tourism services and tourism operators at specific destinations have less adaptive capacity. Destination communities and tourism operators with large investments in immobile capital assets (e.g., hotel, resort complex, marina, or casino) have the least adaptive capacity (Scott et al., 2008).

We turn now to Chapter 3 where the methodology of climate data collection and calculations is explained and argumented in depth for each of the selected datasets.

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2 Data collection and calculations

Highlights

- Scenario-based projections are used to describe future climate change. This report uses three scenarios: RCP2.6, RCP4.5 and RCP8.5, which represent the full range of possible climate strategies in the 21st century. These scenarios are used as input data for climate models, which produce projections for various meteorological variables at selected locations.
- The uncertainty of projections is assessed using the spread of values projected by different models. Projections of air temperature and resulting indicators, such as hot days and tropical nights, are much less uncertain than projections of precipitation. The reliability of projections of relative humidity, cloud cover, and the like, which were used to calculate tourism climate indicators, is even lower.
- We analysed historical data and projections from the Copernicus Climate Change Service for two climate indices (HCI: Urban and CIT: 3S) at locations near major tourist destinations for the reference period (1986–2005) and future scenarios (RCPs) in the periods 2021–2040, 2041–2060, 2081–2100. We selected locations near Slovenian Environmental Agency (ARSO) weather stations, so we could compare the historical period data with measurements.
- We also analysed climate projections provided by ARSO for the number of days in a month with at least 1 mm / 20 mm of precipitation, number of days with snow cover, number of tropical nights, warm days, and hot days for four time periods (2011–2040, 2041–2070, 2071–2100 vs. the reference period 1981–2010) and three RCPs.
- CIT, HCI and effective temperature values were calculated for the historical periods (1971–2000, 1981–2010, 1991–2020, and for comparison with the Copernicus dataset also for 1986–2005 from measurements at selected ARSO weather stations.

– We analysed historical and future climate conditions (number of days with 5 cm / 30 cm of snow cover, total snow precipitation and potential snowmaking hours) at eight ski resorts using data from a Copernicus dataset.

Trends, representative concentration pathway scenarios, reliability

Current trends of already measured climate change are determined based on measurements of meteorological variables and indirect calculations of climate indices to describe the situation in individual sectors, such as tourism. We use a period of at least 30 years to describe the state of the climate. This period is long enough to avoid confounding climate change with the short-term natural variability of individual years or shorter periods.

Scenario-based projections are used to describe future climate change. Increasing levels of greenhouse gasses (GHGs) in the atmosphere have been a major driver of climate change since the Industrial Revolution. Each emissions scenario depends on global socioeconomic factors such as population growth rate, gross domestic product, and technological development in the 21st century, and the projections are based on four scenarios of representative concentration pathways (RCP) (Van Vuuren et al., 2011), which represent the full range of possible climate strategies in the 21st century. We distinguish them by the numerical value of the total radiative forcing in 2100, which tells us the change in the net radiation in the atmosphere compared to the pre-industrial period: from 2.6 to 8.5 W/m^2. At higher values of radiative forcing, we expect larger changes in the climate system.

The optimistic scenario RCP2.6 envisions active climate change mitigation policies and consequently very low GHG emissions, with a surplus at the beginning of the 21st century and a gradual decline thereafter. The moderately optimistic scenario RCP4.5 envisions a gradual decline in emissions beginning in the second half of the 21st century and a stabilization of the radiative forcing soon after 2100. Similarly, in the less commonly used scenario RCP6.0, the radiative forcing stabilizes soon after 2100. The pessimistic scenario that does not foresee mitigation of climate change is RCP8.5, in which GHG emissions are high and their contribution continues to increase after 2100. The scenario is energy intensive due to projected high population growth and lower levels of technological development (summarized based on Bertalanič et al., 2018).

The report uses climate projections for three different scenarios: RCP2.6, RCP4.5, and RCP8.5. The GHG scenarios are used as input data for climate models, which are an approximation of the real state of the climate system and whose spatial and temporal resolution is limited by computing power and limited knowledge of some physical processes (Bertalanič et al., 2018). Simplifications lead to model uncertainties and can be the cause of systematic deviation of the simulated climate from the real one. To some extent, this model uncertainty can be assessed and also corrected by model simulations of past climate with actual measurements (so called bias correction).

Compiling results from different models allows us to assess model uncertainty and identify potential areas of future change. Projections show us the direction of change in climate variables and indicate the magnitude of those changes. They are always given by the magnitude of change in climate variables rather than their absolute value in the future. All results are given in terms of change from the 1981–2010 reference period, which is recommended by the World Meteorological Organization. This type of description reflects the uncertainty resulting from the shortcomings of the climate models and the differences between them. Model simulations of air temperature and the resulting indicators, such as hot day and tropical night, are much less uncertain than simulations of precipitation, where natural variability in space and time is much greater. The reliability of projections of relative humidity, cloud cover, and the like, which are also used to determine tourism climate indicators, is even lower.

For example, the following graph for Bilje (Figure 6) shows the range of the projected changes and is presented with whiskers, which show the range from the minimum to the maximum modelled change that should be analysed in the form of deviations and not abosolute values. To be exact: for RCP8.5 projections for July show a definite increase in the number of hot days in Bilje, in the first period (2011–2040) by 3 days compared to the reference period (1981–2010), with the possible range from 1 to 5 days, in the second period (2041–2070) by 7 days, with the range from 5 to 10 days, and in the third period (2071–2100) by 13 days, with the range from 10 to 16 days. However, for a clearer general picture, we show graphs with the absolute number of days that meet or will meet a certain criterion however the interpretation of the graphs is essential and was based on the median and the interval of expected deviations from the reference values as explained in this example. Median values that are described further on have to be taken with caution, bearing in mind the whole variability and reliability.

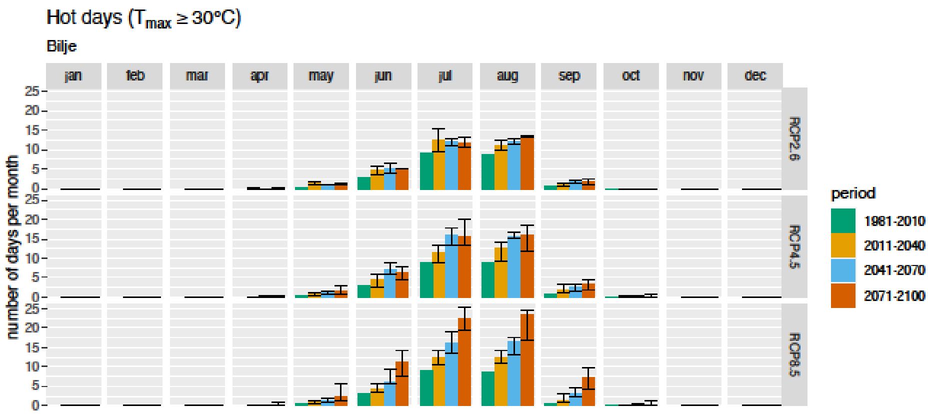

Figure 6: Percentage of warm days per month in Bilje, range of the projected changes presented with whiskers

The selection of tourism climate indices

In the following text, the main tourism climate indices are presented, as well as the indices which were chosen for analysis.

One of the first indices was the **tourism climatic index (TCI)** proposed by Mieczkowski (1985). It was designed as a composite measure of the well-being of tourists since climate conditions can motivate tourists. They can choose a time of the year when climate conditions are at their optimum or select an area that offers the most suitable climate conditions during their fixed holiday time. It can be determined using the equation:

$$TCI = 4 \cdot cid + cia + 2 \cdot R + 2 \cdot S + W,$$

where cid is the daytime comfort index, calculated from maximum daily air temperature (*T*) and minimum daily *f* (relative humidity); cia is the average daily comfort index, calculated from mean daily *T* and mean daily *f*; *R* is the score from the daily precipitation amount [mm]; *S* is the score from daily sunshine duration [h]; and *W* is the score from the daily mean wind speed [m/s]. The climate comfort of the TCI is presented in four categories: unfavourable, acceptable, very good and good, and excellent.

De Freitas and colleagues (2008) developed a second-generation climate index. It is named the **climate index for tourism (CIT),** designed initially to rate beach tourism (3S tourism: sun, sea and sand) but later adapted to specifically appraise cycling, cultural tourism, football, golf, motor boating, sailing and hiking. It can be described as a function of thermal sensation (*T*), aesthetic appeal (*A*) and physical conditions (*P*):

$$CIT = f[(T, A) \cdot P],$$

where the thermal sensation is based on the skin temperature taking into account the body-atmosphere energy balance that integrates the environmental and physiological thermal variables, such as solar heat load, heat loss by convection (wind) and by evaporation (sweating), longwave radiation exchange and metabolic heat (activity level), used to determine the score on the standard nine-point ASHRAE scale; *A* - aesthetic appeal of the sky condition ranging from clear sky to overcast; and *P* -physical threshold of strong wind and high precipitation. To determine the value of *CIT*, various matrices are used for various tourism activities. The climate comfort of the CIT is presented in seven categories from very poor (1–3: unacceptable), marginal to ideal (4–7: acceptable).

The third option is the **universal thermal climate index (UTCI)**, which, according to Błażejczyk and colleagues (2013), offers a better portrayal of human biothermal' conditions than other indices. The UTCI expresses the importance of the non-meteorological variables metabolic rate (*MET*) and the thermal properties of clothing (insulation, vapour resistance, air permeability). It is a function of the following variables:

$$UTCI = f(T_a, T_{mrt}, u, e),$$

where T_a is air temperature, T_{mrt} is mean radiant temperature, u is wind speed, and e is water vapour pressure. The climate comfort of the UTCI is presented in ten categories from extreme cold stress through no thermal stress to extreme heat stress. It has been recently analysed for Slovenian agricultural workers (Črepinšek et al., 2023).

Many indices are related to temperature comfort. The **PET (Physiological Equivalent Temperature) thermal sensation index** values the temperature at which the human heat budget in reference indoor conditions is balanced by the same skin and body temperature as would be observed in the actual outdoor environment (Lindner-Cendrowska, 2013). Even though the PET has not been designed as a tool for assessing weather conditions for tourism, it was used in several studies (Lindner-Cendrowska & Błażejczyk, 2018). The calculation is more complex with the use of human heat balance model.

Next is the **temperature-humidity index (THI)** (Ciobotaru et al., 2019). The THI variability affects the touristic flows, such as the number of arrivals, overnight stays, and average occupancy rates. Hence, this tool can help define periods when conditions are usually favourable or unfavourable for tourism, consequently adapting the tourist offer for a certain period. The caluculation is very simple, following the equation:

$$THI = T_x - (0.55 - 0.0055 \cdot f) \cdot (T_x - 14.5),$$

where T_x is mean daily air temperature and f is mean relative humidity. The climate comfort of the THI is presented in three categories: bioclimatic discomfort due to overcooling, bioclimatic comfort, and bioclimatic discomfort by heating.

The above-listed indices were designed for general or beach tourism and only later adapted for urban tourism. However, researchers developed a customised index, especially designed for the urban environment, called the **holiday climate index (HCI): Urban**.

The HCI was developed by Tang (2013) in his master's thesis and later upgraded by Scott et al. (2016). Tang (2013) developed the index to overcome the deficiencies of the TCI, like (Demiroglu et al., 2020):

- The rating scales and the weighting schemes are primarily subjective and based solely on Mieczkowski's expert opinion and North American climate and cultural context.

- The TCI ranked temperature as one of the most influential climate variables while forgetting a set of others, including precipitation and relative humidity.
- The TCI equation does not account for the overriding effects of physical variables.
- The TCI uses mean monthly data for all its sub-indices.
- The TCI is a general index only for sightseeing activities and does not differentiate the specific requirements of major tourism segments such as beach, urban or winter sports tourism.

Tang's study was based on a study of Canada, New Zealand and Sweden (Scott et al., 2008 in Tang, 2013), where researchers found out that the relative importance of climate variables (air temperature, precipitation, sunshine duration, wind) is different for tourism environments like beach, urban areas, and mountains. Regarding urban tourism, this study indicated that the optimal climate conditions in an urban environment include air temperature of 22 °C, 25% cloud cover and 1-9 km/h wind speed (temperature was the most important parameter for urban tourists, followed by precipitation, sunshine and wind).

Based on these findings, the HCI: Urban was explicitly designed for sightseeing and other general outdoor tourism activities of leisure tourists in urban destinations. To overcome deficiencies of the TCI, the HCI variable rating scales and the component weighting system are based on the available literature (theoretically sound) and a range of surveys over a decade (empirically tested); they include all facets of climate and are simple to calculate, easy to use and understand (Tang, 2013; Scott et al., 2016). The HCI uses daily climate data and estimates average monthly index ratings and probabilities of specific rating categories (very high or low score) (Tang, 2013). Additionally, to address specific climate requirements of different tourism segments, the HCI: Beach and the HCI: Urban have different weights for thermal comfort and cloud cover since beach tourists prefer higher temperatures (Demiroglu et al., 2020). In our study, we have focused on the HCI: Urban, which is determined as:

$$HCI\!: urban = 4 \cdot ET + 2 \cdot A + 3 \cdot R + W,$$

where ET is the score from the effective temperature (described as a separate index below), A is the score from the aesthetic aspect (from the total cloud cover), and R and W are the scores from the physical conditions (from precipitation and wind, respectively). The complete rating system for each facet is defined in Scott et al., 2016. The climate comfort of the HCI is presented in eight categories ranging from 0 to 100: dangerous, unacceptable, marginal, acceptable, good, very good, excellent, and ideal. A suitable climate conditions for urban tourism (general tourism activities, e.g. sightseeing and shopping) in winter, spring and autumn is defined with a score higher than 49, while a suitable climate conditions in summer scores higher than 59 (Tang, 2013). Since its development, many studies analysing the current and future conditions of urban destinations have been executed.

The effective temperature represent the temperature at which motionless saturated air would induce and can be calculated with the following formula

$$ET = T - 0.4(T - 10)\left(1 - \frac{RH}{100}\right),$$

where T is surface air temperature [°C] and RH is relative humidity [%] (Benassi et al., 2019). It represent conditions due to temperature and humidity conditions, thermal comfort being between 19 and 22 °C.

Out of the presented climate indices, **CIT: 3S** and **HCI: Urban** were chosen for the main calculations and analyses, as they are the only two available in the Copernicus CDS, all input data is available in the ARSO archive for calculation of past trends, and they are the most appropriate for the description of climate and climate change impacts on the tourism sector. TCI was upgraded with HCI anyway, UTCI and PET are far more complicated to calculate using models that require various input data and also not designed especially for tourism, and THI is very simple, recently mainly used for the thermal comfort of animals in the agriculture. Regarding the choice of the appropriate index for health, wellness, beach and other types of water tourism, the indices HCI: Beach and CIT: 3S were considered. Comparing the two, the CIT: 3S is more representative of the actual conditions that must be met for the analysed type of tourism. Additionally, the index CIT:3S could be calculated for selected locations for both past and future periods, while HCI: Beach could be calculated only for past periods (from the ARSO archive) as it is not available in the CDS.

Due to the increasingly important consequences of climate change, there has been a great need in recent years for the availability and analysis of climate data, specifically from the point of view of an information system that would allow transparent display of both global and regional climate data (Thepaut & Dee, 2016). At the same time, a wide range of smaller databases and inconsistencies between data from different databases can lead to even greater confusion and misunderstanding among users than if there were no access to data (Merks et al., 2020). In 2014, the European Center for Medium Range Weather Forecasts (ECMWF) thus signed an agreement with the European Commission to provide Copernicus climate change monitoring services, including the Copernicus Climate Change Service (C3S) (Raoult et al., 2017). Climate Data Store (CDS) is a C3S online information system covering many different sources of data on past, present and future climate, which is analysed and prepared for monitoring and projecting various aspects of climate change. The quality control is performed on the data available in the CDS information system, and the data are also homogenized.

We analysed historical data and projections for the two chosen climate indices from the »Climate suitability indicators for tourism from 1970 to 2100 over Europe derived from climate projections« dataset produced by the C3S (available at CDS tourism, 2022). In the CDS, climate projection values, based on EURO-CORDEX projections, are available both for the historical period (1986–2005) and for future emission scenarios (RCPs) in the periods 2021–2040, 2041–2060, 2081–2100. To compute the indices, different climate facets are considered on a daily scale, and a score is assigned to each of them. These scores are then aggregated, resulting in a total index rating from 0 to 100 for the HCI: Urban and from 0 to 7 for the CIT: 3S. The results are grouped into 3 categories based on the value of the index for each day. For the HCI: Urban:

- ideal conditions: HCI $>$ 70;
- marginal conditions: 50 $<$ HCI $<$ 70;
- very poor conditions: HCI $<$ 50.

For the CIT: 3S thermal, aesthetic, and physical facets are combined in a weather typology matrix to determine a climate conditions rating that ranges from very poor to very good:

- ideal conditions: CIT = 5-7;

- marginal conditions: CIT = 4;
- very poor conditions: CIT = 0-3.

In CDS, the number of days in each category is aggregated for each month. To assess the potential role of climate change in shaping the conditions for tourism in different locations, climatologies of both HCI: Urban and CIT: 3S are computed from daily values. A climatology is a long-term average of a given variable (in our case the number of days per month in each category), computed over a period of 20 years. A monthly climatology will produce a mean value for each month over the period of interest (i.e. the average of all the January mean values for that 20 years, and so on). The mean monthly values obtained in this way represent the typical monthly conditions in that climate state (in that period/under that emission scenario). For this report, we used mean monthly values from the dataset. Further details of the methodology used to calculate the indices and prepare the dataset are discussed in the official documentation of CDS (Benassi, 2019).

The number of days per month for each category and time period in CDS is provided on a grid with a horizontal resolution of 0.11, i.e. around 12.5 km. Points of this grid correspond to points of the model grid, which was used in the EURO-COREX models. The computation of indices is performed from the climate facet values given by multiple different models. We used the mean number of days per month in each category averaged across six models to create the plots. To indicate the spread of results from different models we used error bars, which show the 10^{th} and 90^{th} percentile of values across all models. We selected those points on the grid, which were the closest to major tourist destinations in Slovenia. We also made sure the selected points were near weather stations operated by ARSO, so we could compare the historical data from these weather stations to the historical data in the Copernicus dataset (as discussed further on). Projections of HCI and CIT were not prepared with ARSO data, because projections at this level are not available for all input variables (e.g. relative humidity). Using Copernicus data one has to take great care to also compare the data to the ARSO historical data available at the national level in order to see the extent of the deviations and to take the deviations into account when explaining projectinos. The selected grid points are shown in Figure 7.

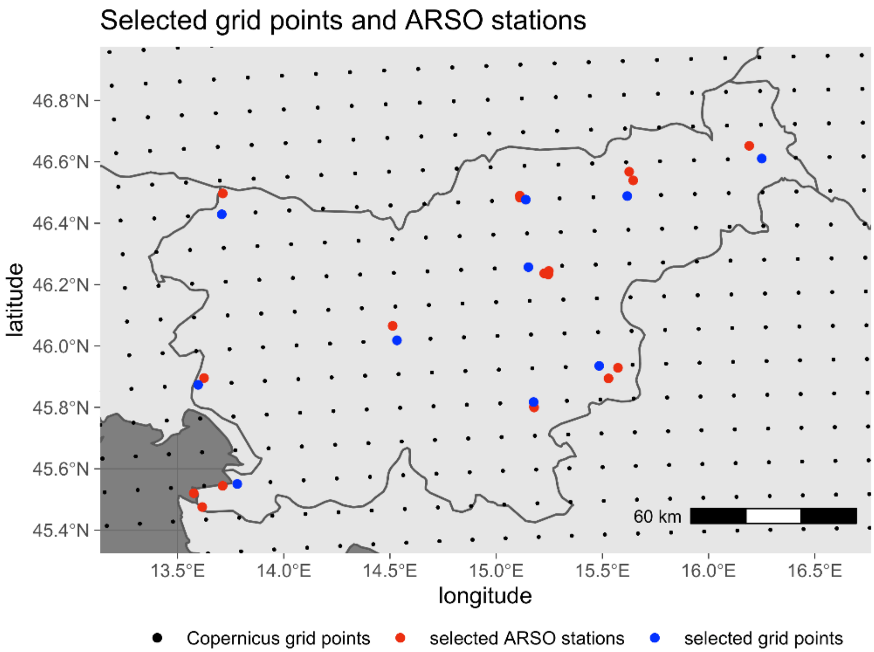

Figure 7: Selected grid points from the CDS and nearby ARSO stations

Source: own formatting

Snow data

Also analysed were past and future climate conditions relevant for ski resorts from the »Mountain tourism meteorological and snow indicators for Europe for tourism from 1950 to 2100 derived from reanalysis and climate projections« dataset produced by the C3S (available at CDS snow, 2022). This dataset contains climate variables based on reanalysis data and EURO-CORDEX models. The values of the variables are computed using 5 different climate models and aggregated for 20-year periods. Quantiles of annual values are computed across all used climate models for a given time period and RCP. The methodology used to produce the dataset is described further in the official documentation (Morin, 2020).

We examined the following variables near major ski resorts:

- number of days with at least 5 cm of natural snow cover on the ground, starting on August 1st to July 31st of next year;

- number of days with at least 30 cm of natural snow cover on the ground, starting on August 1st to July 31st of next year;
- the sum of snow precipitation, from November to the following April (included)
- potential snowmaking hours (for wet bulb temperature lower than -2 °C) in November and December;
- potential snowmaking hours (for wet bulb temperature lower than -5 °C) in November and December.

The data is provided at the level of NUTS-3 statistical regions and with a 100 m vertical resolution. Only one value for each variable is provided for each region and elevation.

Each data point represents the historical value or projection of a variable in a given region at a location, which is at a given elevation. To produce the C3S dataset, locations for data points were chosen in each region for each 100 m elevation band. For this reason, points at two adjacent elevation levels may be in completely different parts of the region. The historical data and projections were then calculated for the chosen locations. The data we used, therefore represents the climate change signal at a specific location in a given region, which we assume to be representative of the signal at ski resorts, which are at the same elevation, but in different locations. Care should be exercised when interpreting the elevation dependence of the variables within a region, as the locations can be far apart.

We selected 8 major ski resorts in Slovenia and classified them into three NUTS-3 regions based on their location (Figure 8). Ski resort Kanin was classified into the Goriška region, Rogla and Pohorje were classified into the Podravska region, and other ski resorts into the Gorenjska region.

For each ski resort, we chose two elevations, one at the lowest part of the ski resort and another one at the highest part of the ski resort or near the top, based on the availability of data for those elevations. The plots presented in the subsequent chapters show the median value of each variable in the region of each ski resort at the selected heights. The median value was calculated across all models for a given period (2021–2040, 2041–2060, 2081–2100 vs. 1986–2005) and RCP. The spread of results from different models is indicated with error bars, which show the 10th and 90th percentile of values across all models.

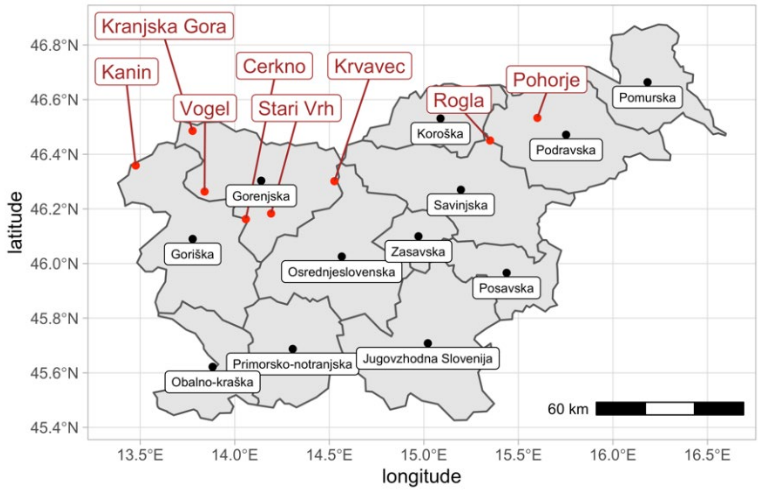

Figure 8: NUTS-3 regions and selected ski resorts

Source: own formatting

Analysed ARSO data

Climate variables relevant for tourism

We also analysed climate projections provided by the Slovenian Environmental Agency (ARSO, 2022) for six meteorological variables:

- number of days with at least 1 mm of precipitation;
- number of days with at least 20 mm of precipitation;
- number of days with snow cover;
- number of tropical nights ($T_{min} \geq 20$ C);
- number of warm days ($T_{max} \geq 25$ C);
- number of hot days ($T_{max} \geq 30$ C).

T_{min} is minimal daily temperature and T_{max} is maximum daily temperature. The projections were prepared using regional climate models (RCMs), except for snow projections, which are based on the mGrowa model. This model uses RCM data as input. Its resolution is 100x100 m, while the resolution of RCMs is 12x12 km. The projections are based on averages of simulations of different regional climate models, six for the RCP4.5 and RCP8.5 scenarios and two for the RCP2.6 scenario, which are based on historical data best simulated the climatic conditions in Slovenia. Bias correction has been performed for temperature and precipitation projections, so for all mentioned variables except number of days with snow cover. We selected ten weather stations near major tourist destinations.. ARSO provided us with values of the above six variables in the grid cells, which contain the selected stations, for four time periods (2011–2040, 2041–2070, 2071–2100 vs. the reference period 1981–2010) and three RCPs. To plot the data for each station and month, we used the median value across all models. The error bars represent the highest and lowest values across models. As mentioned above, only deviations from the reference period should be observed and not absolute values.

Weather station data and calculated indices

We also calculated CIT and HCI values for the historical periods (1971–2000, 1981–2010, 1991–2020, and for comparison with CDS also 1986–2005) from measurements at the above-mentioned selected ARSO weather stations. The indices CIT: 3S and HCI: Urban were computed from maximum daily air temperature, average wind speed, average cloud cover, daily precipitation and relative humidity at 2 p.m. (representing the minimum relative humidity), all measured at ARSO weather stations, using the same methodology as used by CDS thus the results can be compared. The effective temperature was calculated from maximum temperature and relative humidity (for HCI) and skin temperature from maximum temperature, cloud cover and wind speed (for CIT), following the C3S documentation (Benassi, 2019). Then the score for each climate facet was calculated and combined to derive the daily values of the index. This was done using the tables provided in the C3S documentation (Benassi, 2019). For other versions of CIT indices (CIT: cultural&hiking, CIT: cycling, CIT: football, CIT: golf, CIT: motor boating, and CIT: sailing), we used the tables from Bafaluy et al. (2014). Afterwards, the number of days with ideal/marginal/very poor conditions was calculated for each month using the criteria described in chapter 3.2.

During the historical periods, some weather stations moved. For those locations, we combined measurements from different stations nearby. We used three different stations on the Slovenian coast (Koper, Portorož – Beli Križ, Portorož – letališče), two stations in Maribor (Maribor – Tabor, Maribor – Vrbanski plato), two in Cerklje ob Krki (Cerklje – letališče, Gornji Lenart) and three in Celje (Celje - Levec - letališče, Celje, Celje - Medlog). Some measurement data is missing. Most notably, the station in Cerklje has no data from January 1993 to June 2005. For the station in Celje, cloud cover data is missing from April 2017 onwards and for the station in Rateče from June 2017 onwards. The percentage of missing data is small for all other stations (less than 0.13% of days). Days with any missing data were not included in the analysis. The daily values of effective temperature and the indices were aggregated over 30 years; therefore, we do not expect the missing data to have a significant impact on the results, except in Cerklje ob Krki. At this station about a third of the data is missing from the first two of the 30-year historical periods and the first half of the data from the third period. For that reason, we expect the trends at this station to be smaller than they appear in our results.

University of Maribor Press

3 Climate change and health, wellness, beach, and other water-related tourism adaptation

Highlights

- According to the CIT: 3S past calculations and future projections, conditions for health, wellness, beach and other water-related tourism in Slovenia are partly improving due to higher temperatures in late spring and early autumn. This implies an extended season.
- All analysed destinations (except Rateče, which is in a mountain area) will experience a high rise in the percentage of hot days and tropical nights, especially in July and August.
- Lakes and rivers will become more attractive in the future with an increasing number of days with higher temperatures, while coastal destinations can be negatively affected due to extreme temperatures.
- Due to projected increases in air temperature, the occurrence of droughts are expected. This is likely to affect water levels, having an impact on water activities such as rafting and canoeing but also water management, with a potential conflict of interest between local people and tourist authorities on the use of scarce water for the tourism industry.
- Projected increase of very high air temperatures can cause thermal discomfort and health risks for visitors due to heat stress and water degradation.
- Adaptation is needed to minimise visitors' health risks, minimise the energy costs of tourism providers, adjust the tourism industry to expected water shortages but also flooding.

Abstract

Climate change will mainly affect outdoor activities in coastal and other open areas near water. In the aggregate, beach, health and other water-based tourism will most likely gain from climate change, with the season extending to autumn and spring. As outdoor activities in summer are important motives for choosing Slovenia as a holiday destination, this results in a high level of vulnerability if these activities are impaired. As a result of the rise in temperature and the increase in the frequency and duration of heat waves, patterns of energy consumption and the conditions for its production may change, resulting in a significant increase in the need for cooling in summer. With strong tourism growth, an increase in water demand can also be expected. As available water resources decline in many regions because of the depletion of water resources, stakeholders will be affected by water shortage, and adaptation measures will be needed.

According to all scenarios, the number of days with heat stress will increase in the future. Consequently, it is necessary to be aware that some outdoor activities will be possible only for a limited time or not at all. At the same time, the effects of climate change significantly threaten natural resources such as thermal water, as warming will affect thermal water sources. Tourism infrastructure will be at risk due to the expected accumulation of extreme weather events (such as storms, fires and floods) and more extended periods of extreme weather conditions (drought periods, multi-month heat waves, etc.).

Water quality, for example, can be greatly impaired by the higher temperatures in water pipes due to higher soil temperatures. Ground-level air pollution, primarily due to ozone formation at higher air temperatures, harms the respiratory system. Prolonged heatwaves and lack of rain can also negatively affect rivers' water levels and water temperatures. Climate change also affects the health or therapeutic effects that can be achieved in coastal and other health tourism destinations. Overcoming these effects is a particular challenge for service providers and the related development of the destination.

Tourism stakeholders need to analyse the opportunities and risks of climate change early and develop appropriate adaptation strategies individually. Tourism businesses must develop strategies to mitigate rising costs associated with water shortage and cooling expenses. Municipalities should first focus on the vulnerability assessment

of tourism offers, followed by the adaptation of public infrastructure. On the national level, the priorities should be creating policies for climate adaptation and providing funding schemes that allow infrastructure and marketing adaptation.

The significance of water-related tourism in the Slovenian tourism system

The significance of health and wellness tourism

The UNWTO (United Nations World Tourism Organization) defines health tourism as "tourism associated with travel to health spas or resort destinations where the primary purpose is to improve the traveller's physical well-being through a regimen of physical exercises and therapy, dietary control, and medical services relevant to health maintenance" (Rulle, 2008, pp. 20-21). Hall (2003, p. 274) proposes one of the most significant and comprehensive definitions of health tourism as "a commercial phenomenon of industrial society which involves a person travelling overnight away from the normal home environment for the express benefit of maintaining or improving health, and the supply and promotion of facilities and destinations which seek to provide such benefits." Many health resorts have therapeutic properties due to the mineral content of the water, mud, or climate. Patients can benefit from internal therapy, such as drinking the water, inhalation therapy (e.g. inhaling droplets or fumes of water), lavages (oral, nasal, gynaecological), as well as external therapy, which can include baths and showers, hydro massaging, balneotherapy (using thermal and healing waters for bathing, drinking, or inhalation), or mud therapy (applying mud to parts of the body that suffer from various disorders) (Smith and Puczko, 2008).

The concept of wellness takes the idea of health even further and includes domains such as physical, mental and spiritual health, self-responsibility, social harmony, environmental sensitivity, intellectual development, emotional well-being, and occupational satisfaction (Müller and Kaufmann, 2001). Voigt, Brown, and Howat (2011, p. 17) define wellness tourism as "the sum of all the relationships resulting from a journey by people whose motive, in whole or in part, is to maintain or promote their health and well-being, and who stay at least one night at a facility that is specifically designed to enable and enhance people's physical, psychological, spiritual and/or social well-being." There is an emphasis on prevention rather than cure, but some medical treatments may be used in addition to lifestyle-based therapies.

Slovenia is a country with a modern and highly competitive offer of health, prevention and relaxation tailored to the demanding seeker of health and well-being. In Slovenia, the most important treatments involve thermal waters of various qualities and temperatures (from 32 °C to 73 °C) and mineral waters, such as the world-famous Radenska Three Hearts and Donat Mg, followed by seawater and brine, aerosols for inhalation, healing muds and mineral peloids, peat, and the Mediterranean, Pannonian, and sub-alpine mountain micro-climates (SSNZ, n.d.). Each spa and thermal destination is attractive due to its varied regional surroundings, cultural identity and local experiences. Slovenian natural spas and other thermal spa providers have strengthened self-pay treatment and prevention programs based on nature, knowledge and tradition, which address the modern ailments of today, thereby further improving the year-round business, added value, differentiation and market position of Slovenia as a land of health and healthy waters in the Central European area (MGRT, 2022).

The Association of Slovenian Natural Spas unites 13 natural and thermal spas under the name of "Slovenian Natural Spas" and acts as a strategically and operationally oriented tourism marketing organisation. It effectively implements the business interests of its members and markets the health tourism products in Slovenian spas as a whole (SSNZ, n.d.). The current members of the association are: Čatež Thermal Spa, Dobrna Thermal Spa, Dolenjske Toplice Thermal Spa, Thermana Laško, Portorož Thermal Spa, Terme 3000 Moravske Toplice, Olimia Thermal Spa, Ptuj Thermal Spa, Radenci Health Resort, Rogaška Medical Centre, Talaso Strunjan, Šmarješke Toplice Thermal Spa, and Terme Zreče. Other more known spas in Slovenia are also: Lendava Thermal Spa, Topolšica Thermal Spa, Thalasso Spa Lepa Vida, Thermal Spa Snovik, Thermal Spa Banovci, Bioterme Mala Nedelja Thermal Spa and others (STO, n.d.).

The Slovenian spa offer in health resorts that are part of the Association of Slovenian Natural Spas with regards to present surroundings, resources, and trends in the global and European area, health, and wellness market, is divided into six product pillars that are presented in detail in Table 1.

Table 1: Six product pillars of the Association of Slovenian Natural Spas

Product pillars	Definition - the primary motive to visit	Key products
Medical tourism in spas	The primary motive of the visit is TREATMENT (with the use of medical services and local natural medicinal factors in health resorts).	– Rehabilitation – Specialist diagnostics – Plastic surgery – Dental services (Balneotherapy, physical therapy, kinesiological therapy, thalassotherapy, hydrotherapy, therapeutic massages, drinking mineral water, etc.)
Medical Wellness	The primary motive of the visit is PREVENTION (with the use of medical services and local natural medicinal factors in health resorts).	– Prevention – Detoxing – Dieting – Anti-stress – Anti-ageing
Selfness	The primary motive of the visit is LONG-TERM CARE FOR BALANCING THE BODY, SPIRIT, AND MIND (with the use of medical services and local natural medicinal factors in health resorts).	Programs for the establishment of balance in the body, spirit, and mind (Lifestyle balance and Longevity balance that include relaxation, rejuvenating, exercise, nutrition, sleep, spiritual and holistic activities, prevention, etc.)
Thermal break & Aquafun	The primary motive of the visit is an ACTIVE OR MORE RELAXANT THERMAL BREAK in a health resort.	– Aquafun (entertainment in a water theme park) – Wellness break (sauna, massages, and other relaxing activities) – Bathing in thermal pools – Active vacation (despite bathing also activities in nature and at a destination)
Sports team training camps	A type of sport tourism, where the primary motive of the visit is ACTIVE PREOCCUPATION WITH SPORT (PRACTISE).	Sportsmen preparation, based on the usage of the integrated spa offer (accommodation, treatments, massages, etc.) and the sports infrastructure at the destination.
MICE (Business meetings)	The primary motive of the visit is BUSINESS MEETINGS in a spa destination with the uptake of a supplementary offer (wellness).	– Congresses, conferences, seminars, and teaching – Business meetings, fairs, and presentations – Assemblies – Incentive travel – Sport events – Press conferences

In the previous tourism strategy for Slovenia, named "Strategy for the sustainable growth of Slovenian tourism 2017-2022", an organisational structure based on four macro destinations was developed. One of these macro destinations is Thermal

Pannonian Slovenia in the east part of Slovenia, encompassing most of the prominent health resorts in Slovenia. The same macro destination is still relevant in the new strategic period (2022–2028). Thermal Pannonian Slovenia is a macro destination with a strong product profile with a clearly expressed central motive for arrival (thermal spa product). The leading products of this macro destination are:

- HEALTH & WELLBEING (a year-round product focusing on health, prevention, wellness, relaxation and thermal water experiences for visitors of all ages)
- GASTRONOMY (hearty cuisine based on local production and recipes supported by quality wines and beer)
- RURAL TOURISM (year-round tourism based on the offer of tourist farms, smaller providers and brickyards and authentic rural experiences)

Health and wellness tourism is very important for the Slovenian tourism industry. A total of 21.84% of overnight stays in 2019 took place in municipalities classified as health(spa) destinations, which is also the largest share (STO, 2020). The health(spa) municipalities have the most balanced utilisation of overnight stays by season. In Thermal Pannonian Slovenia, domestic guests account for 54% of overnight stays, and this macro destination has the most evenly distributed number of overnight stays throughout the year as the share of overnight stays varies from 17.5% in summer to 30.7% in winter compared to shares of other types of municipalities. The destinations of Thermal Pannonia and Central Slovenia are less exposed to seasonality than the destinations of Alpine and Mediterranean & Karst Slovenia, mainly due to their natural features and the type of offer (health resorts, cities). The smallest share of overnight stays is generated in January, March, December and February when domestic guests generate more than half of all overnight stays. The top markets for the macro destination Thermal Pannonian Slovenia are Austria, Italy and Croatia (STO, 2022).

Relaxation in spas is a dominant motive of the arrivals in Slovenian natural health resorts – bathing in the spa, Aquafun, wellness, and active vacation (together around 70%). Medical tourism and medical wellness (preventive programs) contribute only a fifth of the annual sales, and the remaining products are niche products (SSNZ, 2014). In the new strategic period, the product continues to gain importance, as the COVID-19 pandemic has greatly strengthened awareness of the importance of health, well-being, resilience, good physical and mental condition, longevity and the importance of active and healthy ageing (MGRT, 2022).

The Slovenian Tourist Board has also recognised spa and wellness-goers as an important travel segment. The research of the target groups of Slovenian tourism or personas was approached based on the key motivations in tourism that form the typical segments of tourists. Amongst the 12 personas or target groups of Slovenian tourism, three describe spa and wellness-goers. Based on their dominant motives, the target groups of Slovenian tourism are divided into three segment groups:

- EXPERIENCE (group type - explorers): adventurers, green explorers, active families, urban conscious.
- SOCIALISING (group type - companions): devoted mothers, active nostalgics, carefree youth, urban consumers, social foodies.
- TAKING CARE OF YOURSELF (group type - muses): spoiled lovers of beauty, forever young, relaxed escapists (STO, 2016).

The last target group consists of tourists who put great emphasis on the state of their health and wellness. The personas that should be interested in health and spa services are named "Forever Young", "Beauty and Indulgence Lovers" and "Relaxed Escapists.". They often seek healthcare services, wellness services, beauty treatments, retreats and escape, and learning about themselves (selfness, mindfulness, detox) (STO, 2016).

The significance of beach and other water-related tourism

In this chapter, we will discuss the significance of beach and other water-based tourism for Slovenian tourism. The reason for joining these two types of tourism is that similar weather conditions must be met to execute these activities while outdoors. Water-based tourism relates to any touristic activity (see definition below) undertaken in or in relation to water resources, such as lakes, dams, canals, creeks, streams, rivers, canals, waterways, marine coastal zones, seas, oceans, and ice-associated areas (Jennings, 2006). Generally, beach tourism is considered travel for recreational, leisure or business purposes, specifically on beaches. Beach activity is the sub-sets of coastal and marine tourism, including recreational activities in the coastal zone (Orams, 1999).

The region of Slovenian Istria, which includes the municipalities of Koper, Izola and Piran, is defined as the coastal region of Slovenia. Slovenian Istria is primarily defined by its location by the sea and has distinct Mediterranean features. It consists of flysch hills, which in the southeast pass into the karst landscape and lower-lying plains that reach the coast. High cliffs decorate the coast in several places. Tourism is one of the most important economic sectors in the region. The tourist offer is present in coastal tourist places, but it is still very modest in the hinterland (Jurinčič, 2009).

In the previous tourism strategy, Slovenia is divided into four macro destinations (tourist regions) - Alpine Slovenia, Thermal Pannonian Slovenia, Central Slovenia and Ljubljana, and Mediterranean Slovenia. The coastal destinations are located in Mediterranean Slovenia. In accordance with the strategy, the main products of this region are defined as follows:

- Events and business meetings (year-round business tourism - business guests) supporting events that attract multi-day guests.
- Sun and sea (traditional seasonal Mediterranean product - sun and sea based on beaches, swimming, relaxation, entertainment and outdoor activities).
- Gastronomy (combination of modern cuisine based on the heritage of the environment with an emphasis on the Mediterranean diet and additions of international cuisine; top wines and wine production) and
- Health and well-being (a year-round product - the basis is wellness and relaxation using natural and local healing products from the Mediterranean climate) (STO, 2017).

The total accommodation capacity in the three coastal municipalities is almost 31,887 beds. In 2019, there were 955,789 tourist arrivals and 3,016,067 overnight stays in coastal municipalities (SURS, n.d.a). In the Mediterranean region, domestic guests account for 43% of overnight stays (STO, 2022). The majority of foreign guests in coastal municipalities are mainly from nearby countries, such as Italy, Germany and Austria (SURS, n.d.b). According to data for 2019, seasonality in the Mediterranean region is the second most pronounced among the four Slovenian regions, as most tourists visit this region in July and August. There is also a maritime passenger port in Koper, where 72 cruise ships of various sizes arrived in 2019, which meant slightly more than 115,000 tourists (VisitKoper, n.d.).

None of the 12 Slovenian tourism target groups (personas) specifically addresses the interest in the beach area and beach activities. However, when analysing the personas with relevant areas that could be interesting to potential tourists, the following personas are suitable for the Mediterranean region:

- Green explorers,
- Sociable foodies,
- Beauty and indulgence lovers.

The product areas of active "outdoor" experiences range from easy hiking to demanding mountain climbing, from family to mountain biking and "outdoor" products such as skiing and other outdoor winter activities, water experiences and experiences in the air (paragliding and hang-gliding), golf, horseback riding, caving and adrenaline experiences in adrenaline and adventure parks (Slovenia Outdoor GIZ, 2019).

One of the main subproducts of the outdoor product are water activities. Water activities include various products in the wild (rivers, gorges) and calm waters (lakes, sea). Whitewater products are among the most recognisable and developed "outdoor" products in the Julian Alps, with relatively limited opportunities for volume growth but not quality growth. Due to the attractiveness of the water element, the great interest and the emergence of new forms of recreation, there are many possibilities also in other macro-regions and on calm waters. Most popular activities are kayaking, canoeing, swimming and stand-up paddle boarding. Secondary products are also fishing with classic fishing, sport fishing and flyfishing (Slovenia Outdoor GIZ, 2020).

In Slovenia, the most visited area for water-based activities (other than beach activities) is the valley of the river Soča and Lake Bohinj in the Triglav National Park. Sportsmen and recreationists take advantage of the park's many natural features, mountains and water bodies for activities. A large number of the latter in the park area represents a training ground for various water sports, from canyoning and rafting to fishing. Activities are carried out on lakes, watercourses and waterfalls (Lotrič, Mikoš & Golja, 2015). In addition to the coast, which has largely modernised sea bathing areas, in the past period, some municipalities in the interior of Slovenia have modelled bathing areas with natural and artificial lakes. Velenje lake, Murska

Sobota lake with the Expano location and Sports Centre Radlje ob Dravi are good practices for revitalising previously degraded areas of whitewater areas. Swimming is also popular in many other Slovenian rivers, such as rivers Krka, Kolp, Nadiža and Idrijca (STO, 2022). Sports tourism and recreation (including water sports) are also one of the main products of coastal destinations Portorož and Piran. Otherwise, in recent years, efforts have been made to increase the possibilities of recreation and sports activities (construction of an equipment rental shop) and the inclusion of water sports in the tourist offer, as well as the commercialization and development of the offer (Turistično združenje Portorož, 2018). There is no official data regarding the significance of water sports in the coastal area (such as usage of sup-paddle boards and similar), although according to the interview with the representative of Tourism Association Portorož in 2022, the following activities: jetboat trips, jetski trips and motorised boat trips, are performed by less than 1% of tourists.

Although Slovenia has only 46 km of coastline, various forms of nautical tourism take place in the area of the coastal-karst region. Nautical tourism is most often referred to as tourism, where tourists spend their holidays sailing on the sea with their own or rented vessels. Yachts, sailboats, motorboats and other vessels are intended for recreation and sports. All three coastal municipalities (Piran, Koper and Izola) with marinas highlight nautical tourism in their tourism strategies as a secondary tourist product (Turistično združenje Portorož, 2022; Občina Izola, 2020; Mestna občina Koper, 2018). There is little official data regarding nautical tourism in the coastal area (aside from the number of tourist arrivals by cruise ships). The official statistical office only recorded the number of passengers arriving at the Piran marina on passenger ships, which was 12.665 passengers in 2019 (SURS, n.d.c). The arrivals of tourists that reach Slovenia by yacht or private motorboats is 1% of total tourists according to the interview with Tourism Association Portorož, which was done in 2022.

Due to the lack of data on the growing trend of active "outdoor" tourism in Slovenia, only indirect conclusions can be drawn about the actual visit and popularity of such tourism products. In the years after the end of the economic recession, Slovenia recorded high growth in tourist traffic, with the fastest growth and the largest volume of overnights in Alpine Slovenia and mountain municipalities (besides Ljubljana). At the same time, camps register the fastest relative growth among accommodations. According to data from the official statistical office and the latest surveys among foreign tourists, the largest share of foreign tourists in Slovenia visit mountain municipalities. Among the best-rated elements of the tourist offer, in addition to the safety and friendliness of the inhabitants, they regularly highlight unspoiled nature. For Slovenia, the key markets for active "outdoor" tourism are Germany, the Benelux countries (mainly Belgium and the Netherlands) and Austria (SURS, 2020 in Slovenia Outdoor GIZ, 2020).

Target groups and markets of active "outdoor" tourism that are interested in water activities are (Slovenia Outdoor GIZ, 2020):

- adventurers,
- green explorers,
- active nostalgics,
- active families, and
- devoted mothers.

Generally speaking, outdoor activities are suitable for tourists who want to spend their holidays in touch with nature and seek extraordinary nature, peace, and relaxation.

Literature review: Climate change impacts on health, beach and water-related tourism

This chapter presents climate change impacts that could significantly affect health, beach and water-based tourism activities, as analysed with indicators other than the climate indicators we employ in the results sections of this chapter. The following impacts can be interpreted as variables that should be measured separately and continuously to explore the actual effects. However, from our research and projections on air temperature, precipitation and other selected variables, some conclusions can be made regarding these possible effects.

In addition to good weather, the temperature of water bodies is also an important factor for bathing and swimming in the summer months. One such analysis was carried out at two popular locations in the Triglav National Park, where swimming is an important part of the tourist offer. Lake Bohinj is getting warmer every year; the projection for 2030 shows that in the next 15 years, the average summer temperature of Lake Bohinj will increase to 18.8 °C compared to 16.7 °C in 2013.

Another important bathing area is the Soča river. As in Lake Bohinj's case, the Soča river's temperature also significantly rises in the summer months (June, July and August). At the Log Čezsoški measuring station, the average water temperature of the Soča river in the summer in the period 1983-2013 was just over 9 °C, and the projected one in 2030 is 11.7 °C. The increase in the summer temperature of the Soča river is in favour of the development of bathing tourism in Posočje. Namely, the river is famous for its low temperature. On the one hand, it gives the Soča river charm and an opportunity to create market recognition. On the other hand, it severely limits the number of potential users (Lotrič, Golja and Mikoš, 2016).

Changes in the water temperature of lakes and rivers, under certain conditions, promote the occurrence of cercariae, which is also known as bathing dermatitis. Factors that favour the occurrence of cercariae are standing fresh water, shallow water depth, the presence of water snails and water birds, reed belts or other aquatic plants, and poor environmental conditions (few fish in the water). These problems may increase if climate change leads to higher water temperature (Moshammer et al., 2014). Furthermore, changes in water temperature could favour the presence of algae in freshwaters as well. Warmer water temperatures combined with nutrients such as phosphorus and nitrogen promote the growth of microscopic plant organisms suspended in the water, including blue-green algae (cyanobacteria). The algae often create greenish-blue or red carpets on the water surface, which are then referred to as algal blooms. Mass accumulations of cyanobacteria worsen water quality by reducing the incidence of light for aquatic plants living on the ground and by increasing oxygen consumption. Many cyanobacteria produce substances of various chemical compositions, some of which are volatile, have an unpleasant smell and can be toxic to humans (Dokulil & Teubner, 2012). The water quality, for example, can also be massively impaired by an excessive concentration of various nutrient inputs (in particular nitrates), oils, herbicides etc. Similarly, ground-level pollution of the air with substances such as ozone, carbon monoxide, nitrogen oxides or aerosols can have adverse effects on the respiratory tract (Roson & Sartori, 2014).

Another possible indicator relevant to water activities is the flow. River flow data at the hydrological measuring stations are used to assess the suitability of water sports. This is usually measured in the average days in certain periods when certain river activities such as rafting are allowed, which will be suitable for future activities. The flow of rivers largely depends on the amount of rain and snow (Lotrič et al., 2016).

Stand Up Paddling, or paddle surfing, is a relatively new and increasingly popular water sport where you stand on a large board and paddle. The activity is gradually developing in Slovenia and is currently not widespread. Paddleboarding is mainly confined to areas of calm river sections, lakes and sea. These are activities where hydrological conditions play a small role, and their implementation is mostly dependent only on suitable weather and time of year (adequate air and water temperature and absence of precipitation). The given limiting factors are therefore very similar to the conditions for bathing and swimming (Lotrič et al., 2016).

In fishing tourism, daily parameters such as water level, water temperature and air temperature are of decisive importance. For comfortable and successful fishing, the water level of rivers and lakes must be either low or normal, as elevated waters influence the fishing success. The other criterion is air temperature: on very cold or hot days with a temperature above 25 °C, fish do not catch well (Lotrič et al., 2016).

Changes in the observed physical environmental variables will certainly have a large indirect impact on the chemical and biological state of water bodies (including amount of dissolved oxygen in the water, biological oxygen demand (BOD5) and the risk of eutrophication of lakes), and thus also on the presence of fish. The mechanism of how climate change influences fisheries' development is therefore very complex and multifaceted. In addition to the well-being and safety of fishermen, it also affects the diversity and fluctuation of fish biomass. A reliable and comprehensive investigation of this mechanism exceeds the scope and working objectives of the present work and requires a special professional study with strong biological and ecological expert support. The identified negative trends in the general water balance and the warming of water and air will certainly have a negative impact on the development of fisheries in the future. Namely, the risk of drying out or dangerous overheating of smaller watercourses and stagnant bodies of water, resulting in the death of fish. The development of fishing as a strategic and promising tourist activity is therefore not recommended in view of the established impact criteria (Lotrič et al., 2016).

Another important factor that is expected to change in the future due to climate change is air quality. Climate change has the potential to increase harmful exposures to elevated concentrations of tropospheric ozone and PM2.5 through changes in regional weather patterns (Ebi & McGregor, 2008). Air quality tends to positively influence tourism demand, with decreases in air quality leading to decreases in tourism flows or a lower likelihood of visiting certain destinations. Compared with other environmental pollution, such as water and soil pollution, air pollution is much more visible or sensible and can be perceived more easily by the public, which justifies the high impact that it may have on tourism in a given destination (Eusébio et al., 2021). This is especially important for health tourism as it emphasises the importance of natural environmental dimensions, especially the sub-dimension of air. Investigations of health tourism resources consider the importance of air-related recuperation. Negative ion air (NAI) environments provide effective disease recuperation and healthcare effects for tourists, as well as positive effects related to anti-ageing, sedation, sleep, blood pressure regulation, appetite enhancement, lung function, and immunity (Lee & Li, 2019). Environmental factors such as soil moisture, air temperature, wind speed, humidity, and atmospheric pressure, are the most influential factors affecting NAI (Shi et al., 2021). NAI concentration is also susceptible to various environmental factors, such as gas pollutants and particulate matter, which are already important environmental problems (Wang et al., 2020).

The seasonal shifts, especially in spring, can affect the flowering time of plants and thus significantly affect the well-being of allergy sufferers and the suitability of certain destinations for this group. In addition to this problem of earlier exposure to native pollen (such as birch or hazel), new problems can also arise due to the spread of neophytes, i.e. immigrated species such as ragweed (Ambrosia artemisifolia) (Moshammer et al., 2014). Higher temperatures could lead to some Mediterranean holiday areas becoming a suitable habitat for malaria-bearing mosquitoes. Spain, for example, is currently seen as a safe, easily accessible, no-risk destination not requiring immunisation or courses of treatment against exotic diseases for intending visitors. Increases in the incidence of food poisoning and food related diseases associated with enhanced microbiological activity, for example, salmonella and E. coli, are likely to increase as temperatures rise. There will be a higher risk of epidemics of cholera and typhoid as well as other infectious diseases (Perry, 2006).

Another aesthetic and biological factor is also important for beach tourism. In particular, Algal blooms have had strong negative impacts on tourist arrivals. Algal blooms may affect water quality, cause skin irritations, and in some cases, be poisonous. In 1989 the Italian Adriatic Sea suffered from severe algal blooms, which resulted in a 25% decline in visitor numbers and a major impact on the region's image as a tourist destination (Becheri, 1991). Though storms, currents and other natural phenomena are also implicated, climate change is a direct and indirect factor in algal blooms because of higher water temperatures or greater run-off caused by more intense precipitation. The previous research indicates a considerable vulnerability of beach holiday destinations to algal blooms; however, it is not clear how these events influence spending patterns and the overall economy of holiday regions (Nilson & Gössling, 2013). Another issue that could emerge due to climate change is the increase in the jellyfish population and the emergence of jellyfish that have not been present yet in certain waters. Climate change could trigger increased jellyfish blooms in some locations. Jellyfish regularly generate concern for beachgoers, given that their presence can cause mass injuries or death (Graham et al., 2014).

Beaches are also affected by sea-level rise. Rising seas are likely to exacerbate erosion and reduce the beach's size. As a result of several factors, including sea level rise, higher storm surges and larger spring tides, it will result in an increased risk of coastal erosion and flooding inundation (Becken, 2016). In the period 1960-2015, the average height of the sea along the Slovenian coast rose by 10 cm, on average by 1.7 mm/year, or in the last 20 years by an average of 5 mm/year. It is estimated that in the recent period, in addition to the global increase in mean sea levels, sea level rise is more often than usual influenced by weather conditions in the region. Along the Slovenian coast and in the Adriatic Sea, sea level has been rising faster than the European and global trend in the last twenty years. If infrastructural adaptations were not made, we could expect daily flooding of the lowest-lying urban areas of the Slovenian coast at the end of the century with a similar trend. It is estimated that the height of the sea level of the European seas will rise by 20 to 80 cm. The frequency of floods will therefore be higher by a factor of 10-100 (ARSO, n.d.)

Increasing evidence of glacier retreat, permafrost degradation and reduced mountain snowpack has been observed in many regions, thereby suggesting that climate change may seriously affect streamflow regimes. These changes could in turn threaten the availability of water resources for many environmental and economic systems and exacerbate a range of natural hazards that would compound these impacts (Beniston & Stoffel, 2014). Decreasing water availability and growing demands due to climate change and increasing tourist numbers are likely to result in worsening conflicts between socioeconomic sectors that depend on water to survive. There is already evidence that water shortages may have negatively affected the tourism sector (e.g., study from Kent, Newnham, & Essex (2002) on drought in Mallorca in 1995). Hotels need large volumes of water to cover the needs of a wide range of facilities, such as laundry rooms, kitchens, pools, gardens, and bedrooms (Angulo et al., 2014). There is likely to be an increase in friction, with a conflict of interest between local people and tourist authorities on the use of scarce water. Water-hungry land uses like golf courses and water parks will be seen as water-stealers by local people. Projected decreases in run-off will exacerbate the problem of saline infiltration of water resource (Perry, 2006).

By staying in a hotel, a tourist uses, on average, about one third more water per day than a local person. Tourist water consumption per capita varies between 100-2000 litres per bed per night, depending fundamentally on the characteristics of services provided by hotels (Gössling et al., 2012). Water use varies significantly from one hotel to another depending on a range of factors, including location and climate, category, size, number of beds, year of construction or renovation , range of services and facilities, and ownership (e.g., family run or part of a chain). Bohdanowicz and Martinac (2007), for example, found that higher-category hotels and hotels located in hotter regions, such as the Mediterranean basin, use more water. They also found that consumption rates were influenced by hotel size, number of overnight stays, and type of board (full-board, half-board, etc.). Hotel gardens and pools are an important feature as they consume large volumes of water (Torres-Bagur, Ribas & Vila-Subirós, 2019). Therefore, if water shortages will increase as it is presumed, water restrictions for tourism will be inevitable and certain adaptation measures will have to be implemented.

Various activities based on natural attraction, for example, thermal mineral springs, low-allergen air or peat for mud baths, play a key role in the decision of whether or not to travel to a destination. An impairment or threat to these resources through midge infestation, cyanobacteria or elevated pollutant levels can result in a negative perception from health tourists (Schmude et al., 2021). Climate change induced heat waves can also negatively affect thermal water resources, whichmeans that destinations may not fulfil the guidelines for the respective predicate in the future (Beniston & Stoffel, 2014).

Presentation and interpretation of results for health, wellness, beach and other water-related tourism

The following variables are presented for each location based on their relevance to tourism activities:

- Percentage of hot days per month (when the maximum daily temperature is above 30 °C);
- Percentage of warm days per month (when the maximum daily temperature is above 25 °C);
- Percentage of days with at least 20 mm of precipitation;
- Percentage of tropical nights per month (when night temperature does not drop below 20 °C); and
- Percentage of days per month that are either ideal, marginal or acceptable for 3S (sun, sea, sand) tourism using the CIT: 3S index (Climate Index for Tourism).

Temperature indicators are relevant as thermal comfort is one the most important for beach tourists, especially for people that are more sensitive to extreme heat (such as children and the elderly) (Rutty & Scott, 2014). It also heavily affects the daily habits of tourists on holiday. The days with heavy precipitation were chosen as for many water-based activities (such as canoeing) the water level is crucial for execution of some activities. Additionally, heavy precipitation lowers the (sea) water temperature and causes temporary (sea) pollution (e.g., seagrass) that is not favourable for bathers. Tropical nights are relevant as beach tourism is highly seasonal tourism in months when temperatures are the highest and consequently the cost of air-conditioning is the highest for providers who want to allow tourists to get some rest from heat stress during the night.

An index approach is often used in assessing weather suitability for tourism because of the multifaceted nature of weather and the complex ways at which weather variables come together to give meaning to climate for tourism.

The CIT: 3S defined climate comfort in Slovenia was calculated for the historic periods 1971–2000; 1981–2010; 1991–2020 from the ARSO data archive, and retrieved from the CDS for the future periods 2021–2040; 2041–2060; 2081–2100 with the reference period 1986–2005 concerning RCP2.6, RCP4.5 and RCP8.5 scenarios. Percentages of warm days per month, hot days per month, tropical nights per month and days per month with at least 20 mm of precipitation were prepared by ARSO for past (1981–2010), current (2011–2040) and future periods (2041–2070; 2071–2100 with the reference period 1981–2010) according to RCP2.6, RCP4.5 and RCP8.5 scenarios.

Selected weather stations were chosen for the three types of tourism as they are geographically close to tourism destinations:

- Health and wellness tourism: Murska Sobota (close to Terme 3000 – Moravske Toplice and Terme Vivat), Cerklje ob Krki (Close to Terme Čatež), Novo mesto (close to Terme Dolenjske Toplice and Terme Šmarješke Toplice), Celje (close to Thermana Laško and Rimske Terme).
- Beach tourism: Portorož
- Other water-based tourism: Rateče (close to river Soča), Novo mesto (close to river Krka), Bilje (close to river Vipava)

Bilje

First are presented the projected temperature changes in the percentage of warm and hot days for Bilje (Figure 9 and 10). As seen on graphs, the temperature in Bilje will increase, particularly the number of characteristic days. RCP8.5 scenario stands out as the most unfavourable one for the number of hot days in July and August, however, the uncertainty is much higher for hot than for warm days. Long and frequent heatwaves in July and August will become a serious issue for visitors; therefore, adaptation measures need to be implemented to minimise visitors' health risks.

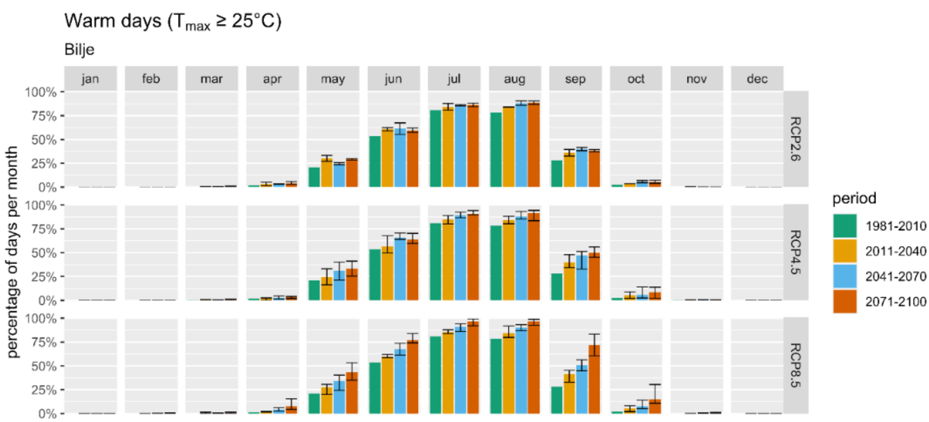

Figure 9: Bilje: The percentage of warm days

Data source: ARSO, 2022.

Figure 10: Bilje: The percentage of hot days
Data source: ARSO, 2022.

Figure 11 presents the projected percentage of days with at least 20 mm of precipitation for Bilje. It is anticipated that occurrence of heavy precipitation days in August will decrease, whereas in other high season months (June and July) the projections are very unclear. Increase is more likely from December to April. However, we can see how the variability of model results is much higher for precipitation events than for characteristic temperature days as it was also expected from high confidence in temperature projections and low confidence in precipitation projections for Slovenia.

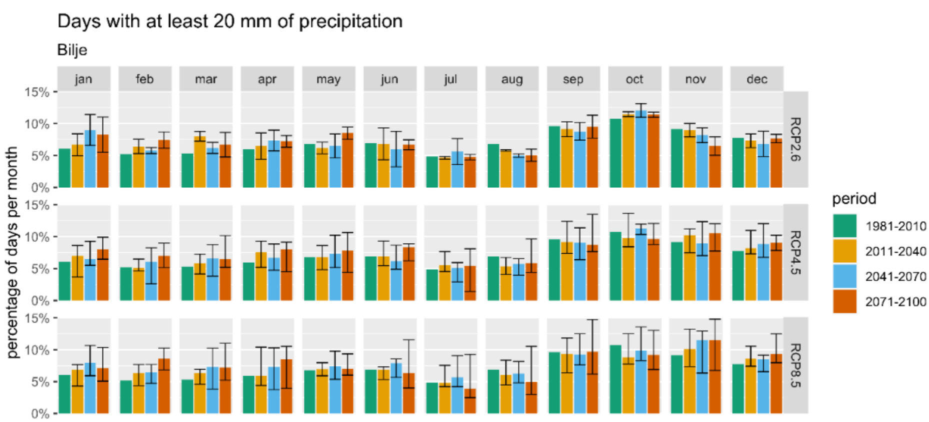

Figure 11: Bilje: The percentage of days with at least 20 mm of precipitation
Data source: ARSO, 2022.

Figure 12 presents the CIT: 3S index for Bilje in the past periods. The graph shows that the percentage of days with ideal climate comfort for 3S tourism is the highest in the summer season; however, a slow extension of the season can be seen, mainly into the spring through the observed periods. It is evident that this type of tourism is highly seasonal, with a peak in July and August.

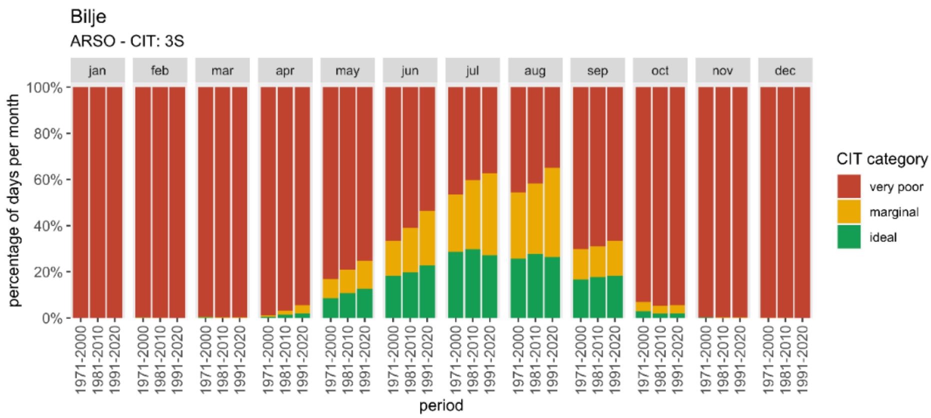

Figure 12: Bilje: The percentage of very poor/marginal/ideal days according to CIT: 3S
Data source for calculations: ARSO, 2022.

Last are presented projections of the CIT: 3S index for Bilje for the future periods according to 3 scenarios (Figure 13, 14 and 15). If we compare the Copernicus data for the reference period with the calculations from the ARSO data we can see some discrepancies as Copernicus data is prepared for the whole Europe and is not downscaled or bias-corrected for Slovenia. ARSO results are better to describe past and present situation, but projections are not available for all needed variables, so Copernicus projections are used. Therefore the absolute values are not to be used as they should be bias-corrected but rather projected deviations. It appears that the highest difference between ARSO and CDS data is in May and September. The same goes for other locations further on.

The percentage of days with ideal climate comfort for water-based tourism in Bilje is projected to stay virtually the same in the summer months compared to the past. However, the RCP8.5 scenario shows that the percentage of ideal days might even decrease (as is the case for August in RCP4.5). The percentage of days with ideal climate comfort for tourism visibly rises in late spring (May) and early autumn (September); therefore, a more extended tourism season is expected.

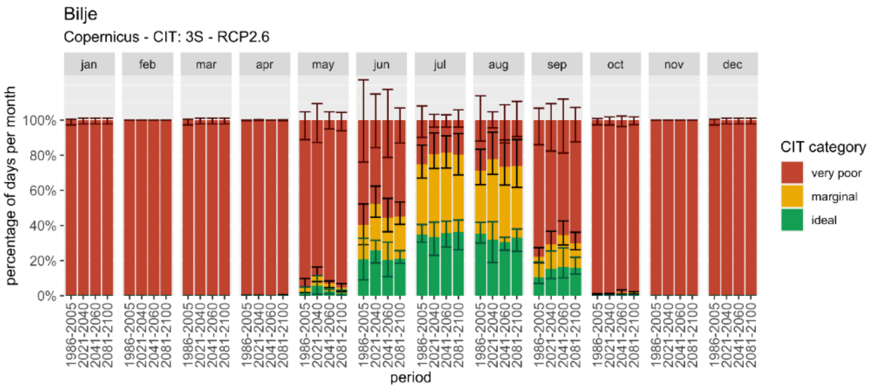

Figure 13: Bilje: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP2.6 scenario

Data source: Copernicus, 2022

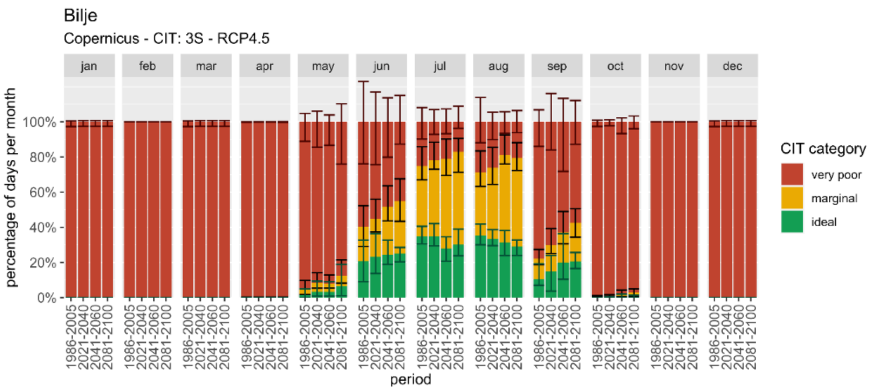

Figure 14: Bilje: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP4.5 scenario

Data source: Copernicus, 2022

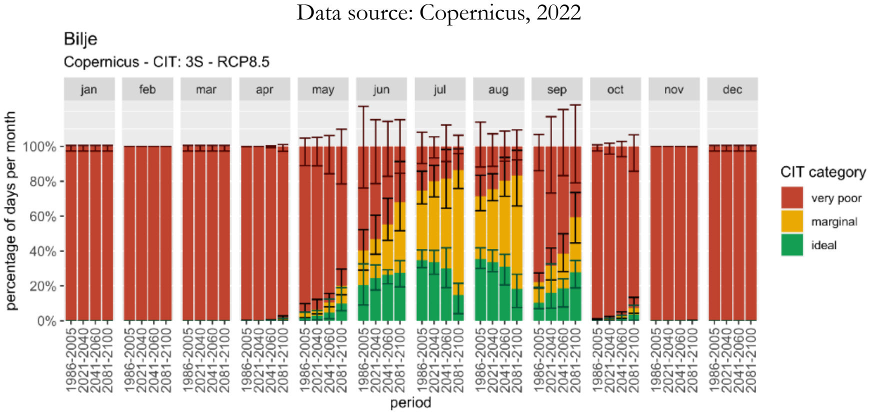

Figure 15: Bilje: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP8.5 scenario

Data source: Copernicus, 2022

Celje

First are presented the projected temperature changes in the percentage of warm and hot days per month for Celje (Figure 16 and 17). It is clear that in all scenarios, the percentage of warm days will increase, which will positively affect the duration of the summer season in the nearby health resorts with its prolongation. The percentage of hot days concerning RCP2.6 and RCP4.5 scenarios does not vary as much as the percentage of hot days concerning the RPC8.5 scenario. In the case of this scenario, big infrastructure changes will be needed as the guests of health resorts are often people with high health risks due to extreme heat.

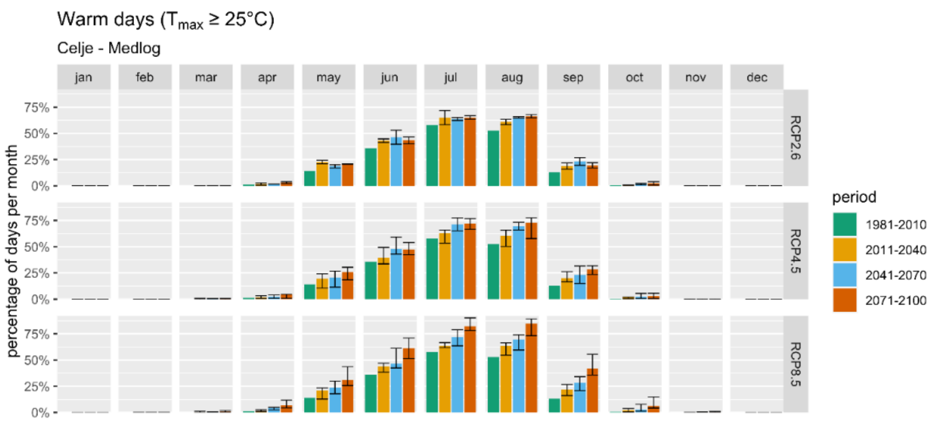

Figure 16: Celje: The percentage of warm days

Data source: ARSO, 2022.

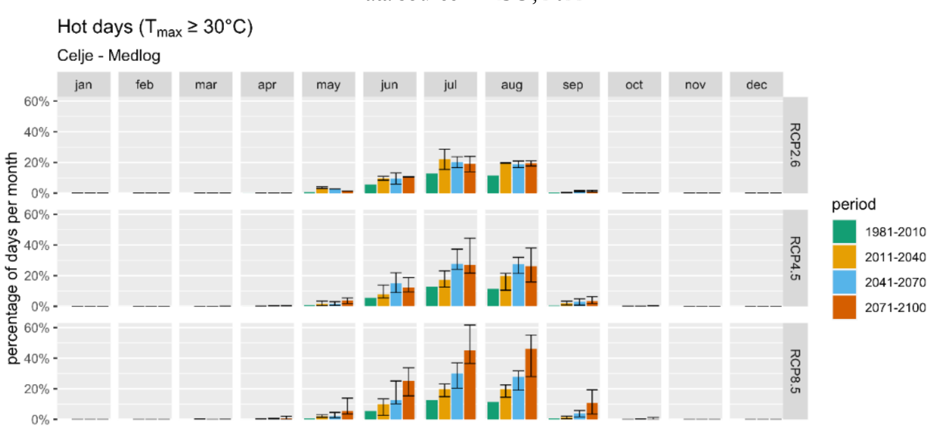

Figure 17: Celje: The percentage of hot days

Data source: ARSO, 2022.

Figure 18 presents the CIT: 3S index for Celje in the past periods. The graph shows that the percentage of days with ideal climate comfort for 3S activities regarding health and wellness tourism is the highest in the summer season; however, past trends show a slow extension of the season, mainly into the spring. It is obvious that this type of tourism is highly seasonal, with a peak in July and August.

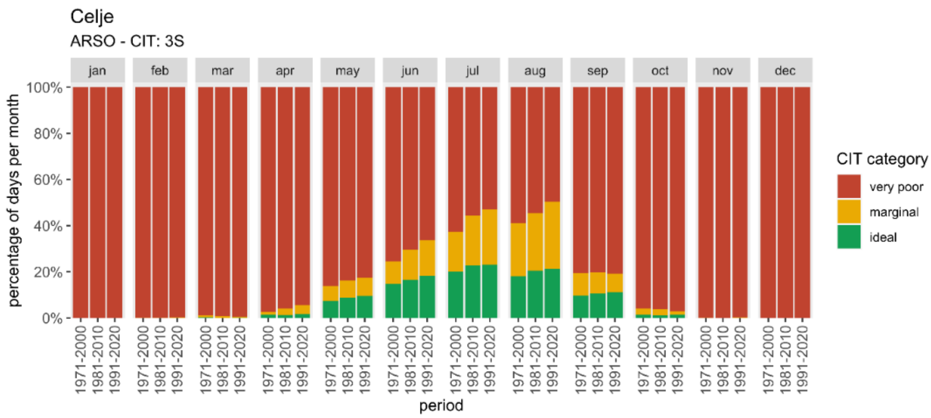

Figure 18: Celje: The percentage of very poor/marginal/ideal days according to CIT: 3S

Data source for calculations: ARSO, 2022.

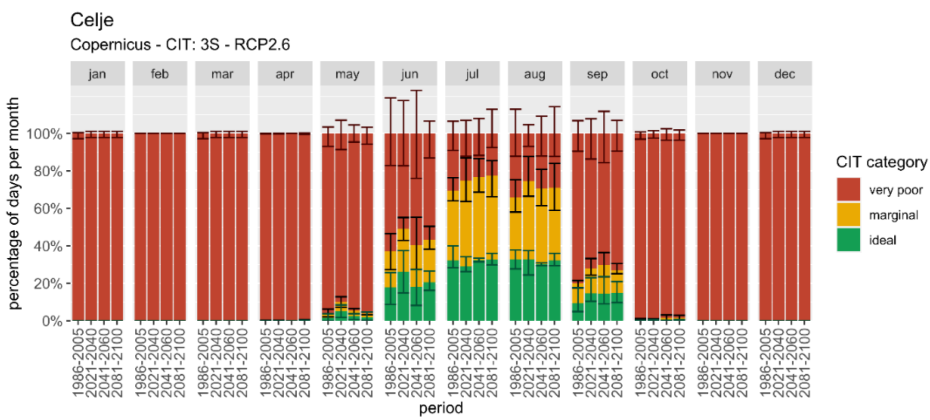

Figure 19: Celje: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP2.6 scenario

Data source: Copernicus, 2022

Second is presented the projected CIT: 3S index for Celje for the future periods concerning 3 scenarios (Figure 19, 20 and 21). The marginally appropriate days will increase in RCP4.5 and RCP8.5 scenario. Regarding scenario RCP8.5, the percentage of days with partly acceptable conditions will visibly increase—however, the percentage of ideal days will decrease in July and August and increase in September. A slight extension of the season is also expected in RCP4.5 scenario.

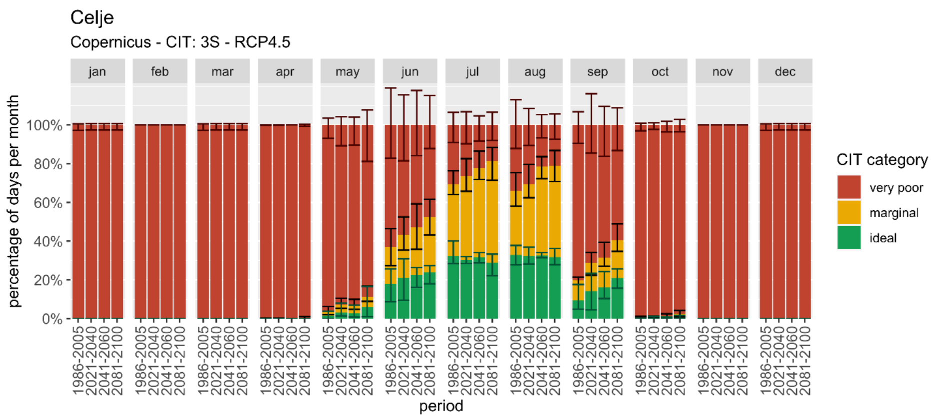

Figure 20: Celje: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP4.5 scenario

Data source: Copernicus, 2022

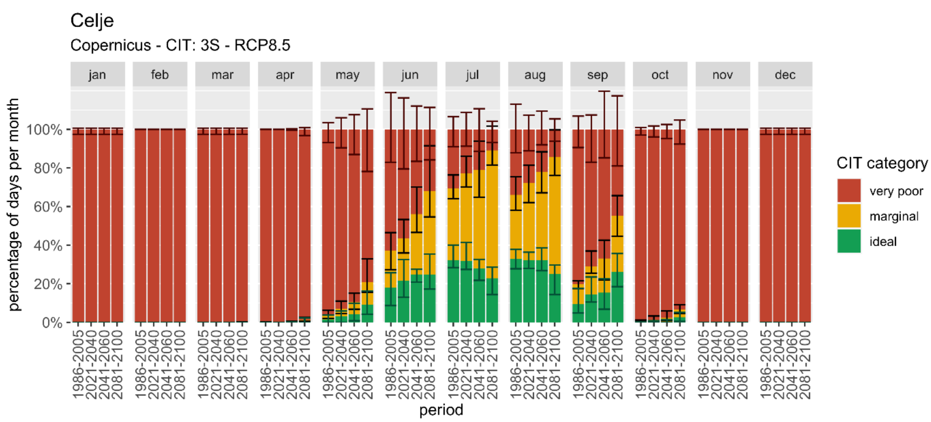

Figure 21: Celje: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP8.5 scenario

Data source: Copernicus, 2022

Cerklje ob Krki

The projected temperature changes in the percentage of warm and hot days per month for Cerklje ob Krki are presented (Figure 22 and 23). Both graphs indicate that the trend of increased frequency of warm and hot days will continue, which is partly positive information for health resorts nearby as it indicates the season extension into late spring and early summer months. Therefore, management changes will be needed, such as opening outside pools and infrastructure sooner. However, a drastic increase (RCP8.5 scenario) of hot days implies the necessity to adapt the infrastructure to increase the thermal comfort of the guest during the heatwaves.

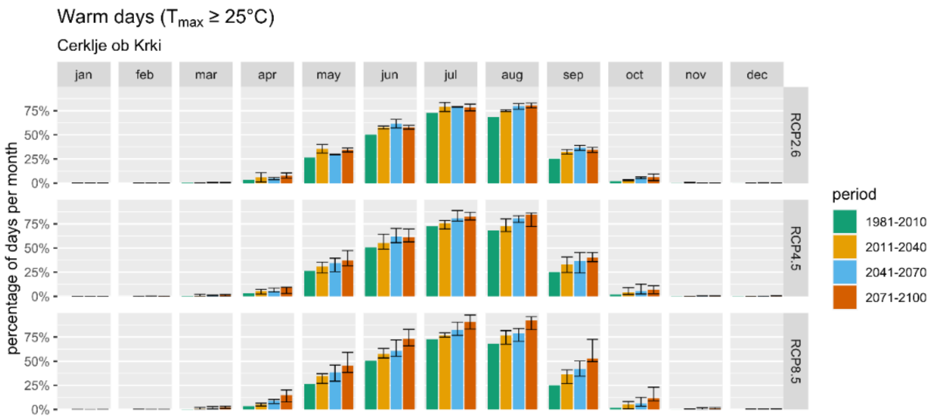

Figure 22: Cerklje ob Krki: The percentage of warm days
Data source: ARSO, 2022.

Figure 20 shows the CIT: 3S index for Cerklje in the past periods. The graph shows that the percentage of days with ideal climate comfort for outside activities related to health tourism is the highest in the summer season (more than 20% of days per month); however, past observations show an extension of the season into the spring months through the observed periods. However, there was a lot of missing data for this particular calculation, so it should be taken with caution.

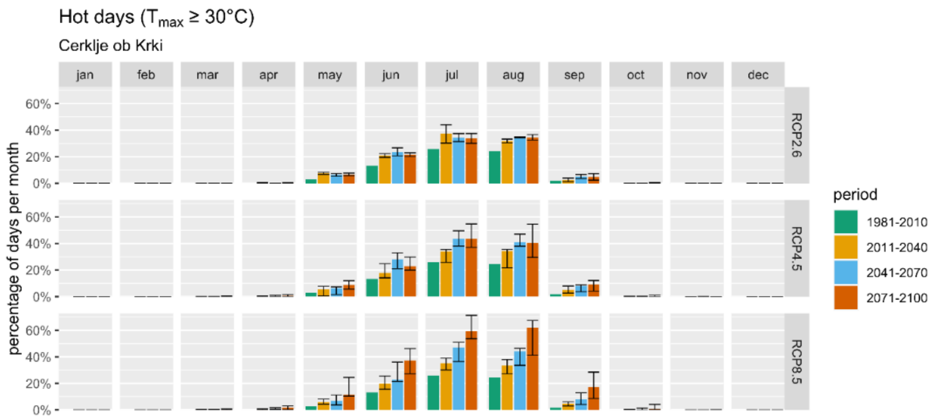

Figure 23: Cerklje ob Krki: The percentage of hot days
Data source: ARSO, 2022.

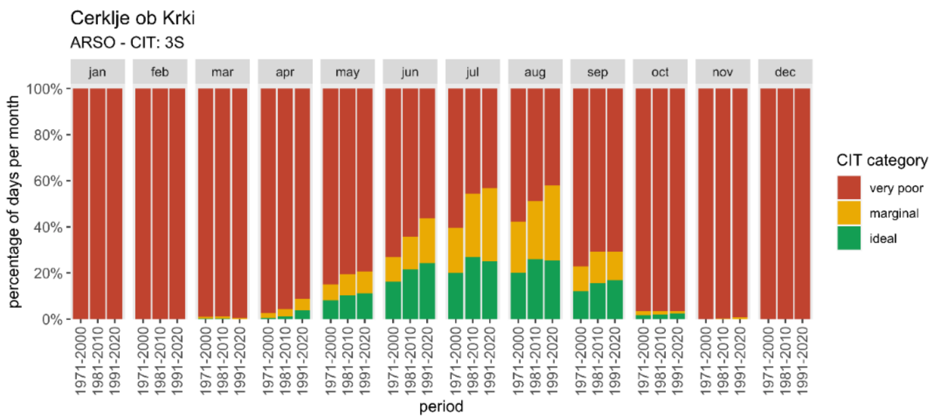

Figure 24: Cerklje ob Krki: The percentage of very poor/marginal/ideal days according to CIT: 3S
Data source for calculations: ARSO, 2022.

Second is presented the projected CIT: 3S for Cerklje ob Krki concerning 3 scenarios (Figure 25, 26 and 27). The percentage of days with ideal climate comfort for tourism in Cerklje ob Krki is projected not to change or even decrease in the summer months. On the other hand, the percentage of these days is projected to rise in September and slightly also in the early autumn (October) and late spring (May), especially in the case of RCP4.5 and RCP8.5. The percentage of marginally appropriate days in expected to significalnty increase in the case of RCP8.5. The unfavourable months for outdoor health tourism activities and water activities on the river Krka will remain the same.

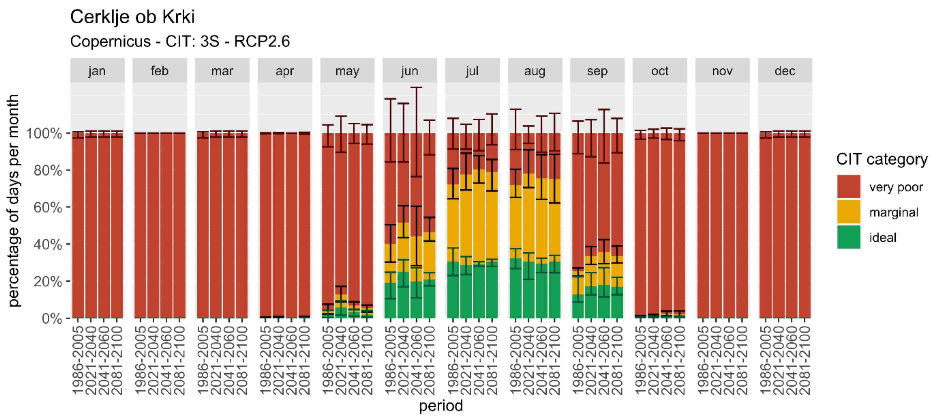

Figure 25: Cerklje ob Krki: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP2.6 scenario

Data source: Copernicus, 2022

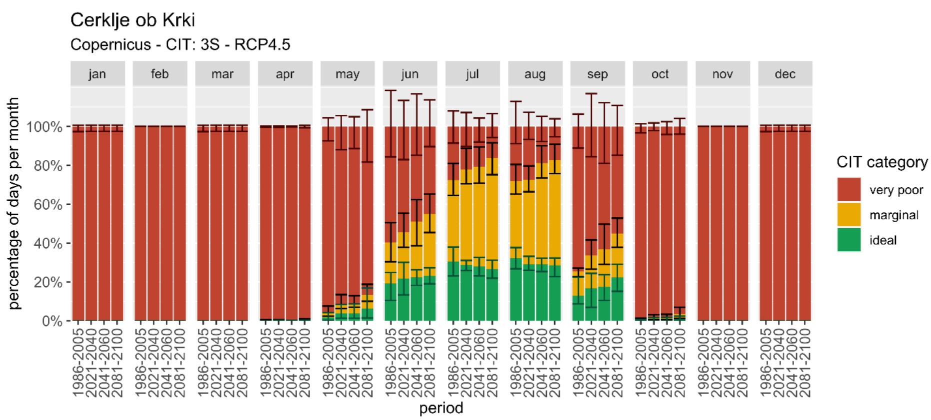

Figure 26: Cerklje ob Krki: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP4.5 scenario

Data source: Copernicus, 2022

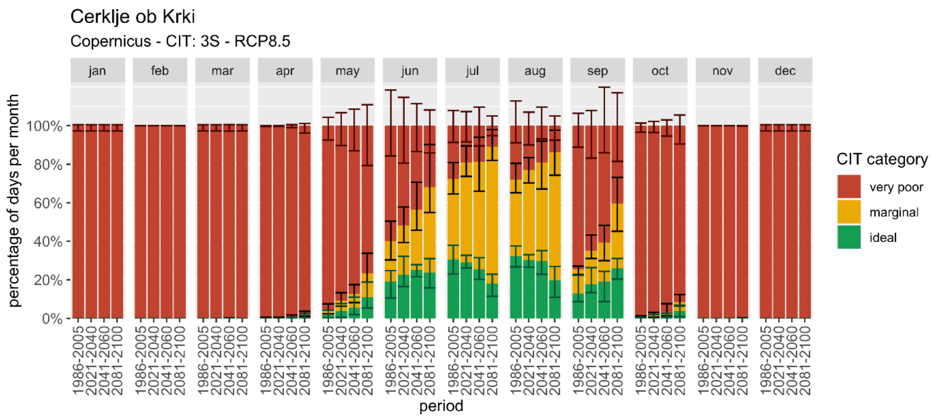

Figure 27: Cerklje ob Krki: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP8.5 scenario

Data source: Copernicus, 2022

Murska Sobota

First are presented the projected temperature changes in the percentage of warm and hot days for Murska Sobota (Figure 28 and 29). As seen on graphs, the number of days with high temperature in Murska Sobota will increase in the whole warmer half of the year. For hot days projections the RCP8.5 scenario stands out as the most unfavourable one in July and August. Such high frequency of hot days in July and August will become a serious issue for visitors (especially the elderly and children); therefore, adaptation measures need to be implemented in order to minimise health risks for visitors.

On Figure 26 the CIT: 3S for is presented Murska Sobota in the past periods. The graph shows that the percentage of days with ideal climate comfort for outside activities related to health tourism is the highest in the summer season (July and August) and slightly increasing in all months from April to September.

Second is presented the projected CIT: 3S for Murska Sobota concerning 3 scenarios (Figure 30, 31 and 32). The marginally appropriate days will visibly increase in RCP4.5 and RCP8.5 scenario. However, the percentage of ideal days can decrease, especially in July and August. A slight extension of the season towards autumn months is expected in both less optimistic scenarios.

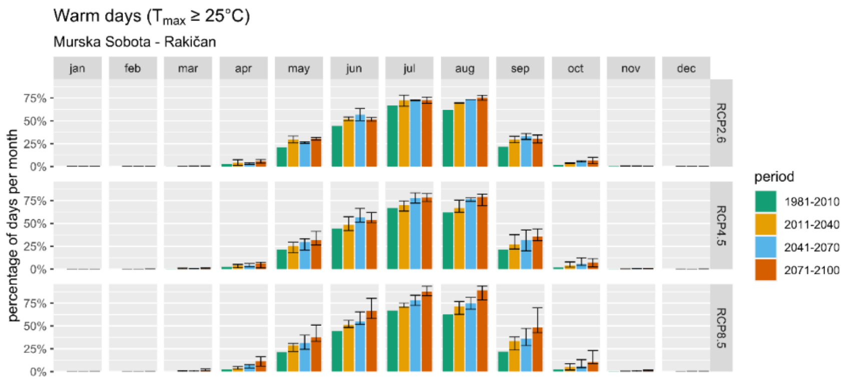

Figure 28: Murska Sobota: The percentage of warm days

Data source: ARSO, 2022.

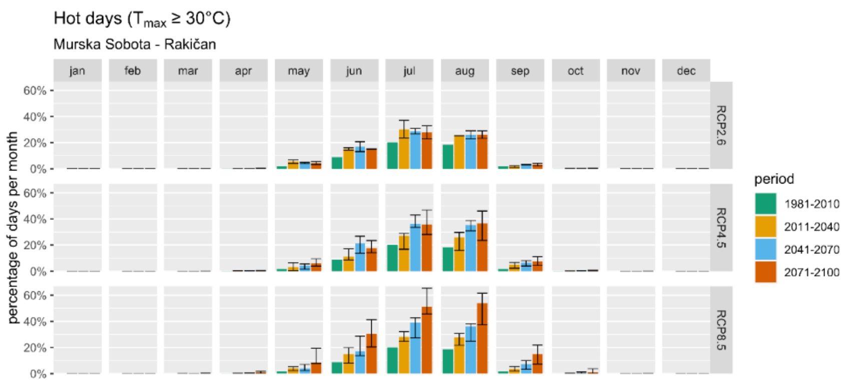

Figure 29: Murska Sobota: The percentage of hot days

Data source: ARSO, 2022.

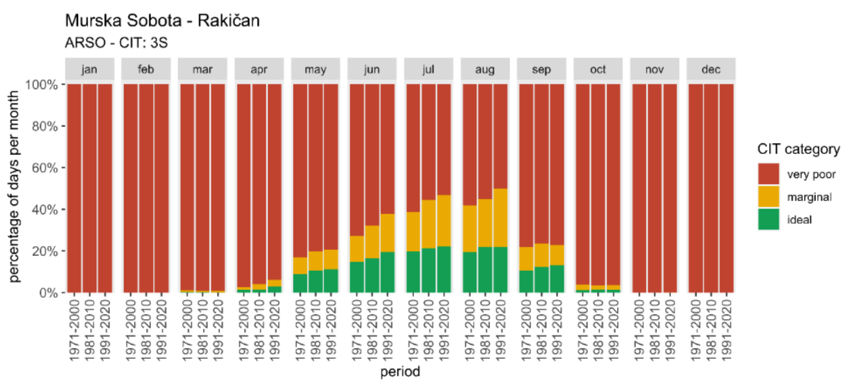

Figure 30: Murska Sobota: The percentage of very poor/marginal/ideal days according to CIT: 3S

Data source for calculations: ARSO, 2022.

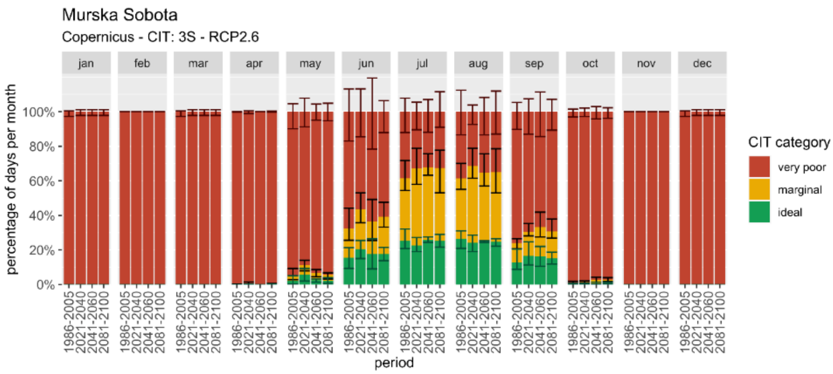

Figure 31: Murska Sobota: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP2.6

Data source: Copernicus, 2022

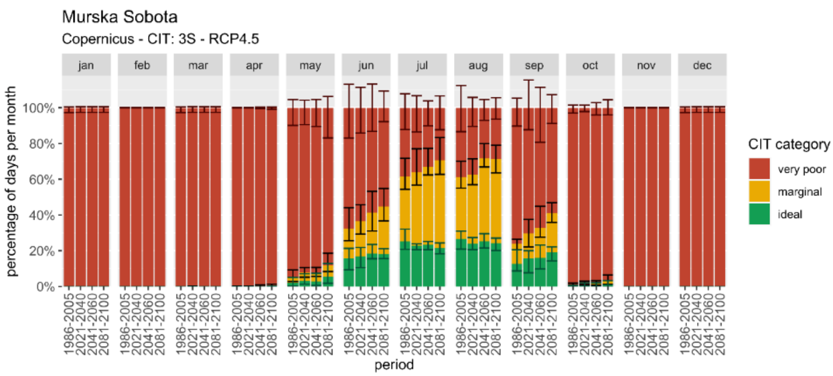

Figure 32: Murska Sobota: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP4.5

Data source: Copernicus, 2022

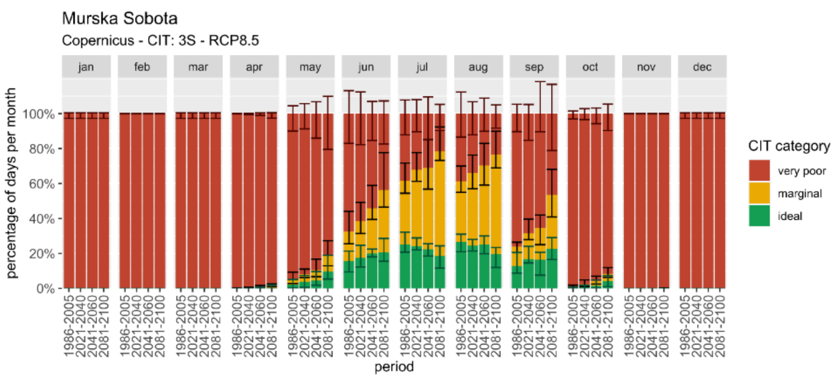

Figure 33: Murska Sobota: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP8.5

Data source: Copernicus, 2022

Portorož

In Figure 34 and 35 are presented projected temperature changes as the percentage of warm and hot days for Portorož. As seen on the graphs, the frequency of these characteristic days in Portorož will significantly increase throughout the century, in the whole warmer half of the year. RCP8.5 scenario stands out as the most unfavourable one for the percentage of hot days in July and August reaching almost the whole month at the end of the century. This is partly positive for the industry as season extension is expected; however, the increased percentage of hot days will be the main reason for reducing thermal comfort for tourists and locals. Hence, adaptation measures should be implemented to provide more favourable thermal comfort conditions for beach activities.

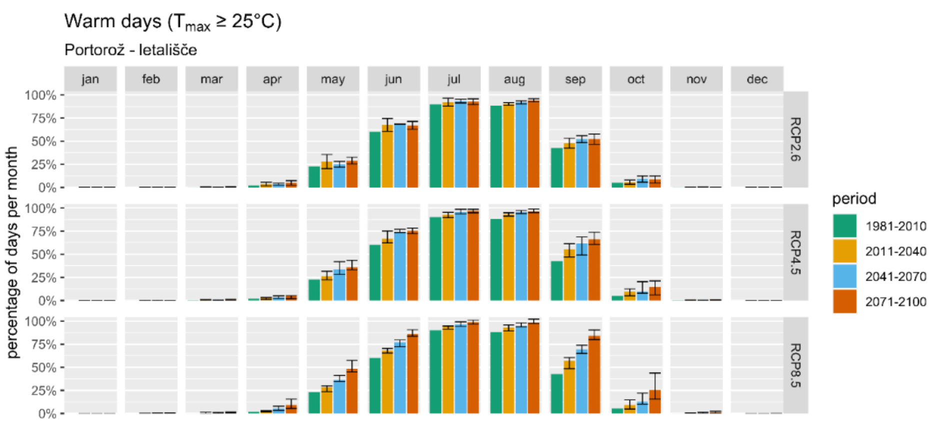

Figure 34: Portorož: The percentage of of warm days
Data source: ARSO, 2022.

Figure 36 shows the projected percentage of tropical nights for Portorož. It is shown that the percentage of tropical nights according to the least optimistic scenario (RCP8.5) could increase even up to 60% and higher in July and August compared to the current period. Such an increase will heavily affect the expenditures connected to energy usage, which will increase due to constant air conditioning.

Figure 35: Portorož: The percentage of hot days

Data source: ARSO, 2022.

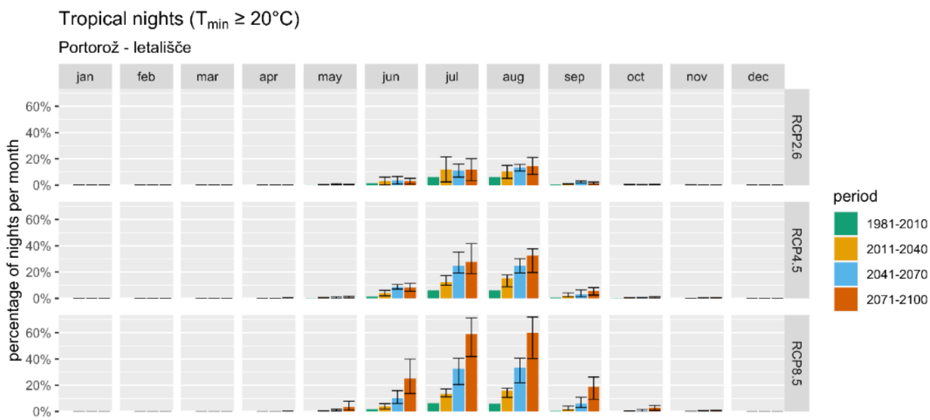

Figure 36: Portorož: The percentage of tropical nights

Data source: ARSO, 2022.

Figure 37 shows the projected percentage of days with at least 20 mm of precipitation for Portorož. Heavy precipitation events are expected to gradually become more frequent in the case of the least optimistic scenario (RCP8.5), which is visible in almost all months, especially in the winter period in the case of RCP4.5 and RCP8.5. Also for the other two scenarios there is mainly an increase or not visible pattern. The uncertainty of projections is very high, changing the direction of the projected change.

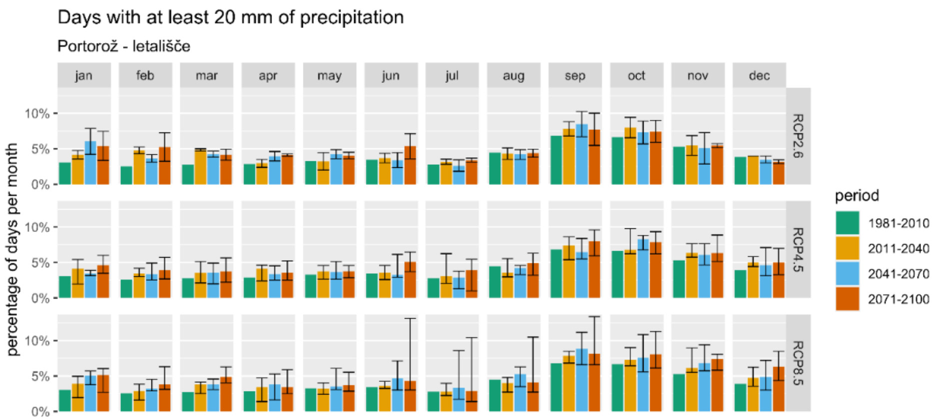

Figure 37: Portorož: The percentage of days with at least 20 mm of precipitation
Data source: ARSO, 2022.

Figure 38 presents the CIT: 3S index for Portorož in the past periods. The graph shows that the percentage of days with ideal climate comfort for beach tourism is the highest in the summer season (June, July and August) with approximately 40% of ideal days per month and positive trend. Past observations show an extension of the season into May and September.

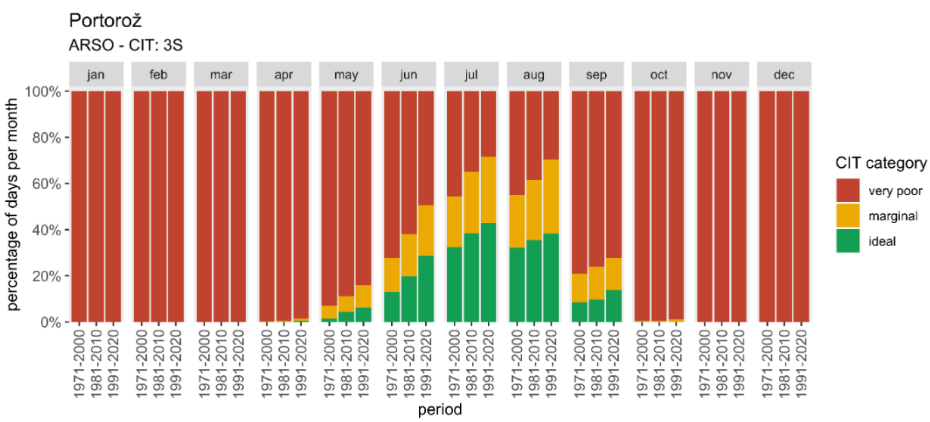

Figure 38: Portorož: The percentage of very poor/marginal/ideal days according to CIT: 3S
Data source for calculations: ARSO, 2022.

Figure 39 presents the CIT: motor boating index for Portorož in the past periods. The graph shows that the percentage of days with ideal climate comfort for motor boating is very high in the two summer months (60 to 80% of days with ideal conditions in July and August) with further positive trend (visible also in other warm months). The season is getting extended not only in May and September, but with the increasing percentage of the marginal conditions for this activity also in April and October, which can result in an increasing number of boats (and passengers) not only in the summer but also in shoulder seasons.

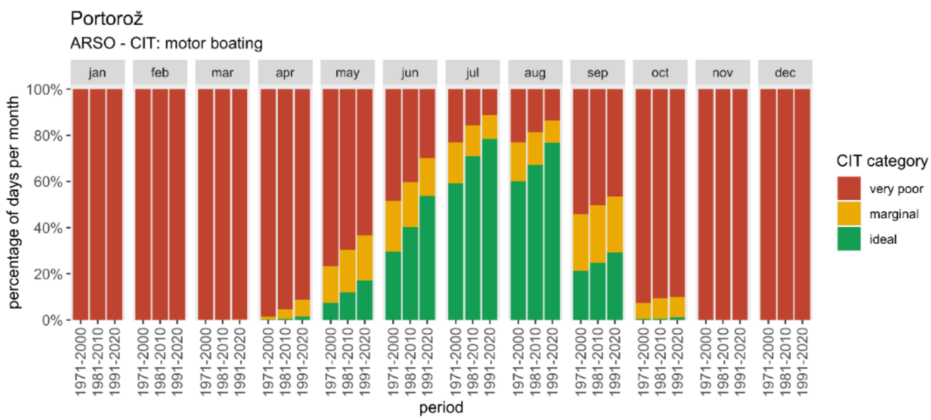

Figure 39: Portorož: The percentage of very poor/marginal/ideal days according to CIT: motor boating

Data source for calculations: ARSO, 2022.

Figure 40 presents the CIT: sailing index for Portorož in the past periods. The graph shows that the percentage of days with ideal climate comfort for sailing tourism is very high in the summer season (June, July and August) with very notable positive trend in all warm months. The season is getting extended not only in May and September, but with the increasing percentage of the marginal conditions for this activity also in April and October, so one can expect that it will be similar in the future as well with further prolongation of the season. There are many more ideal days for motor boating and sailing than for 3S tourism.

Second is presented the projected CIT: 3S index for Koper as the closest grid point to Portorož concerning 3 scenarios (Figure 41, 42, and 43). The percentage of days with partly acceptable climate conditions for beach tourism is projected to be even higher in the summer and spring months than in the past, especially related to the RCP8.5 scenario in 2081-2100. However, the number of ideal days in July and August (which are currently high season months) is expected to decrease due to higher temperatures, which may affect tourists and their well-being.

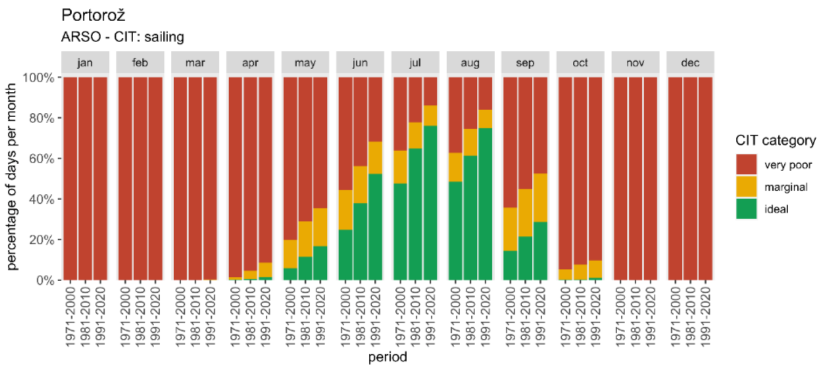

Figure 40: Portorož: The percentage of very poor/marginal/ideal days according to CIT: sailing

Data source for calculations: ARSO, 2022.

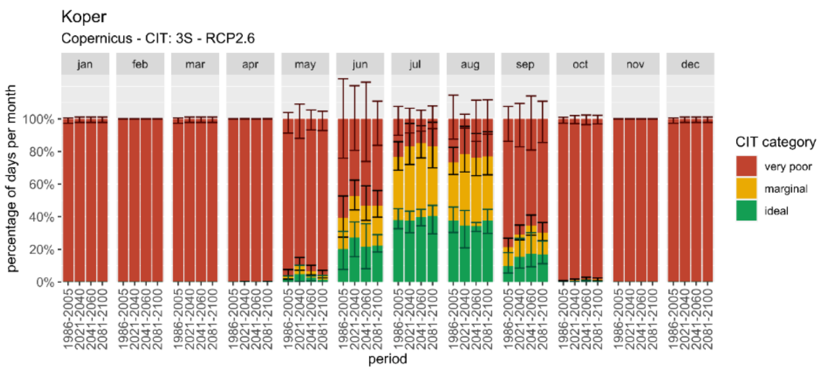

Figure 41: Koper: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP2.6

Data source: Copernicus, 2022

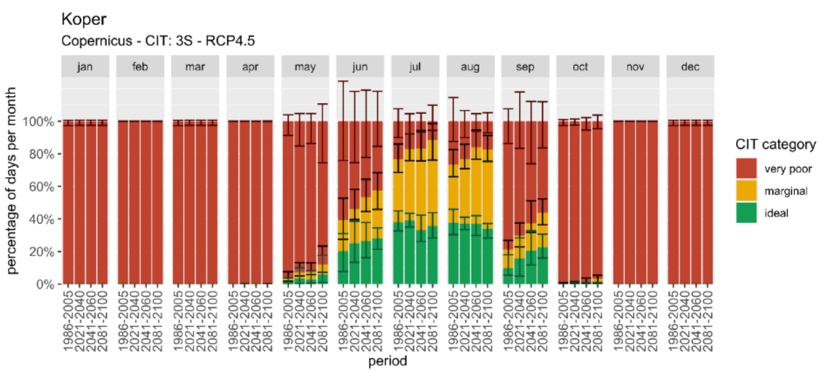

Figure 42: Koper: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP4.5

Data source: Copernicus, 2022

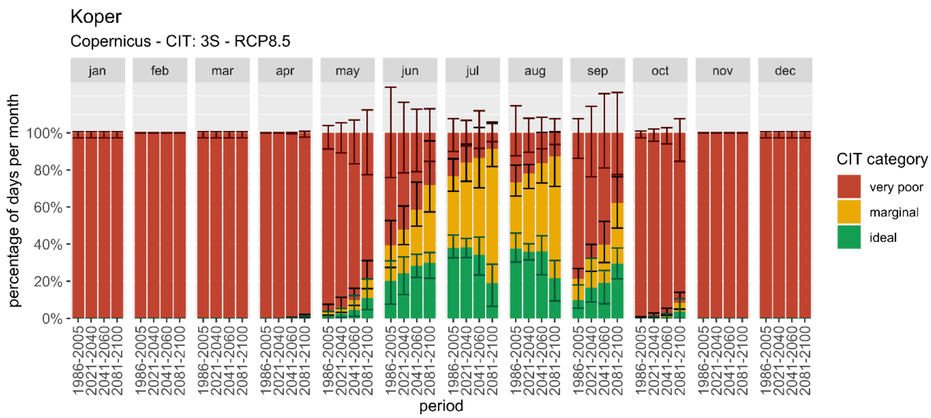

Figure 43: Koper: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP8.5

Data source: Copernicus, 2022

Rateče

In Figure 44 and 45 are presented projected temperature changes as the percentage of warm and hot days for Rateče. As seen on the graphs, especially the frequency of warm days in Rateče will increase, particularly in the summer months and in the case of RCP8.5 scenario, which implies that in the future, this destination can expect an increase in visitors and a rise in the popularity among tourists that are interested in water-related activities.

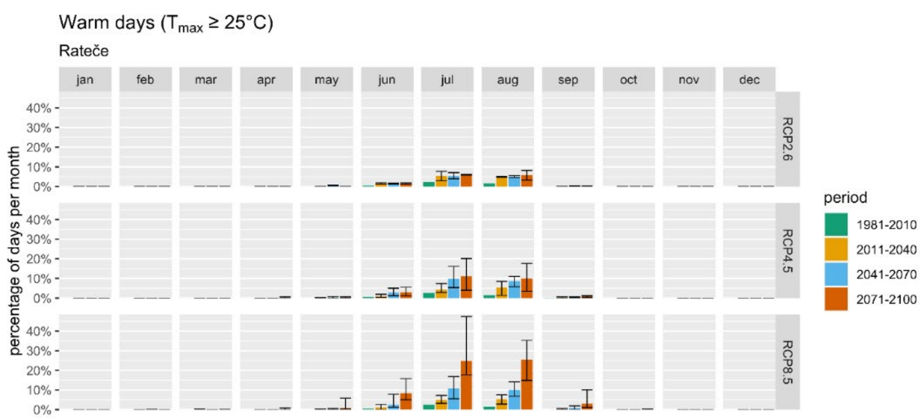

Figure 44: Rateče: The percentage of warm days

Data source: ARSO, 2022.

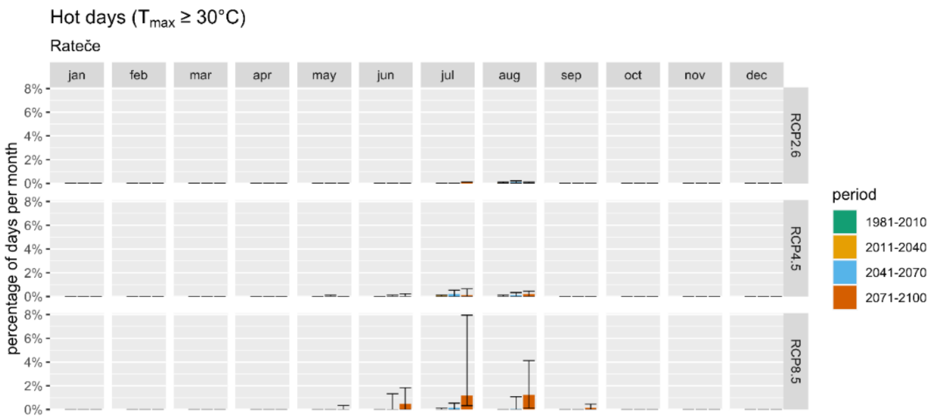

Figure 45: Rateče: The percentage of hot days
Data source: ARSO, 2022.

Figure 46 presents the projected percentage of days with at least 20 mm of precipitation for Rateče for 3 scenarios. It is anticipated that the occurrence of heavy precipitation events can increase from January to May, for other months it is very difficult to say. As already mentioned, the variability is very high with projections of various models changing the sign of the change.

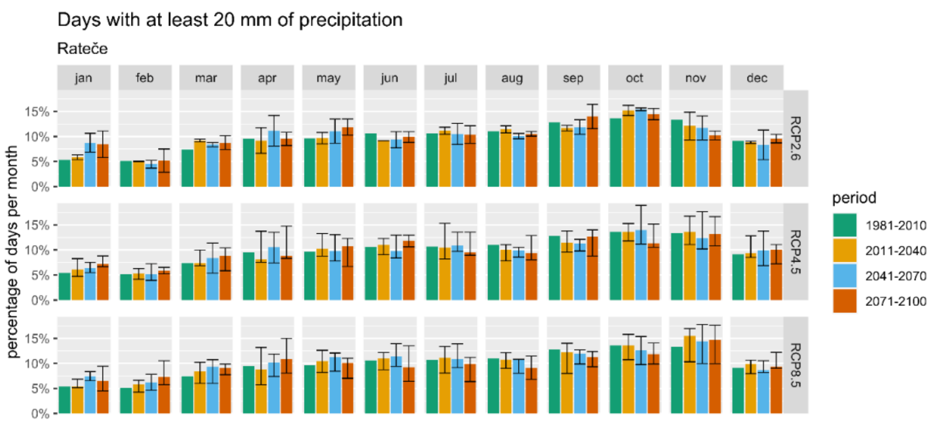

Figure 46: Rateče: The percentage of days with at least 20 mm of precipitation
Data source: ARSO, 2022.

Figure 47 presents the CIT: 3S for Rateče in the past periods. The graph shows that the percentage of days with ideal climate comfort for outside activities related to health tourism is the highest in the summer season. However, there are some ideal and marginal days even in spring and autumn, probably due to more sunshine. The positive trend in the percentage of ideal and marginal days can be seen in June and July.

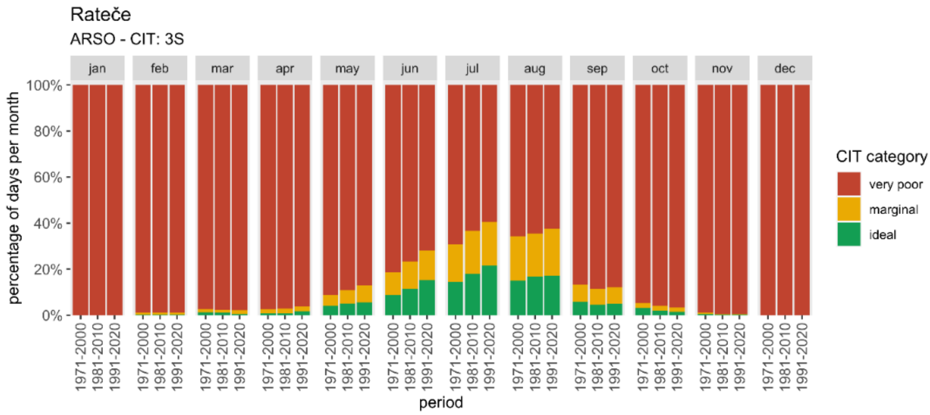

Figure 47: Rateče: The percentage of very poor/marginal/ideal days according to CIT: 3S
Data source for calculations: ARSO, 2022.

Second is presented the CIT: 3S index for Rateče concerning 3 scenarios (Figure 48, 49 and 50). Results for the reference period are very different from the calculations from the ARSO database, but this grid point is a bit further away and can be at even higher altitude. There can be only seen a very slight increase in the less optimistic two scenarios.

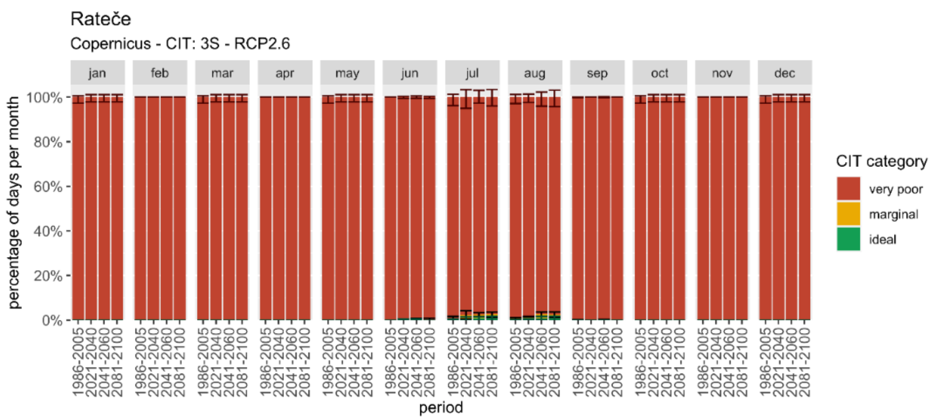

Figure 48: Rateče: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP2.6
Data source: Copernicus, 2022

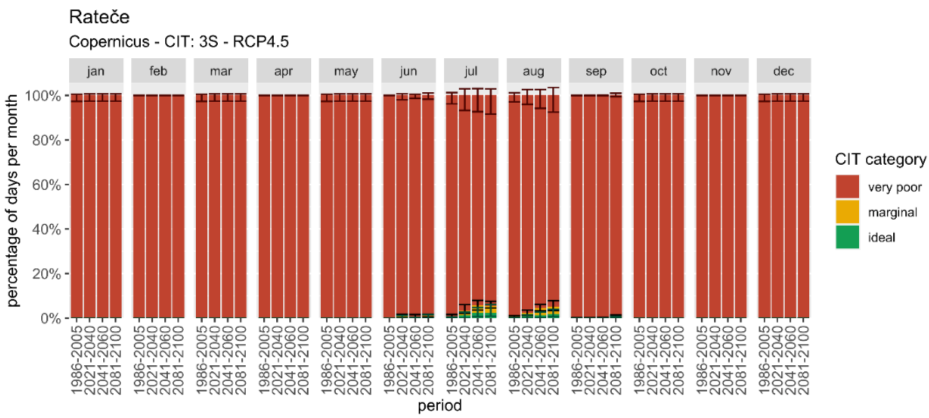

Figure 49: Rateče: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP4.5

Data source: Copernicus, 2022.

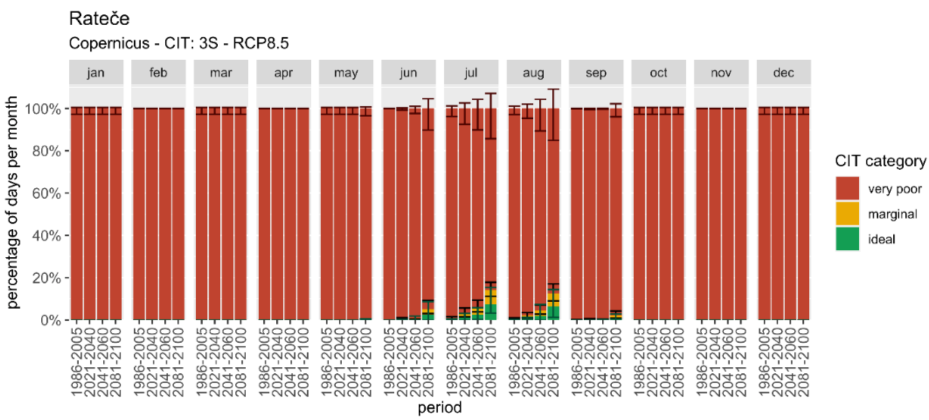

Figure 50: Rateče: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP8.5

Data source: Copernicus, 2022

Novo mesto

In Figure 51 and 52 are presented projected temperature changes as the percentage of warm and hot days for Novo mesto. As seen on the graphs, the occurrence of these days in Novo mesto will increase. RCP8.5 scenario stands out as the most unfavourable one when the percentage of hot days in July and August will highly increase and decrease thermal comfort for tourists and locals. Hence, to provide more favourable thermal comfort conditions for health and other water-based activities, adaptation measures should be implemented, especially for the summer season.

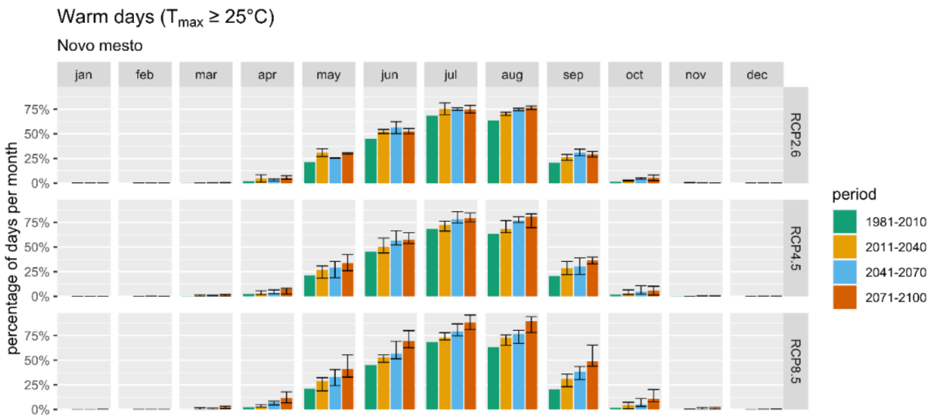

Figure 51: Novo mesto: The percentage of warm days
Data source: ARSO, 2022.

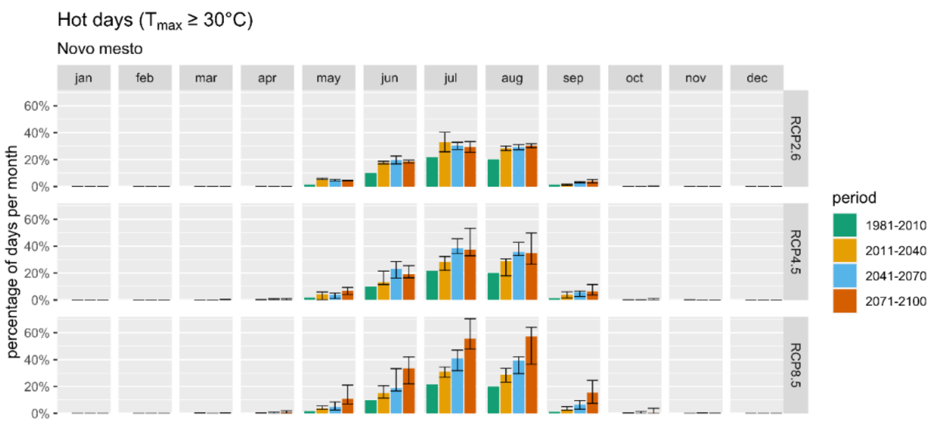

Figure 52: Novo mesto: The percentage of hot days
Data source: ARSO, 2022.

Figure 53 shows the projected percentage of days with at least 20 mm of precipitation for Novo mesto concerning 3 scenarios. This graph is relevant for both health tourism and other water-related tourism activities that are common on rivers Kolpa and Krka. It is likely that in all scenarios, the occurrence of heavy precipitation events in autumn and winter months will increase; however, the main season for this type of tourism are the summer months. Only in August the decrease in days with intense precipitation is anticipated, which may negatively affect water levels on both rivers, but especially for the two less optimistic scenarios the uncertainty is so high that even high increase can happen.

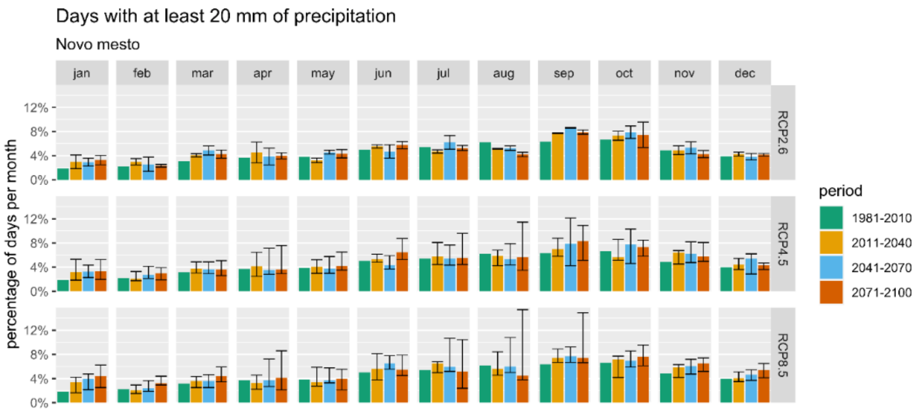

Figure 53: Novo mesto: The percentage of days with at least 20 mm of precipitation
Data source: ARSO, 2022.

Figure 54 presents the CIT: 3S for Novo mesto in the past periods. The graph shows that the percentage of days with ideal climate comfort for outside activities related to health tourism is the highest in the summer season (more than 20% of days per month); however, past observation shows an extension of the season into the spring months through the observed periods.

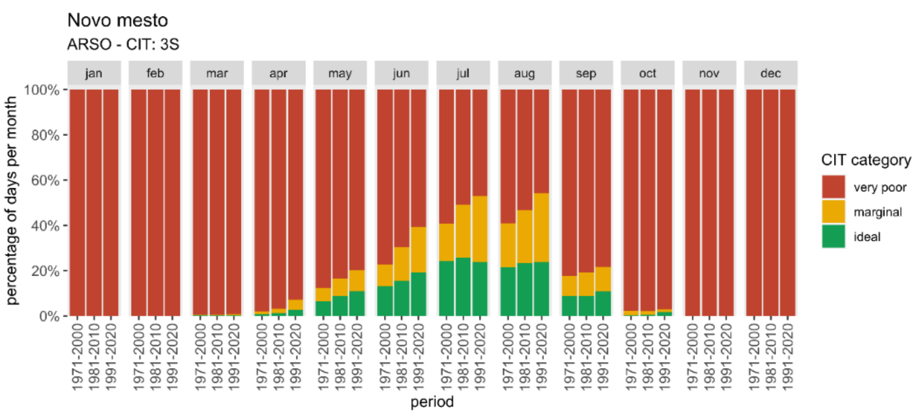

Figure 54: Novo Mesto: The percentage of very poor/marginal/ideal days according to CIT: 3S
Data source: ARSO, 2022.

Second is presented the projected CIT: 3S for Novo mesto concerning 3 scenarios (Figure 55, 56 and 57). The percentage of days with marginal climate comfort for tourism in Novo mesto will be higher in the summer months than in the past. Additionally, the percentage of days with ideal climate comfort for tourism activities will be higher in September and in the spring. The unfavourable months for outdoor health tourism activities will remain the same.

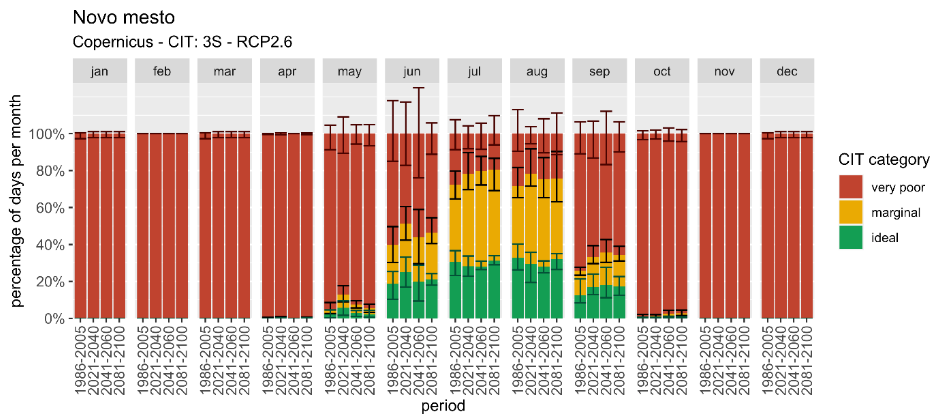

Figure 55: Novo Mesto: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP2.6

Data source: Copernicus, 2022

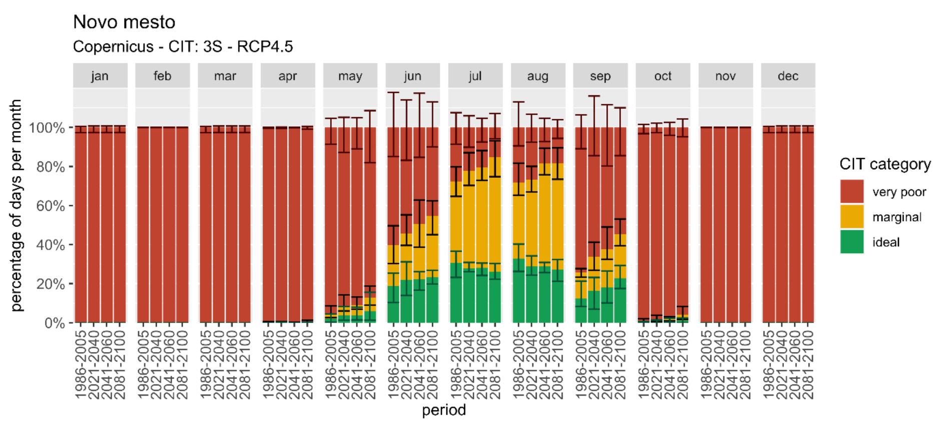

Figure 56: Novo mesto: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP4.5

Data source: Copernicus, 2022

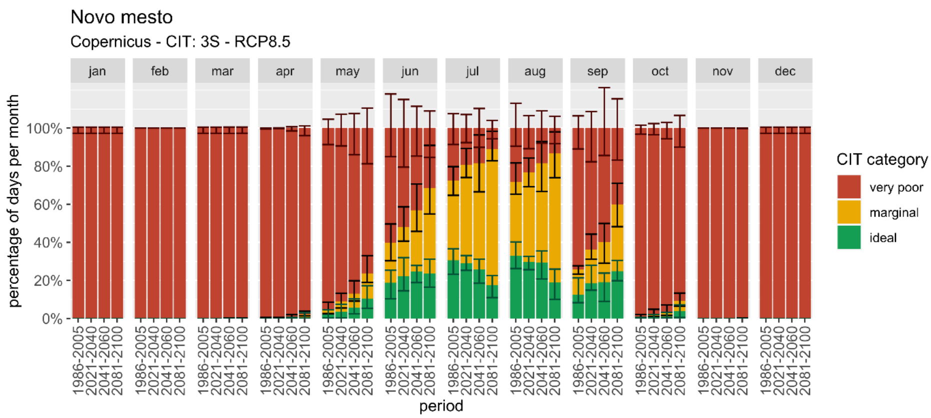

Figure 57: Novo mesto: The percentage of very poor/marginal/ideal days according to CIT: 3S – RCP8.5

Data source: Copernicus, 2022

Conclusions of the analysis

From the analysis of the climate indicators for the future scenarios, we can confidently conclude that the number of days with heat stress will increase, but at some locations the number of days with thermally comfortable conditions for outdoor recreation activities will also increase.

In the aggregate, beach, health and other water-based tourism will most likely gain from climate change, with the season extending to autumn and spring. Adaptation measures such as promoting shoulder season tourism or alternative activities during summer may reduce the loss in overnight stays that could result from avoiding heat waves during months that are currently considered peak season. Overall, it can be assumed that the conditions for bathing tourism at lakes and rivers will tend to improve with global warming. Most Slovenian lakes and rivers are embedded in a spectacular alpine panorama and will become more attractive in the future with an increasing number of days of sunshine and higher temperatures.

More occasions of extreme maximum temperatures will inevitably accompany rising mean summer temperatures. Consequently, tourism and community infrastructure will be affected by hotter temperatures and changes in demand for energy due to the increased need for air-conditioning, especially during peak times. Extreme weather episodes are likely to have a stronger impact than average weather changes.

Our projections and results also suggest other negative impacts of climate change that were not part of our empirical research. With strong growth in tourism and the resulting increase in water demand, available water resources will decline in many regions as water resources (both groundwater and water reserves in the snowpack) are depleted, water bodies and groundwater sources are polluted, and climate change leads to changing precipitation patterns and more frequent droughts, increased evapotranspiration, and altered runoff patterns. Changes in water quality (e.g., algal blooms and increases in harmful cyanobacteria) and water quantity due to warmer waters may become extreme health risks for people who use these waters, such as tourists. In addition, it is very likely that mean sea level rise will contribute to an increase in extreme coastal high tides in the future, leading to flooding and beach erosion. Drought-affected areas are also at increased risk for food shortages and wildfires, as well as increased risk for waterborne and foodborne illnesses. Prolonged heat waves and lack of rainfall also negatively affect ' water levels and water temperatures in rivers, leading to fish kills. In recent years, fishing has been temporarily banned in certain areas due to the drought. Forecasts indicate that this could increase in the future, which would have a negative impact on fishing tourism in Slovenia.

Proposed adaptation measures

Adaptation to climate change refers to an adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities. Adaptation can be pursued by societies, institutions, individuals and governments (WTO & UNEP, 2008). Adaptation, together with mitigation, is the response that the tourism sector has in order to deal with the positive and negative effects of climate change. Adaptation can allow opportunities to be maximised while reducing the threats the phenomenon poses (Scott et al., 2018).

Climate change will have both negative and positive impacts on the tourism sector, and these impacts will vary substantially by market segment and geographic location. Importantly, all tourism businesses and destinations will need to adapt to climate change in order to minimise associated risks and capitalise upon new opportunities in an economically, socially and environmentally sustainable manner. Many adaptation options do not uniquely address the risks of climate change but represent a response to a broader range of climate (e.g., weather extremes, water shortages) and non-climate factors (e.g., general diversification of markets and revenue sources, fuel prices, a general commitment to sustainability).

Adaptation measures for tourists

Adaptation can occur either as an immediate reaction to experienced weather changes or as an indirect reaction to upcoming weather events (Lohmann & Hübner, 2013). It is obvious that heat stress will be one of the most dangerous effects of climate change on tourists during their vacation. During all activities outdoors, considerable health problems can arise from increased heat (circulatory collapses, dehydrations, and exertional hyperthermia). This particularly applies to summer activities (Proebstl-Haider et al., 2021).

The following proposed measures are advised to tourists related to beach activities and other activities in the open sun (Jiricka-Pürrer, Brandenburg & Proebstl-Haider, 2020):

- frequent application of sunscreens with high SPF factor;
- frequent hydration to avoid dehydration;
- spend much time in natural and artificial shadow;
- wearing light and breathable clothing such as linen fabric;
- cover head and hair with protective covers (hat, scarf, etc.);
- avoid jumping into the water when you are hot and sweaty, as the body must gradually get used to the temperature of the water;
- avoid swimming long distances alone; even a very well-hardened and trained body can be overcome by momentary weakness;
- adapt time of certain activities according to weather forecasts (spend more time at best in the morning and late evening); and
- adapt locations and activities according to weather forecasts (including choose indoor activities, transfer to camps with more natural shade).

Regarding activities in warm waters such as kayaking or canoeing on the rivers, tourists must gather as much information as possible about the river before descending and take appropriate safety and rescue measures. Tourists must act thoughtfully and be aware not to challenge nature as rapids often hide surprises and traps. Therefore, these tourists do not only need to gather information about the weather but also about water conditions either from officials such as tourist offices or even locals (Simpson et al, 2008).

The above-mentioned measures are not drastic changes for tourists; however, constant education and warnings need to be provided to tourists as many of these activities tend to be of secondary significance to tourists on vacation.

Adaptation measures for companies or organisations

It is essential to emphasise that regardless of the nature and magnitude of climate change impacts, all tourism businesses and destinations will need to adapt to climate change to minimise associated risks and capitalise upon new opportunities in an economically, socially and environmentally sustainable manner. Suppliers of tourism services and tourism operators at specific destinations have a less adaptive capacity as changes usually require high financial costs (Dogru et al., 2019).

High temperatures and heatwaves in the coastal areas will significantly impact the financial post, especially for energy usage. Using real monitored data for the period 1970–2010, due to the increase in the air temperature, the simulation results show an increase in the cooling load of the demonstration hotel by 33% and a decrease in the heating demand by 22% in a medium-sized hotel in Athens, Greece (Farrou, Kolokotroni & Santamouris, 2016). Infrastructure problems, including power cuts can also be a result of excessive demand for air conditioning (Perry, 2006). In principle, hotels have three options for lowering costs due to increase energy usage: reducing energy consumption, increasing energy efficiency, and switching to renewable energy sources (WTO & UNEP, 2008). Some proposed measures that need to be taken in order to minimise these expenses are:

- reducing the need for air conditioning where possible;
- installation of devices that permit heating, cooling and lighting only when the room is occupied;
- use of energy-efficient appliances (light bulbs, heat exchangers);
- use of alternative fuels (e.g., biodiesel) and renewable energy sources (e.g., wind, photovoltaic, solar, thermal, geothermal, biomass and waste);
- frequent maintenance and cleaning of heating, cooling and refrigeration equipment; and

- installation of energy-efficient systems (e.g. thermal energy conversion (thermal energy from air conditioning exhaust vents can be used in resorts for heating water systems or increasing thermal insulation of buildings)).

New buildings should always be designed on the basis of energy-efficiency considerations, including their positioning, shading, and building materials, as well as the design of the energy system. In the financial sphere, newly-built infrastructure (e.g. hotels) in vulnerable areas may have to be written off over shorter-than-usual periods, which in turn could have an effect on the prices which tourists have to pay (WTO, 2003). Additionally, insurance cover (or alternative schemes) for the recovery of infrastructural and other damage. Increased insurance costs will have to be factored into resort profitability (Simpson et al., 2008).

Due to high temperatures and changed precipitation patterns, water shortages are expected to happen more often in the future. Therefore, rainwater collection, greywater recycling systems and water consumption monitoring will need to be implemented in the buildings. Most popular measures for reducing water consumptions in hotels are: faucet aerators, low-flow devices, dual-flush toilet systems, towel reuse program, bed linen reuse policies, salt water pool conversion, shower and faucet sensors or timers. Water conservation education for employees and guests is also necessary such as save water signs or card in bedroom and other key areas for guests (Torres-Bagus, Ribas & Vila-Subirós, 2019).

Tourism industry associations such as local tourist organisations should:

- enable access to early warning equipment (e.g., radios) to tourism operators;
- develop websites with practical information on adaptation measures;
- use of short-term seasonal forecasts for the planning of marketing activities;
- seek funding to implement adaptation projects;
- identify and evaluate alternative activities and demonstrate their feasibility;
- networking with other businesses offers advantages in reducing the impact of adverse weather conditions such as heatwaves;
- offer activities during less hot times during the day, e.g. morning and late afternoon; and
- offer indoor leisure activities to tourists.

The diversification of tourist products is one of the basic strategies of adaptation to climate change in the fields of policy and management practices as well as business models (Scott et al., 2008). Greater product choice, reduced seasonality and wider market diversity increase the resilience of tourism in the future (Becken, 2013). This measure, which can extend different product lines into a tourist destination or region (products with different atmospheric requirements and less dependency on weather conditions), could give the sector less vulnerability to climate change and climate variability (Moreno & Becken, 2009). Diversification of tourist products could also reduce the seasonality of the tourist industry and expand the area available for tourism. Both of these factors would reduce the risks posed by the effects of climate and climate change for tourism.

The lengthening of the season due to climate change will have a positive effect on beach tourism, with the spring and autumn seasons in particular likely to be more attractive. Hot days can also cause health problems due to physical exertion (Proebstl-Haider et al., 2021). One of the recommended ways of informing tourists in the event of heavy rain and storms is, for example, establishing early warning systems in cooperation with the media (weather forecast) with the support of the tourist destination organisation. In the case of high temperatures, in addition to delivering warnings about heat events, the establishment of service stations as part of the tourist offer is also common (Proebstl-Haider et al., 2021), including appropriate health services (e.g., appropriate access to defibrillators). Preparing weather information is not enough for travel or business planning and decision-making. Data must be delivered to end users in a form that is relevant and interpretable to them. Uncertainty is a fundamental feature of weather and seasonal climate predictions. Effective uncertainty communication helps people better understand the likelihood of a particular weather event and improves their ability to make decisions based on forecasts. However, without this information, projections can be easily misinterpreted and misused in decision-making (Scott, Lemieux, & Malone, 2011).

Adaptation measures for municipalities and regions

Municipalities and broader regional planning organisations have a major impact on adaptation to climate change in water-based tourism.

Most changes can be made regarding public infrastructure and spatial planning, which should strive to minimise the negative effects of thermal discomfort as a result of anticipated heat stress due to climate change. Such measures are (ICLEI Oceania, 2008; Simpson et al., 2008; UN-HABITAT, 2014):

- Installing drinking water fountains, water playgrounds, water distribution sprayers, creating humid fog and other activities related to water-induced cooling effects;
- implementing beach nourishment to deal with beach erosion (also sea walls defences and breakwaters);
- adapting to changed conditions by building tourism infrastructure and resorts further back from the coast;
- implementing water conservation techniques, such as rainwater storage, the use of water-saving devices or waste-water recycling and building reservoirs and desalination plants;
- establishing building design standards encompassing energy-saving systems and other suitable adaptations;
- developing residential planning regarding solar exposure, shading, green areas, wind deflection and wind acceleration through the streets and squares.

Municipalities should form local bodies comprising the main stakeholder specifically to investigate the impact of climate change and make preparations for action (and identify the major gaps in local research and seek action to fill these gaps), which will initiate, participate in or undertake local studies to:

- assess whether/how climate change has already begun to have an impact on tourism;
- prepare physical plans and "hazard maps" of vulnerabilities due to climate change which will affect the industry directly;
- co-operate with scientists, physical planners, public authorities and other appropriate specialists to prepare outline plans of the potential impact;
- define mitigation measures and actions and perform a cost-benefit analysis to assess whether they are appropriate in local circumstances;

- assess the issue of whether additional/new products need to be introduced to cope with changing circumstances;
- define and cost the benefits to the tourism industry that might be gained from appropriate remedial measures and new opportunities for the industry;
- act as a focal point for lobbying actions to bring to the attention of policymakers the issues which will affect the tourism sector;
- initiate discussions with tourism planners, national tourism offices and ministries on the changes to tourism policy and promotional efforts which may be required as the effects of climate change become more pronounced; and
- undertake ongoing monitoring of changes that may be emerging as a result of climate change (e.g., physical changes to destination, visitor health, changing markets, changing products) (ICLEI Oceania, 2008; UN-HABITAT, 2014).

Early warning systems are essential for climate change adaptation. The early warning relates to extreme wind events, storm surges, flooding and heat waves. It involves local agencies, communications tests, stepped responses to early forecasts, a 24-hour 'hotline' and other interventions such as opening air-conditioned shopping malls at nighttime to those individuals most vulnerable to heat. The role of municipalities should be to connect tourism operators to an early warning system (e.g., contact tree, text message) and encourage them to establish information routines. To avoid further health problems in heated waters, water monitoring and corresponding communication to the guests are of particular importance. Information at the shores and beaches via signposts is recommended in this case. Therefore, warning systems should also include warnings regarding water quality in seas, lakes and rivers (swimming areas), which should be monitored more frequently.

National adaptation measures

Firstly, it should be highlighted that an improved understanding of the tourism sector's climate-related risks, the costs and benefits of risk management initiatives, and practical understanding and experience in addressing these risks through adaptation initiatives is needed. Therefore, a capacity needs assessment, carried out through a multi-stakeholder participatory workshop and interviews with key representatives, should be carried out. In the future, a capacity enhancement action plan based on an assessment of the current adaptive capacity of the tourism sector and on the requirements for strengthening this capacity in order to address the current and anticipated climate risks of relevance to the tourism sector should be developed (Simpson et al., 2008).

National level organisations should also be responsible for (Simpson et al., 2008):

- creating policies on the financing of national tourism offices in order to ensure that promotional and marketing activities are tailored to the new climate realities (e.g., promoting "shoulder" seasons);
- implementing ecological tax reform, a national funding policy that financially supports the transition to sustainable, climate-friendly development;
- offering funding (or help to get financing from European initiatives) to reduce energy consumption and enhance the thermal regulation of hotel buildings, for example;
- implementing spatial planning and tourism development strategies for the country and its prioritised types of tourism (passing legislation to change planning policies, zoning, and land use priorities, as necessary);
- implementing measures against water scarcity and extreme weather events and implement land management (e.g., droughts act as drivers of technological and behavioural change and drought regulations issued by the government appear to send important signals to the hotel industry, and trigger the adoption of conservation measures (Dinarès & Saurí, 2015));
- introducing changes to the school year in order to change peak holiday times (as traditional mid-summer periods will become dangerous for the thermal comfort of children); and
- responsible for providing climate information to the tourism sector through cooperation with national meteorological services to efficiently provide information about climate and environmental conditions to visitors and businesses.

National organisations should also be responsible for organising and executing campaigns on UV radiation's dangers (to change public perception of the desirability of having a tan and lower rates of some skin cancers) and other health risks for inhabitants. While these public education campaigns represent a public health adaptation and not a tourism-recreation sector-specific adaptation, one of the principal target audiences are those engaged in outdoor recreation, whether at the beach or anywhere else. Similar should be done regarding the water conservation issue as it is also anticipated to be even more relevant in the future.

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4 Climate change and urban tourism adaptation

Highlights

- According to the HCI: Urban index calculations, conditions for urban tourism in Slovenia are improving due to better climate comfort in all seasons, including winter.
- The urban tourism season can extend to all seasons and offer 365 tourism.
- However, there are some extreme temperature change projections, which can cause thermal discomfort. Ljubljana, Koper and Nova Gorica will experience the highest rise in the percentage of hot days, especially in July and August.
- Even though urban tourists are willing to put up with higher temperatures, several adaptation measures should be taken, most importantly: technical and infrastructure interventions in the building shell & air conditioning, green and water-based urban spaces, intraday adaptation and indoor tourism, informational systems for heatwaves safety, and organisational adaptation of working conditions.

Abstract

According to the HCI: Urban index calculations, conditions for urban tourism in Slovenia are getting better due to better climate comfort in all seasons, including winter. Even summer months remain mainly ideal for urban tourism. Hence, the urban tourism season can extend to all seasons and offer 365 tourism. These findings are also consistent with previous studies.

However, other indices point to more extreme temperature changes, which can cause thermal discomfort. Among selected cities, Ljubljana will experience the highest rise in the percentage of hot days, Koper and Nova Gorica will have the most hot days. In other cities, this rise will be more modest. The number of hot days is expected to grow even during the spring and autumn. Most worrying is the RCP 8.5 scenario, which predicts the highest rise in the percentage of hot days in the period 2071–2100, while projections for other periods do not differ much.

Several studies show that due to the voluntary nature of tourism, urban tourists tend to be more tolerant to various weather conditions (including heat) and more often evaluate them as comfortable than those who are on the spot out of necessity or enjoying other forms of tourism (McKercher et al., 2015; Lindner-Cendrowska and Błażejczyk, 2018; Jiricka-Pürrer, Brandenburg and Pröbstl-Haider, 2020; Lopes et al., 2021). Therefore, the HCI: Urban considers not only temperature but also other factors; hence, the index shows more favourable conditions for urban tourism even if temperatures increase.

Even though tourists are willing to put up with higher temperatures, several adaptation measures should be taken. At the individual level, tourists should take care of their physical adaptation with appropriate clothing, consumption of cool drinks or avoiding open areas. They should also be aware of physiological adaptation, which includes accepting and tolerating the climate conditions as they are and not being annoyed by them. Tourism companies should implement sound business practices (for example, installing cooling and insulation or promoting weather-acceptable seasons to visit the destination). Cities should invest in green and blue infrastructure mainly to reduce heat islands in the urban area. Furthermore, at the national level, countries should implement policies regarding spatial planning and reacting to water scarcity and extreme weather events.

The significance of urban tourism in the Slovenian tourism system

Slovenia has a rich cultural tourism offer, often located in urban areas such as Piran, Škofja Loka, Ptuj, Koper, Nova Gorica, Celje, Novo mesto, Maribor, and Ljubljana. Cultural heritage is a foundation of national identity, also recognised by the national tourism strategy that includes culture in essential Slovenian tourism products (Ministrstvo za gospodarski razvoj in tehnologijo, 2017). City and cultural tourism are mainly regarded as a secondary tourism product. However, the macro-destinations of Central Slovenia and Ljubljana mark it as a primary product, including city breaks, historical heritage, festivals and events, modern and alternative art and city centre discovery. Particular importance is placed on 18 Slovenian historical towns with 80% cultural monuments and 70% of cultural institutions in Slovenia, while historical towns Idrija, Škofja Loka and Ptuj are on the UNESCO Intangible Cultural Heritage of Humanity list (STO, 2021a).

As key target groups of the city and cultural tourism, Slovenian strategies expose four different user personas: urban consumers, aware urban travellers, green explorers, and social gourmands (foodies) – all of whom express a higher level of motivation for city and cultural tourism (STO, 2017). Their origin-destination is usually Slovenia, Germany, Austria, Swiss, Italy, Benelux, France, and Croatia; however, they might also come from Great Britain, Scandinavia, the USA, and Canada (STO, 2021a).

In pre-covid times, Slovenia noted that in 2019 the percentage of overnight stays in urban municipalities was 6.6%, to which we can add 14.1% who stayed in Ljubljana (together 20.7%) (STO, 2020). However, other cultural towns (urban destinations) are noted in the statistics under spa or coastal municipalities since their principal tourism offer is the other type of tourism. This results in even higher numbers of urban tourism overnight stays. The pandemic year 2020 changed that situation, and only 4.9% of overnight stays were noted in urban municipalities, with 5.9% in Ljubljana (together 10.8%) (STO, 2021b). However, city and cultural tourism is recognised as an all-year-round tourism offer, which mitigates seasonality and disperses tourists from overcrowded areas to less-visited ones (STO, 2021a). This is confirmed by statistical data, which show that the demand for urban destinations was constant throughout the pre-covid year 2019 (approx. ¼ of overnight stays in all seasons) (STO, 2020).

Literature review: Climate change impacts on urban tourism

Climate change is affecting various aspects of tourism. Even though we primarily think of outdoor or beach tourism, urban tourism is also disturbed by climate change. Climate change is one of the most important factors in causing irreparable and far-reaching damage to cultural heritage, such as increased maintenance or management costs, direct damage to and accelerated deterioration of historical buildings, and an impact on tourism and local communities. At the same time, there is a lack of awareness of the climate change impact level on World Heritage, a lack of action of countries in implementing specific policies, insufficient financial and human resources and a lack of guidelines, manuals or tools to help in drawing up action plans for the implementation of concrete measures (Spanžel and Sovinc, 2021).

Due to an overall trend toward more frequent short holidays, most city destinations had significant tourism growth and increased demand for city breaks, where urban cultural tourism is the primary offer (Jiricka-Pürrer, Brandenburg and Pröbstl-Haider, 2020). Hence, more tourists face the effects of climate change on their city holidays. This research studied climate change indices and adaptation measures for urban tourism.

The purpose of developing multi-faceted numerical indices for estimating tourism climate is to facilitate an overall interpretation of destination climate and enable objective comparisons among them (Tang, 2013). Mieczkowski (1985) developed and used the Tourism climate index (TCI) to evaluate Edmonton, Toronto, and Sydney (urban) tourism. Results showed excellent and good tourism conditions for Edmonton and Toronto in August-May and for Sidney in May-September. Nicholls and Amelung (2008) used the TCI for the potential impacts of projected climate change on European tourism activity. They found out that the peak season conditions throughout northwestern Europe will improve, and the length of the peak season will increase in many regions (through the summer into spring and autumn). Similarly, Adiguzel and colleagues (2022) used the TCI to evaluate İzmir Province (Turkey's southern/southwestern coast), where spring and autumn seasons were detected as the most suitable periods for İzmir tourism in terms of climate comfort.

Bafaluy and colleagues (2014) analysed the present climate comfort for several types of tourism in the Bay of Palma, Mallorca using the Climate index for tourism (CIT). They found that the ideal climate comfort for cultural tourism is average temperature with a clear sky and no precipitation or wind. Those conditions prevail in spring and autumn, which will remain the most suitable seasons for cultural tourism in the Bay of Palma, while a distinct degradation is expected in summer. Since ideal conditions for cultural tourism would prevail, this kind of tourism can be classified as a steady and valuable tourist asset in the Bay of Palma.

The Universal thermal climate index (UTCI) was used in a study of Warsaw, Poland (Lindner-Cendrowska, 2013). Results showed that even if the UTCI indicated moderate heat stress, most tourists (60%) were satisfied with the thermal conditions and did not seek any change; they would prefer more intensive sunshine and no stronger wind. The Physiological Equivalent Temperature thermal sensation index (PET) alike as the UTCI has not been designed as a tool for assessing weather conditions for tourism, but it was used in several studies (Lindner-Cendrowska and Błażejczyk, 2018). For Warsaw, Poland their survey showed that people preferred warmer than actual thermal conditions in the urban environment for most of the year and even in summer when the PET exceeded 29 °C. The finding also indicated that women more frequently than men preferred air temperature to be higher; older people less frequently preferred changes in their thermal environment; and according to the place of origin, subjects coming from the same climate as in Warsaw declared feeling neutral, while tourists from subtropical climates most often characterised their sensations as cool and slightly cool.

Ciobotaru et al. (2019) showed that the temperature-humidity index (THI) variability affects the touristic flows in the Focşani City in Romania, such as the number of arrivals, overnight stays, and average occupancy rates. Hence, this tool can help define periods when conditions are usually favourable or unfavourable for tourism, consequently increasing the tourist offer for a certain period. They showed that comfortable conditions during the summer and early autumn support urban tourism, among other specific tourism activities.

The study of the Holiday climate index (HCI) for Canada, New Zealand and Sweden (Scott et al., 2008 in Tang, 2013) found out that the relative importance of climate parameters. The study is also in accordance with Lindner-Cendrowska and Błażejczyk's (2018) research, indicating that tourists from different nationalities have different climate preferences. Based on these findings, the HCI: Urban was explicitly designed for sightseeing and other general outdoor tourism activities of leisure tourists in urban destinations as described in Chapter 3.

Tang (2013) studied 15 cities in Europe that represent diverse climate zones. The HCI: Urban scores for the reference and future periods were computed. The main findings are:

(a) Winter months in northern, western and eastern European regions are suitable for urban leisure trips; therefore, climate conditions in the traditional low tourist season of northern, western and eastern European regions could be considered 'acceptable' for leisure tourists.
(b) The projected climate suitability for tourism in northern, western and eastern European city destinations will improve for almost all months of the year in the future periods by 2080 when rated by the HCI: Urban. Climate conditions in that part are expected to improve the most in the spring, summer and autumn months. Whereas a steady increase in HCI: Urban scores is expected for most cities in the summer months.
(c) A significant shift of peak season from the summer months to the spring and autumn months is expected for southern European city destinations. They will no longer be summer peak destinations. However, they will become 'bimodal-shoulder peaks' destinations, with the spring and autumn months as the most suitable time to visit the region for general tourism activities.

Scott and colleagues (2016) studied six European cities, covering a variety of temperate European climates (dry and hot summers; warm summers without a dry season; a cold (continental) climate). The HCI: Urban scores for the reference and future periods were computed. The main findings are:

(a) The HCI: Urban rates the climate of many cities higher than the TCI (particularly in shoulder seasons and the winter months), which is more consistent with observed visitation patterns.
(b) The HCI: Urban indicates more ideal conditions and fewer months identified as unacceptable for urban tourism.
(c) The HCI: Urban does not support the argument that summer conditions in Southern Europe will significantly and rapidly deteriorate in the future. Southern Europe will continue to have the ideal conditions, with higher year-round ratings, including the summer season, for decades to come. Additionally, it indicates that fewer months will be considered unacceptable during winter.
(d) The HCI: Urban provides evidence that climate conditions will improve in Northern and Continental Europe.

Demiroglu and colleagues (2020) studied Antalya in Turkey. The HCI: Urban scores for the reference and future periods were computed. The main findings are:

(a) Antalya loses its ideal conditions since July–August months become thermally challenging yet maintains very good to excellent conditions from April to October. Therefore, a seasonal shift from late spring and early autumn to early spring and late autumn is most apparent.
(b) The study projects a shift of suitable temperature conditions for tourism in the Mediterranean to the current shoulder seasons of spring and autumn. However, this is more relevant for urban tourism since urban tourists are usually a one-time consumption product, are less loyal and prefer lower temperatures than beach tourists, which are limited with a calendar and repeat visits more.

Urban tourism is mainly understood as a geographical term since "adding the adjective urban to the noun tourism locates an activity in a spatial context but does not in itself define or delimit that activity" (Ashworth and Page, 2011, p. 2). Its contrast is rural tourism, which is described as "a country experience, encompassing wide range of attractions and activities that take place in agricultural or non-urban areas" (Slocum, Aidoo and McMahon, 2020, p. 139). A more specific definition states that urban tourism is "one among many social and economic forces in the urban environment. It encompasses an industry that manages and markets various products and experiences to people who have a wide range of motivations, preferences and cultural perspectives and are involved in a dialectic engagement with the host community. The outcome of this engagement realises a set of consequences for the tourist, the host community and the industry" (Edwards, Griffin and Hayllar, 2008, p. 1038).

Hence, to understand what urban tourism means, researchers studied the elements of urban, which are a solid and broad economic base (business and professional activities); a significant public transport network; a significant population (including a commuting workforce); long term planned development; and social, cultural, political and economic interactive relationships (Edwards, Griffin and Hayllar, 2008). In the main, infrastructure has been developed for non-tourism purposes; therefore, tourists, residents, and commuters use it.

All this causes urban tourists and locals to move from one attraction/location to another over the course of the day while taking advantage of the concentration and availability of those locations to see and visit as many attractions/locations as they can. Therefore, we can identify two fundamental dimensions of urban tourism: movement and multi-attraction (Caldeira and Kastenholz, 2018). However, the overall time spent at the destination is usually shorter (Aall and Koens, 2019). Target markets which are attracted by urban destinations are a more educated population and seniors (they are attracted to the cultural heritage of cities and towns); young people (the entertainment, nightlife and events attract them); and business travellers (meetings, incentives, conventions and exhibition market) (Edwards, Griffin and Hayllar, 2008).

The development of urban tourism brings many benefits to the cities including new jobs, revitalisation of urban areas, investments, income and events. However, there are also negative impacts: there is the tension between the quality of life for residents and the development of cities to benefit the tourism industry; and there is the tension between good local environmental standards and over-tourism related environmental problems (Aall and Koens, 2019). Novy and Colomb (2019) warn about the "touristification" of the urban areas when tourism is spreading to previously "untouched" neighbourhoods since tourists wish to live like a local and experience "ordinary" spaces which are off the usual tourist beaten track (Airbnb is a significant driver here). These impacts of urban tourism on people and urban spaces can be categorised into economic, physical, social and socio-cultural, and psychological impacts (Novy and Colomb, 2019). Therefore, the basic principle of developing a sustainable competitive urban destination is of equal interest to residents and tourists (Carlisle, Johansen and Kunc, 2016).

Urban areas possess several key attributes that make them attractive tourist destinations (Edwards, Griffin and Hayllar, 2008). They have a large population; hence, visiting friends and relatives is more likely. There is infrastructure for accommodation, food and beverage, communications, transport, services and other facilities. They have developed tourism attractions and are easily accessible through airports and public transport. The urban tourism attractions offer places urban tourism within cultural tourism, which is defined as "a traveller's engagement with a country or region's culture, specifically the lifestyle of the people in those geographical areas, the history of those people, their art, architecture, religion(s), and other elements that helped shape their way of life" (Slocum, Aidoo and McMahon, 2020, p. 139).

According to former studies, we have designed a classification of urban tourism activities: urban outdoor activities, urban indoor activities, and urban transportation activities.

Urban outdoor activities:

Activities are sightseeing of outdoor sights, town walks, visits to the parks, activities on water surfaces (e.g., SUP, boat ride), outdoor gastronomy offer, and outdoor events (e.g., concerts).

Weather is one of the key determinants of performing urban outdoor activities. Low temperatures and heavy precipitation (meteorological conditions) negatively impact tourists' activities and movements. However, recent studies showed that also maximum air temperature has a significant negative effect on overall tourist satisfaction (Caldeira and Kastenholz, 2018). Therefore, while staying outdoors in warmer seasons, there is increasing demand for shading outdoor spaces to provide lower temperatures in overheated concrete city centres and elsewhere (e.g. sail cloths), access to free drinking water and distribution of tourist flows. Towns need to encourage urban greening.

Urban indoor activities:

Activities are visits to indoor sights (e.g., museum, galleries, churches, historic houses, factories), visits to indoor attractions (e.g., house of horrors), gambling, shopping, indoor business events, accommodation, indoor gastronomy offer, indoor events (e.g., theatre shows, food and wine festivals, party at the discotheque).

Challenges of providing indoor activities are lighting, heating (in cold seasons), cooling (in hot seasons), and ventilation of buildings and venues. This all leads to enormous energy consumption.

Urban transportation activities:

Activities include using public and/or private transport; soft mobility (e.g., bikes, scooters, walking).

Urban areas have a broad public transport network; hence, it is more advisable for tourists to use public transport as an alternative to their private one. Soft mobility lately gained new dimensions with rental electric bikes and electric scooters. They do not emit exhaust fumes; however, they need electricity and charging. Rental bikes and scooters help users cope with higher temperatures in warmer seasons while moving around the town.

Presentation and interpretation of results for urban tourism

Data on climate change vulnerability show that the vast majority of the 100 fastest-growing cities in the world by population are in the extreme or high-risk category over the next 30 years (even in a stabilization climate RCP4.5 scenario, all the cities are likely to experience climate shifts by 2050) (Aall and Koens, 2019).

Slovenia is no exception, and Slovenian cities and towns will face similar confrontations. The HCI: Urban is the appropriate index for urban environments in Slovenia to demonstrate challenges in the future periods; however, there are other climate impacts to be considered for a sustainable and resilient future (e.g., extreme weather events, land cover and urban heat islands).

The HCI: Urban index was used to calculate climate comfort in Slovenia for the past periods 1971–2000; 1981–2010; 1991–2020, and projections for the future periods 2021–2040; 2041–2060; 2081–2100 (with the reference period 1986–2005) concerning RCP2.6, RCP4.5 and RCP8.5 scenario. In addition, the average effective temperature (ET) was calculated for the same past periods, followed by the presentation of the projected percentage of warm and hot days for the future periods); 2011–2040; 2041–2070; 2071–2100 (with the reference period 1981–2010) concerning RCP2.6, RCP4.5 and RCP8.5 scenario. The HCI: Urban is important besides temperature indices since studies showed that sun sensation or radiation significantly influences human thermal sensation in outdoor spaces (Yang, Wong and Jusuf, 2013). Calculations and projections were prepared in the form of median and variability; however, we present the results without the whiskers on the graphs to ensure better clarity of the presented material.

Selected urban areas are covered with the data from nearby weather stations as follows:

- Two major urban areas in Slovenia: Ljubljana – at the weather station Ljubljana Bežigrad; Maribor – at the weather station Edvard Rusjan Maribor airport. Ljubljana is the capital city of Slovenia and its urban and cultural centre. Maribor is the second-largest city and was entitled a European Capital of Culture in 2012.
- Two smaller inland urban areas in Slovenia: Celje – at the weather station Celje Medlog; Novo mesto – at the weather station Novo mesto. Both Celje and Novo mesto are historical towns with rich urban backgrounds going back to the Hallstatt era. Celje was the seat of Slovenian counts Grofje Celjski, and Novo mesto was the centre of the Slovenian cultural revolution in 1920, named Novo mesto spring.
- Two coastal urban areas in Slovenia: Koper – at the weather station Portorož airport; Nova Gorica – at the weather station Bilje. Koper was announced as a Slovenian cultural tourism EDEN destination 2017 competition winner. Nova Gorica is preparing to be a European Capital of Culture 2025.

Ljubljana

First is presented the HCI: Urban index for Ljubljana in the past periods.

The graph shows that the percentage of days with ideal climate comfort for urban tourism is the highest in the summer season; however, a slow extension of the season into the spring, autumn and even winter months can be observed through the past periods. Furthermore, winter months had over 80 % of days with marginal or ideal climate comfort for urban tourism.

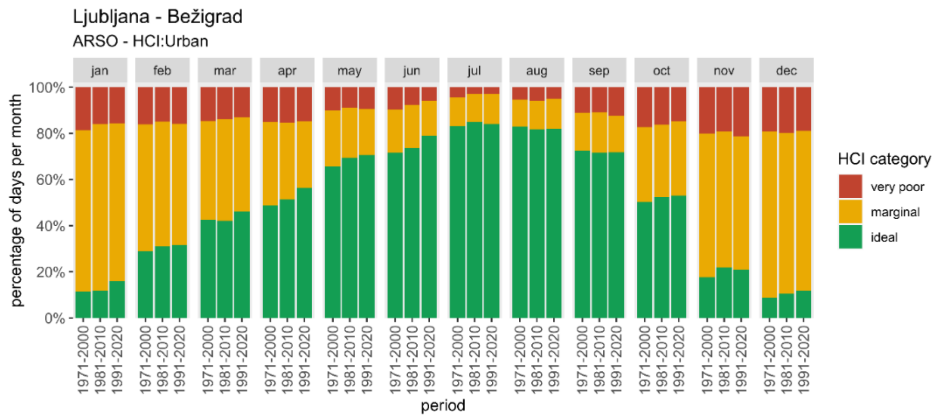

Figure 58: Ljubljana – Bežigrad: The percentage of very poor/marginal/ideal days according to HCI: Urban

Data source for calculations: ARSO, 2022.

Second is presented the projected HCI: Urban for Ljubljana concerning 3 scenarios. Using CDS data we can see the diference in the past period with previous ARSO data, so values are not to be taken in the absolute from, but only as deviations from the reference period. The same goes for further graphs with Copernicus data source.

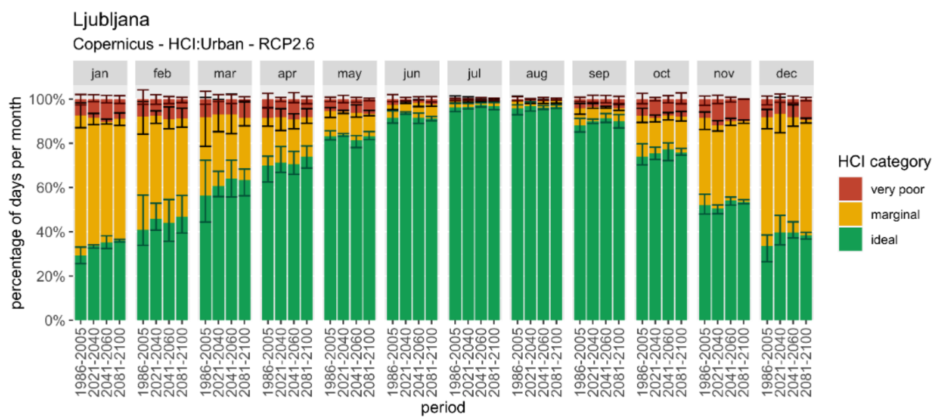

Figure 59: Ljubljana: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP2.6

Data source: Copernicus, 2022.

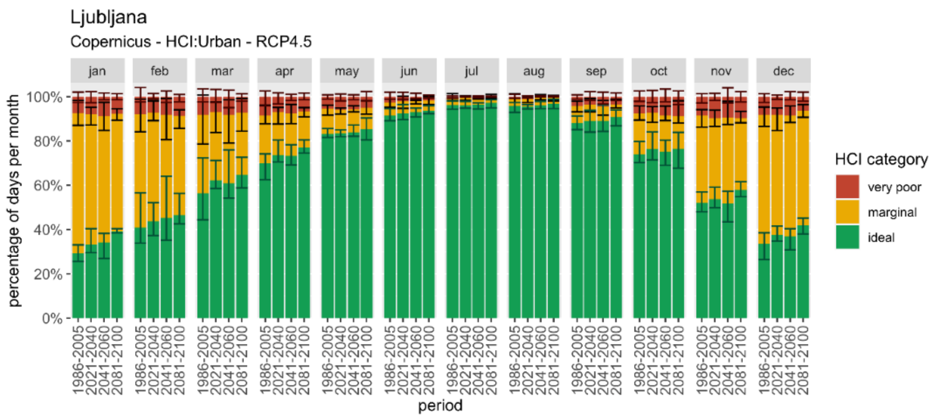

Figure 60: Ljubljana: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP4.5

Data source: Copernicus, 2022.

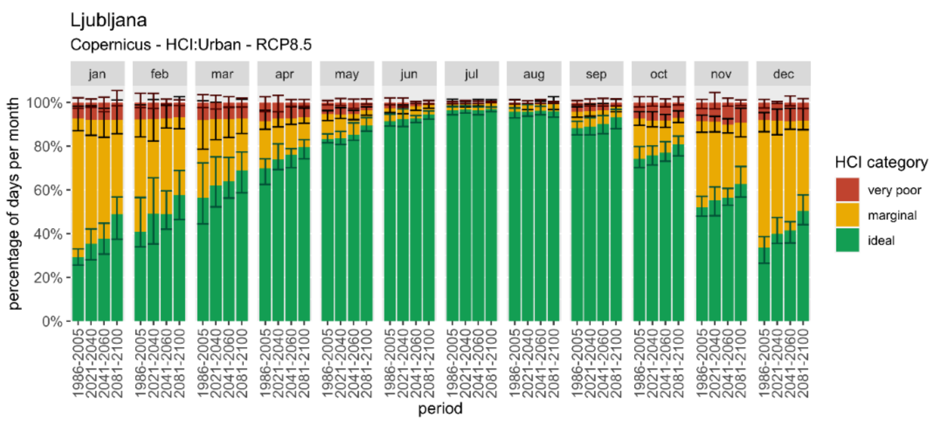

Figure 61: Ljubljana: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP8.5

Data source: Copernicus, 2022.

The projected percentage of days with ideal climate comfort for urban tourism in Ljubljana is as high or even higher in the summer and spring months as they were in the past. Additionally, the percentage of days with ideal climate comfort for urban tourism also rises in the autumn and winter, even for 10-20% of days to the end of the century. The percentage of days with very poor climate comfort for urban tourism in winter in the past was approximately 20%, however, with the increase of ideal days it can decrease, but it is difficult to say from projections. Still, the percentage of days with very poor climate comfort for urban tourism in summer will remain extremely low; therefore, we can expect excellent climate conditions for urban tourism in Ljubljana all year long.

Thirdly are presented temperature changes. The average effective temperature is presented for past periods, followed by the projected percentage of warm and hot days for Ljubljana concerning 3 scenarios.

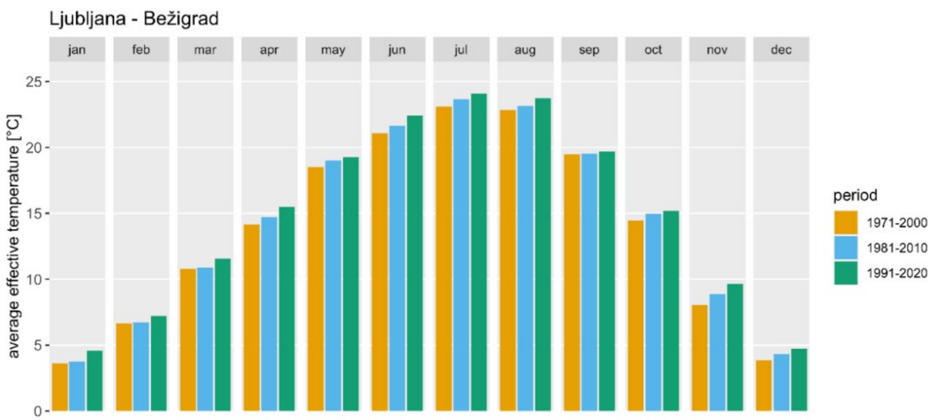

Figure 62: Ljubljana – Bežigrad: The average effective temperature
Data source for calculations: ARSO, 2022.

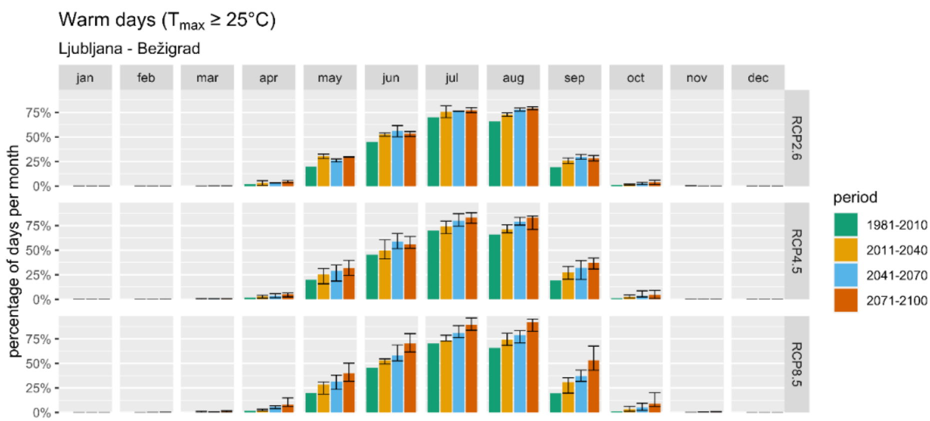

Figure 63: Ljubljana – Bežigrad: The percentage of warm days
Data source: ARSO, 2022.

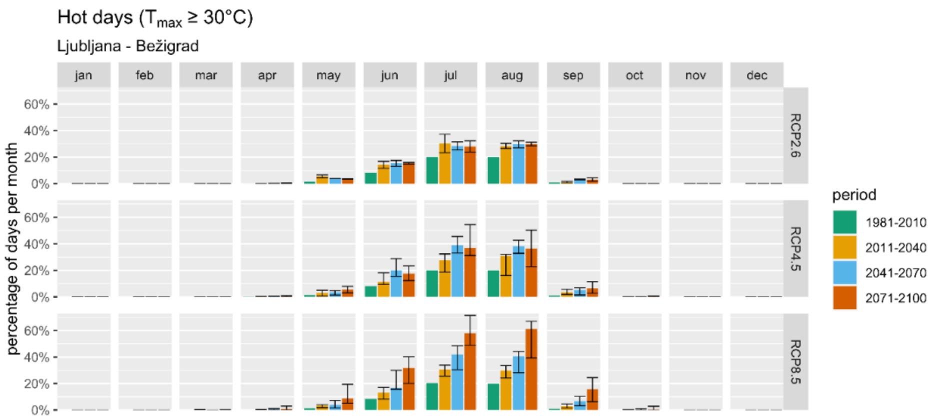

Figure 64: Ljubljana – Bežigrad: The percentage of hot days

Data source: ARSO, 2022.

The average effective temperature in Ljubljana increased during the past periods throughout the year, the most in June (around 2 °C) and not much in September. Higher temperature combined with the same or higher humidity is principally the reason for reducing thermal comfort for tourists and locals and if it was before only the problem of July and August, it is now also of June. As seen on the warm and hot days graphs, the occurrence of both warm and hot days in Ljubljana will increase. RCP8.5 scenario stands out as the most unfavourable one with the expected high increase of hot days occurence in July and August (the median value is 40% days more at the end of the century than in the reference period). Hence, adaptation measures should be implemented in the cities to provide even more favourable thermal comfort conditions, especially for the summer season due to the increasing percentage of warm and hot days.

Maribor

First is presented the HCI: Urban for Maribor in the past periods.

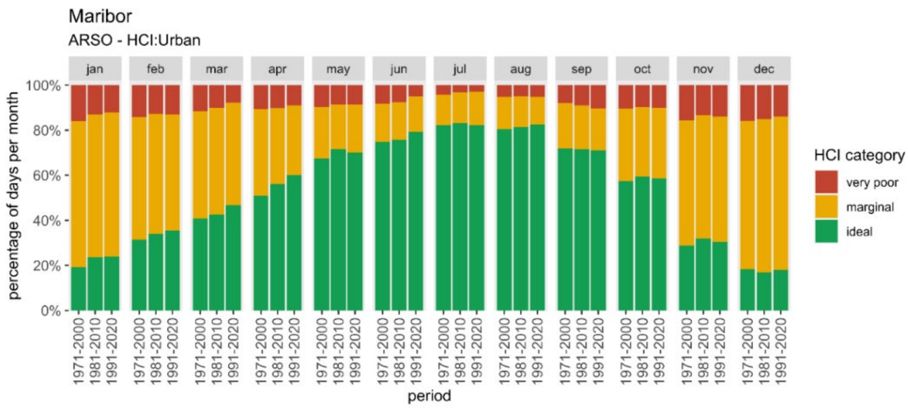

Figure 65: Maribor: The percentage of very poor/marginal/ideal days according to HCI: Urban

Data source for calculations: ARSO, 2022.

The graph shows that the percentage of days with ideal climate comfort for urban tourism is the highest in the summer season, almost 80% in July and August. However, past observation shows an extension of the season into the spring months and even late winter through the observed periods, with all winter months having already over 80% of days with marginal or ideal climate comfort for urban tourism.

Second is presented the projected HCI: Urban in Maribor concerning 3 scenarios. The deviation of the reference period from the historic ARSO data is not that obvious as for Ljubljana.

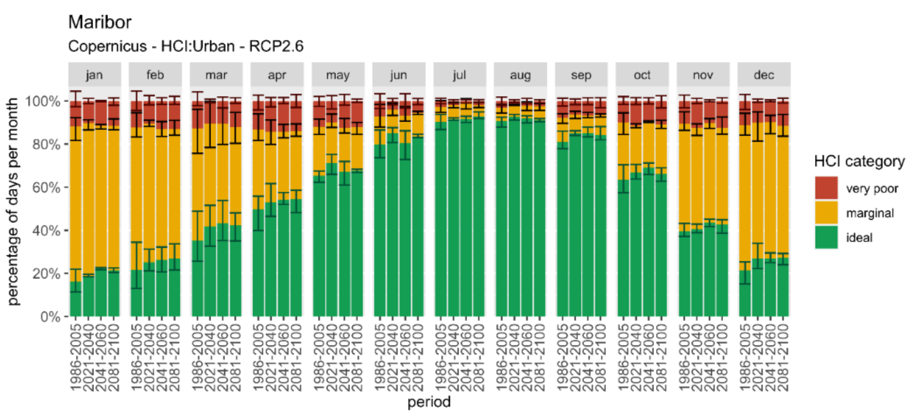

Figure 66: Maribor: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP2.6

Data source: Copernicus, 2022.

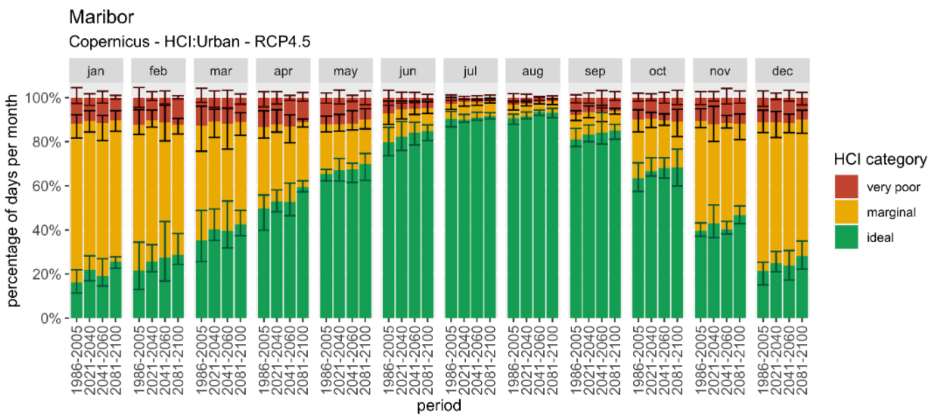

Figure 67: Maribor: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP4.5

Data source: Copernicus, 2022.

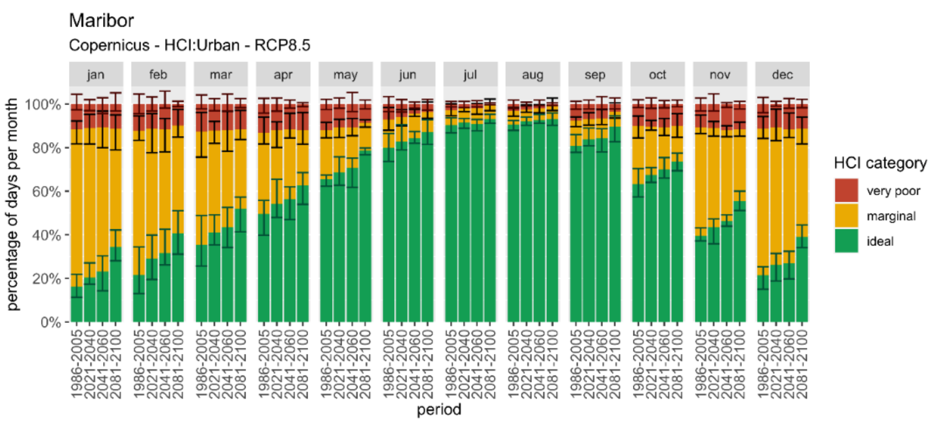

Figure 68: Maribor: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP8.5

Data source: Copernicus, 2022.

The projected percentage of days with ideal climate comfort for urban tourism in Maribor is even higher in the early summer and spring months than in the past with the highest variability in spring. Additionally, the percentage of days with ideal climate comfort for urban tourism also rises in the autumn and winter. The percentage of days with very poor climate comfort for urban tourism in winter in the past was approximately 15–20%; however, we expect it to decrease a bit more in the future. The percentage of days with very poor climate comfort for urban tourism in summer will remain extremely low; therefore, we can expect excellent climate conditions for urban tourism in Maribor all year long.

Thirdly are presented temperature changes. The average effective temperature is calculated for the past periods, followed by the projected percentage of warm and hot days for Maribor concerning 3 scenarios.

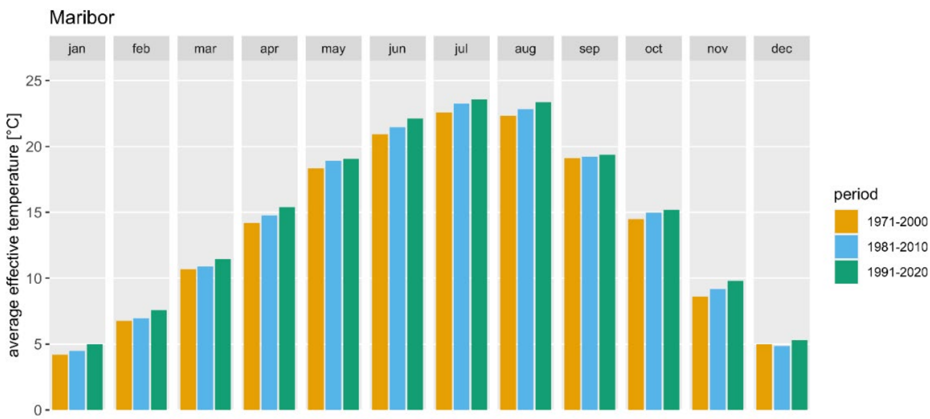

Figure 69: Maribor: The average effective temperature
Data source for calculations: ARSO, 2022.

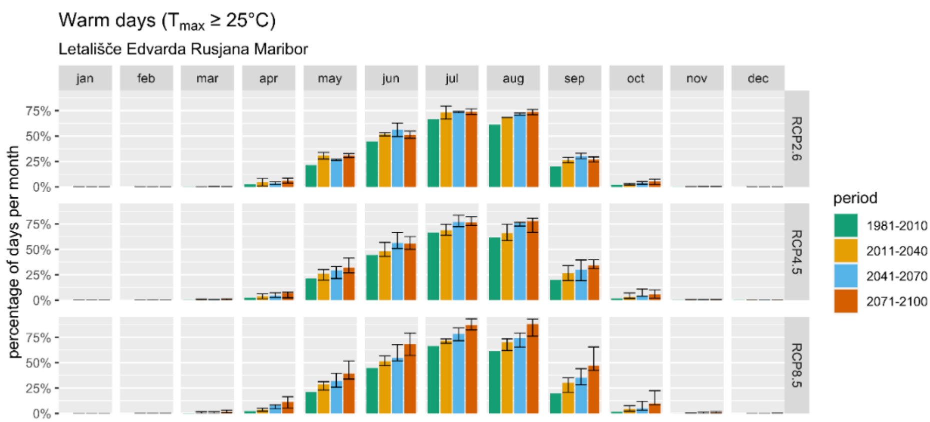

Figure 70: Maribor: The percentage of warm days
Data source: ARSO, 2022.

Figure 71: Maribor: The percentage of hot days
Data source: ARSO, 2022.

The average effective temperature in Maribor increased during the past periods throughout the year, but almost nothing in September. Higher temperature combined with the same or higher humidity means reducing thermal comfort for tourists and locals in July and August, proceeding in the last decades also in June. As seen on the warm and hot days graphs, the temperature in Maribor will increase, with positive trends being very certain. RCP8.5 scenario stands out as the most unfavourable one when we expect the highest occurence of hot days in July and August, 2- or 3-times as many as in the past. Hence, adaptation measures should be implemented in the cities to provide even more favourable thermal comfort conditions, especially for the summer season due to the increasing number of warm and hot days.

Celje

First is presented the HCI: Urban for Celje in the past periods .

The graph shows that the percentage of days with ideal climate comfort for urban tourism is highest in the summer season (more than 70% in July and August). However, past observation shows an extension of the season into the spring months through the observed periods. Nevertheless, even winter months had over 80% of days with marginal or ideal climate comfort for urban tourism.

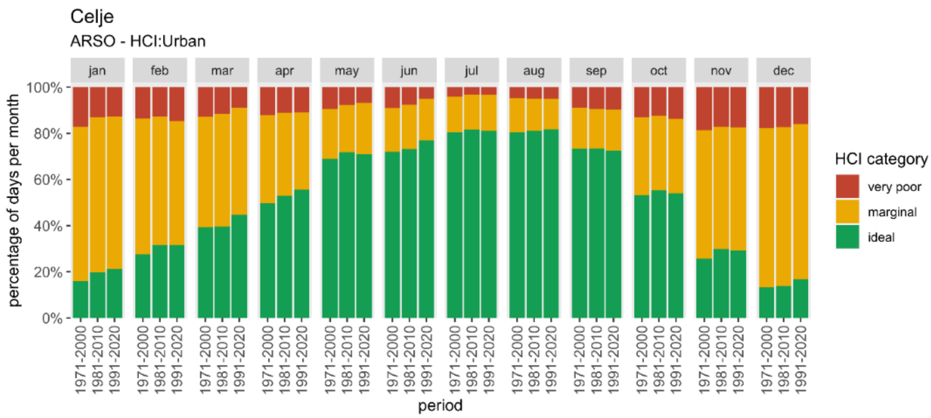

Figure 72: Celje: The percentage of very poor/marginal/ideal days according to HCI: Urban

Data source for calculations: ARSO, 2022.

Second is presented the projected HCI: Urban for Celje concerning 3 scenarios. Like for Ljubljana, the reference percentages of ideal days are quite higher than the calculated from ARSO data, which has to be taken into account and absolute numbers should not be taken from these graphs.

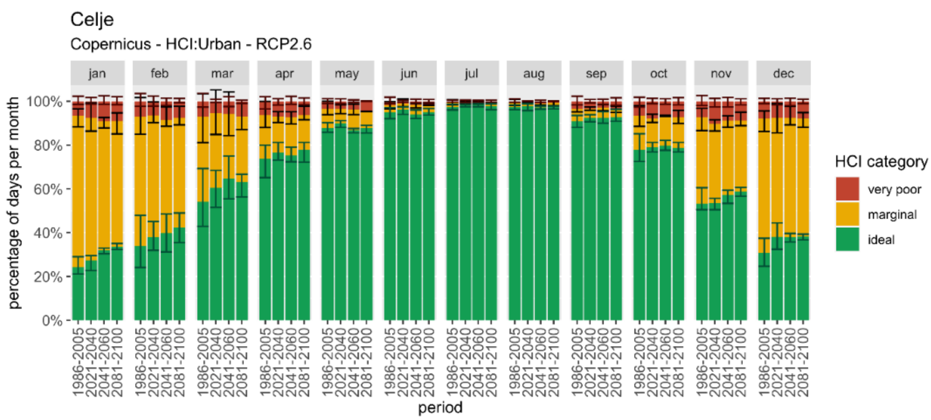

Figure 73: Celje: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP2.6

Data source: Copernicus, 2022.

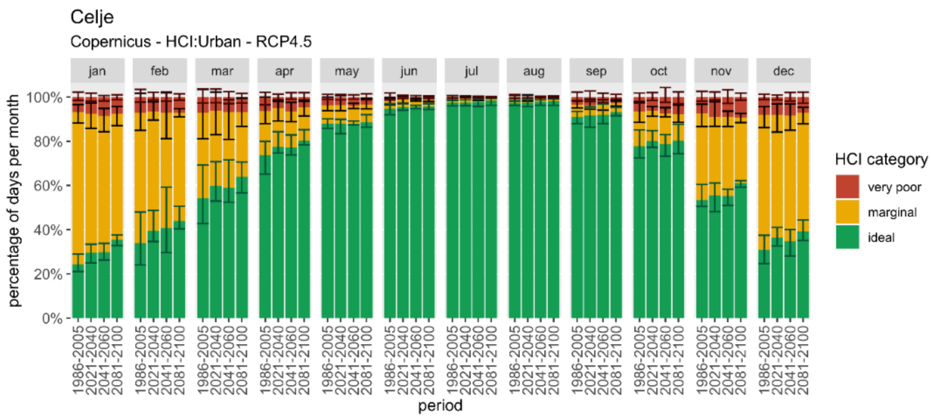

Figure 74: Celje: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP4.5

Data source: Copernicus, 2022.

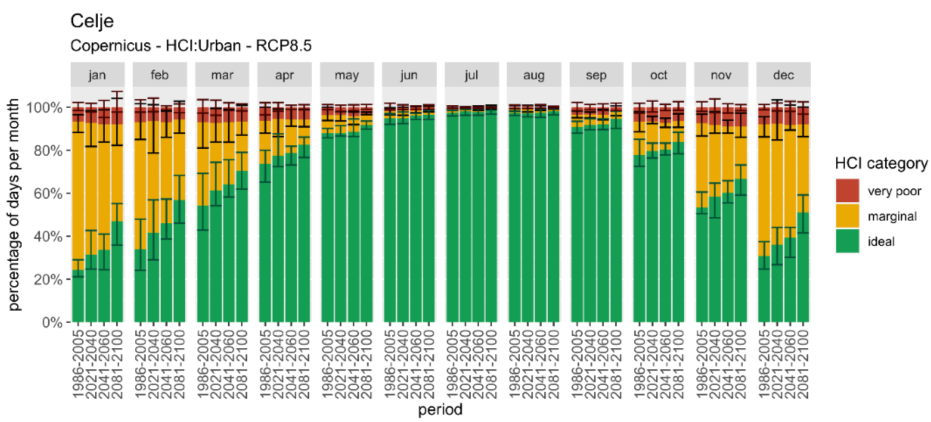

Figure 75: Celje: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP8.5

Data source: Copernicus, 2022.

The projected percentage of days with ideal climate comfort for urban tourism in Celje is even a bit higher in the spring months than in the past. Furthermore, the percentage of days with ideal climate comfort for urban tourism is much higher (with also higher variability) in the autumn and winter. The percentage of days with very poor climate comfort for urban tourism in winter in the past was approximately 15% and is expected to decrease due to the very obvious increase in the percentage of ideal days. The percentage of days with very poor climate comfort for urban tourism in summer will remain extremely low; therefore, we can expect excellent climate conditions for urban tourism in Celje all year long.

Thirdly are presented temperature changes. The average effective temperature is calculated for the past periods, followed by the percentage of warm and hot days for Celje concerning 3 scenarios.

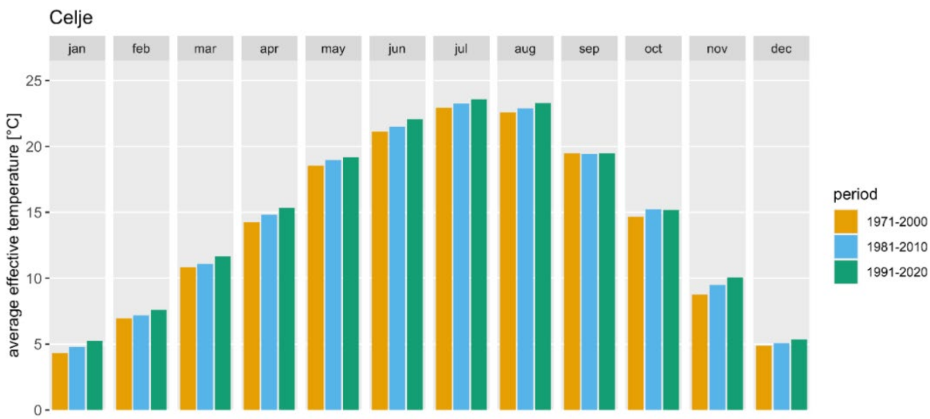

Figure 76: Celje: The average effective temperature
Data source for calculations: ARSO, 2022.

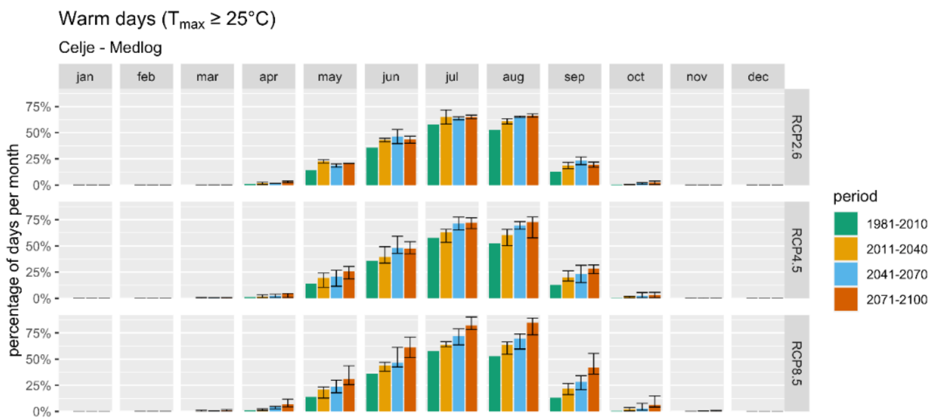

Figure 77: Celje: The percentage of warm days
Data source: ARSO, 2022.

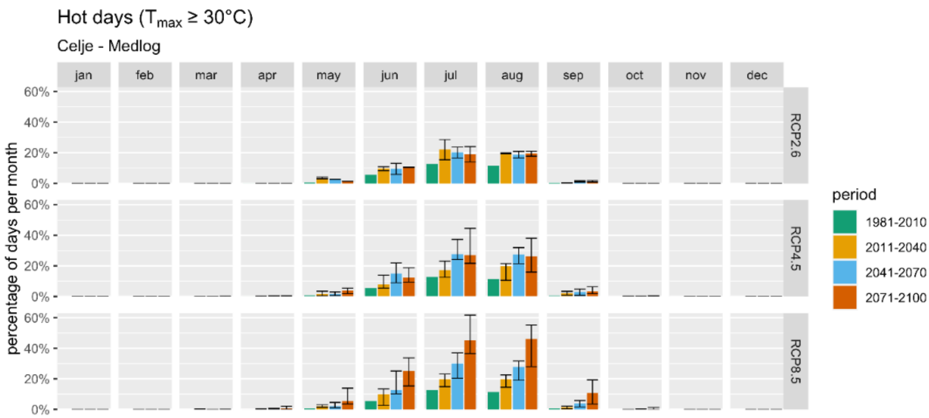

Figure 78: Celje: The percentage of hot days
Data source: ARSO, 2022.

The average effective temperature in Celje increased during past periods throughout the whole year, except in September. Higher temperature combined with the same or higher humidity is principally the reason for reducing summer thermal comfort for tourists and locals, the main change to less favourable conditions was in June (additionally to already existing in July and August). As seen on the warm and hot days graphs, the temperature in Celje will increase, particularly in the summer months. RCP8.5 scenario stands out as the most unfavourable one with high expected increase of hot days in July and August, the occurrence will double or even more than triple by the end of the century. The range of projected change is high, but the increase is undoubtful. Hence, adaptation measures should be implemented in the cities to provide more favourable thermal comfort conditions, especially for the summer season due to the increasing number of warm and hot days.

Novo mesto

First is presented the HCI: Urban for Novo mesto in the past periods.

The graph shows that the percentage of days with ideal climate comfort for urban tourism is the highest in the summer season (around 80% in July and August); however, past observation shows an extension of the season into the early spring months through the observed periods. Nevertheless, even winter months had over 80% of days with marginal or ideal climate comfort for urban tourism.

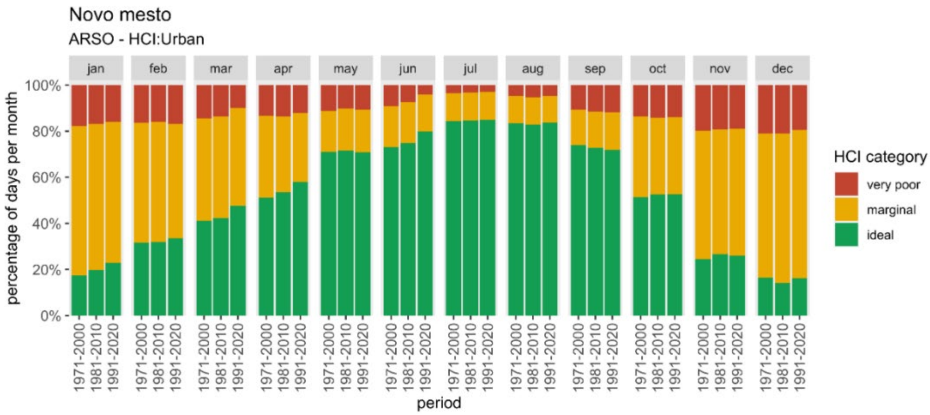

Figure 79: Novo mesto: The percentage of very poor/marginal/ideal days according to HCI: Urban

Data source for calculations: ARSO, 2022.

Second is presented the projected HCI: Urban for Novo mesto concerning 3 scenarios.

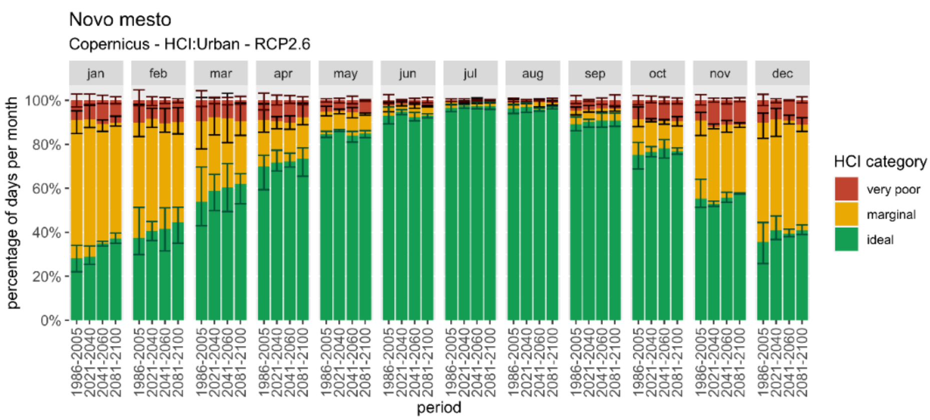

Figure 80: Novo mesto: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP2.6

Data source: Copernicus, 2022.

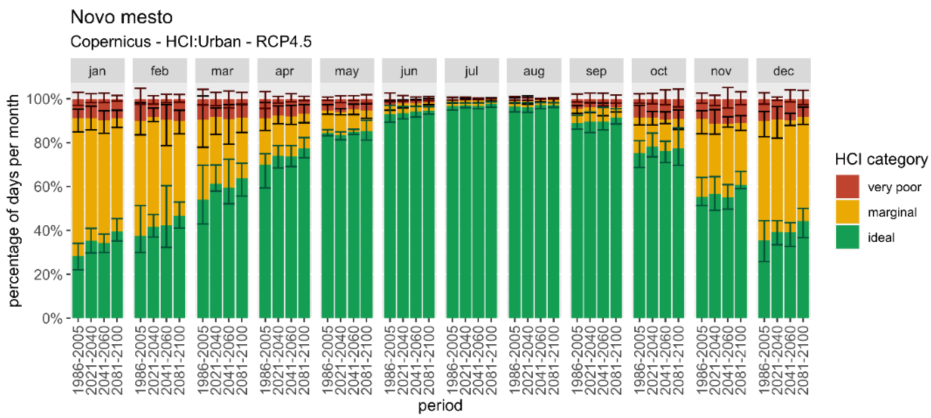

Figure 81: Novo mesto: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP4.5

Data source: Copernicus, 2022.

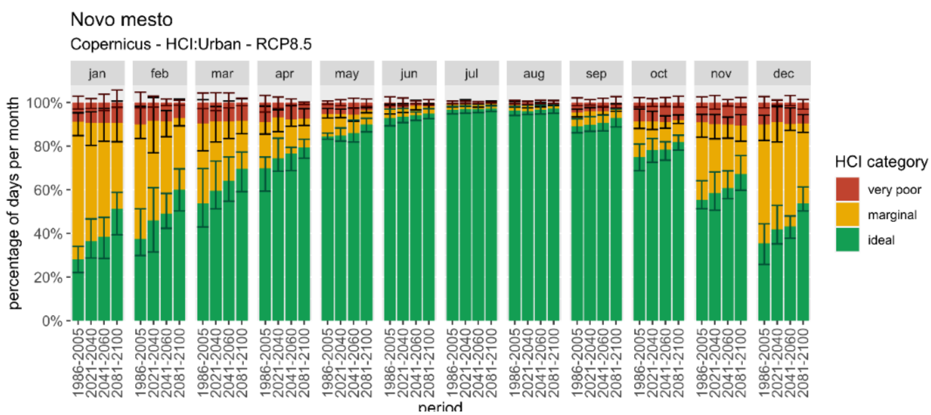

Figure 82: Novo mesto: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP8.5

Data source: Copernicus, 2022.

The projected percentage of days with ideal climate comfort for urban tourism in Novo mesto is almost the same in the summer and late spring as in the past. The percentage of days with ideal climate comfort for urban tourism rises in the autumn, winter and early spring. The percentage of days with very poor climate comfort for urban tourism in winter in the past was approximately 20%, however, we expect it to decrease slightly in the future. The percentage of days with very poor climate comfort for urban tourism in summer will remain extremely low; therefore, we can expect excellent climate conditions for urban tourism in Novo mesto all year long.

Thirdly are presented temperature changes. The average effective temperature is calculated for the past periods, followed by the percentage of warm and hot days for Novo mesto concerning 3 scenarios.

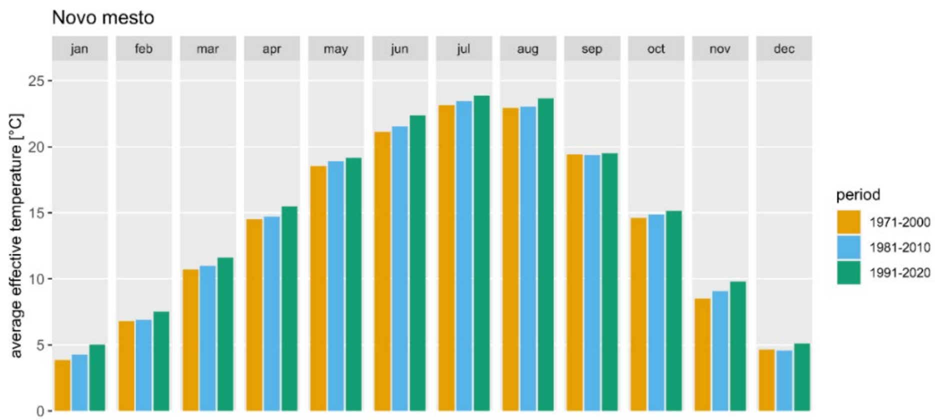

Figure 83: Novo mesto: The average effective temperature
Data source for calculations: ARSO, 2022.

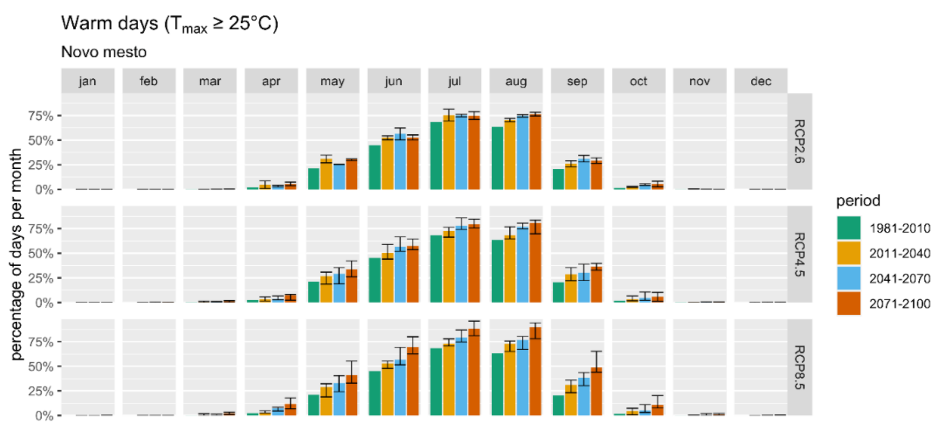

Figure 84: Novo mesto: The percentage of warm days
Data source: ARSO, 2022.

Figure 85: Novo mesto: The percentage of hot days
Data source: ARSO, 2022.

The average effective temperature in Novo mesto increased during the past periods throughout the whole year, which is improving the average thermal comfort in May, and worsening in June, July and August. As seen on the warm and hot days graphs, the temperature in Novo mesto will increase, particularly in the summer months. RCP8.5 scenario stands out as the most unfavourable one with the highest increase of hot days occurence in July and August, the percentage is expected to double or even tripple. The expected range variability is high, but the increase is very certain. Hence, adaptation measures should be implemented in the cities to provide more favourable thermal comfort conditions, especially for the summer season due to the increasing number of warm and hot days.

Koper

First is presented the HCI: Urban for Koper in the past periods.

The graph shows that the percentage of days with ideal climate comfort for urban tourism is highest in the summer season, reaching up to almost 90%. However, past observation shows an extension of the season into spring and autumn months through the observed periods. Nevertheless, even winter months had over 80% of days with marginal or ideal climate comfort for urban tourism.

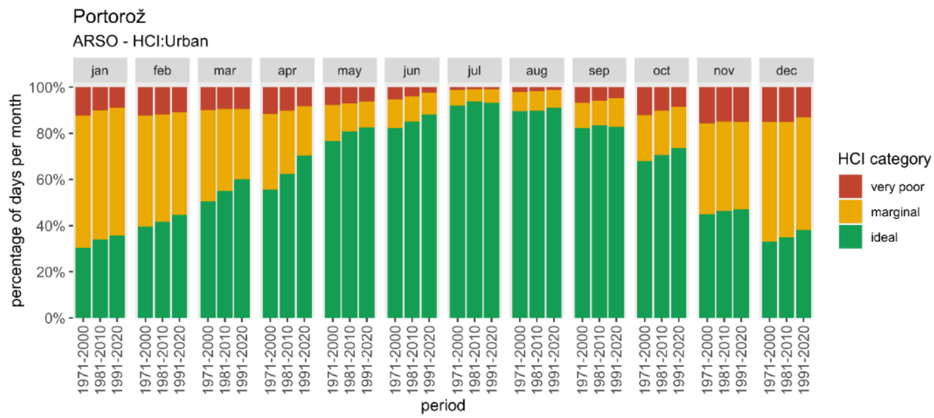

Figure 86: Koper: The percentage of very poor/marginal/ideal days according to HCI: Urban

Data source for calculations: ARSO, 2022.

Second is presented the projected HCI: Urban for Koper concerning 3 scenarios.

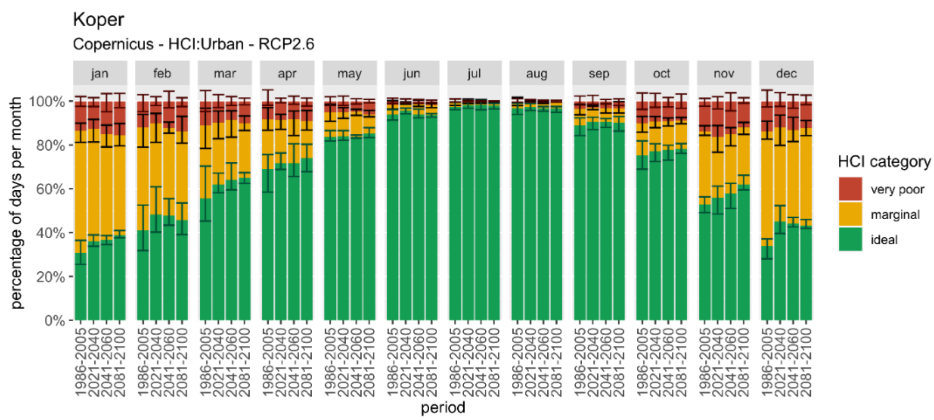

Figure 87: Koper: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP2.6

Data source: Copernicus, 2022.

The projected percentage of days with ideal climate comfort for urban tourism in Koper can hardly be any higher in the summer, however a slight increase or decrease can happen. Additionally, the percentage of days with ideal climate comfort for urban tourism is projected to rise in all other seasons, especially in the winter months, but with higher variability of the change. The percentage of days with very poor climate comfort for urban tourism in winter in the past was approximately 10–15%, but it is not expected to change much in the future. Still, the percentage of days with very poor climate comfort for urban tourism in summer will remain extremely low; therefore, we can expect excellent climate conditions for urban tourism in Koper all year long.

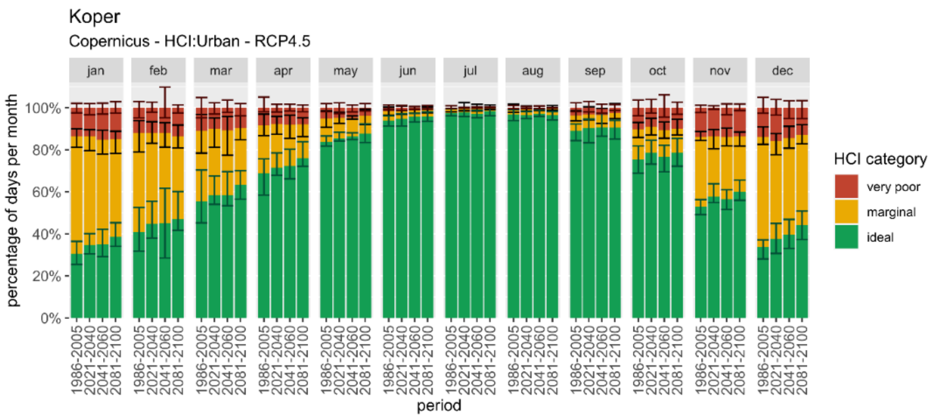

Figure 88: Koper: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP4.5

Data source: Copernicus, 2022.

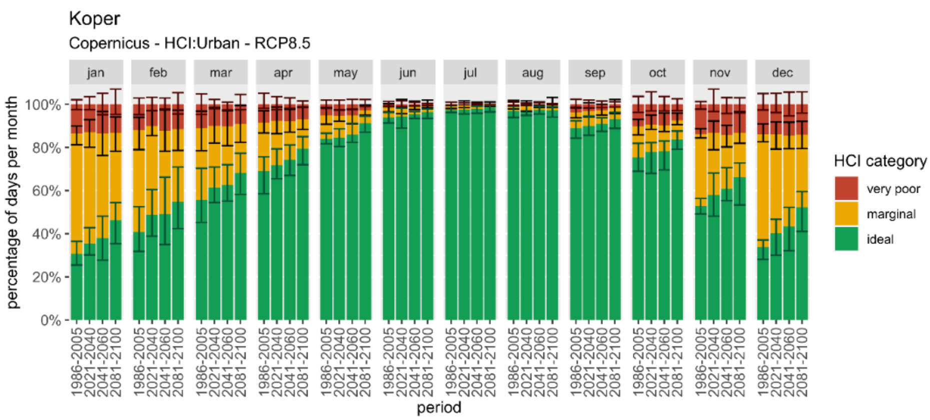

Figure 89: Koper: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP8.5

Data source: Copernicus, 2022.

Thirdly are presented temperature changes. The average effective temperature is calculated for the past periods, followed by the percentage of warm and hot days for Koper concerning 3 scenarios.

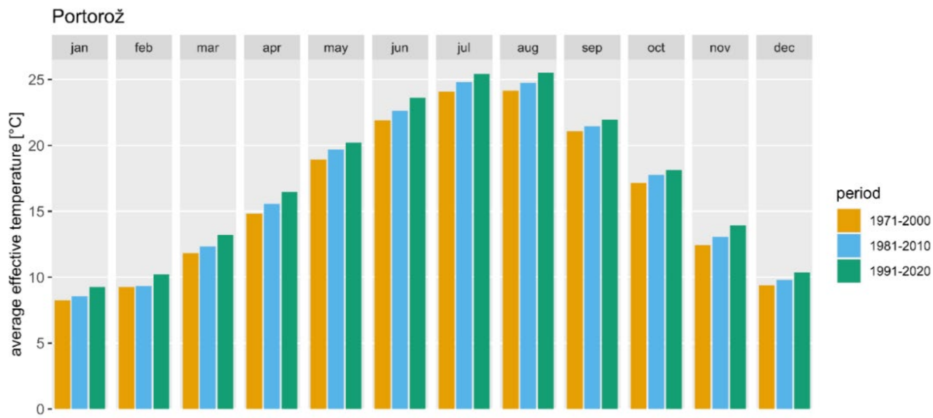

Figure 90: Koper: The average effective temperature

Data source for calculations: ARSO, 2022.

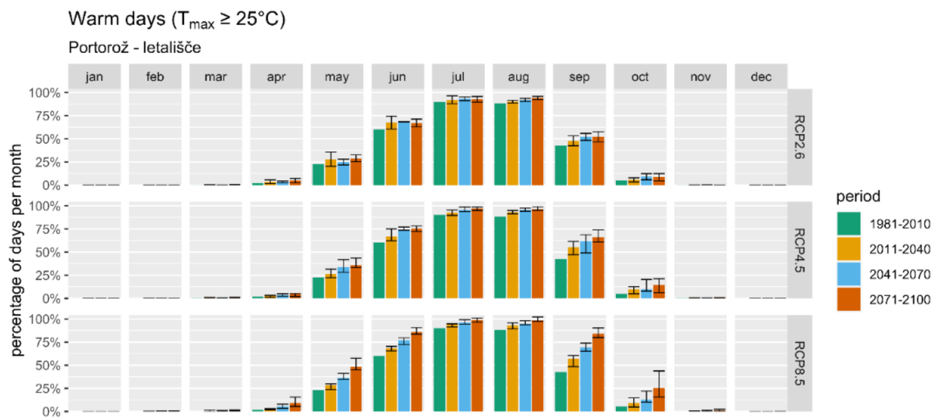

Figure 91: Koper: The percentage of warm days

Data source: ARSO, 2022.

The average effective temperature in Koper increased during past periods throughout the whole year, improving the average thermal comfort in May and worsening during the summer. As seen on the warm and hot days graphs, the temperature in Koper is already relatively high and will increase particularly in the late spring and early autumn months. RCP8.5 scenario stands out as the most unfavourable one with the highest increase in the hot days occurence in July and August, even up to 20% more hot days per month in each period. The occurrence is much higher than in the other parts of Slovenia. Hence, adaptation measures should be implemented in the cities to provide even more favourable thermal comfort conditions, especially for the summer season due to the increasing number of hot days.

Figure 92: Koper: The percentage of hot days
Data source: ARSO, 2022.

Nova Gorica

First is presented the HCI: Urban for Nova Gorica in the past periods.

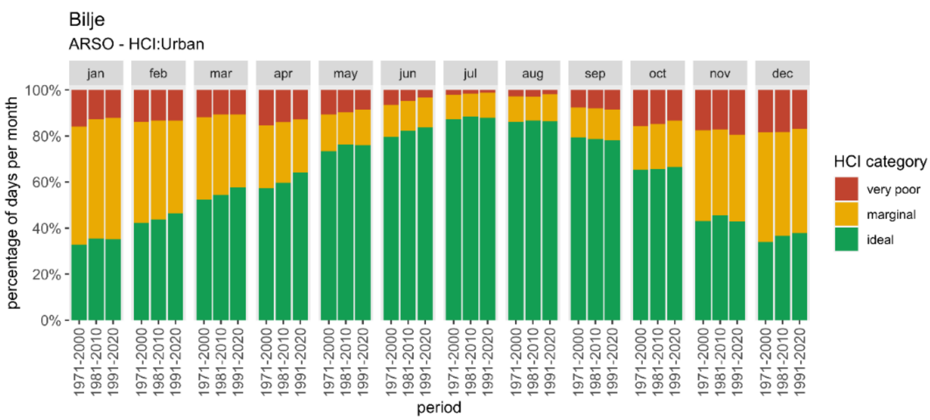

Figure 93: Nova Gorica: The percentage of very poor/marginal/ideal days according to HCI: Urban
Data source for calculations: ARSO, 2022.

As the graph shows, the percentage of days with ideal climate comfort for urban tourism is the highest in the summer season (more than 80% in July and August); however, past observation shows a minor extension of the season into the spring months through the observed periods, difference among periods are not very big, but in May there are around 70% of ideal days, and in March and April 50-60%. Nevertheless, even winter months had over 80% of days with marginal or ideal climate comfort for urban tourism.

Second is presented the projected HCI: Urban for Nova Gorica concerning 3 scenarios.

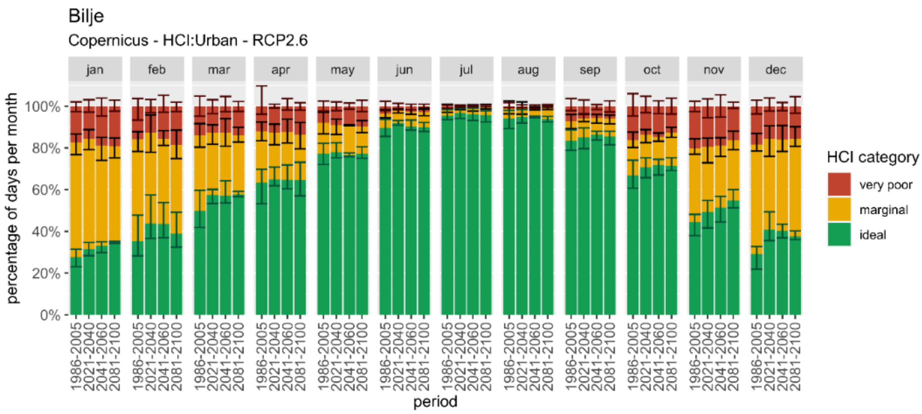

Figure 94: Nova Gorica: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP2.6

Data source: Copernicus, 2022.

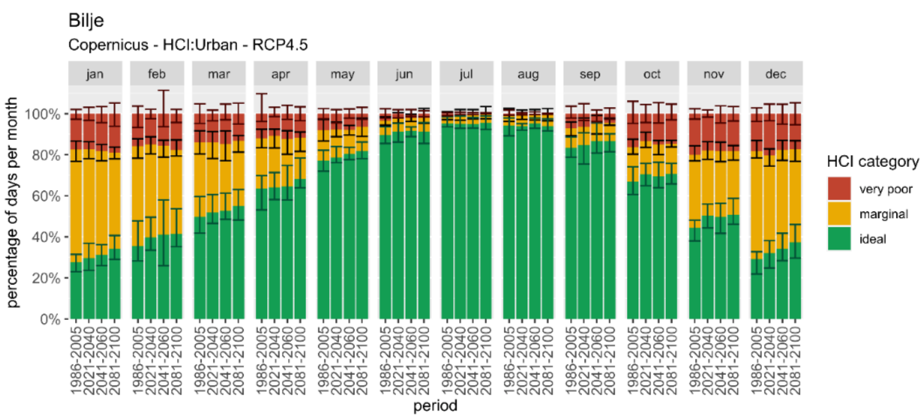

Figure 95: Nova Gorica: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP4.5

Data source: Copernicus, 2022.

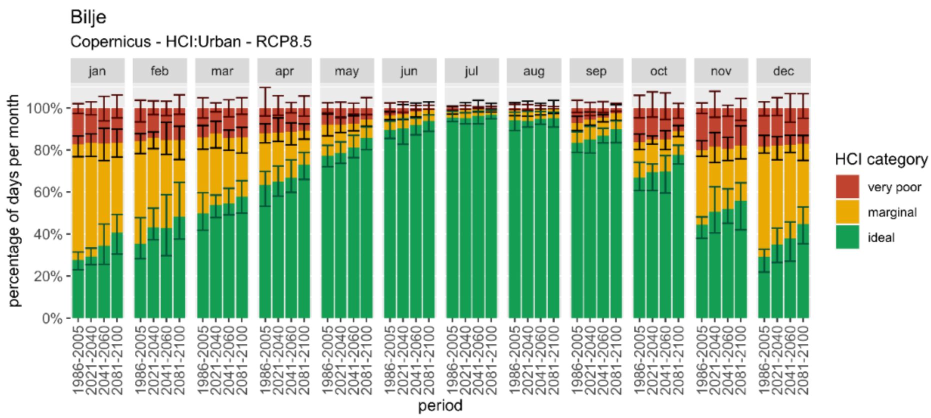

Figure 96: Nova Gorica: The percentage of very poor/marginal/ideal days according to HCI: Urban – RCP8.5

Data source: Copernicus, 2022.

The projected percentage of days with ideal climate comfort for urban tourism in Nova Gorica is stagnating in the summer months. In all other months there is an expected increase. The percentage of days with very poor climate comfort for urban tourism in winter in the past was approximately 15-20% and is expected to stay approximately the same in the future. The percentage of days with very poor climate comfort for urban tourism in summer will remain extremely low; therefore, we can expect excellent climate conditions for urban tourism in Nova Gorica all year long.

Thirdly are presented temperature changes. The average effective temperature is calculated for the past periods, followed by the percentage of warm and hot days concerning 3 scenarios.

The average effective temperature in Nova Gorica increased during past periods in the majority of months, but not in May, July, September, and October, reaching too high even with average values during the summer. As seen on the warm and hot days graphs, the temperature in Nova Gorica will increase, particularly in May, June and September. RCP8.5 scenario stands out as the most unfavourable one since the expected hot days occurrence is very high, escalating through the future periods. Hence, adaptation measures should be implemented in the cities to provide even more favourable thermal comfort conditions, especially for the summer season due to the increasing number of hot days.

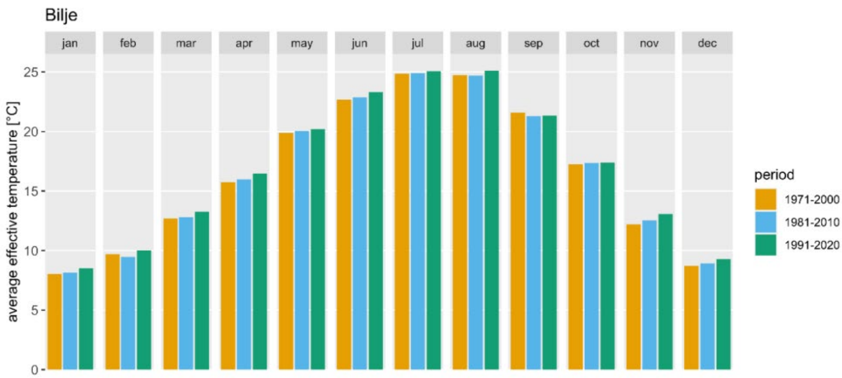

Figure 97: Nova Gorica: The average effective temperature
Data source for calculations: ARSO, 2022.

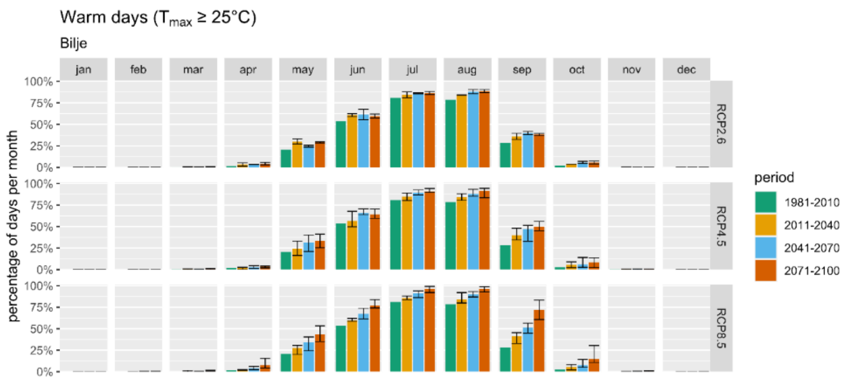

Figure 98: Nova Gorica: The percentage of warm days
Data source: ARSO, 2022.

Figure 99: Nova Gorica: The percentage of hot days
Data source: ARSO, 2022.

Proposed adaptation measures for urban tourism

Literature offers several different urban tourism adaptation measures or strategies for future periods of climate change. Since other studies and current data for Slovenia show that climate comfort in urban tourism will improve throughout the year, no major adaptation strategies would be needed. However, higher summer temperatures call for action, and most adaptation strategies refer to warmer summer months in urban areas. We can categorise adaptation measures into four groups (Pröbstl-Haider, Mostegl and Damm, 2021): adaptation strategies for the traveller (individual consumer adaptation), the tourist operation (business adaptation for companies or organisations), the regional destination (destination adaptation at municipality or city level), and the country destination (national destination policy and adaptation).

Adaptation measures for tourists

Tourists can suffer from the change in biological conditions, particularly from an increase in harmful insects, an increase in algal growth in warmer waters, and the spread of neophytes and allergenic plants (Pröbstl-Haider, Mostegl and Damm, 2021). They may also experience circulatory collapses, dehydrations, and exertional hyperthermia (overheating) due to thermal stress (Burton et al., 2021). Tourists' personal adaptation to climate change can be divided into two parts (Yang, Wong and Jusuf, 2013). First is a physical adaptation, which includes the changes tourists make, in order to adjust to the environment or alter the environment to their needs (for example, altering clothing levels, posture and position, consumption of hot or cool drinks, opening a window, turning a thermostat, opening a parasol, etc.). Another is a physiological adaptation or physiological acclimatisation, which includes accepting and tolerating the climate conditions as they are and not being annoyed by them.

Therefore, tourists should follow the proposed measures (Lin, 2009; Yang, Wong and Jusuf, 2013; McKercher et al., 2015; Jiricka-Pürrer, Brandenburg and Pröbstl-Haider, 2020):

- Walk under the shade of trees or other shelters.
- Seek cooler places, also indoor (air-conditioned).

- More drinking – rehydration.
- Light clothing and wearing a hat.
- Opening umbrellas.
- Apply sunscreen.
- Hair tied back.
- Plan longer breaks.
- Choose accommodation in the greener suburbs or the outskirts of the city.
- Cancel or postpone planned activities or shorten one's stay.

Adaptation measures for companies or organisations

There are many negative effects due to extreme weather and climate-induced cost increases. For example, accommodation businesses have already experienced an increase in energy consumption for cooling in the summer and travel agencies faced changes in demand. Local providers that heavily depend on tourism revenues will lose their attractiveness, and business losses may be dramatic (Lise and Tol, 2002). The event business is significantly affected since extreme weather events cause the cancellation or postponement/relocation of the events and significantly influence the planning, financial success, and visitor experience at outdoor events (Burton et al., 2021).

Therefore, tourism providers should improve their buildings and services through good business practices (Demiroglu et al., 2020; Jiricka-Pürrer, Brandenburg and Pröbstl-Haider, 2020; Pröbstl-Haider, Mostegl and Damm, 2021; Burton et al., 2021):

- Technical and infrastructure adaptations: interventions in the building shell, ventilation, air conditioning, shading, green roofs, greenwalls, green spaces, use of 'cool' paints and coatings.
- However, without rapid decarbonisation of electricity supply, greenhouse gas emissions will increase due to the increased use of air conditioning. Implementation of renewable energy infrastructure, energy-efficient systems and insulation and installation of climate-compatible cooling is therefore necessary.
- Support of individual companies through advice, certification and funding.

- Offer travel and health insurance packages with weather-based guarantees and compensations.
- Choosing another vacation period, designing a new peak season or overall deseasonalisation.
- Proactively planning and scheduling outdoor events only during certain times of the year to take advantage of beneficial weather conditions.
- Provide more information for tourists about climate change: the leading information platforms for travellers, such as travel agencies, travel providers, and booking platforms (e.g. Booking.com or Trivago) must be improved, and climate change should receive more media coverage.

Adaptation measures for municipalities and regions

Core destinations have a major impact on adaptation to climate change in tourism and its variations like urban tourism. Primarily, destination managers should encourage tourism providers to develop climate-adapted products and services (Pröbstl-Haider, Mostegl and Damm, 2021). Otherwise, they will need to be ready for the threat of losing tourists who want to stick to the same vacation period and choose other more suitable destinations for that period (Demiroglu et al., 2020). Nevertheless, not only revenue losses, but also extreme weather events can seriously damage infrastructure and operational facilities (Burton et al., 2021); hence the troubles of destinations can become even more extensive. An awareness of these issues would be valuable to architects, planners, and urban designers to improve their design plans and adapt to changing environments (Nikolopouloua and Steemers, 2003).

Therefore, tourism city destinations should improve (Nikolopouloua and Steemers, 2003; Lin, 2009; Nasrollahi, Hatami and Taleghani, 2017; Jiricka-Pürrer, Brandenburg and Pröbstl-Haider, 2020; Lopes et al., 2021; NCCARF, n.d.):

- Reconsideration of the role and the accessibility of free spaces in urban areas – green and blue infrastructure as well as their capacities and maintenance (creating green areas, adding vegetation, implementing water-related structures in public spaces, and establishing an offer of water-based sports and recreational activities, offering water-based mobility).

- Reducing heat islands in the urban area. Well-thought-out space design improves the microclimates of outdoor public spaces to increase square utilisation rates and climate comfort. For example, natural and artificial shelters on squares for shading (trees, canopies, parasols); facilities for relaxation, resting, and sitting (benches); providing greater environmental diversity in the geographic space for access to the sun as well as the shade, exposure to breezes as well as protection from the wind (arcades, parks, mobile gardens, pedestrian zones, open areas), shading, green roofs, greenwalls, and use of 'cool' paints and coatings both on buildings and other public areas (roads, sidewalks etc.).
- Ensuring proper informational systems for heatwaves safety of both residents and tourists. For example, the Extrema App helps users find the nearest cooling space, free drinking water spot, or plan the best route to avoid discomfort and informs authorities about the areas where victims are to be expected. First developed in Athens, the service has been adopted by Paris, Rotterdam, Milan, and Mallorca and is being scaled across additional cities (Florian, 2022).
- Designing windbreaks (for example, movable canvas awnings, canopies made of various materials such as reeds, bamboo, or vines).
- Planning a network of natural and semi-natural areas which absorb precipitation and reduce water runoff.
- Install drinking water fountains, water playgrounds, and water distribution sprayers, creating humid fog and other activities related to water-induced cooling effects.
- A measure advised especially for the Mediterranean areas are so-called climatic shelters to protect yourself in the time of heatwaves in tourist areas (eco-union, 2019). Barcelona is amongst the first to set up networks of climatic shelters publicly accessible with the aim to provide comfort for everyone in the city within 10 min walking distance (Florian, 2022).
- An important threat for maladaption it the increase of greenhouse gas emissions from transport due to the temporary relocation of city residents to cooler locations during heatwaves and general prolongation of the seasons. The available network of public transport services is especially usable in urban destinations, as urban tourists need no additional equipment for their city break.

- Strategic planning and nature protection of urban forests usage by tourists and locals so it does not come to overcrowding.
- Implementing restrictions on natural resource usage (e.g. lakes) in times of extreme events (such as drought) or overcrowding, or restrictions on a duration of a city break.
- Urban residential planning regarding solar exposure, shading, wind deflection and wind acceleration through the streets and squares (consideration of the density of urban textures, orientation of open spaces and buildings, the width of streets and height of buildings)
- Adaptation of building heritage which takes into account both climate change adaptation (interventions in the building shell, ventilation, air conditioning, shading, green roofs and greenwalls) and climate change mitigation ()the use and reuse of materials, materials from the local environment, the use of traditional knowledge in construction and renovation, energy remediation and mitigation of greenhouse gas emissions). Finally, a key element of climate change adaptation is identifying and potentially digitising endangered cultural heritage (Dizdarevič, 2021).

National adaptation measures

A general tourism strategy should consider climate change both in Slovenia and its competing destinations since climate change will likely lead to important changes in tourist behaviour and the number of visitors (Lise and Tol, 2002).

Therefore, country destinations should improve on a cross-national level (Bafaluy et al., 2014; Michailidou, Vlachokostas and Moussiopoulos, 2016; Aall and Koens, 2019; Jiricka-Pürrer, Brandenburg and Pröbstl-Haider, 2020; Pröbstl-Haider, Mostegl and Damm, 2021):

- Promote other kinds of tourism which are not so strongly climate-sensitive.
- Offer funding to reduce energy consumption and enhance the thermal regulation of, for example, hotel buildings.
- Join global, national and local initiatives to make cities more sustainable (such as the Local Governments for Sustainable Development, Global Platform for Sustainable Cities, The Global Covenant of Mayors for

Climate and Energy, and the C40 network of the world's megacities committed to addressing climate change).

- Design different policies regarding tourism (for example, for protected areas and water usage).
- Implement spatial planning and tourism development strategies.

Implement measures against water scarcity and extreme weather events and implement land management.

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5 Climate change and winter tourism adaptation

Highlights

- Due to the changing climate, Slovenia has already started the process of diversifying its winter tourism offer.
- Climate change will have a major impact on winter tourism in the Alps in the coming years.
- Calculations based on the sample of Slovenian ski resorts show an increase in average temperatures in the winter months and a decrease in the thickness of the snow cover.
- The majority of ski resorts at medium and high altitudes would scarcely be affected due the climate change in RCP2.6 scenario projections. However, in RCP4.5 and RCP8.5 scenarios all ski centres discussed would be significantly affected.
- A "2-tier society" can be seen in the winter tourism sector – few resorts at a high profit, and most resorts and companies unprofitable.
- Winter tourism providers will have to adapt to the effects of climate change with additional offers and investment. They will need to design tourism products that do not require snow or it will be possible to participate in even in rainy conditions.

Abstract

Mountain (winter) sports are a traditional activity in all Alpine countries, they also represent part of the Slovenian national identity. Winter activities are very popular with tourists and residents in Slovenia. Ski slopes and ski resorts are easily accessible,

family-friendly and offer a variety of choices. However, due to the non-competitiveness and obsolescence of Slovenian ski resorts, which, despite tradition, knowledge, manufacturers, and skiing results, can no longer successfully compete with other ski centres, Slovenian winter tourism is becoming an ever-increasing problem.

Winter tourism must be developed in a sustainable manner and adapted to climate change. Strategic priorities include the development of sustainable, authentic, boutique tourism, based on quality products and the exploitation of exceptional natural potential. At the same time, the vulnerability of the mountain world and the tradition of mountaineering must also be taken into account. Climate change brings Alpine and Slovenian tourism major challenges, as it must adapt to it, while at the same time implementing mitigation measures to reduce the sector's environmental impacts.

For many alpine areas, winter tourism is the most important source of income, and snow-reliability is one of the key elements of the offers made by tourism in the Alps. Most Alpine winter tourism destinations are focusing on skiing and related winter sports but increasing temperatures and shortages of snow cover pose a serious threat to ski tourism. The future of many resort destinations in the Alps will therefore depend on how they diversify and adapt to changing conditions. The approach of indicators is widely used in climate variability and climate change assessments to simplify the tracking of complex processes and phenomena in the state of the environment.

Usually, winter destinations mention indicators including maximum snow cover depth (both natural and technical snow); natural snow-reliability; temperatures; and precipitation. Research shows that the winter days with precipitation will slowly increase through years, however, because of temperature rise, there will be less snow days in future years in all scenarios. Results also show a decrease of days with at least 5cm and at least 30cm of natural snow in future periods. There will also be a decrease of snowmaking hours with at least -2°and at least -5°C in future periods.

Climate change has been recognised as a problem for winter tourism, however, it is not regarded as a catastrophe for winter tourism. Climate change must therefore be viewed as a catalyst that is reinforcing and accelerating the pace of structural changes in tourism. Adaptation initiatives may include the production of technical snow, the protection and conservation of the snow coverage area, and the diversification of recreation activities offered during the whole year. Climate change in mountain destinations is also addressed in the Slovenian tourism strategy, which calls attention to adapting to climate change and reducing the carbon footprint. With appropriate measures, mountain tourism destinations will be able to continue to operate successfully in various scenarios of the effects of climate change, offer in-demand activities for tourists and at the same time contribute to a reduced negative impact on the environment. Climate change represents a challenge for tourism, and particularly for winter tourism in mountain areas. It is not the case that tourism's initial position will go through a sudden and extreme change. Instead, climate change needs to be a helping force that will strengthen or add support to and speed up the change in the tourist industry and more clearly highlight the risks and opportunities built into tourist developments.

The significance of winter tourism in the Slovenian tourism system

Winter activities, especially skiing, are very popular with tourists and residents in Slovenia. Slovenian tourism organisation (STO, 2022) states that ski slopes and ski resorts are easily accessible, family-friendly and offer a variety of choices. Ski centres at altitudes higher than 1000 metres above sea level are usually still operating in early spring. They mostly use technical snow, but there are also some ski slopes boasting only natural snow. In addition to the large ski centres, tourists can also visit popular smaller ski centres. Tourists can also use long-distance cross-country trails; there are many groomed sledging runs and also several opportunities to hike in winter. Even if there is not enough snow, it is still possible for tourists to experience winter holidays in Slovenia. They can visit a high-altitude ski centre where at least some ski runs are covered with snow, go hiking and conquer a mountain peak, or find patches of snow in alpine valleys. If there is not enough snow for skiing, tourists can cycle along many cycle paths, visit museums, spas and discover Slovenian tourist attractions (STO, 2022). According to the Association of Slovenian Cable Car Operators, there are 42 ski resorts operating in Slovenia, which are spread over 1,400 hectares and offer a total of just under 275 kilometres of ski tracks, to the top of which winter enthusiasts are taken by more than 100 machines with a total capacity of 140,000 skiers per hour. Between 2010 and 2015, the average Slovenian ski resort operated "merely" for 108 days, or a little less than a third of the year. Among the nine largest, which include Mariborsko Pohorje, Kanin - Sella Nevea, Krvavec, Kranjska Gora, Cerkno, Vogel, Rogla, Golte and Stari vrh, Krvavec recorded the most operating days into one year, which despite the milder winters, due to the good snowmaking system, operated 123 days. Vogel and Rogla follow with 120 days each, while Stari vrh hosted skiers the fewest times a year – 80 days (Delo, 2016).

The persons of Slovenian tourism who represent typical groups of tourists who go to mountain destinations are mainly "adventurers" and "active families", but also "active nostalgics" and "devoted mothers" (STO, 2016). If we look at the overnight stays of domestic and foreign tourists in mountain municipalities (Figure 100), we see that the number of overnight stays peaks in the summer months. In the years before the Covid 19 pandemic, we see significant differences in the number of overnight stays by foreign tourists compared to domestic ones. In 2020, due to the measures, domestic tourists dominated. In the summer months of 2021, foreign tourists once again dominated, while in the winter months of 2021 and the beginning of 2022, we recorded many overnight stays by domestic tourists (SURS, 2022).

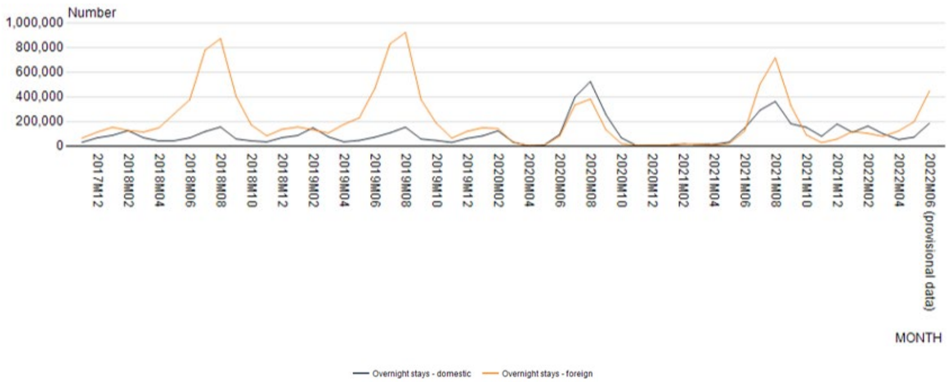

Figure 100: Tourist overnight stays in mountain municipalities
Source: SURS, 2022

However, the winter tourist offer in Slovenia cannot compete with other Alpine (and some Balkan) centres; the cable car infrastructure is outdated, the user experience is of low quality, and tourist services are modest. Instead of spending the night in hotels, visitors choose to sleep in apartments and individual accommodations, which brings the least additional value in terms of spend and also shortens the duration of the visit. Some low-lying ski centres have already closed due to green winters, the ski competition Golden Fox has moved from Pohorje to Kranjska Gora in recent years, but even high-mountain centres that do not have problems with snow are experiencing poor business results (Kanin) (CIPRA, 2021).

Mountain (winter) sports are a traditional activity in all Alpine countries, and they also represent part of the Slovenian national identity. Slovenia has a number of sporting successes, and at the same time, every child learns the basics of the principle of movement in the snow during elementary school education. Therefore, winter tourism must be developed in a sustainable direction and adapted to the consequences of climate change. It is also necessary to formulate a strategy for the decarbonization of winter tourism. CIPRA's request from 2011 is, therefore, still relevant - "Winter tourism must become an integrated part of the local offer, including a social, economic and environmental pillar - new paths must be found in eco-friendly and climate-friendly tourism" (CIPRA, 2022).

The Ministry of Economic Development and Technology recognizes the problems of winter tourism in Slovenia. A normal picture of seasonality should show a second peak in Alpine destinations in winter, while in Slovenia, the curve of seasonal occupancy of accommodation facilities is almost flat from December to May. The share of overnight sales from December to March barely exceeds 20% (i.e. in the winter season, which brings 40% to 60% of the annual sales in Alpine Slovenia to similar Alpine destinations in the EU). The lack of competitiveness and obsolescence of Slovenian ski resorts is becoming an ever-increasing problem (MGRT, 2021), despite the traditions, knowledge, eminent manufacturers, and excellent skiing results. Therefore, Slovenian winter resorts can no longer successfully compete with other ski centres even in the Balkans, much less, of course, in the EU. Therefore, there is an opportunity to strengthen the year-round operation of mountain (ski) centres, strengthen traditional annual outdoor activities in the off-season and transfer them to the winter months (MGRT, 2022).

The key challenges of Slovenian tourism, identified in the evaluation of the past strategic period and in the analysis of the situation, include (MGRT, 2022):

- Disorganization and insufficient quality of public and shared infrastructure (including cable car facilities);
- Functional and environmental orderliness in tourist destinations, which limits the achievement of a quality user experience for tourists and visitors and affects the lower price positioning of private providers and thus the achievement of lower added value in Slovenian tourism; and

– In tourist destinations, there is a lack of common and public functions and infrastructure in terms of tourist attractions.

According to the Slovenian Tourism Strategy (MGRT, 2022), attractions are encouraged and supported as a priority in the strategic period by the investment policy of public, public-private and also private investments. The measure is aimed at quality and sustainable transformation and reduction of seasonality in order to increase competitiveness and added value in the mountain centres of Slovenia. It is necessary to follow the strategic directions in the field of tourism, namely the development of sustainable, authentic, boutique tourism, which is based on quality products and the exploitation of exceptional natural potentials. At the same time, the sensitivity and vulnerability of the mountain world and the tradition of mountaineering must also be taken into account, which for the mountain world dictates a sustainable way of visiting, including minimising the impact on the mountain environment with infrastructure leaving a minimal environmental footprint (MGRT, 2022).

Climate change brings Alpine and Slovenian tourism major challenges, as it must adapt to it while at the same time implementing mitigation measures to reduce the sector's environmental impacts. Winter tourism is strongly connected to nature and depends on it since the availability of environmental resources (e.g. snow) depends upon whether the sector can even offer a certain tourist offer. Winter forms of tourism are undeniably extremely wasteful of energy and space, but it must be emphasized that the largest contributions to greenhouse gases are still related to the way the guest arrives at the tourist centre. Taking care of the tourist in Slovenia who chooses a local ski centre as their winter destination brings benefits to the Slovenian economy as well as advantages to the environment. One of the main development goals is, therefore, financing and co-financing of investments in the quality and sustainable transformation of mountain centres, cable car systems and ski resorts in Slovenia (CIPRA, 2022).

Literature review: Climate change impacts on winter tourism

Mountain ecosystems are considered to be vulnerable to climate change, with potential detrimental effects including the reduction of the snow seasons, the gradual retreat of glaciers, and changes in water storage and availability (Elsasser & Bürki, 2002). One especially vulnerable sector to climate change is winter tourism (Elsasser

& Bürki, 2002; Campos Rodrigues et al., 2018; Steiger et al., 2021), with some resorts likely to experience a significant reduction in the length of the skiing seasons and snow recreation areas throughout the twenty-first century (Campos Rodrigues et al., 2018). Increasing temperatures and snow scarcity pose a serious threat to ski tourism (Willibald et al., 2021). Those responsible for tourism know that what they can offer is highly dependent on snow and that they are at risk from snow-deficient winters (Elsasser & Bürki, 2002).

Technical snow production is an adaptation strategy to tackle risks from climate change and internal climate variability. While technical snow production can drastically reduce uncertainties related to internal climate variability, in low elevations, the technique reaches its limits to counteract global warming by the middle of the century (Willibald et al., 2021). Existing reviews are either focusing on one activity and/or type of tourism or represent a global overview. What is missing are regional or country-specific assessments of both climate change impacts on winter tourism and this sector's contribution to climate change shedding light on potential vulnerability and adaptation as well as the mitigation options of this economic sector (Steiger et al., 2021). The Alps are an important destination for winter tourism, so the following section addresses the findings, especially for the Alpine region.

Winter tourism in the Alps has been dominated, both in marketing and in academic publications, by an almost exclusive focus on winter sports activities, primarily on skiing. Most Alpine winter tourism destinations focus on skiing and related winter sports (i.e. snowboarding). Yet a large share of the potential winter tourism market has other interests that are often not considered by destination developers as viable products. The future of many resort destinations in the Alps will depend on how they diversify and adapt to changing conditions. The face of winter tourism is changing, and the European Alps are on the frontline of the challenges brought by change (Bausch & Gartner, 2020). Snow cover duration and snow depth in Alpine regions will be drastically reduced in the future (Willibald et al., 2021).

For many Alpine areas, winter tourism is the most important source of income, and snow reliability is one of the key elements of the offers made by tourism in the Alps (Elsasser & Bürki, 2002). However, there seems to exist the dominant picture of "Alpine winter holidays = winter sport holidays" in the minds of the public as well as the majority of scholars addressing winter tourism. As the results show, these destinations may be missing out on a large share of the winter market that shows little interest in intensive winter sports activities (Bausch & Gartner, 2020). Non-sporting activities can be, e.g. events, visits to museums and tourist attractions, various courses, wellness, etc. Climate change and the call for reduction of greenhouse gas emissions, the efficient use of (renewable) energy, and more resilient winter tourism regions forces ski resorts across the European Alps to look for "smart" approaches to transition toward a sustainable, low-carbon economy (Polderman et al., 2020). Within the Alps, Slovenia is also facing climate change, which is affecting winter tourism, especially in mountain regions. The successful development of winter tourism in these regions will require monitoring of indicators and adaptation to climate change. Climate change will affect not only uncertain snow conditions but also the demand for winter sports. As seasons characterized by a lack of snow (especially in lower elevations) become more frequent, the charm of skiing will disappear for many due to a warmer climate. Of course, it will not be possible to compensate for the lack of snow with technical measures (e.g. technical snowmaking) and additional supply (CIPRA, 2004).

Indicators are widely used in climate variability and climate change assessments to simplify the tracking of complex processes and phenomena in the state of the environment. Apart from the climate criteria, the snow indicators in ski tourism have been increasingly extended with elements that relate to the technical, operational, and commercial aspects of ski tourism. These non-natural influencing factors have gained importance in comparison with the natural environmental conditions but are more difficult to comprehend in time and space, resulting in the limited explanatory power of the related indicators when applied for larger/longer scale assessments (Abegg et al., 2021). Abegg et al. (2021) define the key snow indicators:

- Number of days with at least x cm of natural snow on the ground;
- Number of days with at least x cm of natural and technical snow on the ground;
- First date of the longest continuous period with at least x cm snow on the ground;
- Last date of the longest continuous period with at least x cm snow on the ground;
- Number of days with at least x cm of snow on the ground within the economically critical key period(s);

- Number of hours with a wet-bulb temperature lower than -x °C for base-layer snowmaking; and
- Number of hours with a wet-bulb temperature lower than -x °C for reinforcement snowmaking.

Further research has been done to address these indicators. The vulnerability analysis of the ski resorts to climate change shown in the study of Campos Rodrigues et al. (2018) addressed the following indicators:

- Maximum snow depth (including both natural and technical snow);
- Natural snow-reliability;
- Proximity to natural parks; proximity to special protection areas for birds (SPA);
- Proximity to sites of community importance (SCI);
- Available beds in the surrounding area; and
- The number of travellers entering the provinces of the ski resorts.

We see that climate change affect winter tourism significantly. Higher temperatures cause less snowfall and more rain, and snow cover forms later and melts earlier. This means a shorter skiing season, higher investment for technical snow production, higher energy consumption and increased pressure on local water resources when providing enough water for technical snow production (Hahn, 2004). The consequences of the operation of technical snow systems on the environment are different and partly controversial. It is often forgotten that skiing and the maintenance of ski slopes are extremely large interventions in the natural environment. Snowmaking cannot be done without a well-developed infrastructure. The distribution of plumbing, air and electrical wiring requires extensive construction work that can only be done with heavy construction machinery. This can damage flora and fauna, the soil and the image of the landscape. Mountain ecosystems are sensitive, and the higher the location of the construction site, the longer it usually takes to rehabilitate the terrain. Decades or even centuries may pass before the soil and growth recover from such stress. In addition, the construction of technical snowmaking devices is often also connected with the mechanical levelling of ski slopes since it is easier to make snow on levelled ski slopes. This is again a gross encroachment on nature and landscape. In addition to greater damage to vegetation as a result of construction works, plants are also affected by technical snow. Technical snowmaking is thus an additional factor of animal agitation, which occurs especially in winter. Noise and light are the most disturbing for animals. Technical snowing of the ski slopes is most intense in November and December, which means that large amounts of water are taken from the watercourse precisely at the time of low natural flow. The construction of underground piping for the snowmaking system often leaves visible soil and vegetation damage for a very long time. Above-ground and firmly attached parts of snowmaking devices, e.g. connections or pumping stations, characterize the landscape all year round (CIPRA, 2004).

Presentation and interpretation of results for winter tourism

In the following graphs, days with at least 1 mm of precipitation, days with at least 20 mm of precipitation and days with snow cover are presented for the town of Rateče, which is located in the northwestern part of Slovenia. In addition, days with at least 5 cm of natural snow, days with at least 30 cm of natural snow, snowfall precipitation and potential snowmaking hours are presented for different altitude levels for Slovenian winter tourism destinations - Cerkno, Kanin, Kranjska Gora, Krvavec, Pohorje, Rogla, Stari Vrh and Vogel.

Rateče

First the projected number of days with at least 1 mm and 20 mm of precipitation is presented for Rateče concerning 3 scenarios (Figures 101 and 102). As seen on the graph, the number of days with 1mm of precipitation si projected to stay in general the same with the projected change being uncertain as models show both increase and decrease. The same goes for the projected percentage of days with heavy precipitation, where the variability among models is even higher and thus uncertainty. The only small increase could be in January and February, which could be a positive indicator for winter tourism as there would be more opportunities for snow precipitation. However, this is only positive if the temperature is low enough for snow precipitation. Therefore, in Figure 100, the projected number of days with snow cover is presented. There will be less days with snow cover in future years in almost all periods and scenarios. In RCP2.6 an increase can be seen in February in the period 2011–2040 and in November in the period 2071–2100. In RCP4.5 an increase can also be seen in February for the period 2071–2100.

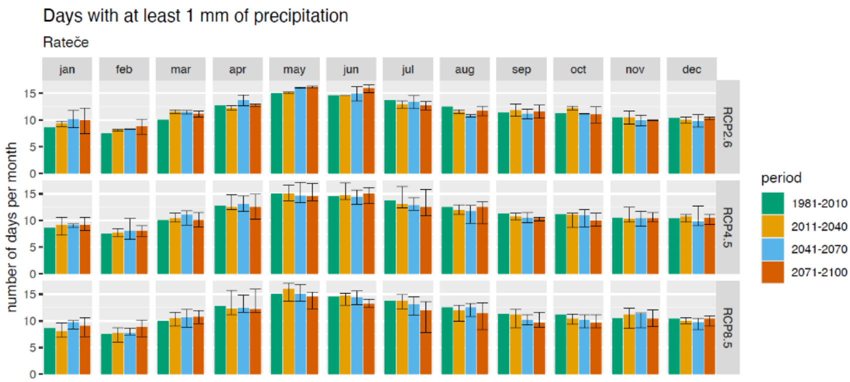

Figure 101: Rateče: The number of days with at least 1 mm of precipitation

Data source: ARSO, 2022.

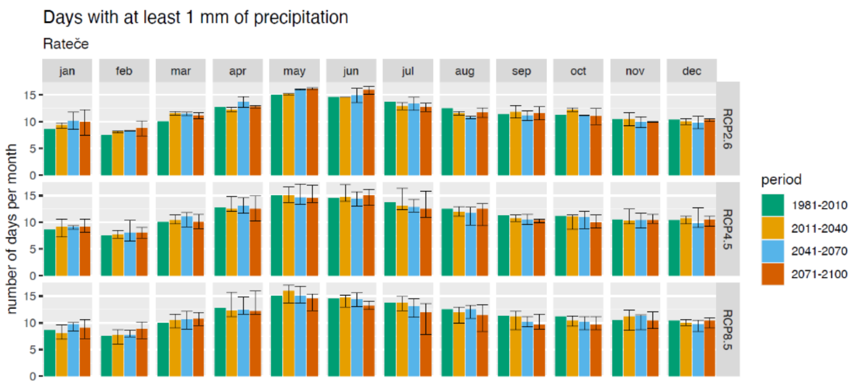

Figure 102: Rateče: The number of days with at least 20 mm of precipitation

Data source: ARSO, 2022.

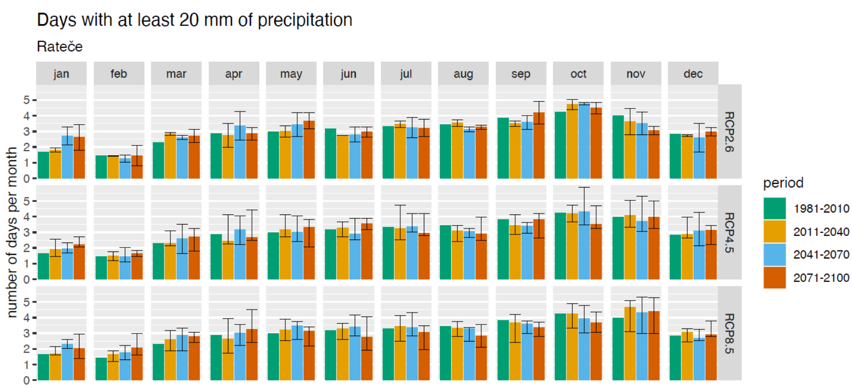

Figure 103: Rateče: The number of days with snow cover

Data source: ARSO, 2022.

Cerkno, Kanin, Kranjska Gora, Krvavec, Pohorje, Rogla, Stari Vrh and Vogel

Figure 104 presents days with at least 5 cm of natural snow for destinations Cerkno, Kanin, Kranjska Gora, Krvavec, Pohorje, Rogla, Stari Vrh and Vogel. For scenarios RCP4.5 and RCP8.5 the results show a decrease of days with at least 5 cm of natural snow in future periods, however with high variability. For example, at destinations Stari Vrh and Vogel we see a major decrease in days with natural snow at 500 m in the years 2081–2100 regarding these two scenarios. Regarding scenario RCP2.6, we can see a decrease of snow days at lower altitudes in comparison to the period 1986–2005. However, the results show relative stagnation or minor increase in days with at least 5 cm of natural snow at higher altitudes after year 2021. At majority of destinations we see a decrease of days with at least 5 cm of natural snow at lover altitudes. Again, it is important to mention, that the following graphs have very high variability, and thus high uncertainty.

Figure 105 presents days with at least 30 cm of natural snow for the destinations Cerkno, Kanin, Kranjska Gora, Krvavec, Pohorje, Rogla, Stari Vrh and Vogel. For scenarios RCP4.5 and RCP8.5 the results show a major decrease of days with at least 30 cm of natural snow in the future periods at lower and higher altitudes, even when variability is taken into account. However, the results of the RCP2.6 scenario show relative stagnation or minor decrease in days with at least 30 cm of natural snow at higher altitudes after year 2021.

Figure 106 presents snowfall precipitation for destinations Cerkno, Kanin, Kranjska Gora, Krvavec, Pohorje, Rogla, Stari Vrh and Vogel. For RCP4.5 and RCP8.5 scenarios the projections show a major decrease in snowfall in future periods at lower and higher altitudes, but the uncertainty is major. However, RCP2.6 shows a relative stagnation or minor decrease in snowfall precipitation at higher altitudes after year 2021. Therefore, this scenario would be positive for mentioned destinations and it is therefore in their strong interest to actively participate in mobilising for the RCP2.6 scenario to become the reality.

Figures 107 presents the potential snowmaking hours when the WBT (wet bulb temperature) is lower or equal to -2 °C in November and December for destinations Cerkno, Kanin, Kranjska Gora, Krvavec, Pohorje, Rogla, Stari Vrh and Vogel. In RCP4.5 and RCP8.5 a decrease of these potential snowmaking hours is projected at lower and higher altitudes. However, in RCP2.6 relative stagnation or minor decrease is projected in the periods 2021–2040 and 2041–2060 and then a minor increase in the period 2061–2100. Again, uncertainty is very high.

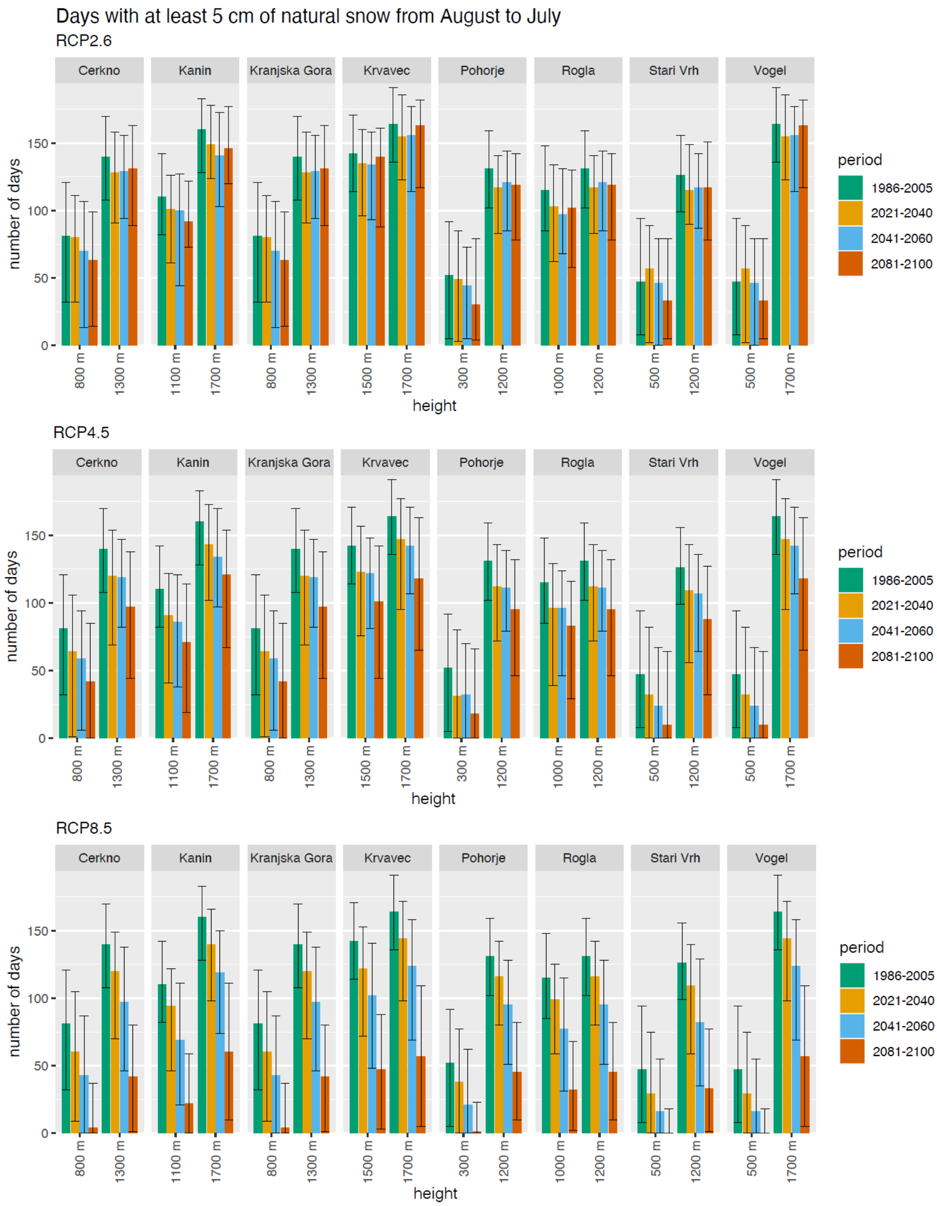

Figure 104: Days with at least 5 cm of natural snow

Data source: Copernicus, 2022.

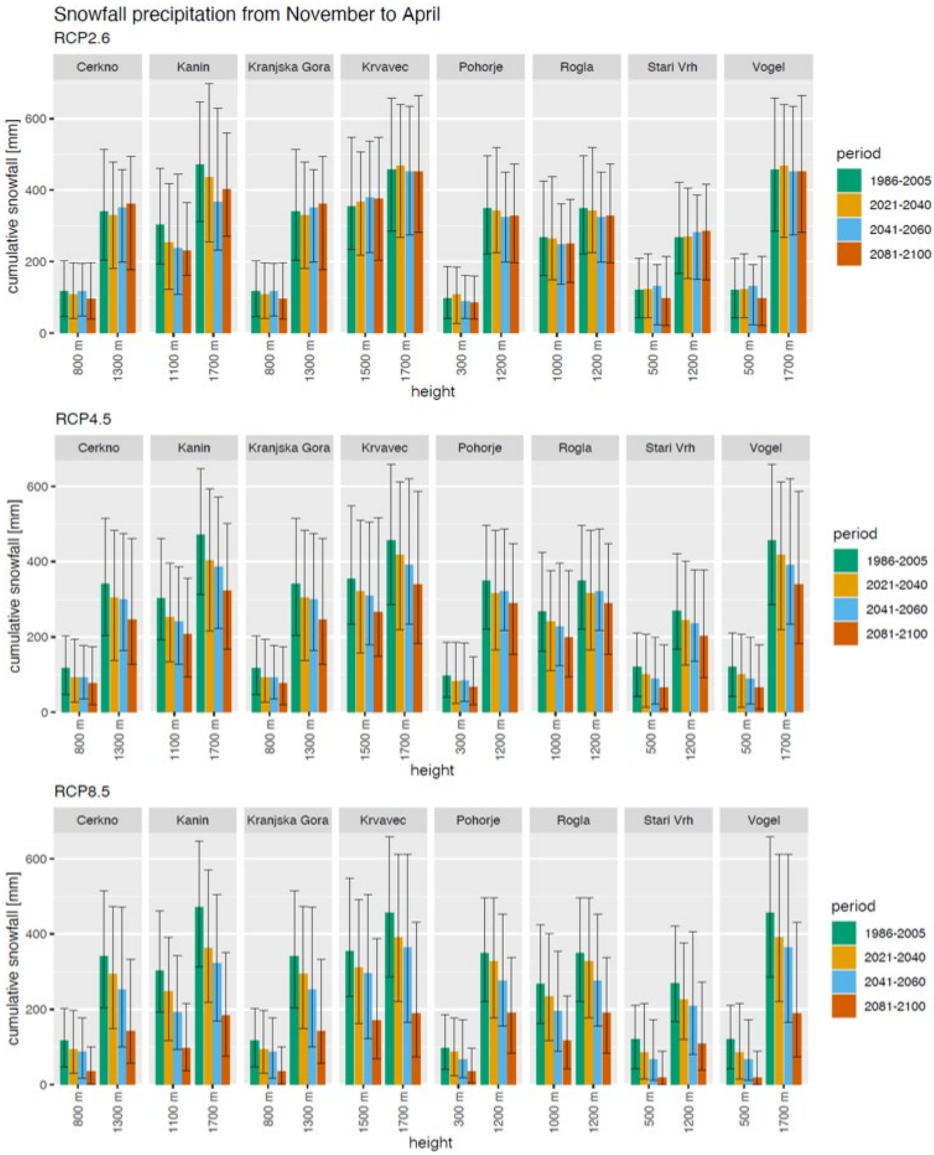

Figure 105: Rateče: Days with at least 30 cm of natural snow
Data source: Copernicus, 2022.

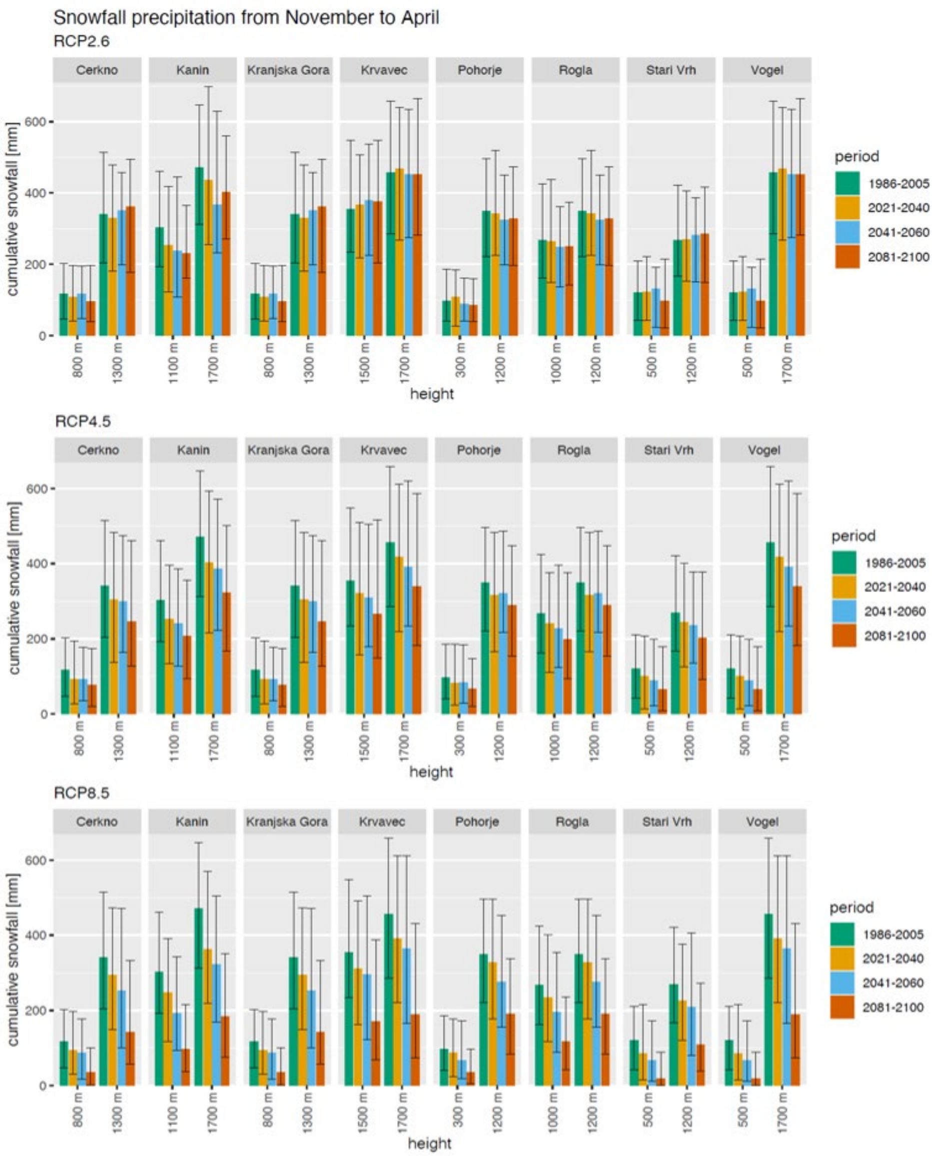

Figure 106: Snowfall precipitation

Data source: Copernicus, 2022.

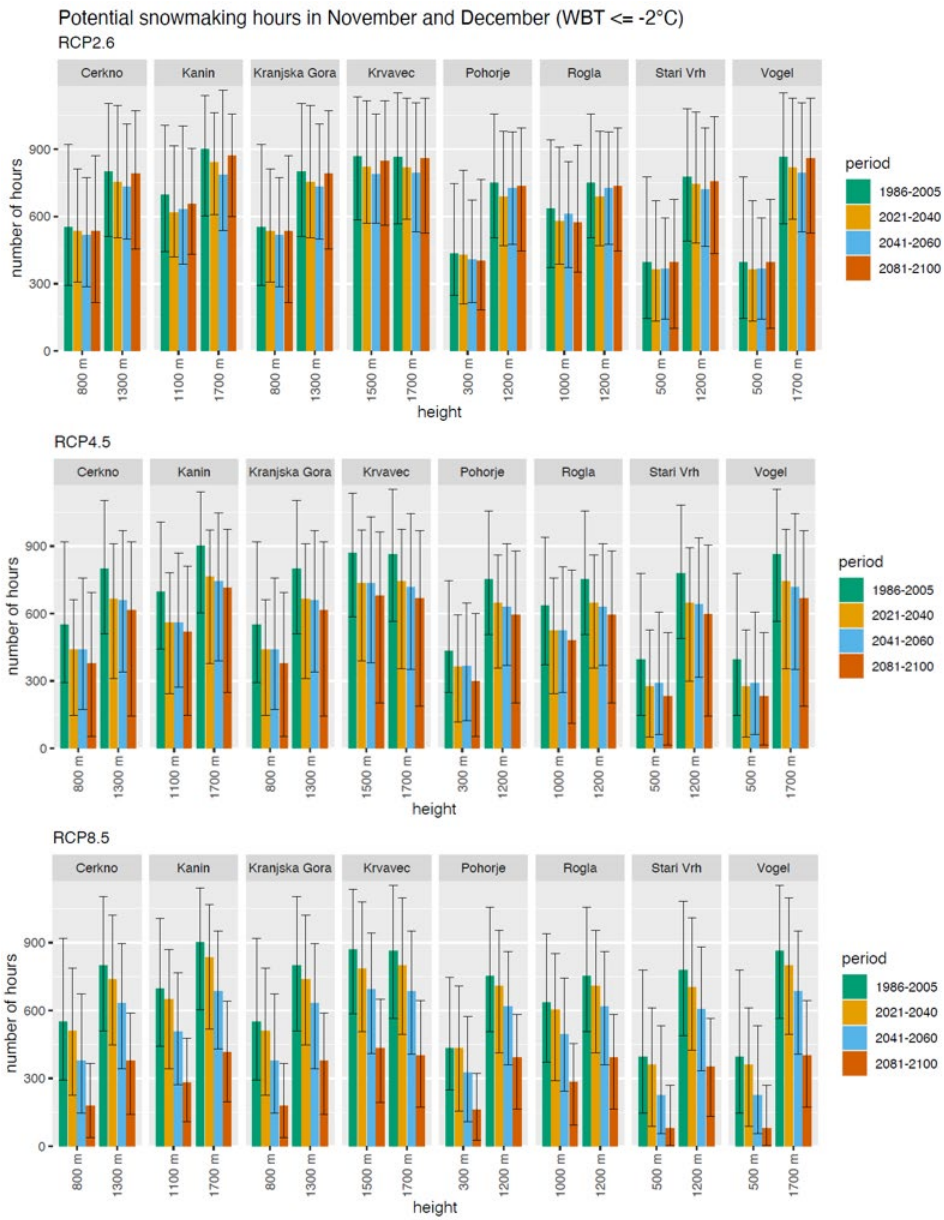

Figure 107: Potential snowmaking hours (WBT ≤ -2 °C)

Data source: Copernicus, 2022.

Figure 108 presents potential snowmaking hours when the WBT is lower or equal to -5 °C in November and December for destinations Cerkno, Kanin, Kranjska Gora, Krvavec, Pohorje, Rogla, Stari Vrh and Vogel. The projections show a major

(RCP8.5) or a bit minor (RCP4.5) decrease of these potential snowmaking hours. However, in RCP2.6 there is a relative stagnation of snowmaking hours. Variability is extremely high, making projections not as reliable as they would be needed for the decision makers.

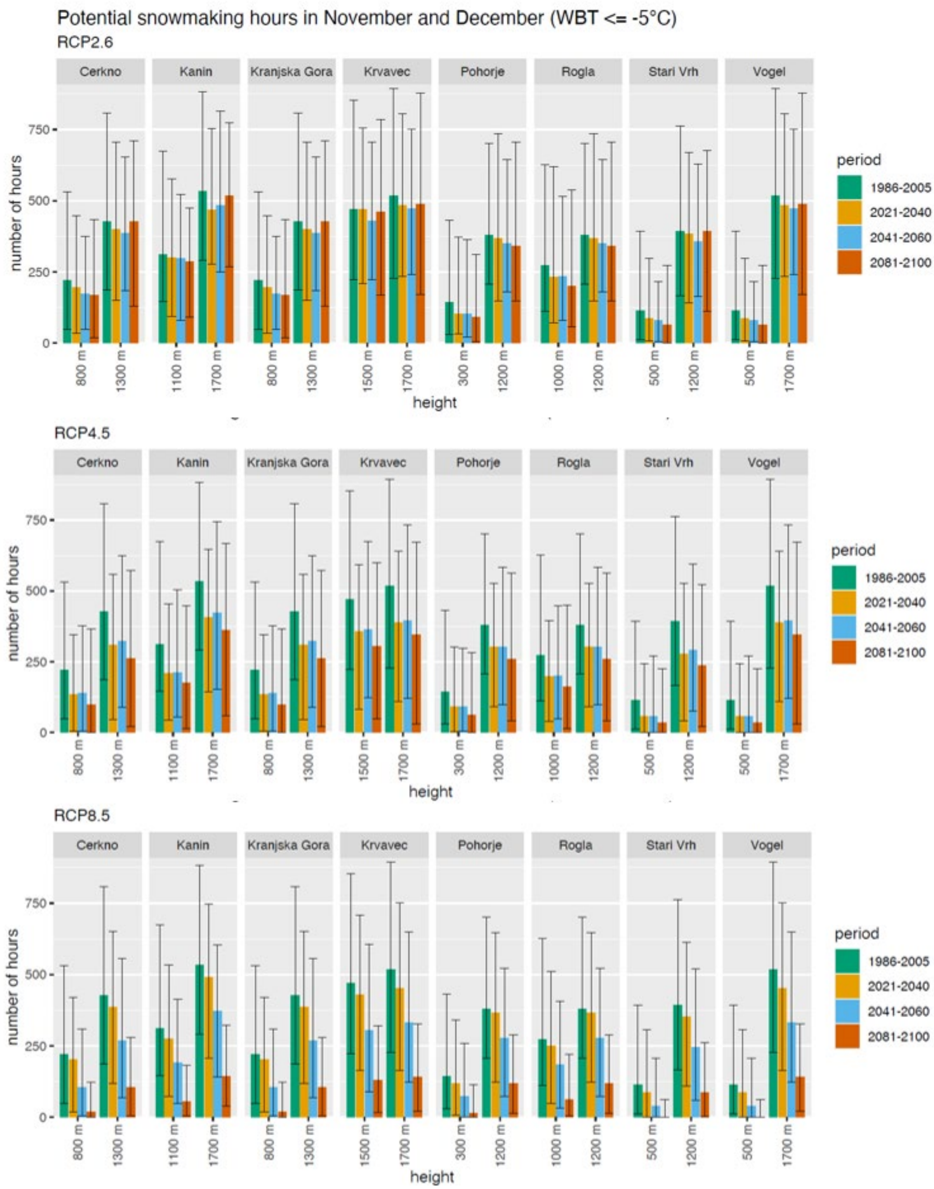

Figure 108: Potential snowmaking hours (WBT ≤ -5 °C)
Data source: Copernicus, 2022.

Proposed adaptation measures for winter tourism

Climate change has been recognised as a problem for winter tourism, however, it is not regarded as a catastrophe. Although climate change could intensify the problems that already exist in ski areas at lower altitudes and speed up structural changes in the sector, the majority of ski resorts at medium and high altitudes can possibly only scarcely be affected according the RCP2.6 scenario (low reliability though). However, in RCP4.5 and RCP8.5 all ski centres discussed are projected to be significantly affected. Yet, climate change is already affecting the strategies and plans of the winter sport resorts. Decrease of snowcover and global warming, together with international competition, have been used as the key arguments for constructing technical snowmaking facilities, as well as for extending existing ski runs and opening new ones in high alpine regions. Winter sports can only survive in the Alps if snow reliability is guaranteed. However, the smaller ski fields at lower altitudes will struggle to finance the necessary investments (such as snow cannons, levelling out ski slopes, and opening higher-altitude chambers in skiing areas). Nevertheless, smaller ski fields in the Alpine foothills play a key role in promoting the importance of skiing. Opinions frequently differ regarding the low altitude ski slopes. While a number of people are in favour of dismantling non-profitable cable-way and ski-lift operations and regard a certain shrinkage of the sector as necessary, others believe that there is an obligation to retain these ski fields for regional economic reasons (Bürki, Elsasser & Abegg, 2003). It is in the interest of the ski resorts to stay under the optimistic scenario, but at the same time, by making snow, they contribute to a larger carbon footprint and also make the situation worse for themselves.

Climate change must be viewed as a catalyst that is reinforcing and accelerating the pace of structural changes in tourism. Today, adaptation strategies are predominant in tourism (including the technical snow production), however, tourism will increasingly have to focus on mitigation strategies (such as reducing greenhouse gas emissions by tourism traffic) (Elsasser & Bürki, 2002). Each resort/destination must come up with its own strategic initiatives to capture new markets. A focus on the non-sports market must be reflected in resort/destination web pages as well as in the products designed specifically for these segments (Bausch & Gartner, 2020).

Research and communication needs are addressed including the need for climate risk assessments for businesses, research on tipping points in tourism demand as well as opportunities for non-snow related tourism products and the needs of non-skiers (Steiger et al., 2021). Winter tourism destinations should focus beside the "winter sport tourist "on the "alpine winter tourist". This segment is a promising substantial market for alpine destinations. This new focus requires: New products designed for a non-sports market, new strategic positioning and marketing, and adapted government structures and decision making (Bausch & Gartner, 2020).

Climate change represents a challenge for tourism, and particularly for winter tourism in mountain areas. It is not the case that tourism's initial position will go through a sudden and extreme change. Instead, climate change has to be viewed as strengthening or adding support to and speeding up the pace of (related to what holds something together and makes it strong) change in the tourist industry and more clearly highlight the risks and opportunities built into tourist developments. The emergence of a 2-tier society in the winter tourism sector – a few resorts and cableway-companies at a high profit, and most resorts and companies unprofitable - will not be due to climate change alone, but also due to the general change in a competitive market. On the one hand, we have the top resorts with their already varied and attractive offers and higher snow-reliability and, on the other hand, we have the smaller locations with their less-extensive developments, less-refined offers and restricted opportunities for further development. Since climate change is relatively long-term process in comparison to other trends in tourism, tourism managers and tourists will have every opportunity to adjust to the different constraints and adopt the corresponding strategies and measures (Bausch & Gartner, 2020). One of the most familiar measures in the struggle against snow-deficient winters is the construction of high cost technical snowmaking facilities. Adopting a fatalistic attitude towards climate change and its impacts should not be considered as a true strategy in this respect. Such attitudes are manifested by the fact that neither suppliers nor consumers alter their behaviour. This could also be described by using the term 'business as usual'. Another approach that can be classified under the heading of 'fatalism' is when tourist transport facilities that were used for winter sports are closed down and dismantled without any attempt at promoting and reinforcing other types of tourism – in other words, when withdrawal from ski tourism is not actively planned. A fatalistic attitude of this type is most readily evident amongst the operators of small, isolated ski-lifts at lower altitudes who experienced severe financial difficulties as a result of the snow-deficient winters (Bürki, Elsasser & Abegg, 2003).

Adaptation initiatives may include the production of technical snow, the protection and conservation of the snow coverage area, and the diversification of recreation activities offered during the whole year. The design and implementation of adaptation strategies have to be adequate to the level of vulnerability associated with each resort as well as minimize their potential socio-economic and environmental costs (Campos Rodrigues et al., 2018). Snow production can represent a valuable adaptation strategy at high-altitude destinations. However, given the increasing economic competition and the changing climate, it will be crucial to build on specific regional strengths to provide high-quality winter and summer tourism activities. Resource consumption and availability as well as snow cover and snowmaking potential are key issues when investing in snowmaking facilities (Rixen et al., 2011).

We see that winter tourism is highly dependent on the amount and reliability of snow cover which itself is exposed to climate change. It is possible to distinguish between two main categories of adaptation options: the first one aims to tackle the problem of exposure to climate stimuli (i.e. the problems of reduced number of days with snow cover) and the second one aims to tackle the problem of economic dependency (i.e. the problem of over-dependency on skiing as the major source of revenue for winter tourism sector). With regard to the first category, Abegg et al. (2007) have shown that four technological adaptation options have already been tried in Alps involving: landscaping to reduce the depth of snow that is needed for skiing, moving to higher altitudes and facing north where snow pack is likely to last longer, glacier skiing to bring forward the ski season and provide more certainty for snow availability, and technical snowmaking which is currently the most common adaptation option (Rixen et al., 2011). All these options are faced with financial constraints and have environmental implications. With regard to the second category, the adaptation option that is gaining currency is the diversification of winter tourism and the promotion of non-ski activities such as, hiking, tobogganing and snow shoeing which require less snow than skiing. Other tourist activities which require no snow (such as indoor sport, health and business tourism, event tourism) can also provide alternative adaptation options. However, although the latter activities are not dependent on snow, they are still dependent on the weather which due to climate change can become wetter and less attractive in these regions (Tranos & Davoudi, 2014).

Slovenian tourism strategy also recognizes the impact of climate change on tourist flows. Projections show that its impact will increase in the medium and long term. Reduced snowfall, increased frequency of drought, flooding of the sea, and heat waves are expected - all of these will have a tremendous impact on Slovenian tourism. The measures envisage the creation of a study of the consequences of climate change on Slovenian tourism, interpretation of the study with conclusions for individual leading destinations and larger companies, financial and advisory assistance to destinations and companies in the preparation and implementation of measures for adapting to climate change and educating and raising the competences and knowledge of key public institutions responsible for tourism at the national, regional and local level (MGRT, 2022). It can be seen from this measure that the funds will also be used to adapt the offer of winter tourism to climate change. It is necessary to make appropriate analyses of individual destinations, as technical snow in the short term can contribute to the extension of the winter season or the possibility of snow activities. However, in the long term it contributes to a larger carbon footprint and thus to climate change, which will have a negative impact on the development of winter tourism and snow activities.

Adaptation measures for tourists

Winter, and especially snow activities, are very popular among tourists in the mountain regions. Mountain areas represent sensitive ecosystems that must be respected by both the local population and tourists. Local community and tourists must respect the principles of sustainable management of the environment, as they contribute to the preservation of the natural environment. According to the recommendations on non-sports activities (Bausch & Gartner, 2020), in the winter months, when there is a lack of snow, it is possible to visit tourist attractions, museums, and events, and tourists can also use sports that do not require snow, such as hiking and cycling. Tourists will therefore adapt to climate change by changing the activities that they engage in on vacation, or by changing their location. Due to the lack of snow in the lower-lying ski centres, tourists and visitors can decide to visit the higher-altitude ski areas.

Adaptation measures for companies or organisations

The winter tourism industry can adapt by product diversification or by technical measures. The latter includes snowmaking that is already widely spread. Another technical measure is snow farming, where snow (natural or man-made) is deposited on a large pile and covered with insulation material. For low altitude ski centers, indoor ski slopes are a possible adaptation option. A potential for emission reduction related to adaptation of winter activities exists in the energy mix, i.e. the share of renewable energy. Snowmaking facilities for example can be adapted with energy being produced during the summer season. Solar energy is an example of good opportunity, as the efficiency is higher in high alpine terrain due to higher radiation and cooler temperatures. Improving the energy efficiency of buildings is another potential for emission reduction, especially for heating and cooling systems.

An important long-term strategy to better cope with climate change is to develop year-round tourism and snow-independent tourism products. Mountain destinations, which until now have been focused only on winter ski tourism, will have to adapt to climate change to a large extent if they want to do business successfully. This applies even more to lower-lying ski areas. First, they must focus on designing year-round tourism, three-way products and activities. It is therefore important to enable sports activities in nature even for the warmer part of the year, e.g. arranged hiking and cycling trails, organized sports activities courses, disc golf, archery and similar activities in nature. It is also necessary to prepare activities for non-sporting tourists, such as guided tours of attractions in the area, events, business tourism, cuisine, wellness and similar tourist products. Secondly, they must focus on offering the mentioned types of products also in the colder part of the year, when there is no snow or when rainy weather prevails, in order to attract tourists and fill accommodation capacities. It is necessary to strive to keep the guests at the destination for several days despite the "bad" weather, given the expected winter conditions.

Adaptation measures for municipalities and regions

The priority at the local level is to support autonomous growth, outside of the tourism sector, as well as diversification of alpine tourism, so that local communities can sustain livelihoods in the mountains. Municipalities should support local entrepreneurialism and improve competitiveness of small local enterprises in comparison to that of larger regional or national ones. They should also promote external experiences to generate fresh ideas at the local level (Hill, 2012). This could be in the form of inviting external researchers and professionals or organising excursions to destinations with similar issues. The task of municipalities is also to maintain social, economic and political autonomy to ensure that the population stays in mountain areas. An important part of adaptation is also research, education and training. Research and educational centres could ensure that visitors get all the information regarding behaviour on destinations. Also, this could be a place to connect locals and researchers with the task to develop well-adapted destination in a sustainable way. Municipalities could also financially assist in measures for natural hazard protection (Hill, 2012).

National adaptation measures

Organisations at the national level need to raise awareness of the issue of climate change and the steps to take in order to adapt to the increased risk. The national policy must support local initiatives with funding and advice. It should also enhance exchange of information, collaboration and communication. Also decentralised and participatory decision making is needed to recognise the specific mountain conditions. There could be increased research programmes to understand the climate change effects in mountain environments, with involving local stakeholders in finding adaptation possibilities. Also, there should be interaction between research, investment policy and local communities. In that way, research can respond to the needs of stakeholders. At the national level there should also be engagement in knowledge and experience exchange programmes with destinations abroad (Hill, 2012). Slovenia recognizes the need to adapt to climate change, and the Slovenian tourism development strategy also strives to strengthen the year-round operation of mountain (ski) centers, strengthen traditional annual outdoor activities in the off-season and transfer them to the winter time. However, detailed analyses of individual areas in relation to different climate change scenarios and the preparation of appropriate measures are necessary. The adaptation of providers and destinations to climate change will be greatly facilitated by the co-financing of projects by the state or European funds. It is therefore necessary to obtain funds and prepare appropriate tenders that will enable ski resorts to obtain funds for the diversification of the offer and to adapt with simultaneous improvement of the carbon footprint in the long term.

6 Climate change and summer outdoor tourism adaptation

Highlights

- Past trends of CIT for cultural & hiking, cycling, football and golf (1971–2020) show an increase of ideal conditions in all analysed destinations for shoulder seasons, and a decrease in August and partly also July in all macro regions except in Alpine Slovenia.
- Future projections show an increase in the average effective temperature in all analysed destinations, increase in the number of warm and hot days and a prolongation of the shoulder seasons for outdoor activities in all macro regions.
- Projections of precipitation show a decrease in the summer while other seasons do not show clear patterns, the uncertainty is high.
- The increase of temperature will probably not lead to outdoor summer tourists substituting Slovenia for other destinations, but more likely to intraday adaptation and higher altitude tourism.
- Prolongation of the seasons is likely to benefit Slovenian summer outdoor tourism, yet more competition is expected from other European destination for the same seasons.
- Higher maximum temperatures, together with indirect impacts such as increase of vector borne disease and rise of allergies, point to health considerations as highly important for future summer outdoor tourism adaptation.
- There are grave hazards for biodiversity as the most important resource of Slovenian outdoor tourism. Next to direct impacts of climate change (increase of wildfires, biodiversity decreases and changes in species distribution) tourism is likely to add to pressures with higher altitude tourism and maladaptive forms of tourism diversification.

Abstract

Our results show important future impacts of climate change for the summer and shoulder seasons of Slovenian tourism:

- increase in the average effective temperature in all macro regions;
- increase in the number of hot days in all macro regions;
- decrease of CIT ideal conditions for outdoor activities in August in all macro regions except in Alpine Slovenia;
- prolongation of the shoulder seasons for outdoor activities in all macro regions; and
- decrease of precipitation in the summer while other seasons do not show clear patterns, the level of confidence is low.

Additionally, we can expect other impacts important for outdoor tourism that were not directly analysed in this report, but based on previous research:

- increase of health risks due to vector disease and allergies;
- drought and need for water management, especially in the Mediterranean Slovenia,
- biodiversity loss;
- increase in forest fires and increased hazard of storms, floods and landslides;
- increase of temperatures in Northern Europe, higher competition for the summer season; and
- prolongation of shoulder seasons for neighbouring countries, higher competition for these seasons.

Most common forms of outdoor tourism adaptation are intraday adaptation, strategically and sustainably building prolonged seasons, and higher altitude tourism as adaptations to temperature increase and related health problems. Most concerning areas for summer outdoor tourism adaptation are on the other hand visitors' and tourism workers' health and biodiversity.

The trends show the increase of the percentage of days with ideal conditions for shoulder season activities and decrease for the summer, especially in the Mediterranean Slovenia, but also in other areas (for example Cerklje ob Krki). Future

research of behavioural aspects of Slovenian tourists is needed; however, we stipulate here that since productivity in general is lowest in the summer and since summer holiday scheduling can aid in decreasing the costs of air-conditioning, we do not expect a decrease of summer holidaying due to the lowering of ideal conditions in July and August, but rather a stagnation or even an increase. Additionally, Slovenian tourism can most likely expect site substitution from lower altitudes and urban areas to higher altitudes and rural areas with promises of natural shading and water-cooling effects. This effect is mostly expected for July and primarily August.

Next to increase of health hazards, the most important threat for future sustainable development of Slovenian summer outdoor tourism is un-checked prolongation of the summer season and increase of the summer visits in the high latitude and other nature areas. This would add to the pressure on carrying capacity of many Slovenian destinations. Appropriate measures of securing positive benefits of deseasonality, inclusing biodiversity protections are needed, especially in relation to hiking and cycling trails. Namely, climate change is projected to have important environmental change impacts that on the one hand affect tourism, while on the other hand can be exacerbated by unchecked outdoor tourism: biodiversity loss and species redistribution, and increase of wildfires.

Furthermore, without appropriate measures to prevent maladaptation, we can expect the increase of air conditioning and forms of tourism diversification that can hinder the mitigation efforts and mean additional pressure on natural resources and further inrease of greenhouse gases such as the increase of VR camping, specific forms of water-based activities (e.g. pools and wellness) and golf-courses under the business as usual scenarios. These potential threats should be directly addressed by strict regulation and appropriate climate mainstreaming of the overall investments in tourism private and public infrastructure.

On the other hand, an important and well-shaped direction of future support to outdoor tourism is development of cycling and hiking as forms of green mobility whereby the future focus should be on interconnecting the separate sections of cycling and hiking trails. Additionally, innovative approaches to summer tourism and recreation can be an important ally in climate change adaptation efforts, combining values of biodiversity protection, human health and wellbeing and climate change adaptation and mitigation. Such directions are well-managed and regulated forms of eco-tourism and recreation. As stressed by the latest 6th IPCC report, indirect opportunities emerge from the co-benefits of implementing adaptation actions that are well considered, such as nature-based-solutions and ecosystem-based adaptations that can make cities and settlements more liveable, increase the resilience of agriculture and protect biodiversity, attract tourists and create recreational space (IPCC, 2022, p. 1892).

The significance of summer outdoor tourism in the Slovenian tourism system

From the green colours of Slovenian national destination brand "I feel Slovenia" (2007), to slogan "Green, active, healthy" (official between 2013-2019), to Slovenian tourism vision in 2017: "Slovenia is a green boutique global destination for demanding visitors, looking for diverse and outdoor experiences, peace and personal benefits." (STO, 2017), we can see the primary importance of outdoor tourism and natural resources in national tourism value propositions.

The reasons for the importance of outdoor tourism in Slovenia are both natural (importance of natural resources) and cultural (historic importance of sports and outdoor activities for the development of Slovenian cultural identity and consequently also national destination image (Ruzzier & De Chernatony, 2013). Information from the Eurobarometer survey shows that Slovenians are amongst most active EU nations (in fourth place, see Figure 115) and that amongst those who exercise, play sport or engage in other physical activity in Slovenia the large majority does so "in a park, outdoors, etc.): 51 % compared to the EU average of 40 % (see Figures 109 and 110).

Both natural and cultural factors have brought about the importance of environmentalism in Slovenia – as reflected by the percentage of areas protected under the different regimes of the Natura 2000, the Ecologically important areas, Natural values, and Protected areas programmes (See Figure 111) and the generally high level of importance of nature for the general public[2].

[2] Slovenia was for example amongst the top countries in public opinion that the deterioration of nature is the single most serious problem facing the world as a whole (Eurobarometer, 2021b).

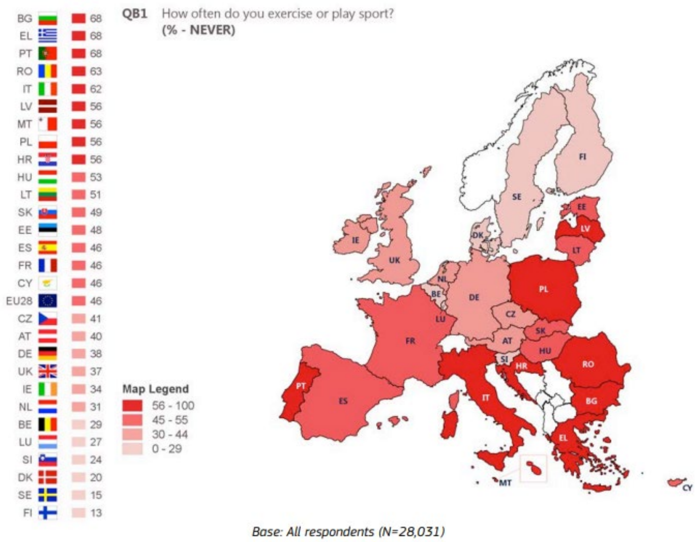

Figure 109: Percentage of Europeans answering that they never exercise or play any sport per country

Source: Eurobarometer (2017a, p. 8)

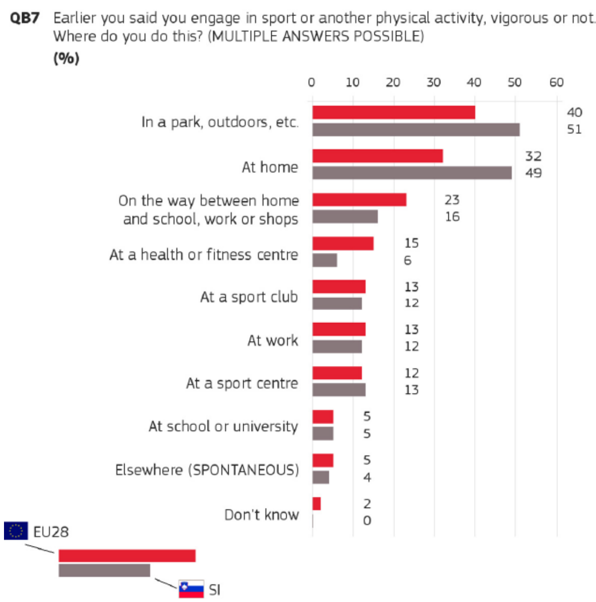

Figure 110: Location of physical activity amongst the respondents in Slovenia, base: respondents who exercise, play sport or engage in other physical activity

Source: Eurobarometer (2017b, p. 3)

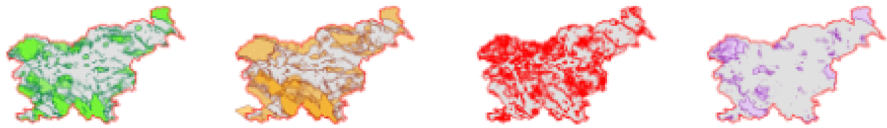

Figure 111: Natura 2000, Ecologically important areas, Natural values areas, and Protected areas of Slovenia
Source: ZRSVN (2021)

One of important weaknesses of Slovenian outdoor tourism is the lack of specific monitoring data since there is no official statistics that would monitor tourism activities beyond statistical data on accommodation (Lesjak et al., 2020), so the importance and target markets are gauged by other means. Lesjak et al. (2020) identified most important target markets for outdoor tourism based on workshops with outdoor tourism stakeholders and concluded that the most important outdoor tourism markets for Slovenia are Germany, Benelux, Austria, Slovenia and Italy.

This chapter covers the following leading (primary) tourism products as identified by the national Strategy for sustainable growth of tourism 2017-2021 (STO, 2017), with the focus on the summer and its shoulder seasons:

- holidays in the mountains and outdoors,
- experiences in nature,
- sports tourism (only non-water-based sports),
- countryside tourism,
- touring (for outdoor activities), and
- gastronomy (only covering outdoor activities such as vineyard tours).

Outdoor activities in nature have been identified as the first of the four leading products according to the new national tourism strategy (MGRT, 2022b). The types of activities included here follow the identification of most important summer outdoor activities within the new tourism strategy (STO, 2022):

- hiking,

- cycling,
- golf,
- horseback riding,
- climbing, and
- adrenalin experiences.

Amongst these activities by far most important summer outdoor ones are hiking and cycling, followed by adrenalin activities and airborne activities, followed by golf, horseback riding and caving (Lesjak et al., 2020). All of these activities are represented in all four of the tourism macro destinations of Slovenia whereby the difference is primarily in the level of physical strain of the activity, reflecting factors such altitude and infrastructure, thus characteristics of the destination, but also one's physical state (e.g. hiking in lower areas and mountaineering and climbing in higher areas, or urban cycling versus mountain cycling).

The outdoor experiences strategy made for the Outdoor Industry Association (Lesjak et al., 2020) identified the so-called Slovenian target group personas (Valicon, 2016) for outdoor tourism, amongst which the bellow include outdoor summer activities:

- adventurists: high-strain outdoor activities: adrenalin sports, mountain hiking/mountaineering, sightseeing of natural attractions, outdoor accommodation in glamping & recreational vehicles,
- devoted mothers: low-strain outdoor activities*:* experiencing nature with family, cycling, low-strain hiking,
- active families: low-strain outdoor activities*:* sports (rafting, hors-back riding), active cycling (bike touring), outdoor accommodation in camping,
- green explorers: low-strain activities in nature, sightseeing of natural attractions,
- active nostalgists: low strain mountain hiking, natural parks and attractions, local sports an culinary events,
- relaxed escapists, beauty and indulgence lovers, forever young: in all three cases combining spa & water-based tourism with low-strain activities such as observing nature, sightseeing of natural attractions, and low-strain hiking, and
- urban conscious: urban cycling (Lesjak et al., 2020).

An important factor for future development of outdoor activities in Slovenia is their positive interconnection with climate change mitigation. As forms of green mobility, the new tourism strategy (STO, 2022) proposes measures to further develop infrastructure and support especially cycling and e-cycling, whereby we can thus expect further development of this sector. Additionally, the new tourism strategy proposes to support the development of car-free destinations, promoting further both cycling and e-cycling but also hiking as the form of slow mobility.

Literature review: Climate change impacts on summer outdoor tourism

The literature review reveals that summer outdoor tourism is mostly effected by temperature change and increased precipitation, which might lead to indirect changes in tourism health and behaviour: intraday adaptation, potentially prolonged seasons, and higher altitude tourism as adaptations to temperature increase but also to environmental change impacts that indirectly affect summer outdoor tourism: increased health problems, increase of wildfires, biodiversity loss and species redistribution. In the next section we turn to present the results of previous relevant tourism research on each of these areas of impacts.

Prolonged season, intraday adaptation, and higher altitude tourism

Although extreme heat events are a serious issue projected for the future of tourism, there seems, however, to be relatively high tolerance of tourists to heat and even to heat waves (Dubois et al. 2016). Craig & Feng (2019) used past data of an USA study outdoor business company to analyse the impact of climate on past sales in six different climate areas. The results show that weather does impact sales, however, except in the case of one location where the temperatures were especially high, their findings show that the sales themselves did not show a decrease in travel. Only one location (i.e., urban Texas) exhibited a significant relationship with high maximum temperatures, and even in this case only for the tent sales category. The authors conclude that while visitors may indicate that they will not travel if it will be too hot, the past sales across the United States at the focal business locations show this was not the case.

The most commonly emphasized impact of climate change for tourism in the northern hemisphere is the positive effect on prolongation of the summer season for outdoor activities due to the increase of sunny days (Hewer & Gough, 2018;

Pröbstl-Haider et al., 2015). Liu (2022) analysed the impact of temperature on individual-level trips (n = 3 million) in U.S.A. public recreation areas. Their results showed a substantial, positive impact of higher temperature on outdoor recreation activities. They conclude that since outdoor recreational activities can relieve (climate related) stress and improve physical health, outdoor recreation can serve as a psychological stress mitigation strategy to combat climate change (conditional on a moderate temperature at the destination location). Similarly, several studies projected increase in financial benefits for outdoor tourism due to prolongation of the summer season. Based on results from a survey amongst visitors to recreational parks in the U.S.A. Richardson and Loomis (2005) projected up to 4.9% and 6.7% for two climate change scenarios (Richardson & Loomis, 2005). Chan and Whichman (2018) projected annual surplus gains of $894 million from climate-induced cycling by mid-century and calculations suggest climate-induced benefits of $20.7 billion per year (Chan and Whichman 2018).

On the other hand, according to Obradovich and Fowler (2017) the probability of monthly physical activity participation increases with temperature up to 28–29 °C but decreases after 36 °C, with a drastic decline after 40 °C (Obradovich & Fowler, 2017). Their findings suggested that increases in global temperatures induced by climate change could result in reductions of physical activity for summer months between June and August but an increase in physical activity during cooler months. Supporting the same conclusion, using data from 27 million bicycle trips in 16 North American cities, Chan and Wichmann (2020) showed that cycling decreases after 26 °C. However, the results also showed that the overall response to extreme heat is mitigated, in part, by intraday adaptation towards recreating during cooler times of day and that cyclists dislike cold temperatures much more than hot temperatures, suggesting potentially important gains for cycling from future warming scenarios (Chan & Wichman, 2020).

While the prolongation of the season might be a positive effect for tourism profitability, the studies that focus on hotel costs project the opposite: the increase of costs and thus decrease of profitability. By using a dataset of the monthly financial records of more than 1700 hotels in 50 U.S.A. states during 2016–2018, He et al. (2019) show that a deviation from 18 °C~20 °C in monthly averaged temperature leads to a decrease in the profit rate. The effect is triggered by fewer customers, less revenue, and higher cost per occupied room partially due to the increased usage of electricity and water. Such an effect can be lasting and is less impactful for higher chain scale hotels (He et al., 2019). A temperature average between 20 °C and 22 °C decreases the profit rate by 3.2%. Given the average profit rate of 174.1%, this indicates a reduction to 171.9%. However, with more extreme daily temperatures such as above 26 °C, the increase in temperature starts to lead to a larger decrease in profit rate. Taking into account the climate change projections these indicate that the profit rate in most climate zones in U.S.A. would decrease during the summertime as the temperature becomes higher. In the meantime, a warmer climate encourages tourism and increases profits during early spring (March to May) as well as in late autumn (September to November). In the winter, which is the off-season for tourism in most zones, the profit rate also slightly increases, although not as much as in the other seasons. However, for south of U.S.A. the increased profit during spring and autumn cannot compensate for the decline during hotter summers. The southern area turns out to lose the most customers because of its summer, while already scorching, would become even less thermally pleasant.

Destination analysts' report (2019 in Day et al. 2001, p. 14) shows that 50% of American leisure travellers expect climate change will impact their travels at some point in the next 5 years, 28.5% of travellers expect climate change will affect the timing of trips, 20,9% claim they will change the destinations they choose, and 15,2% that they will adjust how they travel. Perry et al. (2018) interviewed visitors of recreational parks in U.S.A. with regards to increase in daytime temperature, increase in night-time temperature, increase in number of hot days, increase in rainy days and increase in number of biting insects. Their results show that the participants claim that most of the climate-related changes included in the study will: 1) decrease the amount of park use; 2) shift substantial amounts of use to more northerly parks and parks at higher elevations, and shift use to earlier and later in the conventional state park season; and 3) shift participation among the 10 recreation activities included in the study (Perry, Manning, Xiao, & Valliere, 2018).

Finally, next to changes in recreation in cooler parts of the day as a form of adaptation to higher temperatures (Chan & Wichman, 2020) an important potential result of increasing temperature is the increase of outdoor recreation in higher altitudes. Askew and Boker (2018) analysed climate scenarios for outdoor activities in the U.S.A. recreational parks whereby they found substantial variance with regards to park location. While hiking was projected to decrease in lower altitudes due to both increasing summer temperatures and increasing precipitation it is projected to increase in higher altitudes (Askew & Bowker, 2018). Another research of climate change impacts for outdoor recreation parks in the U.S.A. advised parks to develop more water-based recreation opportunities, extend park operations to earlier in the spring and later in the fall and place more emphasis on northern and high-elevation parks (Perry et al., 2018).

Similarly, for Austria Pröbstl-Haider et al. (2021) argue that in the alpine environment the temperature is not critical in hiking and walking activities because it depends heavily on the altitude, exposure and the shadows cast by mountains. In the last decades, they continue, the number of days and hours with sunshine in the Alps has increased and led to a measurable increase of overnight stays, occurring mainly in the fall. A separate evaluation of destinations at an average altitude of 1000 m and above, focusing on mountain and alpine tourism, shows an increase in overnight stays which exceeds the general trend in summer (Fleischhacker, 2019 in Pröbstl-Haider et al. 2021, p. 4).

Extreme heat and other health related problems

Amongst the most serious impacts of climate change on outdoor tourism is the increase in extreme temperature, having direct effect on human health. Considerable health problems can arise from increased heat: circulatory collapses, dehydrations, and exertional hyperthermia and this particularly applies to summer activities for tourists (Pröbstl-Haider et al., 2021).

Next to direct heat effects for human health, heatwaves affect human health also by decreased physical activity and can have also other indirect effects: sleep disturbance, increased criminal activity, and decreased labour productivity (EASAC, 2019), all of which potentially affect also tourism.

Heatwaves in Slovenia will increase in their number, strength and duration (ReDPS50, 2021). Heat waves and cold spells are associated with increases in premature mortality and morbidity, especially in vulnerable groups, such as the elderly (R. Fink, Eržen, & Medved, 2017). 'Usual' heatwaves affect those who are already vulnerable (the elderly, infants and young children, those with pre-existing health problems and those in hospitals, nursing homes or who are bedridden), whereas extreme, prolonged heatwaves will also affect those who were relatively healthy (EASAC, 2019). Table 2 shows mortality per one million people attributed to extreme weather events in Europe for 1991–2015 whereby we see that heatwaves are by far the most dangerous extreme weather event, affecting primarily Southern and Western Europe.

Table 2: Mortality per one million people attributed to extreme weather events in Europe for 1991-2015 (including Balkan States in the Southern region)

Region of Europe	Heatwave	Cold	Flooding and landslides	Storm	Wildfire
Eastern	11,4	28,3	8,6	1,7	0,54
Northern	11,2	1,7	1,0	2,5	0,01
Southern	178	0,9	6,8	1,2	0,97
Western	192	0,9	2,1	2,8	0,04

Source: EASAC (2019, p. 14)

However, another study showed that despite increasing heat load in Slovenia, there was no statistically significant association between heat waves and the number of deaths in the last observed years 2017 and 2018. The results may indirectly indicate that Slovenia may be on the right track with public health efforts to raise awareness among Slovenes about the danger of heatwaves (Percic et al., 2020) and taking appropriate measures such as staying indoors, improving air-conditioning and intra-day adaptation.

Furthermore, the effects of heatwaves on labour productivity loss need to be taken seriously. Although there is lack of research in this field for tourism, Pogačar et al. (2019) analysed the heat stress of tour guides compared to outdoor workers from manufacturing and agriculture in Slovenia. Within the overall sample of outdoor workers (n = 687 overall out of which 57 tour guides), symptoms of heat stress were perceived by the great majority, especially milder symptoms such as thirst (79%), excessive sweating (79%) and tiredness (65%), and in a smaller proportion enhanced stress (27%), dizziness (24%) and confusion (13%). Only 2% of all workers stated that they had not perceived any kind of heat stress symptoms. 17% of 57 included tour guides described their working abilities during heat waves to be reduced by more than 30%. Most worrisome, the second sample (n = 117 overall out of which 19 tour guides) showed being informed about heat stress impacts and measures to reduce heat stress was the lowest amongst tour guides: only 26%, compared to 41% among farmers and 77% factory workers, which the authors ascribe to the fact that both farmers and tour guides work as self-employed.

Climate change has important consequences for air quality, whereby we see a more complex picture for Slovenia than a simple negative trend. On the negative side, the increase of hot days and tropical nights reinforce the negative health effects of ozone and air pollution (Brasseur, 2009 in (Pröbstl-Haider et al., 2021), p.4). However, climate change and especially climate change mitigation efforts bring important positive consequences for air quality in Slovenia. In the past, the main issue for air quality in Slovenia was SO2 pollution, but after the introduction of ultra-low sulphur fuels and the installation of desulfurization devices in the Slovenian thermal power plants, the concentrations deceased drastically. Currently, the main issues are PM10 and ozone. Slovenia is one of the EU countries with the largest emissions of PM10 per capita and per surface area (Gjerek et al., 2016 in Pucer and Štrumbelj 2018, p. 399). However, Pucer and Štrumbelj (2018) report that air pollution in Slovenia is decreasing which is a result of both lower emissions and also meteorological changes. Slovenia is a small country but encompasses very different landscapes and climates. Southwest Slovenia has submediterranean climate which increases the chance of high ozone levels in summer. On the other hand, most central Slovenian cities are located in valleys and basins that are prone to temperature inversions and low wind conditions in winter that worsen air pollution. The projected increased temperatures have, however, started to reverse these trends and could have affected the decrease in PM10 levels in the past decade and are projected to continue to do so in the future. Additionally, the trends of meteorological parameters showed a significant increase in the amount of precipitation and wind speed at some locations which are known to lower pollutant concentrations. Finally, all monitoring locations (where the 16-year trend was observed) experienced a significant increase in temperature and as the major source of PM10 at most locations is wood burning in stoves for domestic heating, so the increase in temperature should have affected PM10 levels (Pucer & Štrumbelj, 2018).

Another important health-related climate hazard for outdoor tourism is the threat of more biting insects and pest species – changes which are perceived as highly negative by outdoor tourism (Perry et al., 2018). With increasing temperatures there is the increasing risks of some vector-borne diseases for both humans and animals, partly because of shifts in geographical distribution: warmer temperatures enable vectors both to spread to new locations and to survive the colder seasons, for example the West Nile virus, chikungunya virus, dengue virus, associated with mosquito species migrations and some bird species migrations (EASAC, 2019).

Especially tick-borne diseases have received important worrisome focus after the European epidemic starting in the late 1990s. Increased winter activity of some tick species is probably due to warmer winters and hotter summers that are projected to change the dynamics and pattern of seasonal activity, resulting in the bulk of the tick population becoming active in the latter part of the year and more northern permanent populations (Gray, Dautel, Estrada-Peña, Kahl, & Lindgren, 2009). However, as (Randolph, 2010) shows, the past disease outbreaks in Europe could not be directly related to climate change but rather a complex combination of trends in Europe in 1990s: agricultural reforms resulting in changed land cover and land use, and an increased reliance on subsistence farming; reduction in the use of pesticides, and also in the emission of atmospheric pollution as industries collapsed; increased unemployment and poverty, but also wealth and leisure time in other sectors of the population, as market forces took hold. All of these could have brought people into closer contact with infected ticks, with or without any change in the abundance of ticks. It is thus changes in socio-economic trends and human behaviour that showed to be more influential than increased temperatures. The tick-borne disease epidemic, however, did have important consequences in outdoor behaviour. Randolph (2010) reports that there was evidence from a survey in Latvia that many people, except those under the greatest economic constraints, reduced their visits to forests following the peak of TBE incidence in the late 1990s. Šumilo et al. (2008) reported of increased vaccination rates in Slovenia and the Baltics after the surge in the 1990s.

Another recent issue was the increase of the oak processionary moth caterpillars in the summer of 2019 across Europe resulting in pseudo-allergic reactions referred to as lepidopterism (Jia, Wang, Van Vliet, Skidmore, & van Aalst, 2020). In Slovenia both oak and pine processing moth caterpillars are a potential public health issues (NIJZS, 2016). In a study at the outskirts of Vienna the researchers conducted a telephone survey of all the households/institutions located within 500 m of the infested trees: of 1025 people surveyed 57 (5,6%) reported one or more symptoms of lepidopterism, leading to the conclusions that Lepidopterism caused by T. processionea is a public health problem of increasing significance. In years with outbreaks of the pest it can reach epidemic proportions in communities located near infested trees. Contact with airborne setae was mainly responsible for the occurrence of the disease (Maier et al., 2003). The recent spread of the oak processionary moth caterpillars is arguably not so much an expansion caused by climate change but rather a recolonisation of historically infested areas (Groenen & Meurisse, 2012). However, Jia et al. (2020) warn that such outbreaks are no coincidence: it may be just a beginning of more tree-related issues in warmer cities as a consequence of public policy favouring that cities are 'greened up' in order to reduce the impact of heat stress.

Finally, an important health issue for outdoor tourism projected to acerbate with climate change is the rise of allergies. According to the EASAC (2019) report the prevalence of allergic respiratory and skin diseases within the general population in Europe has been estimated at 40% and has increased dramatically over the past decades. This includes allergic rhinoconjunctivitis (pollen allergies) and asthma (although not all asthma is allergic). Climate change has been suggested as one factor accounting for the increasing prevalence of allergic disease. However, the influence of climate change and increased CO_2 is complex in affecting the range of allergic species as well as the timing and length of the pollen season and pollen productivity, also affecting the release and atmospheric distribution of pollen. It is not only the classical climate variables that influence the pollen season. In several experiments that included the most allergenic pollen taxa such as ragweed and grass, it was demonstrated that increasing CO_2 concentrations stimulate plant growth and increase pollen production.

Amongst the pollen allergies one of the most common causes is ragweed – it is estimated that sensitization to ragweed will more than double in Europe, from 33 to 77 million people, by 2041–2060 (Lake et al., 2017). Higher pollen concentrations and a longer pollen season may also increase the severity of symptoms. As seen from Figures 112 and 113, sensitization is projected to increase in countries with an existing ragweed problem (including eastern Slovenia), but the greatest proportional increases are projected to occur where sensitization is uncommon (e.g., Germany, Poland, France) (Lake et al., 2017). For Slovenian outdoor tourism this might have two important consequences. First is the increased sensitization locally, and the second is the indirect consequence of increased sensitization of its primary target markets: with tourists become more sensitive back home they are likely to pay more attention to the problem while planning for travel and thus potentially avoiding Slovenian outdoors especially from August to September (Figure 112).

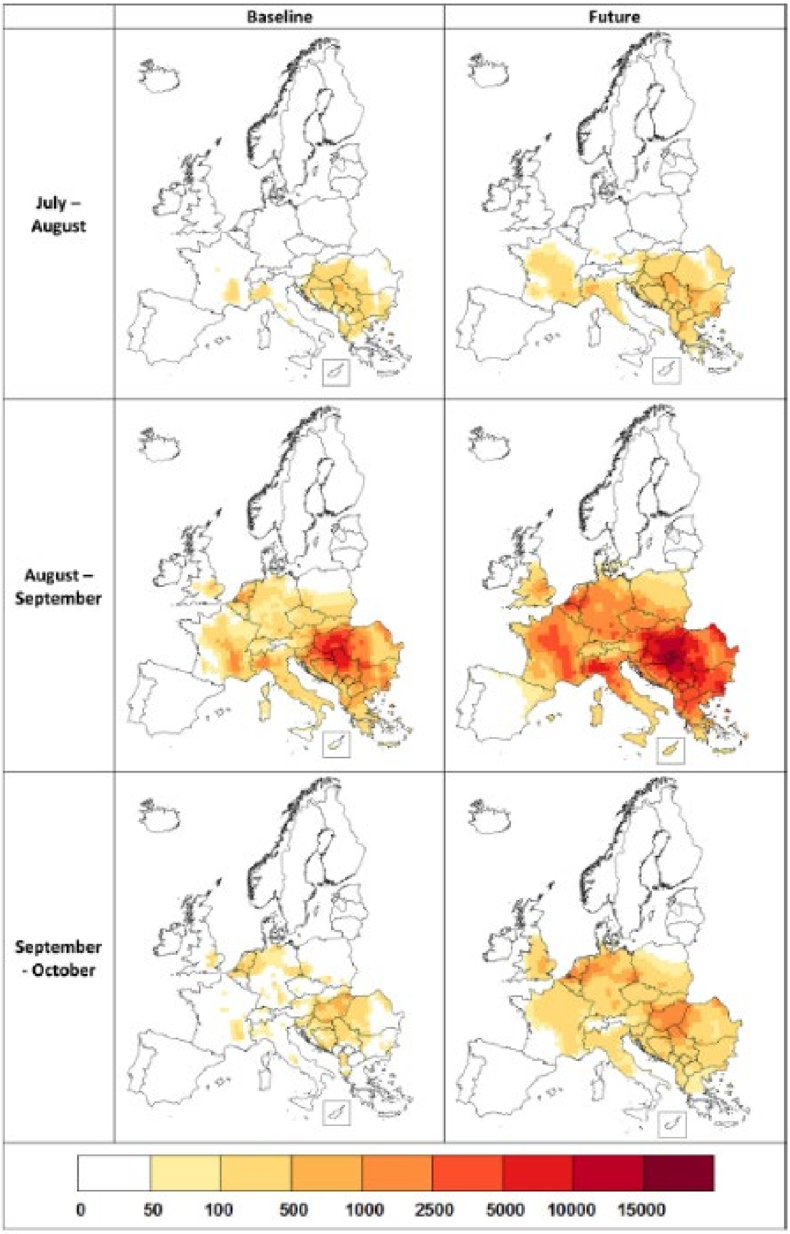

Figure 112: Monthly current (baseline) and future (2041–2060) ragweed pollen counts (grains per cubic meter) across Europe. Data are the average of the CHIMERE and WRF/RegCM model suites for RCP4.5 and a reference plant invasion scenario. © EuroGeographics for the administrative boundaries.

Source: Lake et al. (2017, p. 389) Reproduced from Environmental Health Perspectives with permission from the authors

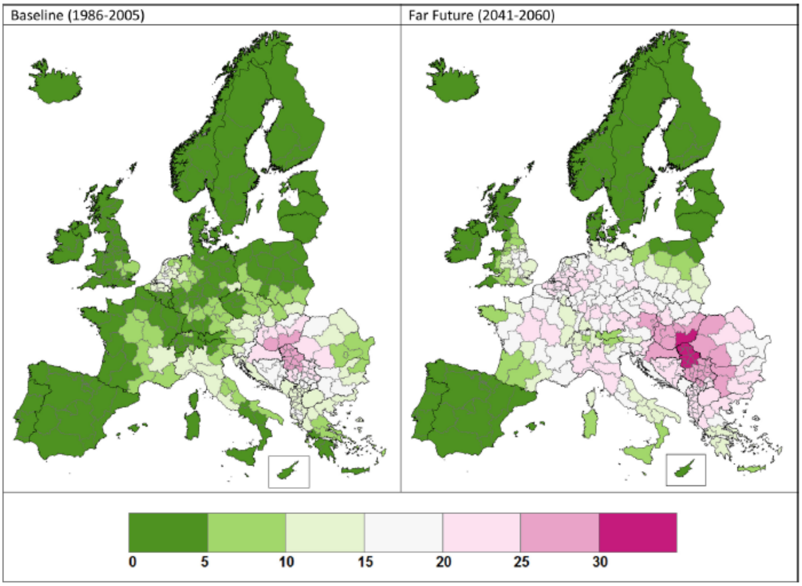

Figure 113: Percentage of population sensitized to ragweed pollen at baseline and in the far future; averaged results for WRF/RegCM and CHIMERE, RCP4.5, and reference invasion scenario. © EuroGeographics for the administrative boundaries

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Increase of wildfires, biodiversity decrease and species redistribution

Slovenian forests are the prime natural resource affecting the outdoor tourism in Slovenia. However, Slovenian nature areas face three interrelated threats because of climate change: increased risks of wildfires, increased risk of pests, and disease and species redistribution.

Slovenia is 58% covered by forests. Most of the forests are in private ownership (79,7%), with the state still owning a large proportion (20,3%, down from 33,9% in 1996 primarily due to the denationalisation processes). The private ownership is characterised by dispersed, small scale ownership which has important consequences for forest management, for example the building of forest paths and infrastructure is difficult since 75% of land owners need to sign that they agree which in some cases is a very large number due to the dispersed ownership (ZGS, 2022).

In Europe, the number of days with high-to-extreme wildfire danger is expected to increase with the changing climate, especially Central and Southern Europe being the most affected (Costa et al. 2020, Figure 114).

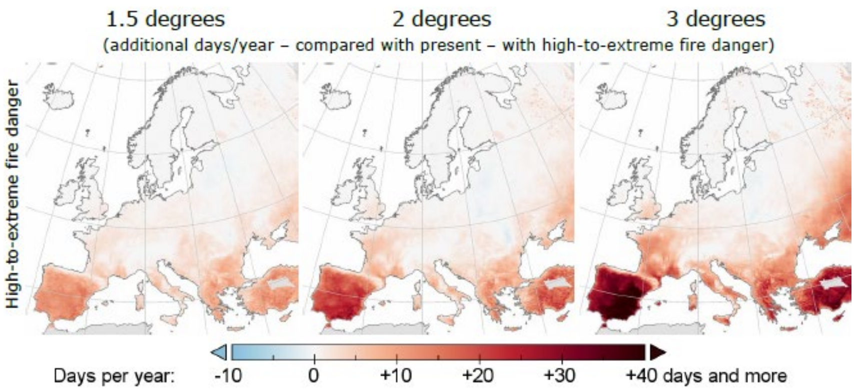


Figure 114: Number of days per year with high-to-extreme fire danger

Source: Costa et al. (2020, p. 4)

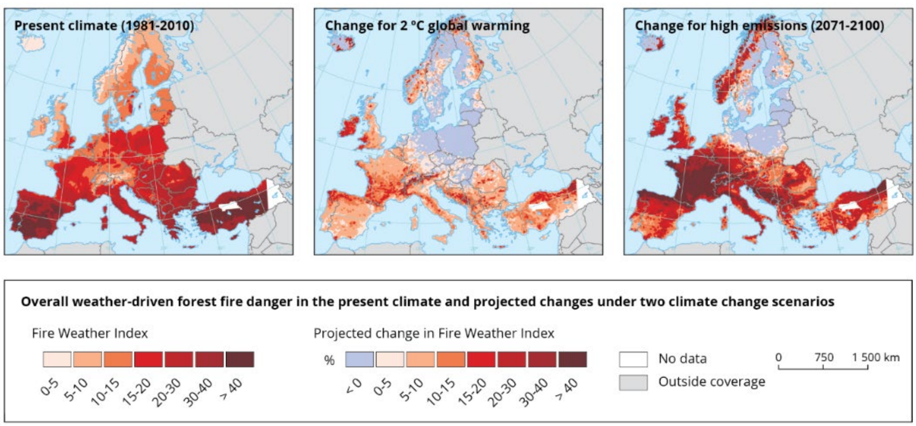
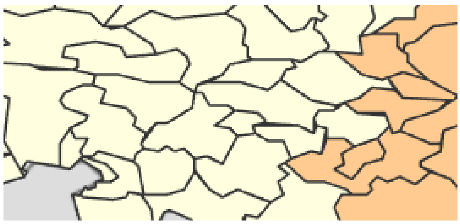


Figure 115: Canadian Fire Weather Index (FWI) for present climate and projected climate under two climate scenarios for Europe

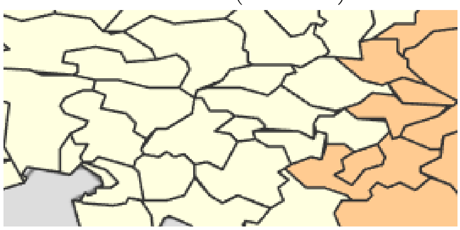
Source: EEA (2017)

As we write this analysis, the devastating European heat wave of July 2022 brought the largest wildfire in the history of independent Slovenia (Šestan, 2022). According to the past data of the National Forest Service, the past 20 years have not seen a strong trend of increasing fires (Jakša, 2021) (note though that the largest fire of 2022 is not yet included in the analysis). However, the projections show this to change. The Canadian Fire Weather Index (FWI) is used to assess fire risk based on meteorological conditions. Projections show an increased risk especially for Southern and Eastern Europe (De Rigo, Libertà, Durrant, Vivancos, & San-Miguel-Ayanz, 2017), with Slovenia facing a potential 20 to 40% increase in forest fires by 2100 under the worst case, daily high-emission scenario (RP8.5) and 5 to 15% increase under the 2 °C global warming scenario (see Figure 116). The most at risks regions of Slovenia are Obalno-Kraška, Posavska, Podravska and Pomurska.

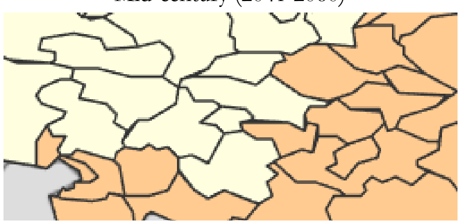
Moderately ambitious mitigation policies (RCP4.5)



Near Future (2021-2040)

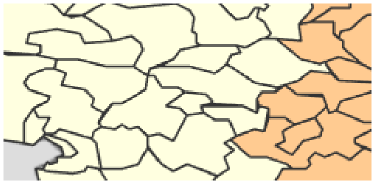


Mid-century (2041-2060)

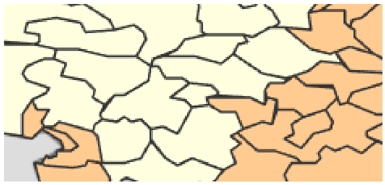


End of century (2079-2098)

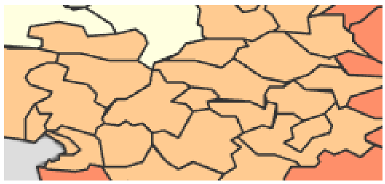
Unambitious mitigation policies (RCP8.5)



Near Future (2021-2040)



Mid-century (2041-2060)



End of century (2079-2098)

Figure 116: Fire weather index: average danger over fire season (June – Sep) projections for regions in Slovenia (colours range from low to moderate to high)
Source: Copernicus (2022b)

According to Costa et al. (Costa, de Rigo, Durrant, & San-Miguel-Ayanz, 2020) climate change is expected to exert a direct influence on the structure and composition of terrestrial ecosystems. This may affect wildland vegetation and negative effects not only on the vegetation before a fire occurs; but also, after the fire, diminishing its resilience and thus limiting the vegetation recovery (post-fire recovery). In addition, vulnerability to fires may worsen further because of declining ecosystem resilience, which may hamper the regrowth of existing species and lead to unwanted ecosystem transitions.

An important consequence of wildfires are their effects on human health. According to Kollanus et al. (2017) in the 27 countries overall, an estimated 1,483 and 1,080 premature deaths were attributable to the vegetation fire–originated fine particles in 2005 and 2008, respectively. Estimated impacts were highest in Southern and Eastern Europe. Moreover, because fires often coincide with heat waves, interaction between air pollution and heat exposure can considerably increase impacts on cardiovascular and respiratory health (Kollanus et al., 2017).

There are limited analyses of the impact of wildfires on the tourism sector. In the short term, tourism is directly affected by conditions caused by wildfires, such as air pollution, evacuations, road access, and accommodation availability (Hystad & Keller, 2008). In the medium term, wildfires affect behaviour of tourists and the destination image (Boustras & Boukas, 2013). Hystad and Keller (2008) report that the mean impact length of a large wildfire in Canada reported by tourism businesses was 6 months following the end of the fire, with the food and beverage sector recovering the fastest (approximately 3 months), followed by the accommodation sector (approximately 5 months), and the entertainment- related sector (approximately 10 months), generally affecting small and medium enterprises more than large enterprises.

After the large 2017 forest fires in Portugal, Estevão et al. (2020) analysed the burned area in each council, the influence on tourist numbers in the region during and after the natural disaster as well as any losses in regional competitiveness. In general terms, the 2017 forest fires would not seem to have negatively impacted on the tourism competitiveness indicators in 2018, showing that there were no negative impacts registered on the number of tourism visits (Estevão, Costa, Nunes, & Peraboa, 2020). However, considering a more detailed level of analysis and a longer temporal frame (2000–2016) in Portugal, Otrachshenko and Nunes (2022) find a considerable negative impact of burned areas on the number of tourist arrivals, both domestic and inbound. Additionally, they included climate projections for 2030 and 2050. The estimated annual costs to the Portuguese economy due to the impact of burned areas in 2030 range between €17.03 and €24.18 million for domestic tourist arrivals and between €18.26 and €38.08 million for inbound. In 2050, they project, those costs will increase at least fourfold (Otrachshenko & Nunes, 2022).

Tourism management responses to wildfires are generally limited to securing the safety of tourists at the time of crisis and repairing the destination image after wildfire crises (Boustras & Boukas, 2013) and planning wildfire strategies at the organisational level (Hystad and Keller 2008). Climate change projections are used for warnings regarding the need for such assessment in future tourism investments (Otrachshenko & Nunes, 2022). Broader perspectives, however, point out to the need for interconnection of tourism and forest management, such as biotechnical protection measures (representation of mixed forests, combustible material that is less susceptible to fire, construction of fire protection rail tracks, construction of observation points and organisation of forest monitoring system, creation and implementation of a fire occurrence assessment system) and safe tourism activities (areas designed for fire making are properly marked and their safety is ensured, barrels with sand for extinguishing smaller fires in the initial phase are provided, forest fire danger signs are properly placed) (Ratknić & Braunović, 2015). Broader still, the role of tourism in prevention of wildfires is in its relationship to biodiversity, the topic to which we turn in the next section.

Slovenian forests' biodiversity is projected to be hit hard by the climate change. Over the last two decades, we have observed a decline in Norway spruce growing stock, with the highest rate of decrease in areas below 500 m a.s.l., and an increasing trend for European beech. Together with temperature increase (with an average annual rate of about 0.4 °C per decade), the Slovenian forests have witnessed important disturbances, such as the ice storm in 2014, followed by bark beetle outbreaks. Overall, the three dominant species (beech, spruce, silver fir), which together account for more than 70% of the total growing stock, have shown a declining trend over the last 20 years. The patterns observed are broadly consistent with earlier projections developed for different climate change scenarios and with those reported in many other European countries (Kutnar, Kermavnar, & Pintar, 2021). While the understory vegetation across Slovenian Forest showed that between 2005 and 2015, there has been substantial species turnover and a decrease in diversity across the network of sites and that the most frequent or common species largely increased in cover over time, which may have led to loss of more rare or infrequent species (Kutnar, Nagel, & Kermavnar, 2019). The future of silver fir and Norway spruce in Slovenia appears to be uncertain (Kutnar et al., 2021).

Climate change and biodiversity are tightly interconnected – worsening of one fuel the downward spiral of the other and vice versa. Climate change is projected to affect both the biodiversity decrease and biodiversity redistribution. For marine, freshwater, and terrestrial species alike, the first response to changing climate is often a shift in location, to stay within preferred environmental conditions, thus poleward and/or to cooler higher elevations for species on land. Production of natural resources required for food security, patterns of disease transmission, and processes of carbon sequestration are all altered by changes in species distribution (Pecl et al., 2017).

For forest-based tourism, the most important indirect effects of climate change on forests next to increased wildfires are changes in forest composition, tree species and fall colours and invasive species (Day et al., 2021). Biodiversity is an important resource for tourism development since it reflects the abundance and quality of natural resources. Climate change is projected to impact specific tourism activities depending on biodiversity; for instance, if climate change reduces the likelihood of seeing a particular bird species, as is predicted for Indiana U.S.A. that demand will likely reduce, both for general tourists and avid birdwatchers (Day et al., 2021). The assessment for protected areas is that each 1% increase in biodiversity is associated with a 0,87% increase in tourism (Chung, Dietz, & Liu, 2018). A long-term analysis of impacts of climate change gas emissions and air pollution showed that these have had a combined negative impact on tourism development and the authors claim this is primarily due to deforestation and natural resource depletion resulting in reduced investments, less resources and minor importance from the government agencies (Sajjad, Noreen, & Zaman, 2014).

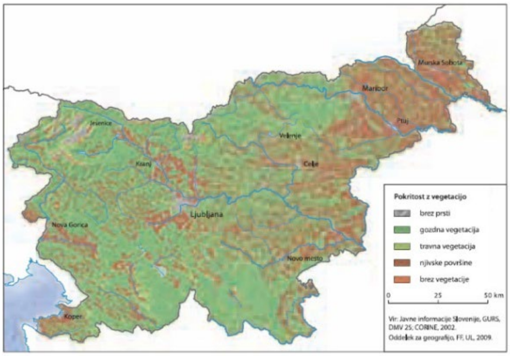
However, according to Pröbstl-Haider et al. (2021) there is no solid evidence that gradual and less visible impacts on biodiversity, such as phenological shifts, changes in bird migration or the significant decline of individual plant species – if these were attributable to climate change – would lead to measurable changes in tourism behaviour. The possible explanation is that this is probably due to the fact that guests cannot usually compare conditions to the situation before the impact of climate change, and therefore experience them as a unique event. On the other hand, if the change is more of a clearly visible nature, such as the increasing cases of the bark beetle infestations, these do very negatively affect visitors' landscape experience and intention to visit (Schneider, Arnberger, Cottrell, & Von Ruschkowski, 2019).

The relationship between biodiversity, climate change and tourism should take into account also the impacts of tourism on biodiversity. The role of tourism in protecting biodiversity has historically been a double-edged sword. On the one hand, it has been a strong force behind the protectionist movements, aiding in the historical process of securing protected areas of nature parks and reserves. Tourism, particularly small-scale and locally owned ecotourism ventures, is identified as a tool to enhance the livelihoods of people around protected areas (Nyaupane & Poudel, 2011). On the other hand, and with much greater impact, tourism is a significant contributor to all five principal pressures directly driving biodiversity loss – habitat change, overexploitation, pollution, invasive alien species and climate change (Hall, 2010). Tourism and outdoor recreation have long been analysed for their role on biodiversity decrease, such as the damaging effects of roads and human trampling to tree roots, soil compaction and soil erosion, effects of tourism infrastructure and transport on habitation and wildlife and air quality (Cigale, 2004; Cigale et al., 2010; Martin, Hodge, & Whitesides, 2022).

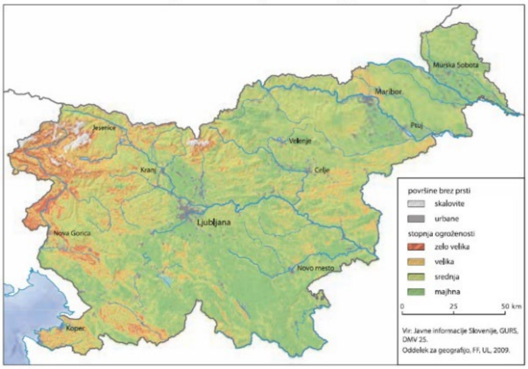
The EU forest strategy for 2030 (EU, 2021) calls to protect, restore and enlarge the EU's forests to combat climate change, reverse biodiversity loss and ensure resilient and multifunctional forest ecosystems. Amongst the measures proposed is improving the size and biodiversity of forests, including by planting 3 billion new trees by 2030, promoting alternative forest industries, such as ecotourism, as well as non-wood products, such as cork, honey and medicinal plants, and protecting the EU's remaining primary and old-growth forests. "The growing trend of nature tourism and nature-based wellbeing services, provided it respects the carrying capacity of the environment and the relevant legislation, are an opportunity to accelerate the green transition of the tourism sector and provide significant income opportunities in rural areas and improve rural welfare, while further promoting biodiversity conservation and the preservation of carbon stocks." (EU 2021, p. 9). However, the empirical evidence shows that even ecotourism, as it is typically practiced, leads to deforestation. Ecotourism also sometimes leads to forest regeneration in agrarian landscapes, but negative trade-offs, for example old-growth deforestation or water pollution, may occur. Only when accompanied by strict conservation mechanisms (e.g. protected area, payment for ecosystem services, monitoring/enforcement), ecotourism can protect forests (Brandt & Buckley, 2018).

Figure 117 shows the vegetation cover in Slovenia and potential soil erosion risk due to hiking trails, whereby we see that especially the Alpine space is under potentially high risk of soil erosion as the negative influence of recreation on marked and especially unmarked trails.

If climate change brings an extension of tourism seasons and movement of tourists to higher altitudes in order to escape heat, then the relationship between biodiversity, climate change and tourism in Slovenia is in risk of becoming one in which the effects of tourism on biodiversity are importantly aggravated – tourism thus not becoming the solution to the issue of protecting forests against climate change as hoped by the EU forest strategy for 2030 (European Commission 2021) but rather its additional negative effect.



Vegetation cover



Potential soil erosion risk due to erosion of hiking trails

Figure 117: Vegetation cover and hiking trails soil erosion risk

Source: Repe & Mrak (2018, p. 157 and 161)

Complex picture of precipitation

While there seems to be relatively high tolerance of tourists to heat and even heat waves the rainy conditions appear to have clearly negative effects for outdoor activities (Dubois, Ceron, Gössling, & Hall, 2016; Liu, Yu, & Hsieh, 2021). For Slovenia, the indications seem to be that although summers are generally drier, the number and intensity of storms will increase. Although seemingly counterintuitive, hotter and drier summers also bring more rain in the form of worse storms. The frequency and intensity of extreme rainfall events is connected to hotter summers, as warmer air holds more moisture, adding energy to storms.

According to ARSO in the national *Resolution on long-term climate change strategy for 2050* (ReDPS50, 2021) the past measurements show a decrease in annual precipitation, however, all scenario models show that the trend will reverse in the next decades since winters will become wetter. For all emission scenarios, average annual precipitation will increase by up to 20% at the end of the century compared to 1981–2010. This increase will mostly be the result of an increase in winter precipitation, which will be greater in the east of the country. The RCP8.5 scenario predicts an increase of winter precipitation by up to 40% at the national level and by up to 60% in the eastern Slovenia, but projections for precipitations are highly uncertain (ReDPS50, 2021).

While winters will be wetter, ARSO projects that within other seasons changes will be within the limits of natural rainfall variability. However, the change will be in the extreme precipitation since both the intensity and frequency of extreme precipitation will increase, with the increase being most pronounced under the RCP8.5 emissions scenario (ReDPS50, 2021). To this increase in the strength and number of occurrences of exceptional precipitation, it is necessary to add the increase in temperature, which means that there will be less precipitation in the form of snowfall, thereby reducing water retention in the cold part of the year. In terms of number of storms, Slovenia is one of the top countries of Europe. Each year there are several severe storms which cause major damage, mostly from hail, strong gusts of wind and downpours. Strong short-lived downpours or abundant several-day rainfall can cause flooding, since the predominantly torrential character of watercourses means they rise very quickly. Saturation of the terrain can trigger landslides, already an important problem for Slovenia (ARSO, 2022; ReDPS50, 2021) (Auflič et al., 2021).

For tourism the issue of extreme precipitation is not only in tourists avoiding rainy days but especially in the problem of guaranteeing tourists' safety with the increase of the extreme weather events. However, even though safety is one of highly important factors for outdoor tourism (e.g. (Cheng, Chen, Hong, & Chen, 2022; Perić, Đurkin, & Vitezić, 2018; Smith & Espiner, 2007), the research on climate and safety of outdoor tourism is very sparce and focuses mostly on the perceptions and behavior of tourists and much less on the role of organizations and destinations (Jeuring & Becken, 2011, 2013).

Presentation and interpretation of results for summer outdoor tourism

The following variables are presented for each location based on their relevance to tourism activities:

Data analysed for each destination:

- ARSO past trends for average effective temperature (1971–2020)
- ARSO past trends for CIT specific activities: cultural & hiking, cycling, football, golf (1971–2020)
- ARSO projections for number of hot days (Tmax ≥ 30 °C) per month (RCP 2.6; RCP 4.5; RCP 8.5) (1981–2100)
- ARSO projections for number of warm days (Tmax ≥ 25 °C) per month (RCP 2.6; RCP 4.5; RCP 8.5) (1981–2100)
- ARSO projections for number of days with at least 1 mm of precipitation per month (RCP 2.6; RCP 4.5; RCP 8.5) (1981–2100)
- ARSO projections for number of days with at least 20 mm of precipitation per month (RCP 2.6; RCP 4.5; RCP 8.5) (1981–2100)

Figure 118: Outdoor tourism promotion of the four Slovenian macro destinations

Source: STO (2021a, p. 9)

Promotion of Slovenian tourism followed the strategic division of Slovenia into four macro destinations, reflecting to some extent also the climate diversities of Slovenia (see Figure 118). The four macro destinations all share hiking and cycling as the prime promoted outdoor tourism activities, while at the same time differ in other specific activities, as seen from the promotion of outdoor tourism for the four macro destinations (Figure 118).

The selection of weather stations for data analysis followed the dispersal of two different locations per macro destination along with representation of different altitude levels. The selected weather stations are per macro destination are (presented according to altitude):

Mediterranean Slovenia:

- Portorož, altitude 2 m
- Bilje, altitude 55 m

Thermal Pannonian Slovenia:

- Murska Sobota, altitude 187
- Cerklje ob Krki, altitude 157

Ljubljana & Central Slovenia

- Ljubljana, altitude 299 m
- Kočevje, altitude 467 m

Alpine Slovenia:

- Šmartno pri Slovenj Gradcu, altitude 445 m
- Rateče, altitude 863 m

Mediterranean Slovenia: Portorož and Bilje

Portorož (altitude 2 m) is a coastal destination, primarily focused on 3S tourism (see Chapter 3). However, other non-water based outdoor activities such as walking, and cycling are increasingly supported throughout the coastal Slovenia via gradual improvement of the infrastructure (e.g. Parenzana Trail). Additionally, international sport events are one of the main directions of the local tourism strategy (Lesjak, Brezovec, & Fabjan, 2018).

Bilje (altitude 55 m), on the other hand, is in the Karst Mediterranean region (approx. 80 km (1 h of drive) from the coast) in the Miren Kostanjevica Municipality which borders with Italy. Local tourism strategy is directed towards active outdoor tourism (walking, cycling), gastronomy tourism (wine & culinary tours) and culture & event tourism (CPOEF, 2018).

First, we focus on past trends. Figure 119 shows average effective temperature – an index including both temperature and humidity – for the past fifty years (1971–2020) for both destinations. Past trends show a gradual increase of average effective temperature throughout the year in both destinations, with Portorož showing a stronger trend which is more pronounced for the end of the summer and into the autumn. In Portorož in the past 50 years the average effective temperature increased by about 0.5 °C in the spring and about 1 °C in the summer and the late autumn. Bilje shows an increase by a bit less than 0.5 °C in the spring, a stagnation in the summer and early autumn and an increase by about 1 °C in the late autumn.

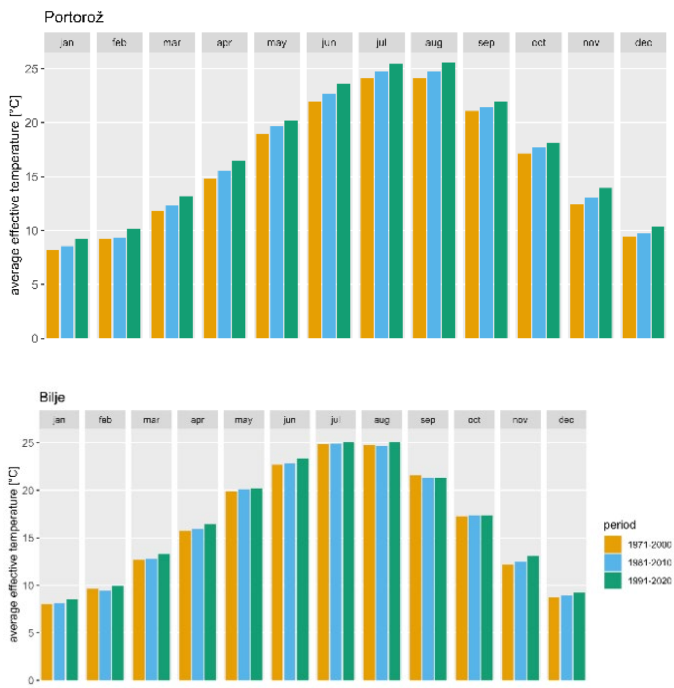


Figure 119: Portorož & Bilje: past trends of the average effective temperature (1971–2020)

Data source for calculations: ARSO, 2022

Next is presented the CIT for specific outdoor activities (based on information on temperature, cloudiness, wind, and precipitation) for both destinations (from 1971 to 2020). In terms of comparing CIT data amongst the different activities there seems to be very similar trend for all of the analysed activities: cultural & hiking, cycling, football, and golf. As seen from graphs, similarly as with average effective temperature, CIT shows a strong past trend of prolongation of ideal conditions both in the spring and autumn for all four types of analysed activities. Here again Portorož shows a stronger improvement in the autumn. For July and August, however, the occurence of ideal conditions decreased. Bilje, on the other hand, shows less seasonal conditions, reaching lower spikes in the summer, but extending more evenly over more months of the year. Nevertheless, here too a trend of decreasing ideal conditions can be seen in July and August.

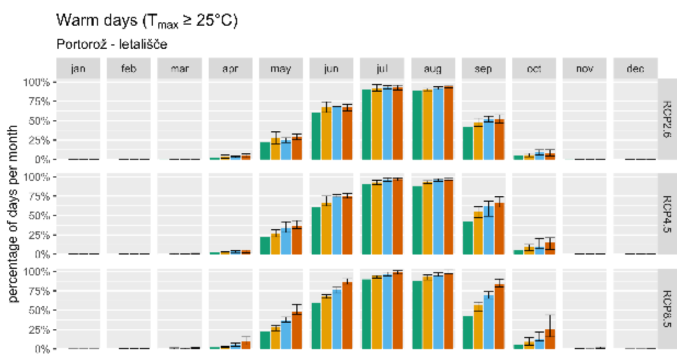
The past trends thus show the extension of the percentage of days with ideal conditions for shoulder season activities and a decrease for the summer in the Mediterranean Slovenia. Now we turn to the future projections. Figure 120 shows the temperature changes in the percentage of warm and hot days for Portorož and Bilje concerning the three scenarios.

The past trends are projected to continue: the temperature in both Portorož and Bilje will increase. July and August will continue to be very hot, with the percentage of hot days higher by more than 15% in the RCP8.5 scenario. The projections are supporting the thesis based on the past trends of the CIT for outdoor activities that July and August will continue to be less favourable in the Mediterranean Slovenia due to extreme heat.

As for the shoulder seasons the projections shows an increase of warm and hot days in all three scenarios, with a much higher increase expected in the RCP8.5. For Portorož, according to the RCP8.5 in May the number of warm days is projected to be higher by 25%. For September an increase is projected to be even higher: warm days are projected to reach 35% higher percentages in the RCP8.5. Similarly, number of hot days in May is projected to be higher in the RCP8.5 by about 30% of the days in the month in the next 50 years. For September, the number of hot days is projected to increase by 20% of the days in the month in the RCP8.5. The projections for Bilje show a very similar trend (see Figure 120).

Figure 120: Portorož & Bilje: past trends of the CIT for specific activities: cultural & hiking, cycling, football, golf (1971–2020)

Data source for calculations: ARSO, 2022



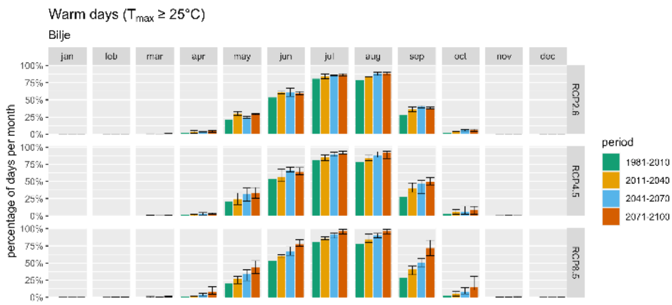


Figure 121: Portorož & Bilje: projections of the percentage of warm days per month (RCP 2.6; RCP 4.5; RCP 8.5) (1981–2100)

Data source: ARSO, 2022

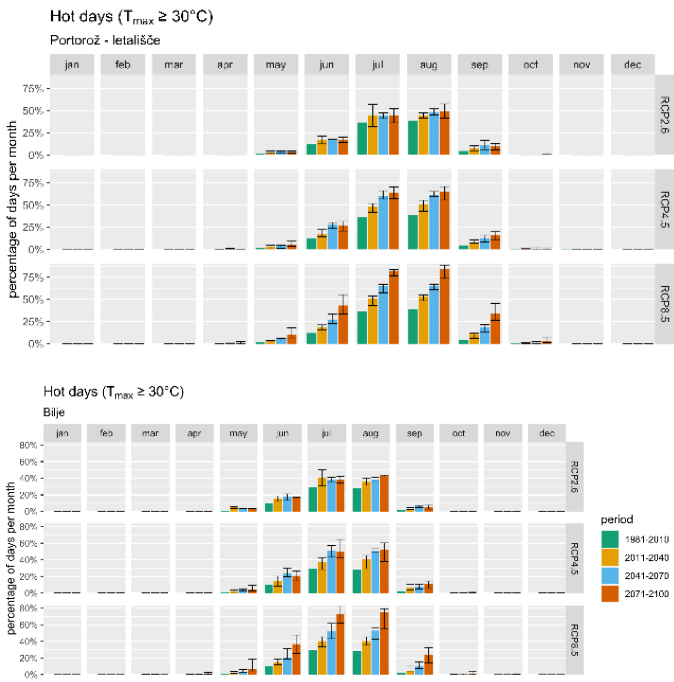


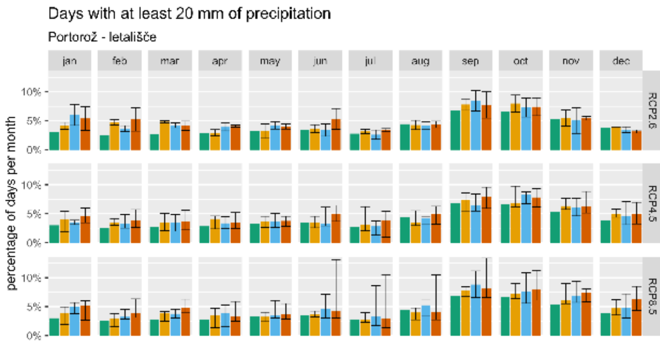
Figure 122: Portorož & Bilje: projections of the percentage of hot days per month (RCP 2.6; RCP 4.5; RCP 8.5) (1981–2100) – mind the unequal scale

Data source: ARSO, 2022

Next, we turn to the projections of precipitation. Figure 123 shows the projected percentage of days with at least 1 mm of precipitation per month for the three scenarios according to the reference period. Especially within the RCP8.5 the reliability of projections for spring and early summer (as judged by the range of whiskers) is not very high. However, other scenarios show that for July and August and partly also September the number of days with at least 1 mm of precipitation is projected to decrease, while winter months show a slight increase. Summer is thus projected to continue to be mostly rain-free, while the projections for the shoulder seasons show variable results and thus not a very clear trend.

Figure 123: Portorož & Bilje: projections of the percentage of days with at least 1 mm of precipitation per month (RCP 2.6; RCP 4.5; RCP 8.5) (1981–2100)
Data source: ARSO, 2022

Finally, we analyse the projections of heavy precipitation as indicated by the percentage of days per month with at least 20 mm of precipitation per month for the three scenarios. Figure 124 shows that in contrast to the strong trend of falling number of days with 1 mm of precipitation in July and August, the number of days with high levels of precipitation is not projected to fall as visibly but rather stagnate or vary in Portorož in both months and fall only in August in Bilje. This indicates that although there will be less days with percipitation in general, this does not mean that there will be less stormy days. Additionally, June, September and October, show an increased trend of the number of days with at least 20 mm of precipitation per month (with again low reliability for the RCP8.5 scenario), whereby we can thus expect more heavy rainfall (i.e. storms) in these months. Consequently, the issue of tourists' safety in these events needs to be an important element of future tourism adaptation.



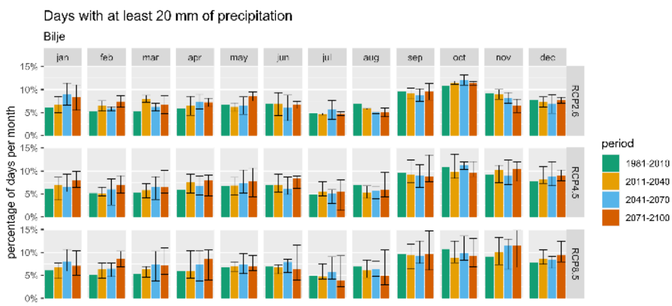


Figure 124: Portorož & Bilje: projections of the percentage of days with at least 20 mm of precipitation per month (RCP 2.6; RCP 4.5; RCP 8.5) (1981–2100)
Data source: ARSO, 2022

Thermal Pannonian Slovenia: Murska Sobota and Cerklje ob Krki

Tourism in the macro destination Thermal Pannonian Slovenia is primarily characterised by geothermal wellness and spa offer (see Chapter 3). Murska Sobota (altitude 187 m) is in the East of Slovenia characterised by Pannonian planes and subcontinental climate, appropriate especially for cycling and walking, and is known for sports events such as running marathons and activities in nature next to the river Mura (UNESCO The Mura River Biosphere Reserve). Although the area is capped by the Goričko hills (Goričko Nature Park), its primary geographical characteristic is the vast Pannonian plane. The local strategy for tourism development focuses on cycling and walking and, as is often the case in the Pannonian area, on the development of tourism and recreation next to artificial lakes, such as the previously degraded gravel pit lake Soboško jezero (e.g. with outdoor fitness and outdoor picknicks and the EXPO pavilion) (Sobota, 2015; ZKTS-MS, 2018).

Cerklje ob Krki (altitude 157 m) is located in the Krško – Brežice basin, Brežice Municipality known for the large thermal resort Terme Čatež, which has a strong segment also in camping tourism, and a smaller thermal resort Terme Paradiso. Outdoor recreation is focused on walking, cycling, river tourism, experiences in natural parks and to a smaller extent also hiking in the surrounding hills, and golf in Mokrice. Similar as to Murska Sobota, the local municipality is looking for ways to strategically support outdoor activities next to an artificial lake, in this case the recently built hydropower accumulation lake Brežice on Sava river (Rangus et al., 2016).

Figure 125 shows average effective temperature for both destinations in the past fifty years (1971–2020). Past trends show a steady increase of average effective temperature throughout the year in both destinations. In Murska Sobota in this period the average effective temperature increased by about 0.5 °C in the spring and by about 1,5 °C in the summer and the late autumn. Cerklje ob Krki shows an importantly greater increase: here, the average effective temperature increased by about 1,5 °C in the spring and by about 2,5 °C in the summer and the late autumn.

Figure 126 shows CIT for cultural & hiking, cycling, football, and golf in the past periods for both destinations. In terms of comparing CIT data amongst the different activities there seems to be a similar trend in all analysed activities. Compared to Mediterranean Slovenia, the two destinations from Thermal Pannonian Slovenia do not show a decrease in occurence of ideal days according to CIT in July and August but rather a stagnation throughout the past 50 years. Furthermore, CIT shows a strong past trend of prolongation of ideal conditions both in the spring and autumn for all four types of analysed activities in both destinations. Here again, similar as with the past trends of the effective temperature, Cerklje ob Krki shows a stronger improvement in the autumn, especially in September.

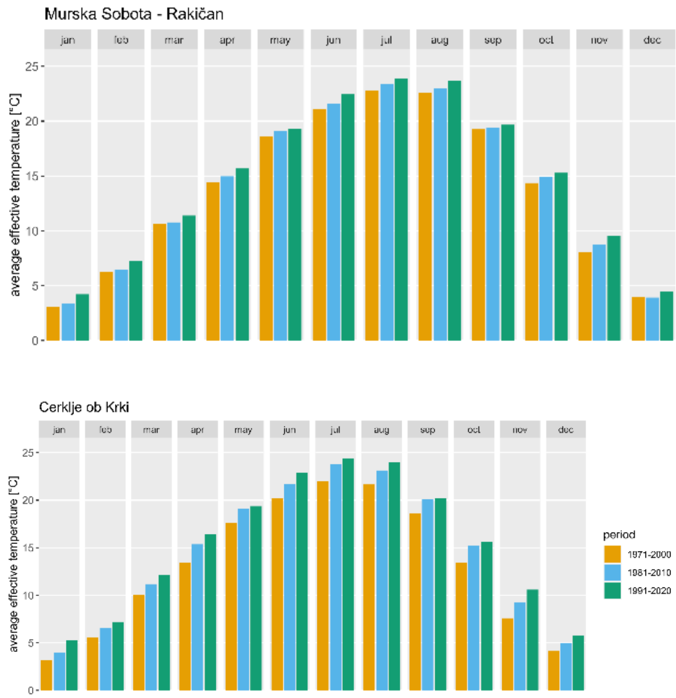


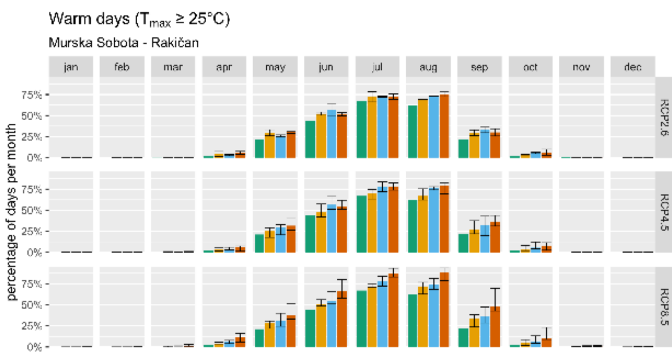
Figure 125: Murska Sobota & Cerklje ob Krki: the past trends of the average effective temperature (1971–2020)

Data source for calculations: ARSO, 2022

Figure 126 shows the projected percentage of warm and hot days per month for Murska Sobota and Cerklje ob Krki concerning three scenarios. The projections show that the past positive trend of daily temperatures will continue, which as we have pointed out in Chapter 3, is a positive information for health resorts nearby as it indicates the season extension into late spring and early summer months. The same could be said for outdoor activities that can be expected to continue as an important additional offer of geothermal health resorts and are a strategic direction of local municipalities (e.g. recreation in the vicinity of artificial lakes). However, again, a drastic increase (RCP8.5 scenario) of hot days implies the necessity to adapt not only the pool and surrounding infrastructure to heat waves but also other outdoor activities. This is true especially for highly intensive sports activities and events organised in the lower planes (e.g. running marathons or cycling competitions) whereby in contrast to the Slovenian hills the forest coverage is much lower due to intensive agriculture, in addition to no shade from the hills, meaning a much lower level of natural shading.

Figure 126: Murska Sobota & Cerklje ob Krki: the past trends of CIT for specific activities: cultural & hiking, cycling, football, golf (1971–2020)

Data source for calculations: ARSO, 2022



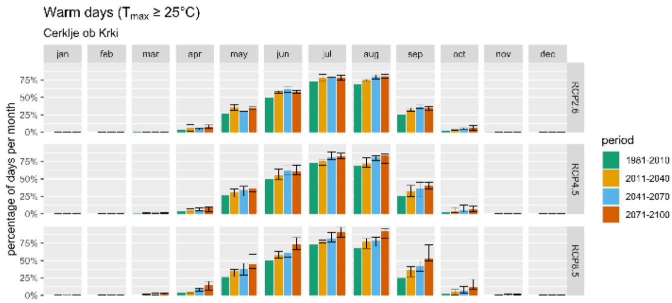


Figure 127: Murska Sobota & Cerklje ob Krki: projections of the percentage of warm days (Tmax ≥ 25 °C) per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100)

Data source: ARSO, 2022

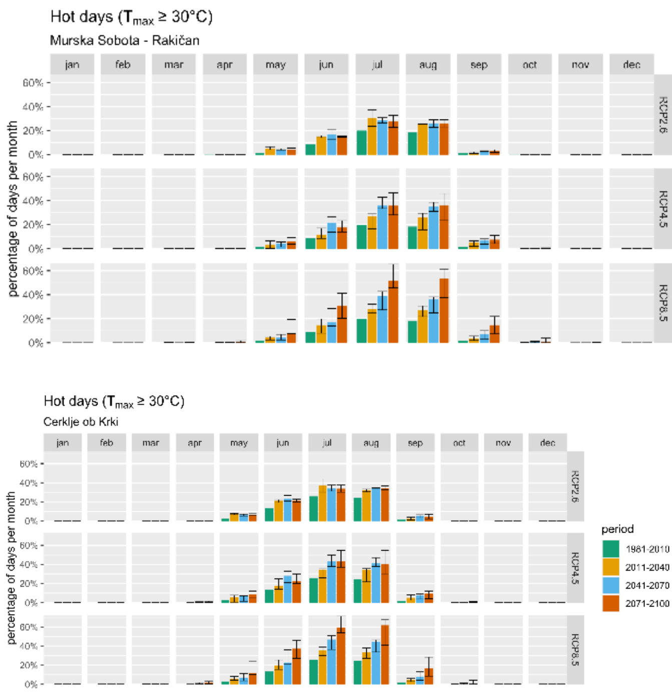
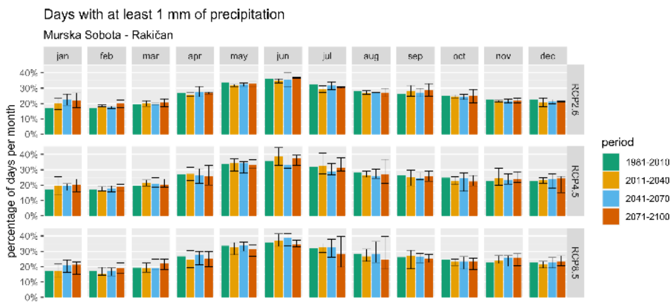


Figure 128: Murska Sobota & Cerklje ob Krki: projections of the percentage of hot days (Tmax ≥ 30 °C) per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100)

Data source: ARSO, 2022

Finally, we focus on the projections of precipitation. Figure 129 shows the percentage of days with at least 1 mm of precipitation per month for the three scenarios. In contrast to Mediterranean Slovenia which has a strong trend of less days with precipitation in the summer and more in the winter and spring, Thermal Pannonian Slovenia's climate shows the peak of days with percipitation in the late spring: the highest percentage of such days per month are in May and June. The projections show more or less stagnation of rainy days with increasing uncertainty with the higher number of the scenario.



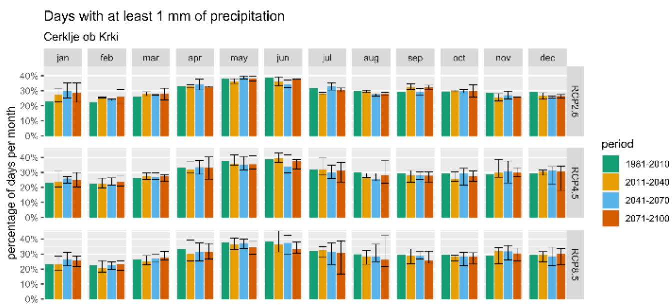


Figure 129: Murska Sobota & Cerklje ob Krki: projections of the percentage of days with at least 1 mm of precipitation per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100)
Data source: ARSO, 2022

Figure 130 shows the projected percentage of days with at least 20 mm of precipitation per month for the three scenarios for both destinations. While for July we can expect a stagnation in the number of days with heavy rainfall, for August we can expect a slight decrease. May, June, September and October, on the other hand, show a slight increase. A specific outlier seems to be the projection for June for Murska Sobota, where according to the RCP2.5 the percentage of days with heavy precipitations are expected to increase more. Other scenarios do not show the same trend so this needs to be taken with caution. Especially for the worse two scenarios and for the end of the century is the variability of projections very high.

Figure 130: Murska Sobota & Cerklje ob Krki: projections for the percentage of days with at least 20 mm of precipitation per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100) - mind the unequal scale

Data source: ARSO, 2022

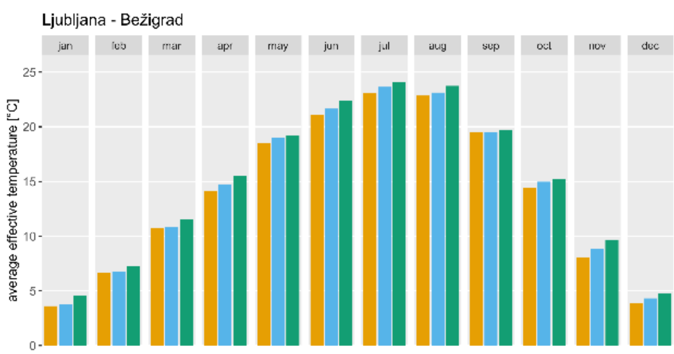
Ljubljana and Central Slovenia: Ljubljana and Kočevje

Chapter 4 on urban tourism covers Ljubljana in depth. Therefore, this chapter only focuses additional information that is important from the perspective of summer and shoulder season outdoor tourism and from a broader perspective for the overall macro destination. The Central Slovenia and Ljubljana macro destination's main outdoor products are experiences in nature in the several regional or natural parks, hiking and cycling. Ljubljana is considered the main hub for one-day touring to other areas of both this macro-destination and all of Slovenia. As both the capital and the national tourism central hub, Ljubljana is home to most types of summer outdoor activities, although sport represents a minor element in Ljubljana tourism and is considered only as a supporting product. Outdoor activities are becoming increasingly important for the surrounding destinations and nature parks (Notranjska Regional Park, Ljubljana Marshes Nature Park, Tivoli, Rožnik and

Šišenski Hrib Landscape Park). Ljubljana's strategic direction is to continue supporting a sustainable lifestyle of its residents (Ljubljana, 2020). Especially compared to capitals of Southern Europe, Ljubljana fares much better in the everyday local usage of cycling as a form of mobility, taking 5th place amongst all European capitals (EU, 2020). However, Ljubljana still tackles the issue of bad air quality primarily due to car transport, therefore the issue of green mobility and the role of cycling is one of primary strategic priorities (Ljubljana, 2020). Finally, although not directly mentioned in the current Ljubljana tourism strategy, an important outdoor activity for Ljubljana residents is hiking to nearby hills, with worries regarding the carrying capacity of these nearby areas (Smrekar, Erhatič, & Šmid Hribar, 2011).

Kočevje on the other hand is a highly important outdoor area of Slovenia with its vast forests and several forest reserves: 90% of Kočevsko is covered with forests, amongst other it includes UNESCO protected forest reserve Virgin Forest Krokar which is forbidden to enter and is home to several protected species. Outdoor recreation in Kočevsko is based on hiking and cycling, but also innovative products such as bear watching and outdoor recreation centres with future plans to provide also e-cycling options and to support hiking and cycling infrastructure. Here too future tourism plans include the extension of recreation at a man-made Kočevje lake, a remnant of the past mining history in the area (Uran Maravić, 2020).

Figure 131 shows the average effective temperature for the past periods for both destinations. As discussed in Chapter 4, the average effective temperature in Ljubljana increased during past periods throughout the year approximately by 1 °C, with the highest increase in October and November. The same could be said for Kočevje, with a similar trend of increase.



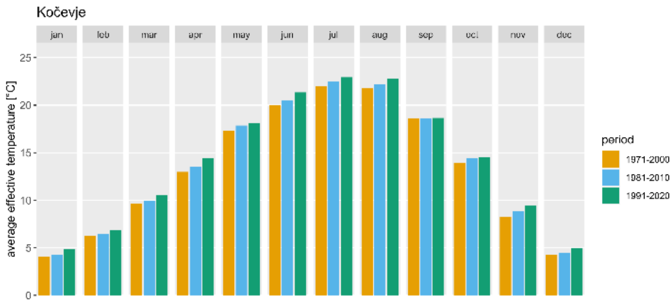


Figure 131: Ljubljana & Kočevje: the past trends of the average effective temperature (1971–2020)

Data source for calculations: ARSO, 2022

Figure 132: Ljubljana & Kočevje: the past trends of CIT for specific activities: cultural & hiking, cycling, football, golf (1971–2020)

Data source for calculations: ARSO, 2022

Figure 132 shows CIT for cultural & hiking, cycling, football, and golf in the past periods 1971–2000; 1981–2010; 1991–2020 for Ljubljana. In terms of comparing CIT data amongst the different activities there again seems to be a similar trend in all of the analysed activities. Similar as to both Mediterranean Slovenia and Pannonian Slovenia, CIT for central Slovenia shows a strong past trend of prolongation of ideal conditions both in the spring and autumn for all four types of analysed activities. CIT, similarly as to Mediterranean Slovenia, shows a decrease of ideal CIT conditions for July, but a relative stagnation for August in Ljubljana and a slight decrease for Kočevje for all activities.

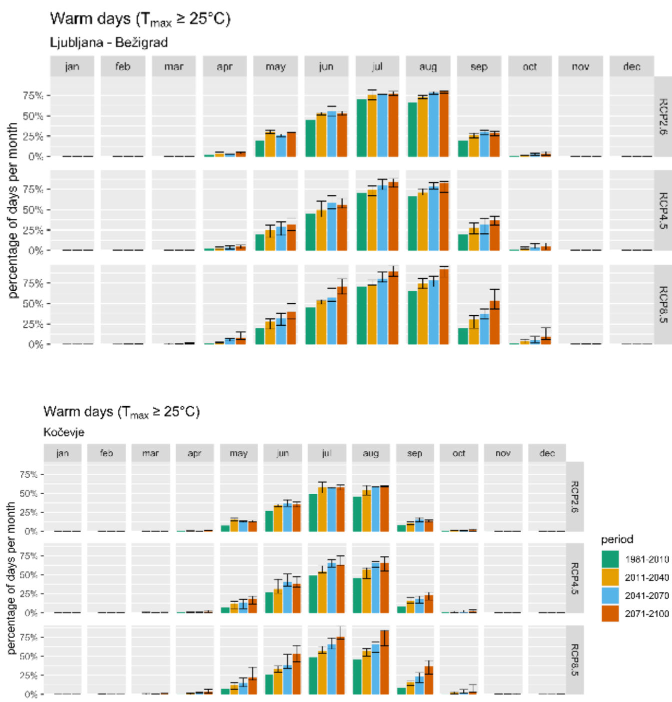


Figure 133: Ljubljana & Kočevje: projections of the percentage of warm days (Tmax ≥ 25°C) per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100)

Data source: ARSO, 2022

If we turn now to projections, Figure 133 shows the projected percentage of warm and Figure 134 the projected percentage of hot days per month for Ljubljana concerning three scenarios. The projections show that the positive temperature trend will continue, which is good information for outdoor recreation especially in the shoulder seasons. However, here again RCP8.5 scenario stands out as the most unfavourable in terms of projected much higher frequencies of hot days in July and August. Such a drastic increase implies the necessity to adapt to heat waves not only for urban activities, as pointed out in Chapter 4, but also outdoor activities such as cycling and hiking.

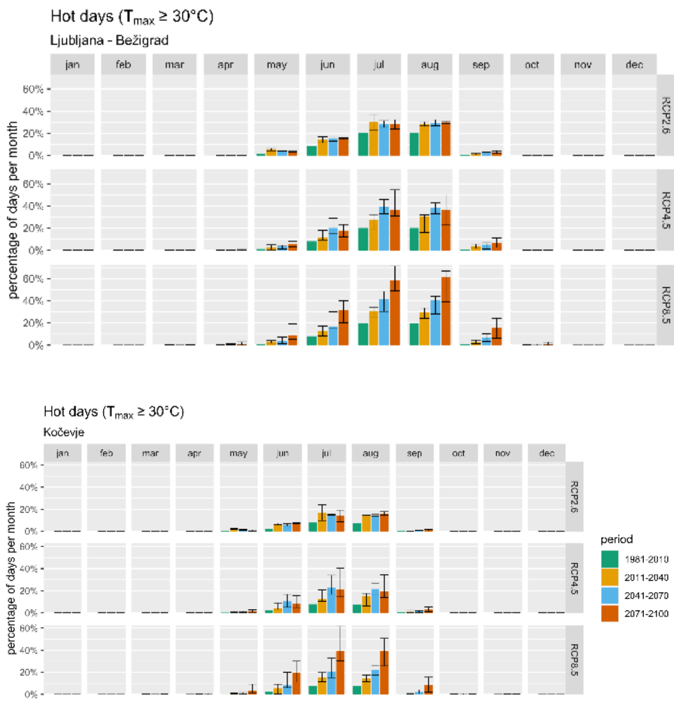


Figure 134: Ljubljana & Kočevje: projections of the percentage of hot days (Tmax ≥ 30°C) per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100)
Data source: ARSO, 2022

Figure 135 shows the projected percentage of days with at least 1 mm of precipitation per month for the three scenarios. The projections show an increase in the number of days with precipitation in the winter, and a decrease for July and August in all three scenarios for both destinations, but with high variability. Spring and autumn, however, show variable projections within the three scenarios and thus not easily discernible trends.

Figure 135: Ljubljana & Kočevje: projections of the percentage of days with at least 1 mm of precipitation per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100)
Data source: ARSO, 2022

Figure 136 shows the projected percentage of days with at least 20 mm of precipitation per month for the three scenarios. Here, again the trends are not clearly pronounced. While for July we can expect a stagnation, for August we can expect a decrease of heavy precipitation, but for the end of the century especially in Kočevje, there is enormus variability in RCP4.5 and RCP8.5. May, June, September and October on the other hand show an increase of days with heavy precipitation.

Figure 136: Ljubljana & Kočevje: projections of the percentage of days with at least 20 mm of precipitation per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100) - mind the unequal scale.
Data source: ARSO, 2022

Alpine Slovenia: Šmartno pri Slovenj Gradcu and Rateče

The last macro destination is Alpine Slovenia. In the east it includes Pohorje mountain range and Maribor city while in the west it includes Julian Alps, Karawanks and Kamnik-Savinja Alps. It is known for both winter and summer outdoor tourism, with the new tourism strategy strongly supporting diversification of winter tourism and development of summer and shoulder seasons products (MGRT, 2022b).

Šmartno pri Slovenj Gradcu (altitude 445 m) is located in Koroška region. It is positioned close to the large Kope–Ribnica Pohorje Ski Resort in the Pohorje mountain range (altitude 1542 m to 715 m). Local tourism strategy emphasises hiking and mountain biking as the most important summer outdoor activities, followed by other nature related products (farm stays, glamping & camping) and sport events (L. Fink, 2021).

Rateče (altitude 863 m) is located in the Julian Alps, municipality Kranjska Gora. Four of the most visited Slovenian municipalities in 2019/2020 are located in the Julian Alps (Bled, Kranjska Gora, Bovec and Bohinj) where at least for some areas the tourism carrying capacity is argued to be exceeded (Jurinčič, 2022; Šegota, Mihalič, & Kuščer, 2017; Zekan, Weismayer, Gunter, Schuh, & Sedlacek, 2022). Especially vulnerable is the Triglav National Park (Mrak et al., 2017). Local tourism strategy of Kranjska Gora was one of the first that included an in-depth analysis of projected climate change impacts, at that time primarily emphasizing the need for technical snowmaking but also projecting the growth of temperatures in the summer and thus increase of visitors in the summer (Kovačič, 2015; Žerjav, 2007). Additionally, weather patterns and climate change projections have been analysed for the option of increasing the potentials for climatic health resorts as potential tourism products (Cegnar, 2015).

Figure 137 shows the average effective temperature for the past periods for both destinations. Similar as to other parts of Slovenia, the average effective temperature in Slovenian mountain ranges steadily increased in the past 50 years. For Šmartno pri Slovenj Gradcu the increase per month was between about 0.5 °C and 1 °C throughout the year with the exception of November where the increase was about 1.5 °C. For Rateče, which lies at almost twice the altitude the increase was smaller: about 0.5 °C throughout the year with November again showing a higher increase (about 1 °C).

Figure 138 shows CIT for cultural & hiking, cycling, football, and golf in the past periods for both destinations. As with other CIT data for previous macro destinations in terms of comparing CIT data amongst the different activities there seems to be a similar trend in all activities with one specific exception: it seems that for Šmartno pri Slovenj Gradcu CIT for football as a more physically extensive activity reached about 15% of more ideal days than for other activities. In Rateče this difference is not so pronounced. Although there is no specific CIT data for other similarly extensive physical activities, such as mountain biking or mountaineering, we can assume here that if the physical requirements are of similar difficulty as with football, then the medium mountain altitudes such as Šmartno pri Slovenj Gradcu (445 m) are indeed importantly more appropriate for such activities in the summer.

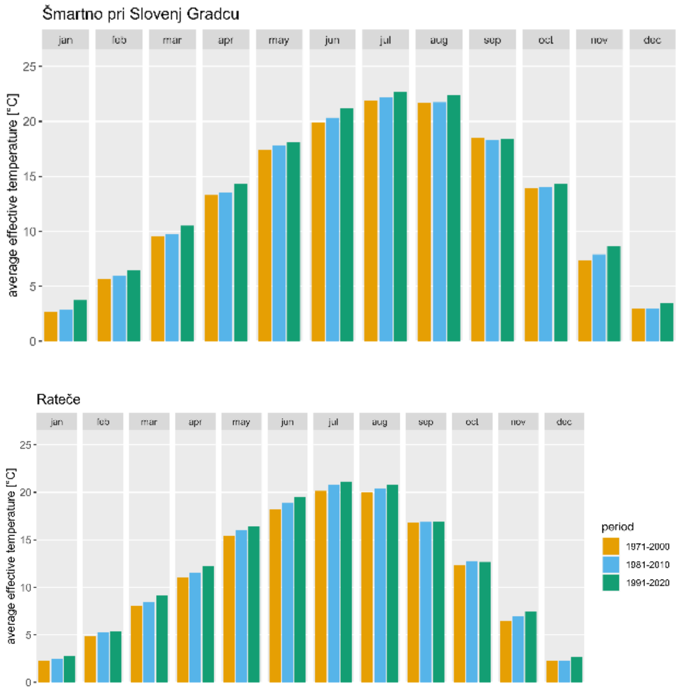


Figure 137: Šmartno pri Slovenj Gradcu & Rateče: the past trends of the average effective temperature (1971–2020)

Data source for calculations: ARSO, 2022

If we analyse the data with regards to the seasons we see that there was not visible increase for the summer for Šmartno pri Slovenj Gradcu, while only a slight increase for Rateče, thus showing that the ideal conditions in the summer remained approximately the same in both destination throughout the past 50 years. This is different, however for the shoulder seasons: the CIT data yet again show a strong past trend of prolongation of ideal conditions both in the spring and autumn for all four types of analysed activities in both destinations with an approximately 5% higher percentage of days with ideal conditions for each activity.

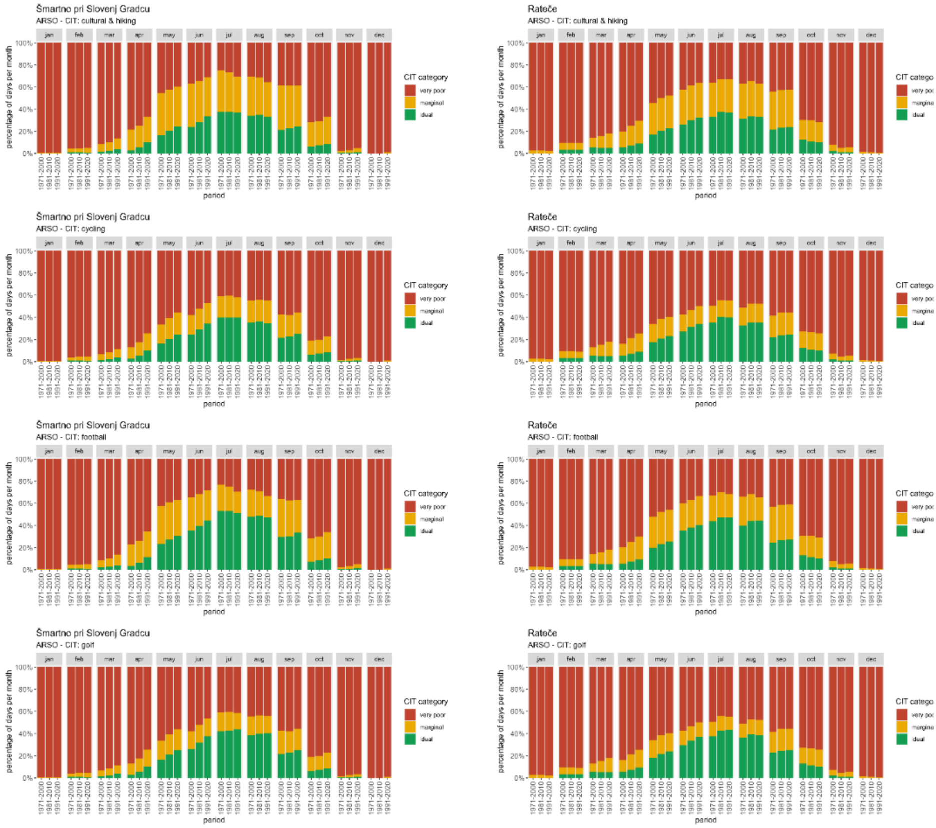


Figure 138: Šmartno pri Slovenj Gradcu & Rateče: the past trends of CIT for specific activities: cultural & hiking, cycling, football, golf (1971–2020)
Data source for calculations: ARSO, 2022

If we turn now to projection for the future. In Figure 139 are presented temperature changes as the percentage of warm days for both destinations concerning three scenarios. As seen from the graph, the trends seen in the past are expected to continue. For Šmartno pri Slovenj Gradcu the percentage of warm days per month is expected to rise. The projected rise is about 30% in the RCP2.6 scenario in the summer and even about 100% in the RCP8.5 scenario with the increase being very certain. The percentage of warm days per month is much lower in Rateče due to its higher altitude. It is expected to increase for about 5% of days in the month in July in the RCP2.6 scenario and for about 10% in the RCP8.5 scenario in the middle century, with possible extreme increase to the end of the century.

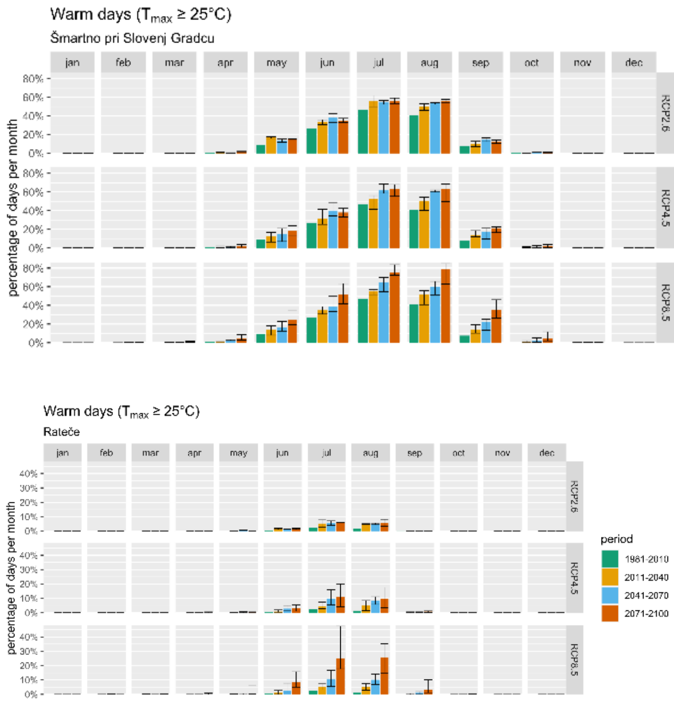


Figure 139: Šmartno pri Slovenj Gradcu & Rateče: projections of the percentage of warm days (Tmax ≥ 25°C) per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100) - mind the unequal scale.
Data source: ARSO, 2022

Figure 140 presents temperature changes as the percentage of hot days for both destinations concerning three scenarios. Similarly, as with warm days, hot days are expected to increase. Most profound expected change is for Šmartno pri Slovenj Gradcu for the RCP8.5 scenario where the projections show an increase by about 30% of hot days per month (the increase itself is very certain, however, its magnitude variability is very high). Such an increase could be highly problematic for mountain ranges, potentially having important consequences for Slovenian mountains: the loss of biodiversity and species redistributions, the increase of fire danger, spread of vector borne disease and other extreme heat related problems for the delicate high-altitude environments.

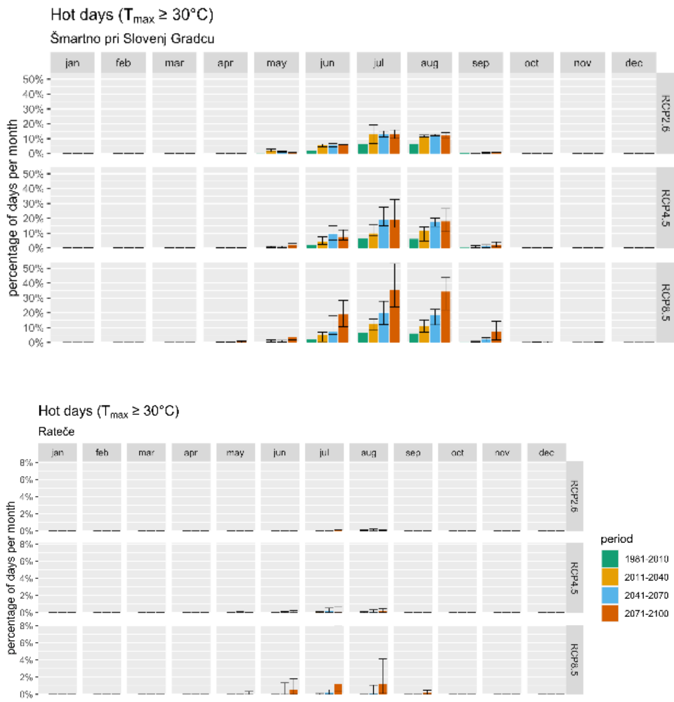
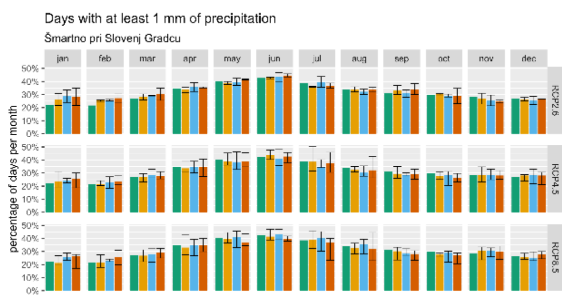


Figure 140: Šmartno pri Slovenj Gradcu & Rateče: projections of the percentage of hot days (Tmax ≥ 30°C) per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100) - mind the unequal scale.
Data source: ARSO, 2022

Finally, we turn now to projections of precipitation. Figure 141 presents the percentage of days with at least 1 mm of precipitation for both destinations concerning three scenarios. Compared to other macro destinations the projections for Alpine Slovenia do not show a decrease of number of rainy days in the summer but rather a stagnation. Winter months on the other hand are mainly projected to see an increase in the percentage of days with precipitation.



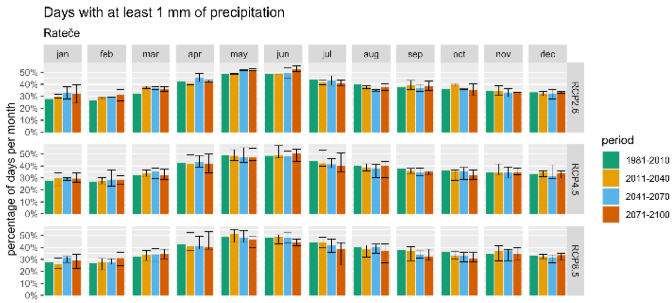


Figure 141: Šmartno pri Slovenj Gradcu & Rateče: projections of the percentage of days with at least 1 mm of precipitation per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100)

Data source: ARSO, 2022

Figure 142: Šmartno pri Slovenj Gradcu & Rateče: projections of the percentage of days with at least 20 mm of precipitation per month (RCP2.6; RCP4.5; RCP8.5) (1981–2100) – mind the unequal scale.

Data source: ARSO, 2022

Figure 142 presents the projected percentage of days with at least 20 mm of precipitation for both destinations concerning three scenarios. While winter months are expected to see an increase of heavy percipitation, the patterns for other months are not as clear, but more often showing an increase or a stagnation in heavy percipitation than a decrease. As for most of the precipitation projections, there is mainly a high uncertainty with models showing decrease or increase for the same month.

In the next section we turn to proposed measures of adaptation of Slovenian summer outdoor tourism to projected climate change impacts.

Proposed adaptation measures for summer outdoor tourism

Adaptation measures for tourists

McCreary et al. (2019) identified five main areas of individual-level coping measures for outdoor tourism and climatic factors: informational coping, strategic substitution, site substitution, activity substitution, and temporal substitution. Their results show that concern about climate change is significantly related to all five individual level coping mechanisms. Summer outdoor tourists were however, less likely to consider adaptation than winter tourists. In response to past climate-related impacts, winter tourists were three times more likely to engage in strategic, temporal, and information coping and one to two times more likely to engage in site or activity substitution than summer visitors.

We will discuss each of the five areas of individual adaptation to climate change with relation to findings in previous literature and our results, adding also a sixth area: willingness to support climate change adaptation and mitigation measures.

Informational coping

Information, particularly weather forecasts, are one of the ways how visitors can overcome climate-related constraints. From one-third (Hamilton and Safford, 2015 in McCreary et al. 2019, p. 25) to nearly all (Rutty and Andrey, 2014 in McCreary et al. 2019, p. 25) of outdoor tourists check the weather of a destination before their trip. Climate change and extreme weather events (and the media coverage of these) will likely influence information-seeking behaviour by outdoor tourists and, consequently, other behavioural coping strategies such as where visitors go, when they make their visit, and what type of gear they pack (McCreary et al. 2019).

An important element in informational coping is the knowledge of visitors with regards to safety measures and familiarity with safety protocols and information. Jeuring and Becken (2011, 2013) analyze the outdoor tourism in New Zealand and discuss the most common risks of extreme weather events: track closures, road blocks, flash floods, landslides, hypothermia, getting lost, traffic accidents and risk to tourist itinerary/activities. Tourists are especially vulnerable in these cases since they are unfamiliar with the local environment, are disconnected from local communities, face language barriers, are not necessarily familiar with local traffic routes and the fact that tourist attractions are often remote and thus at risk for difficult interventions. Their survey amongst New Zealand tourists showed that about one third thought they themselves are primarily responsible for their safety, about half thought the responsibility is shared and about 15% projected the responsibility to external actors, such as the government and the travel agency. This in turn affected their safety information seeking and preferences and was dependent on gender.

As was stressed in Chapter 4 with regards to water activities, also for outdoor activities, especially hiking and mountaineering, tourists must gather as much information as possible about the weather and take appropriate safety and rescue measures. In Slovenia, particularly the issue of safety of hikers and mountaineers has been debated as an increasingly growing concern with the increasing number of accidents and needs for rescue missions (Belhar, 2020).

Another important area of information coping is awareness of heat dangers to one's wellbeing and health. This goes hand in hand with the needs for improvement of so called "heat alert" systems at a destination level. Following the idea of easy-to-understand alert systems such as for hurricanes and earthquakes, there is a need for such systems also for heatwaves, with a proposal for a 4-step warning category. What is needed is large-scale awareness raising regarding the precautions needed for each of the levels of heat danger, both in prevention and in first aid in heat stroke incidents (Myrivili, 2022; UNDRR, 2022).

Strategic substitution

Strategic (or tactical) substitution is used to describe a variety of behaviours (not related to spatial, temporal, or activity substitution) that allow recreationists to overcome uncertain environmental conditions or climate-related constraints. Strategic substitution refers to using different gear, equipment, or methods (e.g., bow hunting and rifle hunting, tent camping and using back-country shelters) to overcome constraints or goal interference. Strategic substitution is considered a negotiation tactic, where constraints (adverse conditions) trigger effects such as negotiation or coping behaviours, resulting in modified or mitigated (rather than simply reduced) use. Climate change in the form of increasingly frequent and/or unpredictable severe weather events may for example influence backpackers to purchase and carry more sophisticated wind and waterproof gear during backcountry trips (McCreary, Seekamp, Larson, Smith, & Davenport, 2019).

Also counted is technical adaptation of the equipment: strategic substitution focuses on an improvement of the used equipment in order to continue the activity, e.g. use of a different type of boat to adjust to shallower waters. For air sports, technical adaptation is necessary to make the equipment less susceptible to changing winds (Pröbstl-Haider et al., 2021). Innovation in the field of sports equipment outdoor activities shows potentially important future improvements in gear and garment, such as protective & cooling clothing (e.g. (Cai et al., 2018).

Wilkins' et al. (2018) research showed that campers were the most influenced by weather, increasing precipitation in particular. However, the analysis also showed the difference between tent and RV campers, as RV campers reported lower levels of influence of weather than tent campers. So, a potential individual-level form of strategic adaptation to increased summer precipitation is likely to be the increase of RV campers, pointing out the economic differences in the possibilities for climate change adaptation amongst tourists.

McCreary et al. (2019) interviewed Canadian outdoor tourists and concluded that age was a significant predictor of strategic substitution, with those visitors under the age of 35 more likely to engage in strategic coping strategies than older visitors. Additionally, income was the only variable significantly related to strategic coping, demonstrating an intersection of wealth and age that influences the likelihood of recreationists coping strategically through gear or technology. Longitudinal studies are needed to determine if younger visitors "outgrow" their caution and concern about climate change or if this characteristic follows this generation of visitors through older adulthood (McCreary et al., 2019).

The following activities advised for tourists in Austria (Jiricka-Pürrer, Brandenburg and Proebstl-Haider, 2020) can also be applied as important individual-level strategic substitution measures for outdoor tourists in Slovenia with regards to projected increasing temperatures and increased number of sunny days:

- frequent hydration to avoid dehydration;
- spend much time in natural and artificial shadow;
- wearing light and breathable clothing such as linen fabric;
- cover head and hair with protective covers (hat, scarf, etc.); and

We can add to these also the following:

- adapt equipment and clothing (e.g. substitute cycling for e-cycling, substitute tent camping for RCV), and
- adapt accommodation options (we can expect higher needs for air-conditioned facilities, even in higher latitudes or in buildings where there was no need for air-conditioning in the past due to Mediterranean-type of building).

However, without rapid decarbonisation of electricity supply, greenhouse gas emissions will increase due to the increased use of air conditioning, which is a highly important risk of maladaptation.

Temporal substitution

Temporal substitution refers to changing the timing of recreational pursuits to overcome conflicts or constraints, such as crowding or adverse environmental conditions. Climate change will likely impact trends in outdoor recreation on an annual scale, as seasons favourable for hiking and camping change in response to long-term weather trends (e.g., favourable temperatures) and storm seasons (McCreary et al., 2019).

The following activities advised for tourists in Austria (Jiricka-Pürrer, Brandenburg & Proebstl-Haider, 2020) can also be applied as important individual-level temporal substitution measures for outdoor tourists in Slovenia with regards to projected increasing temperatures:

- adapt location of activities according to weather forecasts (including choosing indoor activities, moving to camps with more natural shade); and
- adapt time of activities according to the time of day (perform activities at best in the morning and late evening).

Based on our research results we can expect two important forms of temporal substitution for summer outdoor activities in Slovenia in the future:

- adaptation of the time of activities according to the time of day: outdoor tourists adapt by choosing to perform activities earlier in the day or later in the evening, and
- adaptation of the time of activities according to the changing seasons: outdoor tourists adapt by substituting their summer travel earlier in the spring or later in the autumn.

Potentials for adaptation of the time of activities according to the changing seasons is one of the most salient results of this research: we can reliably expect the extension of the summer season into shoulder seasons in all four macro destinations. The shift from skiing in winter to mountain biking in summer in mountain destinations with a significant cable car industry is perceived as an investment in the future to save the tourism industry. As Pröbstl-Haider et al. (2021) argue, the cycling offer is discussed as the "new skiing" in the long run, also with regard to added value (Rottenberg, 2016 in Pröbstl-Haider et al., 2021 p. 41). Furthermore, switching to cycling as an important holiday activity is expected to provide a positive impetus for everyday behaviour (Pröbstl-Haider et al., 2021).

However, although the weather patterns might allow for such temporal substitution this might be possible only for some specific segments (i.e. retirees, or those with flexible employment options). Vacation periods are often tied to seasons of the home climate, national and school holidays, and agreements at work. Changes in economic structure, demography, and air conditioning could loosen these ties.

Because of this, and the reasons indicated above, it is very hard to predict changes in tourist behaviour due to climate change (Lise & Tol, 2002).

The summer holidaymaking is namely a very much socially determined activity, constrained by the employers' rules and working processes on the one hand and the educational policies on the other hand. As the projections show an increase of effective temperature for the future, we might reasonably expect that employers will continue to limit their workers' holidays options to the hottest months since these are the times of the year when the workers' productivity is expected to be the lowest and summer holiday scheduling can aid in decreasing the costs of air-conditioning. Climate ADAPT (EEA, 2022a) for example proposes that one of the measures of climate change adaptation is allowing workers to take longer summer holidays. We thus hypothesize here that what we can expect in the future is not a decrease of tourism demand in the summer but rather an increase.

Activity substitution

Activity substitution is the concept of outdoor recreationists swapping activity choices rather than the location of their recreational experience, allowing visitors to avoid unwanted conditions or situations, usually with an experience that can be substituted as closely as possible to their original endeavour (Miller and McCool, 2003 in McCreary et al. p. 24). Climate change is projected to indirectly impact recreation activities by limiting, or enhancing, the opportunity for those activities. For example, precipitation will impact lake levels and determine whether boating access is feasible from launch facilities that may be inaccessible during low and high water events (McCreary et al., 2019). Another example is that challenge-oriented activities (hunting and golf) may be substituted with another competition-oriented opportunity, or non-challenge activities (camping and swimming) may be interchanged by visitors seeking calmer recreation experiences (Ditton and Sutton, 2004).

A study amongst U.S.A. tourists showed that less specialised outdoor tourists (i.e. nature-based generalists) reported the largest influence of weather on their activities. However, they also may be the most adaptable, since they participated in more activities and changed the activities they participated in the most. This is important because there are micro-climates within a single tourism destination, which provides tourists some capacity to adapt to weather; for instance, moving to the beach when temperatures are hotter than desired. Thus, the authors suggest that it may be beneficial to advertise a wide range of recreational activities available at the destination so tourists have an awareness of options to adapt to negative conditions (Wilkins, de Urioste-Stone, Weiskittel, & Gabe, 2018).

Our results show that although past CIT trends do not show very high variability of ideal conditions amongst the five analysed types of activities, future projections indicate that we might expect changes in the summer especially with regards to physically extensive activities, with especially so called "generalists" replacing these for their easier alternatives (e.g. hiking in lower slopes, or hiking in more shaded areas). Substitution of outdoor activities for the indoor alternatives due to heat waves is also highly likely form of adaptation.

For specialists, on the other hand, we might reasonably expect other forms of substitution rather than activity substitution, especially in line with the trend of improving equipment. Since specialists are the tourists that are the most passionate about their specific activity, they are also probably most willing to pay for additional costs of equipment and most willing to look for options for site and temporal substitution.

Next to highlighting the range of possible outdoor activities, we might reasonably expect also new activities to develop in the future. Specifically, e-cycling is a type of activity that is, together with measures on climate change mitigation, an activity that we expect to increase in the future. Since the innovation trends are accelerating, we might reasonably expect technical solutions also for other not yet known or popularised activities and thus activity substitution also in other innovative trends.

Site substitution

Climate change may influence site selection, and substitution, especially due to variations in precipitation at specific sites. Site (i.e., spatial or resource) substitution is the most common among recreationists who are highly involved (e.g., skilled, committed) in an activity, and care less about where (the resource or spatial context) they recreate (Aas and Onstad, 2013 in McCreary et al. 2019, p. 24). Site substitution, however, has mostly been discussed for winter tourism: inadequate snow cover for skiing may displace visitors to higher altitude ski destinations or ski operations capable of snowmaking (McCreary et al., 2019).

Future research of behavioural aspects of Slovenian tourists is needed; however, our results show that Slovenian tourism can most likely expect site substitution from lower altitudes and urban areas to higher altitudes and rural areas with promises of natural shading and water-cooling effects. This effect is mostly expected for July and primarily August, however also other months will most likely see the effect with the increase of frequency and intensity of heat waves.

On the other hand, in terms of site substitution in the form of tourists replacing Slovenia for another destination the results do not show such drastic projections that we would expect Slovenian tourism losing out in the summer and shoulder seasons (this is, however, a reasonable threat for the winter tourism, see Chapter 5). A specific exception, however, might be the highly involved recreationists (e.g. professional or highly involved cyclists) that might be looking for site substitution in the future months of July and August, especially with the Northern Europe projected to increase the number of ideal days in the summer and shoulder seasons.

Individual willingness to (financially) support adaptation and mitigation measures

An important question for climate change mitigation and adaptation is the role the tourists can have in climate adaptation planning and their acceptance of adaptation measures. A survey amongst visitors to a Taiwanese nature park (Liu et al., 2021) showed a generally high level of support to climate change adaptation measures. The survey participants, however, reacted negatively with regards to the measure: "Building unique buildings in the area as a supplement to damaged natural scenery", showing that enjoyment of nature is not a negotiable element of value proposition of outdoor recreational activities. The measures that were in particular supported by the survey participants were measures aimed at enhancing biodiversity (strengthening the implementation of conservation projects), visitor safety- and security-related measures (setting up pavilions to reduce heat stroke danger, providing real time weather and safety information) and measures that would decrease the costs for tourists (reduced park admissions and accommodation costs and free shuttle bus) – although the question is why the authors have not asked about increased park admissions as a type of adaptation measure since decreasing the costs is not a self-evident adaptation measure, especially with regards to the issue of mass tourism. More likely, climate change adaptation will bring additional costs and the question of visitors' support for these is of prime importance.

Some tentative answers can be found in McCreary et al. (2018) research who analysed nature-based tourists' willingness-to-pay for a license plate that would direct funds toward regional climate adaptation planning. Results showed a $30 cost annually is significantly influenced by increased income, age, climate related risk perceptions, and place meanings (McCreary et al., 2018). Wilkins et al. (2018) showed that outdoor specialist tourists in Maine U.S.A. have slightly higher belief/concern in climate change, while the generalists have the highest stated willingness to donate money or educate others about climate change. The average answers to items "I would be willing to donate money to reduce my carbon footprint when traveling to Maine" and "I would be willing to donate money to help deal with the impacts from climate change in Maine" were 2.73 (on a scale from 1 to 5).

For Slovenia further research is needed, whereby the main focus should be the interconnection of tourists' support for both climate change adaptation and mitigation measures. Some preliminary information can be found on the regular Eurobarometer public opinion research on climate change. In 2021, the percentage of people who said that climate change is the single most serious problem facing the world was 18% for EU overall, while for Slovenia only 11%. On the other hand, Slovenians were much more likely to state that the deterioration of nature is the most important problem (16% in Slovenia versus 7% EU average) (Eurobarometer, 2021a, 2021b). We hypothesizes here that the domestic tourists may be most prone to measures that aim at securing biodiversity and natural resources in climate change adaptation measures. This is also the area where the latest IPCC report (IPCC, 2022) stresses the indirect opportunities that can emerge from the co-benefits of implementing adaptation actions and the role of tourism. They point to nature-based solutions (NbS) approach to adaptation that can make cities and settlements more liveable, increase the resilience of agriculture and protect biodiversity. Ecosystem-based adaptation can attract tourists and create recreational space (IPCC, 2022). We hypothesize that the domestic support will be the highest for adaptation measures aimed primarily at improvement of local recreation opportunities and quality of live such as green shading and nature-based landscaping of water reservoirs and degraded areas. This is especially important with regards to expected increase in higher altitude tourism and the need for conservation measures especially in the Alpine Slovenia.

A highly promising area for future development is the combination of outdoor activities (hiking, cycling, e-cycling) and green and slow mobility as measures of climate change mitigation. At the individual level we can expect the tourists' support for green mobility to increase with the expected increase in policy changes for support of green and slow mobility and expected increase in climate change awareness.

Adaptation measures for companies or organisations

Day et al. (2021) report that in general climate change is perceived by tourism providers as "slow moving and low risk" (Chin 2015 in Day et al. 2021, p. 29) and that typical outdoor tourism providers responses include adjusting part-time/seasonal workers schedules or adjusting facilities to accommodate weather changes such as rain or heat. Adaptation can, however, include a broader spectrum of measures. We can talk primarily of three interrelated areas of proposed adaptation measures for Slovenian tourism providers: marketing adaptations and product diversification, adaptations of organisational processes, and technical and infrastructure adaptation measures. We will discuss each of these areas bellow, taking into consideration also recommendations in similar other research.

Marketing adaptations: segmentation, promotion, product diversification and dynamic pricing

Day et al. (2021) point out that in the short term, bad weather does not necessarily affect the likelihood to travel. However, over time, disappointment in weather conditions may have lasting impacts on destination reputation. Poor weather reduces visitors' satisfaction with the destination experience and their intention to return. Tourism and recreation organizations will thus need to monitor these changes in consumer satisfaction and behaviour to adapt to changes in demand effectively (Day et al., 2021). Next to monitoring conditions and visitor characteristics, Perry et al. (2018) advise outdoor recreation parks to find new markets of people who are less climate-dependent, adopt differential pricing to affect changing use patterns and work to change visitor expectation and level of preparedness.

Increasing temperatures in Northern Europe will most likely bring new pressure on tourism markets. Slovenian tourism providers thus need to analyse the impacts of future potential increased competition from Northern Europe to their operations and adjust marketing strategies accordingly (especially Germany, the Netherlands, U.K. and Benelux as the primary Slovenian markets). As Tufts stresses, the impacts of climate change will be experienced differently from region to region depending not only on local variations in climate change but also on changing competitive contexts (Tufts, 2010). Residents in regions with better climate indices have a higher probability of travelling domestically and a lower probability of travelling abroad (Eugenio-Martin and Campos-Soria, 2010). In the case of Slovenia, this includes the question of how climate change will affect Slovenian primary tourism markets. Specifically, as the temperatures rise in the North of Europe, so does their interest in domestic tourism, as shown for example by analysis of domestic tourism in U.K. after a very hot summer (Giles and Perry, 1998). More research is needed to see how this will develop further, but tourism enterprises need to closely follow changes in demand and strategically prepare their marketing in advance.

As pointed out several times in this chapter, one of the most salient changes will be the prolongation of the summer season, which is a positive development for the future of Slovenian outdoor tourism. In the future, marketing needs to adapt both by building on the prolonged season as an added value, but also by adapting timing of promotional campaigns where this will be necessary. However, since the extension of the season is limited by social constraints, primarily school holidays and work holidays, an important marketing adaptation is also to analyse the effects of prolonged season on organisation's specific target markets and adjust marketing strategies accordingly. This is especially relevant for the types of tourism, that already focuse on the shoulder seasons (MICE and sport events) but also from the perspective of specific segments (e.g. to what extent can we talk about prolongation of the season for family tourism, which is highly dependent on school holidays).

Product diversification has been a long-time advised measure for climate change adaptation primarily for winter tourism, to both diversify within the winter season but also to diversify and extend the offer to other seasons. For summer outdoor tourism product diversification means primarily an appropriate measure to adapt to heat waves by developing activities less affected by heat in the summer: water based outdoor recreation, indoor recreation, less physically straining activities. As argued above, we can expect an increase in interest in water-based activities potentially also replacing some of non-water based outdoor activities in July and August and outdoor activities for indoor alternatives due to heat waves. Additionally, new types of activities might emerge with the future development.

Correspondingly, a related area of adaptation measures is to promote a wide area of products available at both the organisational and destination level. According to Wilkins et al. (2018) the so called "generalists" among outdoor tourists are the most adaptable, since they participate in more activities and change the activities they participate in the most. This is important because there are micro-climates within a single tourism destination, which provides tourists some capacity to adapt to weather; for instance, moving to the beach when temperatures are hotter than desired. Thus, the authors suggests that it may be beneficial to advertise a wide range of recreational activities available at the destination so tourists, particularly nature-based specialists, have an awareness of options to adapt to negative conditions (Wilkins et al., 2018).

An important factor for product diversification is education of personnel, as shown by the case of French Alpine guides who are affected by climate change and show different approaches to adaptation (Mourey, Perrin-Malterre, and Ravanel, 2020). Mourey et al. (2002) identified two categories of Alpine guides: one seems to have difficulties in adapting to the effects of climate change while the other seems to face the challenge with greater ease. This difference depended on the activities which each Alpine guide chooses to practice. In summer, those guides who mainly practiced traditional mountaineering were less adaptable than those who have diversified, offering activities which can be done outside the high mountain environment. The authors conclude that alpine guides have the possibility to adapt through the diversification of their activities. However, this implies a redefinition of their job that does not always correspond to their preferred vision of the profession.

Finally, a potentially important area of tourism providers' marketing adaptations to climate change is the measure of dynamic pricing, in general becoming ever more popular with the rise of digital business models. Here previous research has focused on climate change and ski tourism (Malasevska et al., 2020; Steiger, Posch, Tappeiner, & Walde, 2020). Malasevska et al. (2020) show that dynamic prices induce greater demand and could increase revenue by 0.5% to 7.5%. Moreover, skiers have a strong preference and higher willingness-to-pay for good weather-related skiing conditions, suggesting that skiers prefer skiing during the midweek at a higher price, instead of on the weekend, if the skiing conditions are better in the midweek. More research is needed on the effectiveness and the future role of dynamic pricing for summer and shoulder season tourism, however, at this point we can advise the Slovenian tourism providers to start exploring the ways of introducing dynamic pricing policies in areas and seasons most affected by climate change in the future, especially with regards to compounding risks of climate change and exceeded tourism capacity in high altitude and vulnerable areas of Slovenian outdoor tourism.

Adaptations in organisational processes and risk management

The most important area of proposed adaptation measures are measures in response to safety of both personnel and tourists. Organisations should take appropriate measures to protect tourism workers and tourists from heat stress, educate personnel on health stress risks and appropriate responses, employ enough and well-prepared safety personnel, and inform both personnel and tourists on safety measures with regards to primarily heat waves and outdoor tourism, but also natural disasters related to the projected increase in rainfall in some areas: intense storms, flooding, and landslides.

The second necessary area of climate change adaptations are adjustment of activities according to time of day. This may require tourism organisations to rethink their scheduling, e.g. agencies to rethink their itinerary schedules (starting earlier and having rest time opportunities at the temperature peak hours), accommodation providers to rethink their catering schedules, e.g. providing breakfast in the earlier hours, and transport providers to adapt to these shifts. But it might also provide an opportunity to create new products and experiences, e.g. night-time hiking.

The third, more challenging area of organisational adaptation, are the adaptations of organisations to the future prolongation of the seasons. According to Čavlek et al. (2019) the projections for the Island of Lošinj, Croatia show a clear opportunity for the island to extend its tourism season. Successful adaptation will thus depend on the ability of the island's many stakeholders to collectively deliver an extended season. However, this consideration was not identified in the workshops with the island's tourism stakeholders, pointing to the need for greater communication and strategic consideration of extended season. We argue here that the challenge is not only the diversification of products, as identified above, but rather the difficulties connected to transforming the business models that have for a very long-term been based on seasonal products, especially with regards to the dependency on seasonal labour. The seasonality is the root of a number of problems in Slovenian tourism system and is identified as one of the main issues to tackle also within the new tourism strategy 2022–2028 (MGRT, 2022b). So, the prolongation of the seasons seems to be a boon for tackling the issue of seasonality. On the other hand, the problem might be more complex than it seems at first glance.

Although there is currently no official data that would allow for such analysis and thus more research is needed, a specific hindrance for future development might be the interrelation between the winter and summer seasons in dependence on seasonal labour. That is, the flows of seasonal workers that work in the Mediterranean in the Summer are thought to move to work in the Alps in the Winter. How exactly is Slovenia positioned in these international migrant labour flows is not clear and needs to be analysed on a systemic national level. What we might expect is the continuation of the increased international competition for tourism labour also in the shoulder seasons. Organisations that rely heavily on seasonal labour need to invest more in long-term planning of human resources – an issue that is already highly problematic in the post-COVID tourism.

Another area of future organisational adaptations is financial climate change risk management: financial risks assessments that necessarily include climate change projections, insurance policies and weather derivatives. Since weather derivatives are the latest development, we describe them more in depth here. Weather derivatives are financial instruments whose value depends on the index of weather variables such as temperature, rainfall, and snowfall (Tang & Jang, 2012). According to Climate ADAPT (2022) weather derivatives are similar to but different from insurance. Insurance covers low-probability, catastrophic weather events such as hurricanes, earthquakes, and tornadoes. In contrast, derivatives cover higher-probability events such as a dryer-than-expected summer. Weather derivatives are currently by far less used than insurance schemes in the EU. However, they are considered as effective instruments for hedging against the risk associated with weather variability under today's climate and may become even more attractive under projected future climates characterized by increased variability and increased frequencies of extreme weather (EEA, 2022b). Most of the research on weather derivatives in tourism focused on their application for ski resorts. Tang and Jang (2021) using Monte Carlo ski resort as an example, simulate that reveal that snowfall forwards could reduce ski resorts' cash flow volatility up to 25.8%. The authors claim that this hedging strategy is also applicable for other nature-based businesses, such as beach resorts and golf courses. Weather derivatives have been simulated to be an effective risk management technique also especially for weather dependent cultural events (Martinez Salgueiro & Tarrazon-Rodon, 2021) and rainfall effects for tourism in general (Franzoni & Pelizzari, 2019) their usage is however not yet commonly applied in tourism. Here we can advise Slovenian outdoor tourism providers to analyse their weather derivatives options and start preparing for the future climate change risks.

Technical and infrastructure adaptation and adaptation of natural conditions

The final area of organisational adaptation includes technical and infrastructure adaptations and adaptations of natural conditions. Technical adaptation of the equipment includes improvement of the used equipment in order to continue the activity, e.g. use of a different type of boat to adjust to shallower waters. For air sports, technical adaptation is necessary to make the equipment less susceptible to changing winds (Pröbstl-Haider et al., 2021). Technical adaptation of the infrastructure includes measures such as irrigation, artificial pools, artificial canoe routes, the reconstruction of trails and new connections (bridges) in case of melting glaciers, or the constriction of nets to protect against rockfall (Pröbstl-Haider et al., 2021). Adaptation of the natural conditions are measures by which the climate change vulnerability is reduced by improving the natural conditions, e.g. enhancing the continuity of rivers and creeks to improve fish migration, planting vegetation along river banks to improve fish habitats, or by redesigning golf courses and planting trees. Gliders may also consider the relocation of takeoff and landing spots to adapt to changing wind systems (Pröbstl-Haider et al., 2021).

In general, the most important area of climate change adaptation for Slovenian tourism in the future is the adaptation of infrastructure and equipment to increased temperatures and droughts in the summer. Slovenian tourism needs to strategically invest in energy efficient and low carbon solutions for air-conditioning and its alternatives. He et al. (2018) advise that practitioners should inspect ways of lowering the additional operating costs resulting from climate change. The authors furthermore advise the so-called green lodging programs to help hotel owners save on energy and water expenditure, either via the supply-side change such as the modification of the energy or water supply system or demand side intervention such as increasing the visibility of electricity consumption information to customers.

Slovenian tourism operators are advised to strategically invest in:

- green shading and other cooling measures,

– consumer energy savings programs,
– insulation and other infrastructure building alternatives, and
– use of geothermal energy and other renewable sources of energy for cooling.

As an opportunity, Slovenian tourism could tap into the New European Bauhaus Movement: "a creative and interdisciplinary initiative that connects the European Green Deal to our living spaces and experiences. The New European Bauhaus initiative calls on all of us to imagine and build together a sustainable and inclusive future that is beautiful for our eyes, minds, and souls" (EU, 2022)

In Slovenia the most prominent sustainability certification schemes for tourism providers are The Green Scheme of Slovenian tourism, the Green Key, the EU Ecolabel for tourist accommodations, Authentic from Slovenia for territorial collective brands. All of these provide an important support in the direction of sustainable management. Additionally, they are an important mechanism of adaptations to the future trend of increased awareness amongst the tourists.

The adaptation of technical infrastructure is often critically discussed since such measures tend to have significant impacts on the landscape and in some cases also on other forms of land use (Pröbstl-Haider et al., 2021). For Slovenia we expct that water management will attract more public scrutiny, discussion and clash of interests in the future, especially in the Western Slovenia but not strictly limited only to there. The drought in the Summer of 2002 revealed several cases of clash of interests between tourism and local interests, either because of wastewater management at tourism peaks, such as was the case in Bled (STA, 2022) or because of regional water savings needs in the Mediterranean Slovenia (Batista Štader, 2022).

The summer outdoor activities, especially golf, can expect heightened criticism. Similar to Austria (Pröbstl-Haider et al. (2021)), the same can be expected for Slovenia as well – the increased needs for irrigation of golf courses due to drought stress. They recommend several measures, starting with detailed recording of the consumption figures for water to increase the awareness in companies or clubs and to obtain comparative data. Irrigation is often also in conflict with agricultural land use. In the case of golf courses, both the adaptation of the technical infrastructure as well as an adaptation of the environmental conditions might be considered. Particularly water-consuming parts of a course could be completely redesigned. In this context, various authors are also calling on tourists, athletes and management to rethink how golf courses are supposed to look, to discuss designs that are closer to nature, include more natural difficulties, and which are clearly different from the current design of uniform green and standardized bunker landscapes: *"Economical water and energy management, rich biodiversity and an attractive facility both from a sportive and aesthetical perspective should no longer be seen as contradictions"* (Pröbstl-Haider et al., 2021, p. 13).

Adaptation measures for municipalities and regions

Heat and health considerations for outdoor tourism

For some destinations summer heat in July and August will become an important issue. Although we do not project that the increase of summer heat will decrease the number of visiting tourists, destination marketing does need to address the issue by actively educating tourists and stakeholders regarding the dangers of heat and the need for low-carbon alternatives to increased air-conditioning.

The most important health challenge for Slovenian outdoor tourism is the issue of tourists and tourism workers health with regards to heat waves and to a smaller extent also to expected increase in vector spread diseases. For outdoor activities it is especially the combination of heat with humidity that is the most problematic. During hot, humid weather, sweat cannot evaporate as easily from the skin, so athletes are at greater risk of developing illnesses such as heat exhaustion and heat stroke – the latter being potentially fatal (Zhongming, Linong, Xiaona, Wangqiang, & Wei, 2019).

Most importantly, local destination management needs to put special emphasis on informing tourism stakeholders regarding the future dangers of heat waves and related increasing energy needs. As the energy needs for cooling will increase in the future, extreme efforts are needed in finding, supporting and securing solutions for both health protection while at the same time following the imperative of reducing greenhouse gases. As the UNEP climate adaptation handbook for battling heat in cities (UNEP, 2021a) shows, there are numerous measures needed (see also Chapter 3 in this book report?). Securing appropriate infrastructure is an important direction falling on the responsibility of local governance. Here we propose Slovenian local destinations to follow the proposed pathways for cities: provide baseline assessments as the starting points of action, identify and support heat-resilient design and infrastructure, district cooling, energy-efficient and thermally efficient buildings, community-centric initiatives to advance heat equity and access to cooling, build awareness and capacity amongst stakeholders and fund sustainable cooling interventions.

Next to informing both tourists and tourism health workers regarding the dangers of heat an important direction is establishing a well- operating health system for tourists especially in the time of heatwaves. Ensuring appropriate coverage of defibrillators and their usage in Slovenia nearby to outdoor recreation facilities and tourism hotspots is of a prime importance. However, the AED defibrillators location website of Slovenia shows that there are still many tourism areas lacking a defibrillator. Additionally, in destinations with high levels of tourism the introduction of specialised tourism ambulances which are currently not yet common in Slovenia is highly advisable.

Information and early warning systems

For information coping to be effective at an individual level, there must necessarily be a system-wide option in place. Pröbstl-Haider et al. (2021) stress the role of early warning systems which would be helpful for many activities to avoid tourists getting into risky situations due to flooding, thunderstorms or extreme heat. Enhanced information material also includes tailored maps, including information on typical risks. In an alpine environment, careful selection of the suitable time windows for selected activities may be part of the awareness-raising campaigns and early warning systems (Pröbstl-Haider et al., 2021).

Educating tourism personnel, local destination stakeholders and tourists regarding the dangers of heat stroke and the measures for safe outdoor activities at times of increased heat is of prime importance. Similarly to the Extrema App for urban areas which helps users find the nearest cooling space, free drinking water spot, or plan the best route to avoid discomfort sing real time weather data (Florian, 2022) a specific direction for outdoor tourism are digital solutions that would combine health and weather data with the rising trend of digital navigation of various hiking and cycling trails.

Although early warning systems are primarily developed for local residents, local destination management needs to assure that tourists as well are well informed and that local strategies of protection from the heat, flooding, landslides and water scarcity take into consideration the safety and interests of tourists as well as residents.

Adaptations of destination marketing

Climate change adaptation for destination marketing of outdoor tourism in Slovenian destinations includes four specific considerations:

- destination marketing changes related to the potential of extended summer and shoulder seasons,
- destination marketing changes related to summer heat,
- destination marketing changes related to climate change in competing destinations, and
- destination marketing changes related to changes in tourists' climate change awareness.

The changes of climate conditions alone will not suffice for the prolongation of the summer and shoulder seasons. Next to adjusting the temporal planning of the marketing campaigns local destination marketing needs to analyse their current target markets and project their future climate change reactions with the aim of finding best target market positioning for the extended seasons. A consideration of social circumstances of their target markets, primarily the holiday availability in the extended seasons is needed. As argued above, expected is the increased pressure of employers to providing holiday leave in the summer as a trend that can negatively influence the fight against seasonality. On the other hand, we might see an increase in the trends of remote work, shorter work week and measures of staggered holidays. What we need to know in the future is how these trends will affect the main Slovenian markets (e.g. Germany versus Italy).

Furthermore, as with rain, local destination marketing is advised to promote a variety of activities and options for individual adaptation measures at the time of heat waves, such as the indoor activities or temporal adjustment within the time of day.

Destination marketing changes related to climate change in competing destinations include following closely the trends in competing destinations, primarily in the Mediterranean and the Alpine environment. Both areas are projected to be importantly affected by climate change. In a nutshell, as argued above, the Mediterranean will be forced to look for alternatives to the extreme heat in the summer and the Alps will be affected by the negative effects to winter tourism, loss of glaciers in the summer, but also extended shoulder seasons. This means that we can expect an increase in competition for the shoulder seasons and Slovenian destination marketing needs to prepare accordingly.

Slovenian outdoor tourism is especially vulnerable to the rainy conditions. Next to systems of securing tourists' safety and health, the adaptation measures include tackling the tourists' acceptance of rainy conditions. As Amelung and Viner (2006) point out, tastes and fashion are not stable over extended periods of time. The modern habit of sunbathing, for example, was not part of popular culture until relatively recently. Many things may change over the next decades that increase or decrease the relevance of the climatic resources for tourism in general. Sunbathing is for example now seen as a potential health risk (Amelung & Viner, 2006).

Extending the seasons includes actively addressing the challenge of rainy days for the tourists. Destination marketing can both identify the target markets that are more willing to travel when the risk of rain is greater, but it can also be actively involved in awareness raising that via appropriate technical adaptation (e.g. better clothing) many of the activities originally planned can still be highly enjoyable even if in rainy conditions. Finally, destination marketing can also promote the product diversity at the local and national level, so that on rainy days tourists can adjust by selecting other activities than originally planned. Here again, cooperation amongst the four macro destinations has an important future potential.

A specific case in point is camping. Wilkins et al. (2018) report that people who were tent camping for their overnight accommodations were more likely to state the importance of the weather when selecting their destination, and also the importance of the actual weather during their trip. Thus, this group would be the most likely to change future behaviour due to the weather. However, the weather variable that had most influence on campers was precipitation. With increased precipitation expected due to climate change, fewer campers may choose to visit the area. Campgrounds could adapt to this weather sensitivity by adding more awnings, sheltered camp spots, or sheltered picnic areas so visitors who prefer camping are less influenced by increased precipitation (Wilkins et al., 2018). Their analysis also showed that RV campers reported lower levels of influence of weather than tent campers. In the future we might thus expect an increase in VR camping. However, similarly as an increase in air-conditioning, VR camping too means an important increase in greenhouse gases and thus includes dangers of maladaptation to climate change when the climate change adaptations conflict with climate change mitigation efforts.

Finally, Slovenian destination marketing needs to consider the future trends of changing tourists' awareness and adapt accordingly with appropriate sustainable offer. The Green Scheme of Slovenian Tourism, a certification scheme currently including more than 200 destinations and tourism providers, is an important direction of future development both as a means to educate and inform destinations regarding appropriate green management and as a potentially important marketing tool.

Greater cooperation among destinations: e-cycling networks, hiking trails and thematic routes

Slovenia is covered with various thematic routes: Slovenian Tourism Association counted approx. 700 thematic routes in Slovenia (Prah, 2021). While some routes are highly successful most struggle with long-term durability and almost all are highly dependent on voluntary labour, as the analysis Cultural Routes of the Council of Europe in Slovenia showed (Turnšek et al., 2021). Future cooperation at the local level along these routes should be of prime strategic direction, especially with regards to green mobility as a climate mitigation measure but also in securing the long-term durability of trails, whereby inter-municipality cooperation is needed.

Here, local destination management needs to consider both infrastructure and technical adaptations of outdoor tourism. With regards to technical equipment supporting infrastructure development of cycling routes, a very common measure in Slovenia in the past decade was the development of municipality-level public rental cycling systems. As a form of adaptation for the future we recommend the extension of these systems for e-cycling, especially for the summer months, higher altitudes, and longer distances. Such e-cycling systems could thus operate not only within municipalities as is the current practice, but interconnecting much larger areas, starting within the four macro-regions.

Generation of knowledge, integral planning and management, offer of incentives

The destination management organisations of the four macro regions face a number of similar challenges for future development of outdoor tourism with regards to climate change. The general adaptation measures such as the generation of knowledge and raising awareness, integral planning and management and offer of incentives for climate change adaptation at the local level are thus highly advisable for all four of the macro regions.

A common critique of the role of tourism in the current state of climate change adaptation governance is that on the one hand local adaptation plans usually do not include tourism and recreation and on the other hand tourism and recreation strategies do not include climate change adaptation and mitigation (e.g. (Day et al., 2021; IPCC, 2022). Local governance thus needs to secure the inclusion of destination management in integral planning and management of local development while destination management organisations on the other hand need to actively advocate for such involvement. Almost all the above proposed measures of climate change adaptations fall outside of the narrow destination management responsibilities and even in cases where this is primarily the responsibility of destination management organisations, such as destination marketing and tourism taxation, the intersectoral cooperation is still highly needed. For example, targeting climate change aware tourists necessary involves cooperation with sectors responsible for green mobility and public transportation.

Integral local management of tourism in climate change adaptation in Slovenia means active involvement and cooperation of destination management organisations with multiple other sectors of the local governance: starting with local sports and culture associations, which are usually the most interactive channels of communication with citizens in Slovenia, and involving energy, agriculture, water, transport and local civil protection sectors, to address the climate change challenges (see Figure 143).

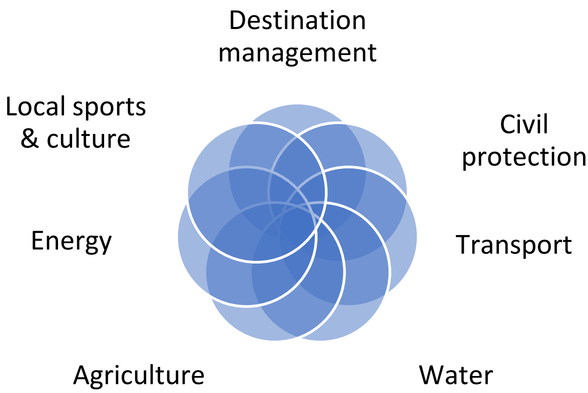


Figure 143: Integral planning and destination management of climate change adaptation at the local level: need for cooperation of sectors
Source: own formatting

An important area of integral destination management is the role of tourism in support of local food production. Tourism industry stakeholders should collaborate with local farms to sustain local produce and maintain local yields both with regards to future energy prices trends (Vij et al., 2021) and the dangers of reduced agriculture production projected by the IPCC for Europe and the rest of the world (IPCC, 2022).

National adaptation measures

The impacts of climate change affect all geographic, administrative and socioeconomic levels. Therefore, local planning must interact with the supra-municipal bodies at the regional and state level. Similarly, tourism depends on different systems (energy, transport, environment, health) to supply resources and generate tourist sites. The tourism system is complex, so adaptation strategies must consider the cross-functionality of policies, integrating the different administrative and policy areas of relevant authorities and agencies (eco-union, 2019).

All of the proposed measures for destinations at the municipality level described above should be considered also for destination management and marketing of outdoor tourism at the national level. In this section we thus focus only on additional measures specific for the regulatory power of the state, starting with integral and inclusive planning that avoids maladaptation to climate change.

Preventing maladaptation

As the most important starting point, the state should ensure policy alignment integrating climate mitigation and adaptation, biodiversity, and pollution concerns in tourism policies, strategies, and initiatives (Neufeldt, Christiansen, & Dale, 2021; UNEP, 2021b).

Analysed from the perspective of summer and outdoor tourism, the latest Strategy of Slovenian tourism 2022–2028 (MGRT, 2022b) and the latest main promotional document of Slovenian outdoor tourism (STO, 2021a) do not directly address climate change adaptation of summer outdoor tourism. Adaptation is addressed generally with the future measure of preparing a national model of climate change adaptation of Slovenian tourism (which is the aim of this report). The five broad strategic goals as presented by the strategy are generally in line with the results of this report:

- to increase quality and value and ensure a year-round tourism offering;
- to increase the satisfaction of locals, tourism employees and guests;
- to position tourism as a generator of value and sustainable development;
- to decarbonise and balance Slovenian tourism; and
- to ensure a competent and efficient management structure.

However, a more detailed analysis of the measures themselves shows an inherent discrepancy and a complete lack of climate mainstreaming, especially with regards to the goal to decarbonise Slovenian tourism. According to the European Commission (EC, 2022a) climate mainstreaming requires programmes in all policy areas to consider climate priorities in their design, implementation and evaluation phases. In the latest financial framework this includes:

- an overall target of at least 30% for climate-relevant expenditure;
- a 'climate adjustment mechanism', allowing for action to be taken in case expenditure levels are likely to be insufficient to reach (programme-specific) climate spending targets;
- the development of an effective climate tracking methodology to track the level of expenditure; and

- the application of the ‘do no harm’ principle to ensure that money spent under the budget does not prevent the EU from achieving its climate and environmental goal.

Although the Slovenian tourism strategy claims decarbonisation as the main strategic goal, most of the measures do not directly support this goal and the “balanced growth scenario with the "Somewhat more and much better" principle” does not directly support decarbonisation of the overall sector. While the targets are to reduce the carbon footprint per units of overnight stay, GDP % of tourism and added value, the overall calculated projections for this scenario ((MGRT, 2022b) p. 109) still include a 5% increase of CO_2 emissions for Slovenian tourism sector – while the goal of the EU is to deliver a reduction of emissions of at least 55% by 2030 compared to 1990 levels.

These potential threats should be directly addressed in implementation of the main investment pillars of the strategy by strict climate mainstreaming of the overall investments in tourism private and public infrastructure. A current example of a positive direction are the rules on eligibility criteria for public funding via the National Recovery and Resilience Plan, which is a direct result of the EU climate mainstreaming efforts (e.g. at least 50% of the investment needs to be spent on energy efficiency according to PURES-3 criteria, the investment is in line with the “Do No Significant Harm” Policy, after the investment the beneficiary needs to become part of the official sustainability monitoring and certification schemes) (MGRT, 2022a). More research and analyses are needed; however, we argue that the rules need to be even stricter and that minimum 50% is most likely not raising the bar high enough for the public funding to secure the net-zero transition as intended by the EU climate mainstreaming. At the minimum, in the future all investments should necessarily include climate change vulnerability analyses and climate adaptation and mitigation action plans together with implementation oversight.

According to the latest IPCC report (IPCC, 2022), there is increased evidence of maladaptation across many sectors and regions globally. Maladaptive responses to climate change can create lock-ins of vulnerability, exposure and risks that are difficult and expensive to change and exacerbate existing inequalities. Maladaptation can be avoided by flexible, multi-sectoral, inclusive and long-term planning and implementation of adaptation actions with benefits to many sectors and systems.

Most important potential dangers of maladaptations of Slovenian summer and outdoor tourism which need to be addressed via national integral planning and management are:

- increase of air conditioning without necessary climate change mitigation (greenhouse gases reduction solutions both in reduction of energy use and switching to net-zero energy);
- prolonged seasons that would just add to the pressure on carrying capacity of many Slovenian destinations without appropriate measures of securing positive benefits of deseasonality, and without appropriate biodiversity protections, especially in relation to hiking and cycling trails; and
- diversification of tourism offer that would hinder instead of benefit sustainable development of Slovenian tourism: VR camping increase without necessary greenhouse gas reduction solutions, water-based activities that would add to the pressures of tourism on water management, extension of golf-courses without appropriate water management solutions.

On the other hand, the current Slovenian tourism strategy (MGRT, 2022b) puts important emphasis on slow sustainable mobility at the destination as one of the core measures. And with regards to summer outdoor tourism, we see an important and well-shaped direction of future support to cycling and hiking as forms of green mobility whereby the focus is on interconnecting the separate sections of cycling and hiking trails, including internationally. Additionally, the strategy includes development of e-cycling system which will be integrated with the public transport systems and hotel reservation systems which is a positive development also in the direction of climate change adaptation. Finally, the green mobility measure of introduction (and certification) of at least one new car free destination per year is also a measure that further supports outdoor tourism in Slovenia. For destinations that will aim for this status it would be wise that the government also introduces climate change adaptation and mitigation action plans as a necessary and obligatory condition for the status.

Biodiversity protection

As our data show one of the most important directions for the future climate change adaptation of Slovenian tourism is the continuous care for hiking trails, especially prevention of soil erosion and measures of biodiversity protection in higher altitudes and protected areas. The state should regulate land use and boost environmental conservation.

Adaptation of the natural conditions are measures by which the climate change vulnerability is reduced by improving the natural conditions, e.g. enhancing the continuity of rivers and creeks to improve fish migration, planting vegetation along river banks to improve fish habitats, or by redesigning golf courses and planting trees. (Pröbstl-Haider et al., 2021). Important area is also the infrastructure adaptation: artificial pools, artificial canoe routes, the reconstruction of trails and new connections (bridges) (Pröbstl-Haider et al., 2021).

Biodiversity loss is becoming increasingly recognised to be the twin challenge of climate change, as emphasised by the latest IPCC report (IPCC, 2022). Regarding outdoor tourism in the summer and shoulder seasons the ADAPTUR model (eco-union, 2019) proposes the reduction of the vulnerability of tourism infrastructure to climate risks by increasing the number of protected areas in mountain areas to improve active management against climatic risks. As argued above, Slovenia has a very high number of protected areas. The focus of local destination management should be on securing active involvement in the future protection of these areas and the management of negative consequences of tourism flows through these areas.

The EUROPARC Federation of Nature Protected Areas in Europe, including Natura 2000 sites, stresses that to address the twin challenges of climate change and biodiversity loss, two underlying needs must be considered:

- involve protected areas in spatial planning and climate change adaptation strategies at multiple levels of governance and assess risks, costs, and benefits of climate change impacts on socio-ecosystems at multiple geopolitical levels: European, national, subnational, ecosystem, species.
- ensure concrete and coherent integration of biodiversity and climate change priorities in EU policies. The lack of integration may lead to conflicting objectives and inefficient or harmful actions.

A survey amongst European protected area representatives showed that protected areas should have an access to financing dedicated to climate change adaptation as well as means to further involve local communities and their political representatives.

There is also a pressing demand for capacity building and the development of knowledge on climate change adaptation and mitigation from a nature management perspective (De Sadeeler and Coudurier 2019 in (EUROPARC, 2021), p. 2).

Water management

As argued above, an important conflicting topic for Slovenia now and in the future is the issue of water management, whereby we can expect future clash of interests between tourism and other sectors. Integral management is needed to ensure sustainable supplies of both drinking and irrigation water and rehabilitation and restoration of rivers, lakes and wetlands.

Next to educating and influencing the tourism providers, the role of both the national tourism strategy and local destination management is to find ways in which tourism becomes an ally in necessary adaptation infrastructure: improvement of local drinking water infrastructure, wastewater management infrastructure and agriculture water reservoirs.

While there is a need to protect recreational areas and their role in biodiversity, they may also serve as an important adaptation measure, interconnecting the needs of the residents, the tourists and nature. Recreation areas can thus be an important adaptation result of the local water management: both with regards to drought and floods. Slovenian local destination management of all four macro destinations needs to take on a role of active involvement in local policies and infrastructure development, operating as an advocate for nature-based solutions and an important ally in local water management strategies, taking on a role of supporting collaboration between local authorities, residents and local tourism organisations.

Next to the issue of golf courses, we expect the issue of water reservoirs to be another important area of contested debate of water management in the future. Since more rain in the winter and more drought in the summer are expected, building new and sustaining old water reservoirs will continue to be an important area of climate change adaptation. Here, the role of tourism and water management is a contested debate since the water reservoirs should primarily serve the needs of agriculture and should not be an additional burden to the environment. However, there are cases of good practice, such as the new artificial lake in Murska Sobota which serves both the needs of tourism and recreation, and the irrigation needs of a large agriculture company nearby. Additionally, we see important potentials for the future development of bio-pools, as is the case of a new pool in Radlje ob Dravi and as is the past development of tourism and recreation along artificial lakes in in Austria.

Furthermore, we expect outdoor recreation and tourism to have an important role in considerations of future flood protection management, especially with the direction to the nature-based solutions. The state is proposed to co-finance innovative adaptation projects that take into consideration drought and water management, biosecurity protection and recreation. A good practice example as identified by the UNEP handbook on heat management, is also directly connected to management of flooding. The Isar-Plan is a river restoration project in Munich, Germany that replaced around 8 kilometres of the monotonous canal-like riverbed – forced into walled riverbanks in the mid-nineteenth century – with a diverse, rewilding river landscape. This 11-year project (2000-2011) was a joint solution in response to the need for flood protection, improvement of water quality, and increased calls from citizens for green and recreational spaces in the city (UNEP, 2021a)

Climate services

The state is responsible for implementation of early warning systems for the prevention of natural disasters caused by climate change and communication during extreme events to visitors and residents. The protocols should be re-evaluated and updated on a regular basis, taking into account also the outdoor, rural and often hard to reach nature of many tourism activities in Slovenia.

Furthermore, for tourism stakeholders to be able to adapt they need further access to climate services such as used in this report, especially on a smaller geographical scale. Slovenian Environment Agency ARSO and Copernicus data should not only be easily accessible but accompanied by appropriate interpretations for the tourism sectors. As the ADAPTUR tourism climate adaptation guide argues, climate services are products with specific applications that are derived from the transformation of basic climate data and information. That is, they involve the practical translation of large volumes of data that are difficult to interpret for the end user, so that they serve to improve decision-making. Tour operators (TO) and Destination Management Organisations (DMO) can use historical series of climate information and long-term projections for strategic planning. Climate data can influence investments, the selection of locations, and architectural and landscape design. Insurance companies can also provide flexible contracts associated to climatic conditions that operators and tourist destinations can adapt to their particular characteristics and climate conditions. In addition, climate information can help governments to respond to disasters and climate-related risks with emergency plans and regulations, such as environmental impact assessments, hazard warning systems, evacuation systems, fire prevention, natural resources management systems (eco-union, 2019).

Social aspects of seasonality: staggering of holidays

At the national level, the options of staggering holidays need to be analysed as potentially important measures of addressing social aspects of seasonality (Corluka, 2019) . The case of domestic winter tourism in Slovenia has in the past showed that at least with regards to school holidays the two ministries responsible for tourism and education can cooperate and find more flexible arrangements as proven by two cases. The first is the division of winter school holidays in Slovenia in two different time slots so to avoid overload on the Slovenian winter tourism system. The second is the shift of winter school holidays planned for next year: in 2023 the winter school holidays are rescheduled to happen approximately one month earlier than usual due to the organisation of Planica 2023 FIS Nordic World Ski Championship. The reaction of school principals was, however, reportedly negative (Kuralt, 2022) and this shows the difficulty of systemic yet flexible changes in the holiday arrangements. While winter tourism has one of the strongest voices in the national system, it remains to be seen whether this will be the case for summer outdoor tourism and recreation. We hypothese here that this primarily depends on the national recognition of specific sports as elements of national identity. Sports is namely an important element of national identification with the Slovenian tourism destination brand (Ruzzier & De Chernatony, 2013). Most saliently, the achievements of Slovenian cyclists at the global sports arena in the past decade might affect also support for such flexible arrangements and proposals in the future also beyond winter tourism.

7 Conclusions

Background to the project

The 6th IPCC report (IPCC, 2022) identifies five steps of national adaptation: a) preparing the groundwork for adaptation, b) assessing the risks and vulnerabilities to climate change, c) identifying adaptation options, d) implementing adaptation action, and e) monitoring and evaluation of adaptation activities. In 2018, Slovenia's general progress was evaluated to be still on the level of preparing the groundwork (IPCC, 2022, p. 1882). The 6th IPCC report furthermore analysed planned and implemented adaptation in the European tourism sector. With regards to adaptation plans the general conclusion was that with the exception of winter tourism, the sector in Europe is still very much on the low level of climate change adaptation. Consideration of tourism in national strategies is limited and tourism strategies rarely mention adaptation while most tourism operators focus on near-term coping strategies and do not consider longer-term adaptation.

The latest national tourism strategy of Slovenia (MGRT, 2022) is the first to directly address climate change adaptation of Slovenian tourism. The strategy stresses the need of preparing the groundwork and "developing a model of climate change adaptation of Slovenian tourism". The strategy points to the hereby presented research as the main measure of climate change adaptation at the national level. This study, funded by Ministry for Economic Development and Technology and

National Research Agency thus means an important further step in three of the five basic steps of national adaptation process: (a) preparing the groundwork for adaptation within the tourism sector, (b) assessing the risks and vulnerabilities of Slovenian tourism to climate change, and (c) identifying possible adaptation options.

Slovenian tourism and climate change

National discussion with regards to climate change and tourism started more than a decade ago. At the time, especially two projected impacts were identified: (a) the diminishing snow cover and related vulnerability of Slovenian winter tourism (Faletič & Černe, 2007), and (b) the rising of the sea level and related flooding of the coastal areas (Golobič, Gulič, Bogataj, Mladenovič, & Praper, 2008).

However, although the risks with the two impacts were assessed and possible adaptation options were identified, there seemed to be very limited levels of translation in implementing adaptation options or climate change awareness at the national and local destination management. Climate change adaptation in Slovenian tourism has to date mostly been limited to technical adaptations for winter tourism via artificial snowmaking and to some extent also to diversification of winter tourism to summer and shoulder seasons. In contrast to some other Alpine countries such as 2016 French Mountain Act whereby it is legally binding to include climate change consideration when constructing new tourism units, no such binding regulations were made in Slovenia for snow-related tourism.

Furthermore, although the prolongation of the summer season as one of main impacts of climate change on Slovenian tourism has been identified in the past (Plut, 2007), there was no specific data available with regards to the extent of such prolongation for the different tourism activities spread across Slovenia, nor were specific adaptation options proposed beyond pointing out that this is potentially good news for the future of Slovenian tourism. Additionally, an overall analysis of climate change impacts that would include specific forms of tourism in Slovenia was still missing. This study fills this gap, accompanied by recommendations with regards to adaptation options for four broad types of Slovenian tourism, to some extent reflecting the four macro destinations of Slovenian tourism: winter tourism, urban and cultural tourism, water-based tourism and summer outdoor tourism.

Finally, next to the specifics of the four different types of tourism activities, the aim of this report was to take into account also the broader context when proposing adaptation options for Slovenian tourism: (a) how climate change is projected to affect other European competitive destinations having also indirect impacts for Slovenian tourism, (b) the indirect impacts Slovenian tourism might have on biodiversity and heritage preservation according to climate projections, (c) the sectoral interconnection of tourism with other societal structures in climate change adaptation, and (d) the intersection of climate change adaptation and necessary measures of climate change mitigation, identifying the most important area of potential maladaptation.

Destinations/types of tourism chosen

Taking into account the ideal climate conditions necessary for each type of tourism activity the analysis in this study follows the categorisation of four main types of tourism activities based on which the location points were selected representing the diverse activities:

(a) Health, wellness, beach and other water-related tourism:
- Celje, Cerklje ob Krki, Murska Sobota and Novo mesto as locations in the Thermal Pannonian Slovenia macro destination,
- Portorož in the Mediterranean Slovenia, and
- Rateče in the Alpine Slovenia for lake and river-based tourism.

(b) Urban and cultural tourism, including MICE tourism:
- cities and towns of Slovenia across the range of four macro destinations: Ljubljana, Maribor, Celje, Novo mesto, Koper and Nova Gorica.

(c) Winter outdoor tourism:
- Rateče as the highest weather station close to Kranjska Gora, and
- main skiing destinations in Slovenia: Cerkno, Kanin, Kranjska Gora, Krvavec, Pohorje, Rogla, Stari vrh, Vogel, all in the Alpine Slovenia.
- Summer outdoor tourism:
- Portorož & Bilje in the Mediterranean Slovenia,
- Murska Sobota & Cerklje ob Krki in the Thermal Pannonian Slovenia,
- Ljubljana & Kočevje for Ljubljana & Central Slovenia, and
- Šmartno pri Slovenj Gradcu & Rateče in the Alpine Slovenia.

Climate change projections and past data are thus analysed and interpreted for each of the selected four areas of tourism activities in Slovenia, covering different climate data and including interpretations specific for these activities.

Data method and limitations

The analysis uses past climate data and three scenarios of climate change until the end of the 21st century: RCP2.6 (optimistic), RCP4.5 (middle) and RCP8.5 (pessimistic). Two databases were used to get a wider range of available data: historical data and projections from the Copernicus Climate Change Service for two tourism climate indices (HCI: Urban and CIT: 3S) and snow data (number of days with 5 cm / 30 cm of snow cover, total snow precipitation and potential snowmaking hours) for the reference period (1986–2005) and future scenarios (RCPs) in the periods 2021–2040, 2041–2060, 2081–2100; and ARSO archive data to calculate CIT, HCI and effective temperature values for the historical periods (1971–2000, 1981–2010, 1991–2020, and for comparison with the Copernicus dataset also for 1986–2005) and climate projections for the number of days in a month with at least 1 mm / 20 mm of precipitation, number of days with snow cover, number of tropical nights, warm days, and hot days for four time periods (2011–2040, 2041–2070, 2071–2100 vs. the reference period 1981–2010) and three RCPs.

The uncertainty of projections is assessed using the spread of values projected by different models. Projections of air temperature and resulting indicators, such as hot days and tropical nights, are much less uncertain than projections of precipitation. The reliability of projections of relative humidity, cloud cover, and the like, which were used to calculate tourism climate indicators, is even lower, so projections need to be explained with caution. It is always important to look at differences relative to the reference period and not at absolute values of projections as they are not bias-corrected.

Summary of findings and recommendations for destinations/types of tourism

According to the 6th IPCC report the adaptation solutions should be judged on whether they are effective, feasible, and conform to principles of justice. Effectiveness refers to the extent to which an action reduces vulnerability and climate-related risk, increases resilience, and avoids maladaptation. Maladaptation refers to actions that may lead to increased risk of adverse climate-related outcomes, including via increased greenhouse gas emissions, increased or shifted vulnerability to climate change, more inequitable outcomes, or diminished welfare, now or in the future. Most often, maladaptation is an unintended consequence (IPCC, 2022).

In Table 3 we summarise the main climate change impacts on Slovenian tourism identified by the analysis of climate data. We follow the 6th IPCC report approach (IPCC, 2022) to visualise the main climate change impacts, representing the area of impacts, the effectiveness of proposed adaptation options and the feasibility of adaptation options. To as far as the available literature on climate change adaptation in tourism allows, we applied the approach originally developed by (Singh, Ford, Ley, Bazaz, & Revi, 2020) to the analysis of feasibility of the proposed adaptation measures of the four main types of analysed tourism: water-based, urban and cultural, winter and summer outdoor tourism. Finally, each area of proposed adaptation options includes the identification of most important threats to climate change mitigation (maladaptation) and opportunities for a positive impact of adaptation measures on climate change mitigation efforts.

Temperature increase: prolongation of shoulder seasons

The first main identified impact of climate change for Slovenian tourism is the prolongation of shoulder seasons due to temperature increase, which will impact most tourism activities positively with exception of winter tourism. While Slovenian outdoor and water-based tourism is not expected to be affected by the temperature increase in the Summer to the level that it would be avoided by the tourists, the Mediterranean destinations will highly likely look for adaptation options due to the temperature increase in the Summer. Similarly, Alpine destinations will look for diversification due to the impacts on winter tourism. Both will highly likely result in increased competition of the region for shoulder seasons. At the same time, North of Europe will have better conditions for domestic tourism in the Summer, resulting in greater competition for the Summer season.

The proposed adaptation options for this impact are product diversification for the shoulder seasons for all types of tourism, shift of events to shoulder seasons, mainly feasible for urban and cultural tourism and summer outdoor tourism, while less so for water-based tourism and inappropriate measure for winter tourism. Especially urban tourism shows great potential for adaptation in extension to year-long tourism, while marketing (including product development) adaptations to climate change impacts in the rest of Europe are necessary and feasible in all four areas of tourism, with, however, limited effectiveness since its success primarily depends on adaptation of other destinations.

Finally, the prolongation of the shoulder seasons brings important threats in the form of increase of negative tourism impacts due to growth of tourism in the shoulder seasons, e.g., increase of loss of biodiversity and increase of hiking trails soil erosion. At the same time, the prolongation of the summer season shows also a potential opportunity in climate change mitigation efforts as it affords and increase in green mobility (hiking, cycling) not only as more sustainable tourism activities but also as an elementary transport mode to and around destinations.

Temperature increase: decrease of snow cover

The most important impact of temperature increase is the projected decrease of snow cover and decrease of snowmaking hours. At the same time, with equal or increased precipitation, we can expect more rainy days in the winter.

In Table 3 we assess the potential adaptation measures for winter tourism. The least effective in the long run are measures that insist on holding on to snow as the only or main pillar of winter tourism in Slovenia: the continuation of snowmaking, since the appropriate conditions for snowmaking are also decreasing. Indoor ski slopes are a relatively feasible measure of infrastructure adaptation, with however important impacts on the environment while effective only to a degree (compared to the winter experience of natural snow). Most important direction of future adaptation of winter tourism destinations should continue to be the diversification to the summer and shoulder seasons which is both effective and feasible. Furthermore, diversification of non-snow related winter activities. Its effectiveness and feasibility is, however, limited since rain is amongst the least favoured conditions amongst tourists and would require adaptations that include also important behavioural and attitude shifts amongst the tourists. Finally, government regulation is needed to secure that climate change considerations will be obligatory included in future investments and subsidies of winter tourism.

Proper regulation and full attention to climate mainstreaming in financing of winter tourism adaptation is furthermore needed with regards to winter tourism due to the potentially important threats winter tourism adaptation brings to climate change mitigation efforts. First, greenhouse gas emissions will increase due to the increased energy needs for snowmaking and indoor ski slopes. Second, increase of snowmaking will increase pressure for water resources. Additionally, although less reliable, lack of snow cover might push winter tourists to increase the distance of travelling, eventually increasing the travel carbon footprint.

Temperature increase: health related impacts

Temperature increase will bring important impacts especially for summer and shoulder seasons: increase of number and intensity of heatwaves and increase of heat and humidity stress, increase of vector-borne disease and allergies, increase of susceptibility to allergies in target markets. Additionally, an indirect consequence of temperature increase is a continuation or potential increase of holidays in the summer in target markets due to employers reducing energy costs at the time of lowest productivity, thus showing further pressure towards increasing summer tourism, potentially negating the effects of prolonged shoulder seasons on de-seasonality of Slovenian tourism.

The most effective measures for combating the health-related impacts of temperature increases are technical & infrastructure interventions in the building shell, ventilation, air conditioning, increase of green spaces, organisational adaptation of working conditions, health plans, including coverage of defibrillators and tourism ambulances. Followed by informational systems for heatwaves safety, increase of water-based tourism and indoor tourism in the summer, escape to nearby non-urban destinations meaning a potential increase of rural tourism in the summer, behavioural change and awareness raising campaign about heat impacts, and intraday adaptation of tourism activities. Most of these measures are highly feasible for all three types of summer tourism: water-based, urban and cultural, and outdoor tourism. Important challenges are, however, present with organisational adaptation of working conditions and health plans, including coverage of defibrillators and tourism ambulances where we propose future research and where Slovenian tourism will highly likely need more support in the future.

Finally, it is important to warn that especially air conditioning means an important threat to climate change mitigation efforts. Without rapid decarbonisation of electricity supply, greenhouse gas emissions will increase due to the increased use of air conditioning. Additionally, we can expect an increase of greenhouse gas emissions from transport due to the temporary relocation of city residents to cooler locations during heatwaves, increase of VR camping, and general prolongation of the seasons.

Changed patterns of precipitation in the summer

Continuation of observed changed patterns of precipitation in the summer can lead to an increase of drought occurrence and a decrease of water levels at rivers and lakes, importantly affecting all four types of tourism in Slovenia, but most seriously water-based tourism. Furthermore, dry periods in combination with higher temperatures can lead to a decrease of water quality and related potential health impacts. An increase of water temperature on the other hand supports prolongation of the shoulder seasons for water-based tourism.

All types of Slovenian tourism are thus proposed to invest in water saving and efficiency, behavioural change and awareness raising amongst tourists and avoid investments in forms of tourism that hinder water management. This is proposed to be regulated via inclusion of inclusion of climate considerations in investments and subsidies of water-based tourism. On the other hand, tourism can be an advocate for investing in nature-based solutions and water reservoirs potentially supporting the systemic shifts needed for climate change adaptation in Slovenia.

In general, water management will continue to be an ever-pressing issue for Slovenian tourism whereby we can expect increased pressure and conflict for water resources with other sectors of society due to: increase of tourism in the shoulder seasons, increase of water-based tourism as an adaptation measure for the summer heat, increase of snowmaking, and heightened criticism of golfing as an activity which requires large amounts of water.

Impacts on tourism safety

Increase of forest fires danger and increase of storms, floods and landslides will require Slovenian tourism to invest in tourism safety plans and informational systems, including behavioural change and awareness raising. An important direction for the future is the interconnection of tourism, primarily summer outdoor tourism, and forest management.

Impacts on societal change

Finally, although societal changes were not directly under analysis, an important future direction of adaptation of Slovenian tourism to climate change is adaptation to potentially increased awareness of climate change mitigation needs amongst tourists. We expect that primarily European markets will be amongst the first to reflect this growing trend, both as a reflection of climate change activism (e.g., flight shaming campaigns) and the European Green Deal policy direction.

Slovenian tourism should further increase its marketing (including product development) activities to incorporate these changes. Increase in tourists' awareness might namely bring important opportunities for sustainable offer in Slovenian tourism. Heightened tourists' awareness and stricter regulation will furthermore potentially lead to increased scrutiny with regards to greenwashing in tourism, putting thus great responsibility on the Green Scheme of Slovenian Tourism certification.

Table 3: Summary of proposed climate change adaptation measures for tourism in Slovenia

Impact type	Adaptation options	Threats & potential opportunities for mitigation
Temperature increase: prolongation of shoulder seasons + Prolongation of the shoulder seasons for most types of activities -/+ Mediterranean (too) hot in the Summer & need for diversification of tourism in the Alps potentially leads to increased competition for shoulder seasons - North of Europe will have better conditions for domestic tourism	- Product diversification for the shoulder seasons - Shift of events to shoulder seasons - Extension of urban tourism to year-long tourism - Marketing adaptations to climate change impacts in the rest of Europe	- Increase of negative tourism impacts due to growth of tourism in the shoulder seasons, e.g. increase of loss of biodiversity, increase of hiking trails soil erosion. - Increase in green mobility (hiking, cycling) as elementary transport mode.
Temperature increase: decrease of snow cover - Decrease of snow cover & decrease of snowmaking hours - With equal or increased precipitation, we can expect more rainy days	- Snowmaking - Indoor ski slopes - Diversification to the summer & shoulder seasons - Diversification of non-snow related winter activities together with necessary behavioural change and technical adaptation - Regulation: inclusion of climate considerations in investments & subsidies	- Greenhouse gas emissions will increase due to the increased energy needs for snowmaking & indoor ski slopes. - Increase of snowmaking will increase pressure for water resources. - Lack of snow cover might push winter tourists to increase the distance of travelling, eventually increasing the travel carbon footprint.
Temperature increase: health related impacts - Increase of number and intensity of heatwaves & increase of heat & humidity stress - Increase of vector-borne disease & allergies - Increase of susceptibility to allergies in target markets - Continuation or potential increase of holidays in the Summer in target	- Technical & infrastructure: interventions in the building shell, ventilation, air conditioning, green spaces - Informational systems for heatwaves safety - Increase of water-based tourism & indoor tourism in the summer - Escape to nearby non-urban destinations: increase of rural tourism in the summer - Behavioural change and awareness raising - Intraday adaptation	- Without rapid decarbonisation of electricity supply, greenhouse gas emissions will increase due to the increased use of air conditioning. - Increase of greenhouse gas emissions from transport due to the temporary relocation of city residents to cooler locations during heatwaves, increase of VR camping, and general prolongation of the seasons.

Impact type	Adaptation options	Threats & potential opportunities for mitigation
markets due to employers reducing energy costs at the time of lowest productivity	- Organisational adaptation of working conditions - Health plans, including coverage of defibrillators & tourism ambulances	
Changed precipitation patterns in summer - Increase of drought & decrease of water levels at rivers and lakes - Decrease of water quality - / + Increase of water temperatures	- Invest in water saving and efficiency - Behavioural change and awareness raising - Tourism can be an advocate for investing in nature-based solutions and water reservoirs - Regulation: inclusion of climate considerations in investments & subsidies of water-based tourism	- Increased pressure and conflict for water resources due to: increase of tourism in the shoulder seasons, increase of water-based tourism as an adaptation measure for the summer heat, increase of snowmaking, potential increase of golfing.
Impacts on tourism safety: - Increase of forest fires danger - Increase of storms, floods and landslides	- Tourism safety plans & informational systems, including behavioural change and awareness raising - Interconnection of tourism and forest management	
Impacts on societal change + Potentially increased awareness of climate change mitigation needs amongst tourists (primarily European)	- Marketing adaptations to potential increase in tourists' awareness	- Increase in tourists' awareness might bring opportunities for sustainable offer in Slovenian tourism. - Heightened awareness and stricter regulation will potentially lead to increased scrutiny with regards to greenwashing in tourism.

Table 4: Main adaptation options to climate impacts in Europe: Role of tourism in Slovenia

Impact type	Adaptation option	Role of tourism in Slovenia
Adaptation options for food system: Drought	Irrigation Change of sowing/harvest date Change of cultivars Soil management	Include tourism development in planning of irrigation reservoirs: potential for recreation benefits Finance local food procurement
Water-related climate impacts and risk in Europe: Water scarcity	Supply: Storage (reservoirs) Supply: Water diversion and transfer Supply: Desalinization Supply: Water reuse Demand: Water saving and efficiency Demand: Regulate distribution Demand: Economic instruments Demand: Land management and cover change Monitoring and operational management, drought early warning systems	Plan for water availability in investments: avoid investments in pools and golfing at water scarce areas Invest in water savings and efficiency, including behavioural change
Water-related climate impacts and risk in Europe: Flooding river	Ecosystem based (e.g., floodplain restoration, widening riverbed) (Protect) Retention and diversion (Accommodate) Wet and dry proofing (Accommodate)	Include tourism development in ecosystem-based adaptations Plan for flooding risks in investments
Water-related climate impacts and risk in Europe: Flooding pluvial	Retention: green roofs (Accommodate) Retention: parks (Accommodate) Update drainage systems and pumps (Accommodate)	Invest in green roofs at tourism infrastructure Include tourism development in planning of parks Invest in drainage systems and pumps Plan for landslide risks in investments
Water-related climate impacts and risk in Europe: Flooding coast	Ecosystem based (e.g., wetlands, oyster reefs) (Protect) Sediment based (e.g., nourishment) (Protect) Wet and dry proofing (Accommodate)	Include tourism development in ecosystem-based adaptations Invest in wet and dry proofing Plan for flooding risks in investments
Risk for cities, settlements and key infrastructure in Europe: Reduction of thermal comfort	Interventions in the building shell Ventilation (natural/mechanical, including night) Air conditioning Shading Green roofs, green walls	Invest in tourism accommodation infrastructure, focus on sustainable energy for air conditioning Include local destination management in urban planning Invest in green shading, especially at resorts Diversify the tourism offer, focus on green transportation

Impact type	Adaptation option	Role of tourism in Slovenia
due to increasing temperatures and extreme heat	Urban green spaces Use of 'cool' paints and coatings Escape to nearby non-urban destinations	
Health related impacts and risks to human health: Mortality, morbidity, exposure, stress from heat	Behaviour change measures Natural cooling Building interventions Green infrastructures Heat proof land management Heat health action plans Bundle of options	Educate tourists and personnel with regards heat stress Invest in natural cooling Invest in building interventions Invest in green infrastructures Include tourism development in heat proof land management Build heat health action plans Consider bundle of options, including defibrillators and specialised tourism ambulances

Source: Adaptation based on IPCC 6th report (IPCC, 2022) and own results

Future adaptation pathways/transformation for Slovenia

Adaptation measures can be differentiated according to the level of system change and guided strategic thinking: coping, incremental, and transformative. As Salim et al. (2021) discuss on the case of glacier tourism, coping (or reactive) strategies do not lead to profound changes in the system. Coping strategies are mainly reactive and are implemented when the effects are not severe, the elements of the system do not have the opportunity to respond in another way, or the need for changes is not recognised. Examples of coping strategies in glacier tourism are covering the glacier surface with white covers to limit shrinkage or constantly renovating a trail to access a glacier. Incremental adaptation strategies provide the opportunity to continue the threatened activity by implementing minor changes. This strategy too provides limited changes that can sometimes increase the vulnerability of the system. For example, as access to the Fox and Franz Josef glaciers became more difficult and dangerous, operators substituted walking with helicopter-assisted hikes. If they can continue to operate, they become more vulnerable, as the price has increased fivefold and has become fuel-dependent activity, indexed on energy costs. The third type of adaptation is the transformative strategy, which aims to transform the system from its vulnerabilities and move it out of an unsustainable trajectory (Salim et al., 2021).

As has long been clear for Slovenia, amongst the four analysed types of tourism in Slovenia winter tourism is the type that needs dire transformative changes directed from technical coping measures towards diversification of offer in other seasons. However, also other types of tourism need to address other climate change impacts in a strategic and transformative way. Prolongation of the seasons, impacts of heat to human health, changed precipitation patterns, threats to tourists' safety and societal change all need a transformative strategic approach in Slovenia tourism. We argue here that such transformative approach considers the role of tourism in the broader context of climate change adaptation systemic changes. Table 3 presents effectiveness and feasibility of main adaptation options to climate change impacts in Europe as assessed by the 6th IPCC report (IPCC, 2022). Transformative adaptation of Slovenian tourism is the one which Slovenian tourism recognises its role in addressing the main climate change impacts hand in hand with other societal sectors.

We recommend Slovenian tourism that next to specific adaptation measures identified above, takes on an active role in climate adaptation in cooperation with other sectors, primarily food systems, energy, water management, nature conservation and culture since in all these sectors tourism acts as a potentially powerful ally in transformative adaptations needed, but can also be a powerful hindrance. With exception of winter tourism, Slovenian tourism industry is one of the rare sectors that is projected to benefit from climate change, therefore it bears greater responsibility both to other sectors of Slovenian society, but also to other global societies.

This study provided a detailed analysis of projected climate change impacts on Slovenian tourism with recommendations for future necessary climate change adaptation on four levels: the tourists, the tourism providers, local and macro-reginal destinations, and finally the national level. For future analyses Slovenia needs to develop a system of monitoring of tourism adaptation and mitigation. A recent review of research into tourism and climate change showed that to date a comprehensive analysis of the integrated carbon and climate risks and associated mitigation and adaptation responses, including any complementary or antagonistic interactions, has not been completed for any tourism destination (at any scale) (Scott & Gössling, 2022).

Further research is needed primarily in five directions:

- monitoring of implementation and effectiveness of adaptation responses,
- integration of adaptation responses with mitigation efforts,
- tourist behaviour and markets responses to climate change,
- tourism stakeholders' awareness, involvement & communication on climate change, and
- climate change and tourism workforce.

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Tourism Climate Change Adaptation: The Case of Slovenia

Maja Turnšek
University of Maribor, Faculty of Tourism, Brežice, Slovenia
maja.turnsek@um.si

DOI
https://doi.org/10.18690/um.ft.6.2024

ISBN
978-961-286-926-7

This monography is a result of the national research project "V7-2128 Climate change and sustainable tourism development in Slovenia". It prepares the groundwork for adaptation within the tourism sector in Slovenia, assesses the risks and vulnerabilities of Slovenian tourism to climate change, and identifies possible adaptation options of Slovenian tourism. The analysis uses past climate data and three scenarios of climate change until the end of the 21st century. Two databases were used to get a wider range of available data: the Copernicus Climate Change Service and Slovenian Environment Agency archive data. The analysis focuses on four main areas of Slovenian tourism: (a) water related tourism, (b) urban and cultural tourism and MICE tourism, (c) winter outdoor tourism and (d) summer outdoor tourism. The results confirm past comparative research about Slovenian tourism being less vulnerable to climate change, with the important exception of winter tourism. While some of the climate change impacts are expected to even benefit Slovenian tourism, adaptation processes are still highly recommended both with regards to direct impacts, such as the increase of temperature, and indirect impacts such as the expected increase of tourism impacts on biodiversity due to the prolonged summer season.

Keywords:
tourism,
climate change,
adaptation,
tourism climate index,
Slovenia

University of Maribor Press

University of Maribor

Faculty of Tourism

Slovenian Research and Innovation Agency

REPUBLIC OF SLOVENIA
MINISTRY OF THE ECONOMY, TOURISM AND SPORT

The decision to publish the work is well-founded. The author's research exhibits innovation, grounded in robust methodology and scientific principles.
The research findings are presented and analyzed suitably, encompassing adaptation recommendations and potential individual-level contributions.
Notably, the authors have introduced novel content exceeding 30% in comparison to existing research within the field.

Tea
GOLJA
Juraj Dobrila University of Pula

The writing style is contemporary and professional, appealing also to the general public. It thus represents a good resource for students, teachers, tutors, and managers on all levels, particularly the latter, and will improve the research in the field of climate change impacts on tourism.

Iva
SLIVAR
Juraj Dobrila University of Pula