CLIMATE INDICES AND WINTER PROXIMITY TOURISM IN THE MOUNTAIN ENVIRONMENT: A LITERATURE REVIEW

FRANCESCA A.M. TATULLI - ALESSANDRO PEZZOLI

CLIMATE INDICES AND WINTER PROXIMITY TOURISM IN THE MOUNTAIN ENVIRONMENT: A LITERATURE REVIEW

Introduction. – Proximity tourism, a burgeoning trend in the post-pandemic era, is marked by a preference for destinations near urban areas. This trend, while presenting new challenges, also offers potential benefits. The escalating tourist influx to these areas presents new challenges regarding environmental sustainability and local economic impacts. Mountain and alpine regions, with their pristine natural environments, diverse outdoor activities, and the allure of escape from urban life, have emerged as prime destinations for proximity tourism (Gössling, Scott, Hall, 2021).

The concept of proximity tourism is familiar but has increased in response to the Covid-19 pandemic. The need to avoid international travel and reduce the contagion risk has led many people to discover or rediscover local and regional destinations (Chang, McAleer, Ramos 2020). Regarding this new phenomenon, a study conducted in Italy by Venturella, Sciortino and De Cantis (2023) showed that this trend of traveling with the country had increased post-pandemic. Observing absolute numbers, the trips made abroad due to the restrictions 2019 had reduced dramatically from 19 million in 2019 to 3 million in 2020. To quantify the trend of traveling within one's region, an intraregional tourism index was devised by this study, as seen in figure 1.

Fig. 1 – *Intra-Regional Tourism Index (2019-2021)*

Intra-Regional Tourism Index		
2019	2020	2021
0.20	0.27	0.24

Source: Venturella, Sciortino, De Cantis (2023, p. 115)

It is clear here that there is a preference of residents to stay within the region they reside in.

Various types of research investigated proximity tourism, which focuses on exploring nearby destinations. Jeuring and Diaz-Soria (2017) and

López Sánchez, Linares Gómez del Pulgar and Tejedor Cabrera (2021) discuss the significance of this type of tourism, with the former emphasising the need to rethink the relationship between the exotic and the mundane and proposing a tourism planning model for peri-urban areas. Jeuring and Haartsen (2017) examine how people's preferences for proximity or distance in vacation destinations relate to their sociodemographic characteristics, attitudes, and tourism behaviour within their home region, as well as how they represent proximity and distance in their motivations for engaging in proximity tourism. Rantala and others (2020) and Diaz-Soria (2016) further delve into the potential of proximity tourism, with the former suggesting a post-anthropocentric approach and the latter highlighting the role of guided tours in enhancing familiar places. Diaz-Soria (2016) and Rantala and others (2024) both emphasise the conscious decision-making process involved in becoming a tourist in a proximity destination, with the latter calling for a reconfiguration of tourism theory. Lastly, Merigó and others (2020) provide a bibliometric analysis of the most cited papers in the tourism field, potentially including these studies. It identifies the main topics and keywords that will predominate in future research in these fields, including proximity tourism.

Moreover, Diaz-Soria (2016) as Jeuring and Haartsen (2017) explored the role of proximity in tourism and discussed the construction of otherness and the attractiveness of near-home destinations, including mountain areas.

Mountain areas offer a unique attraction due to their biodiversity, the possibility of outdoor sports, and isolation and tranquillity. However, this trend brings several management challenges, as an uncontrolled influx of tourists can lead to overcrowding, environmental degradation, and pressure on local infrastructure (Nepal, Chipeniuk, 2005).

Along with the growth of proximity tourism, climate change presents significant challenges for mountain destinations (Steiger and others, 2022). The impacts of global warming are particularly evident in these environments, where rising temperatures and changing precipitation patterns affect the length and the quality of winter seasons, reducing snow availability and altering local hydrology (Steiger and others, 2017). These changes threaten the long-term sustainability of winter tourism, a significant economic attraction in many mountain areas, and require a reassessment of tourism offering strategies to include activities not dependent on snow conditions (Scott and others, 2019).

In this context, climate measurement tools such as the Holiday Climate Index (HCI) and the Climate Index for Tourism (CIT) become essential for tourist destinations. These indices, which assess the climatic propensity of a location for tourism by considering variables such as temperature, precipitation, and wind, provide valuable indications for determining the ideal frequency of tourist visits (Rutty, Scott, 2014). Using such tools allows for more efficient management of tourism flows, directing promotion policies towards times of the year that offer optimal climatic conditions for visitors and minimising negative environmental impacts (Becken, 2013).

This literature review introduces a novel perspective by integrating climate indices with proximity tourism, explicitly focusing on mountain environments. Compared to recent publications, it uniquely addresses the post-pandemic shift towards local travel and its impact on mountainous regions. It offers a comprehensive examination of how climate change influences winter tourism. The review synthesises existing studies on proximity tourism, sustainable tourism, and climate indices, providing a multidisciplinary approach highlighting the importance of adaptive strategies and innovative tools like the Holiday Climate Index (HCI) and the Climate Index for Tourism (CIT). It also identifies gaps in current research and suggests future directions, such as localised climate indices and diversified tourist activities, thereby contributing to more resilient and sustainable tourism planning.

The structure of the review will be as follows. The second section describes the research methodology, including the use of databases like Scopus and Google Scholar and tools like Connected Papers and Elicit for article selection and analysis based on specific keywords.

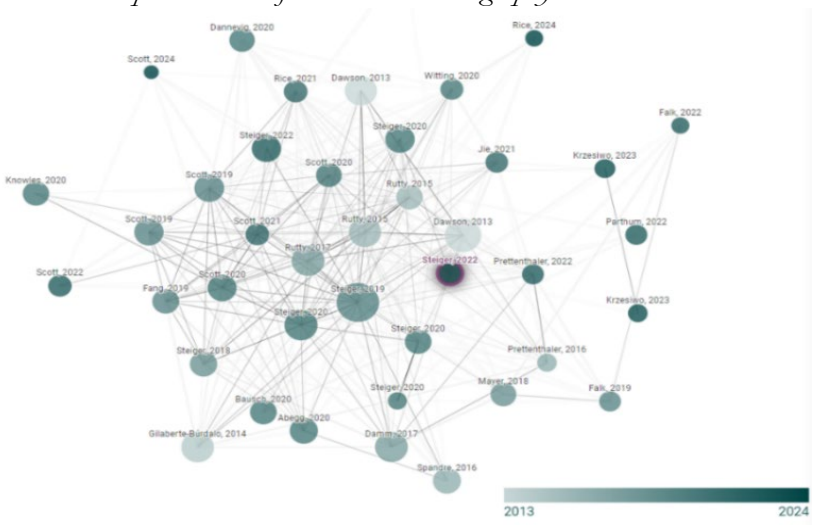
The third section will be the core of the manuscript, where key themes such as proximity tourism and sustainable tourism, the impact of climate change on winter activities, and the relevance of climate indices in tourism planning will be analysed.

In the fourth section, "Discussion", findings on the integration of climate indices into tourism planning, the need for adaptive strategies, and the practical implications for policymakers and tourism are presented. Finally, the research's conclusion is described in the fifth section.

This structure ensures a thorough exploration of the interplay between tourism trends and climate change, providing actionable insights for enhancing the sustainability of mountain tourism.

Materials and Methods. – The leading platforms used to set up the search for articles were Scopus and Google Scholar. Moreover, the digital tools Connected Papers and Elicit were used to facilitate the selection and analysis of scientific articles. Connected Papers made it possible to graphically visualize connections between related studies (fig. 2), helping us to identify relevant articles not only on the basis of citations but also by thematic affinity. This allowed us to explore related research fields and identify articles potentially overlooked by a traditional search. Elicit, on the other hand, using artificial intelligence helped identify and answer specific questions and synthesize critical article data, facilitating a rapid literature evaluation. With its ability to extract essential information such as methods, results, and comparisons between studies, elicit simplified critical analysis, allowing us to focus on highly relevant research. Integrating these two tools optimized the search process, making it more efficient and focused.

Fig. 1 – *Visual representation of the relevant bibliography*



Source: Connected Papers

The keywords employed were "climate change", "winter tourism", "winter sport", "proximity tourism", "sustainable tourism", "climate index", "climate indices", and "Italian Alps". The search with the above-mentioned keywords produced many results, particularly for the "climate change" keyword. Therefore, the search was refined by setting "climate change and winter tourism" together, handling "proximity tourism" and

"climate indices" on their behalf. At this point, titles and abstracts were scanned, and where necessary, the full text was read to decide whether to include or exclude, obtaining 13 relevant articles. The deadline for inclusion was June 14, 2024 and from each of these three criteria: (1) articles focused on proximity and sustainable tourism; (2) articles related to climate change and outdoor activities; (3) articles that included climate change indices and state-of-the-art on the topic have been extrapolated and their consequential usefulness to the research has been explained.

Literature Review. – This section will analyse the main three themes surrounding this research's focus: *proximity and sustainable tourism*, *climate change and winter activities*, and *climate indices*. State-of-the-art research on the topic will be extrapolated from each of these, and their consequential usefulness to the research will be explained.

Proximity tourism and sustainable tourism. – After the prolonged Covid events of four years ago, the topic of proximity tourism has begun to gain ground among vacationers. Proximity tourism is a way of travelling favouring those who aim for something other than distant, exotic locations that involve long commutes and significant planning. The mete of proximity is those close to the place of departure that can be reached safely. By car, in campers with bicycles towed and legs on shoulders, or by motorbike to discover nearby and sometimes forgotten places, moving independently and inaccessible places is the new trend.

Italy is a perfect case study for observing the concept of proximity tourism, given the proximity of beaches and mountain areas near large cities such as Turin and Milan.

For example, the Vialattea ski resort is a perfect case study of how proximity tourism can enhance local resources and promote sustainable tourism development. Located just 95 km, approximately 1 hour and 30 minutes from the metropolitan city of Turin, it offers a wide range of winter and summer activities, making it an ideal destination for proximity tourism.

However, the escalating tourist influx to these areas presents new challenges regarding environmental sustainability and local economic impacts. This underscores the urgent need for strategic and careful management of available resources, highlighting all stakeholders' pivotal and valued role in the tourism industry (Buckley, 2020).

Research completed by Silvia Blasi and others (2024) looked at the

relationship between proximity tourism and climate change in depth. Considering that tourism is one of the most important economic sectors in many countries worldwide, it is clear that sustainability is of crucial importance for its continuity in the future (World Travel and Tourism Council, 2020). To make sense of the myriads of tourist offerings, Silvia Blasi and others screened the current online offerings to decipher who concretely can be considered sustainable. She accomplished this thanks to a methodology that involved creating an index of the presence and degree of sustainable awareness on the offering websites. Web scraping allowed the researchers to collect the data, enabling them to construct a network of sustainable accommodation providers. The geographical proximity connected to the proximity tourism aspect was measured by using the local labour system (LLS) criterion (Sforzi, 1997), which was also employed in a study for tourist destination analysis in Italy (Lazzeretti, Capone, 2008; Lazzeretti, Petrillo, 2006). LLS is defined as local aggregations of neighbouring municipalities characterized by high demographic density. Such analysis techniques are fundamental to creating a clear image of the local tourist offering.

Blasi also states that collaborative innovation in tourism and hospitality benefits local network relationships (Marasco and others, 2018). Regarding collaboration, it is also worth noting that considering the ecosystem means having a keen understanding of competition and cooperation between firms. An increasing number of researchers have researched this phenomenon to analyze business and innovation (Blasi, Sedita, 2020). Not only this, but growing attention has also been given in literature to the need for a certain degree of cognitive proximity in local systems to promote innovation and economic development in the region (Capone, Lazzeretti, 2018) and, most importantly, resilience to external shocks like severe climate change (Blasi, Sedita, 2020).

Having considered this, the techniques of using the internet to gather these insights into what the tourist companies are offering in terms of services, products, and their self-representation is increasingly relevant as it is non-intrusive (Arora and others, 2016) and relatively inexpensive to obtain (Gök, Waterworth, Shapira, 2015). Nowadays, responses to online questionnaires are constantly declining, so an innovative approach that appeals directly to the website's infographics could be very advantageous. Electronic word of mouth from customer review websites concerning proximity locations has also been looked at by many researchers, such as Sparks and Browning (2011), Mishra, Urolagin and Jothi (2019), Calheiros

and others (2017) and Zhang (2019). Regarding this information gathering, Blasi, having conducted her research with Veneto as a case study city, found that only around 44.9 % of the analysed accommodation websites contained correct and usable information. Of this 44.9 %, a further screening to investigate the degree and characteristics of sustainability in tourism accommodation was completed using keywords. The subtopics covered here were sustainability in tourism, sustainability in tourism facility buildings and certifications. A hybrid approach was employed using a qualitative lexicon approach with manual picking of the relevant terms. This was followed by applying a word-embedding methodology by inserting a machine-learning algorithm proposed by Mikolov and others (2013). The results of this procedure can be seen in figure 3, where only 19.9 % of the results contained sustainability topics.

Fig. 3 – *Tourist accommodation facilities in the Veneto Region*

Type	Website	Websites containing sustainability topics	%
Guest room	425	53	12.5
Farmhouse	426	147	34.5
Hotel	2,052	405	19.7
Other	88	28	31.8
Apartment	109	8	7.3
Bed and breakfast	713	95	13.3
Camping	128	52	40.6
Country house	20	5	25.0
Guest house	2	1	50.0
Residence	65	9	13.8
Mountain hut	71	12	16.9
Total	*4,099*	*815*	*19.9*

Source: Blasi and others (2024, p. 485)

The farmhouse and campsite categories show the highest commitment to sustainability, most likely due to their geographical locations being in nature. The commitment and manifestation of these sustainability goals should be viewed through a new theoretical framework that combines organisations' cognitive and geographical proximity. Environmental sustainability is strongly related to tourism thanks to revealing its interconnections with social and governance dimensions. This is why it would appear as though proximity tourism is more likely to adopt sustainability practices compared to traditional offerings. Mihalic and Kscuer (2022) state that the acknowledgement of policymakers of this trend will help initiate sustainability certifications for tourist destinations, reduce the risk of tourist flow inequalities, and avoid the phenomenon of over-

tourism. Such risk of overtourism is also considered when it comes to land management and educating tourists on how to respect the environment of the locality they are visiting.

Such observations of local tourism and the consequences of the tourist flow were made by Mason and Neumann (2024) in their study of the impacts of climate change on British Columbia's backcountry. Climate change has profoundly impacted tourists' trail paths in this region due to extreme events such as smoke, dust, fire, flood, area closures, and beetle outbreaks. As in the previous study, communication with local authorities and trail managers is vital in understanding the cause-effect tourists have on the ecosystem. Ongoing anthropogenic pressures applied to the environment in this region are intensifying (Kirchmeier-Young and others, 2019; O'Neill and others, 2018), which is causing an increase in the need for maintenance of the local trails. Furthermore, climate change's influence on the Canadian Rocky Mountain parks is set to grow by 36% in the next 30 years (Scott and others, 2007), with associated costs estimated at over 32 billion Canadian dollars. The climate characteristics that will further impact how long these trails will be accessed are the higher temperatures, lower snowpack amounts, and longer warm weather seasons. Such activities stemming from the warm weather climate differ from those of the cold climate and, therefore, require different managing scenarios. The changing weather variables will lead to extreme temperatures and precipitation events, such as floods, droughts, heat waves, electrical storms, and wildfires (Kirchmeier-Young and others, 2017; Dale and others, 2020). Planning the land use is therefore crucial for the sustainability of tourism here and its survival, given the everchanging effects of climate change. Natural resource management is a fundamental aspect of this region, and critical activities, such as hiking, skiing, and mountain biking, rely on these areas. While proximity tourism is strongly present here, it is worth noting that transport-related emissions must be considered in developing these critical perspectives on outdoor recreation and sport. Also, wildlife must be regarded as their ecosystems are the first to be impacted by climate change.

Climate Change and Winter Activities. – Climate change has been one of the key drivers in pushing the industry to find solutions to mitigate this phenomenon over the recent decades. Literature in this area has looked at, in particular, the impact that mountainous areas face from reducing snow concerning rising temperatures. Countries with high winter sport

tourism, like Austria and Italy, will face future impacts from the reduced snow levels. At a managerial level, adequate plans will be required to adapt to the changes, and several measures must be taken. Such measures would include adapting strategies to increase the performance of more or less affected regions and general public investment for artificial snow production to keep the regions hit by low snow economically valid. The strong dependence on snow for these regions is the main reason these winter tourism localities will be hit strongest by climate change (Scott, Gossling, Hall, 2012). Research on how skiing tourism has been impacted by climate change began in 1986 (Harrison and others, 1986; McBoyle and others, 1986). However, while these focused on a more global view, few have concentrated their efforts on regional or country-specific assessments. A study by Steiger and others (2021) took Austria as a case study for climate impact on winter sports. Winter tourism accounts for nearly half (48%) of annual overnight stays (Oesterreich Werbung). The tourism industry here in this respect is so high that there are over 1.1 million beds in 62,000 tourist accommodations (*ibidem*) in a country comprising 8.859 million inhabitants (*ibidem*). These are impressive numbers, and one can perceive the importance of ski tourism in this region. With the climate change phenomenon being felt more in recent years, it was observed that a shift of demand in ski resort destinations created losses in the southern regions of Austria, such as the federal state of Carinthia and shifted the gains in western regions, such as Tyrol (Firgo, Fritz, 2017). The breakdown of winter sports exercised in this region is divided between alpine skiing (59%), winter hiking (13%) and snowboarding (9%). Only a tiny percentage practise cross-country skiing (3%) (Oesterreich Werbung). To reach said sports destinations, the means of transport are subdivided into the following: private cars (76%), followed by aeroplanes (13%), trains (7%), and coaches (3%) (Oesterreich, 2018b). Out of the said modes of transport, there is a positive note to mention that air travel is the highest of greenhouse gas emissions (GHG), keeping a low percentage concerning the rest (*ibidem*).

This may also indicate that proximity tourism is strong in this segment. Studies have also seen that despite air travel carrying a low percentage, it has indeed doubled since 2012% when it was only 9% (*ibidem*).

The optimisation of public transport would be an excellent way to contrast and lower the previously said data share on air travel. It is also worth noting that winter sports occur at a relatively high altitude. Therefore, the degree of climate impact depends on altitude and the region, as Austria

has distinct climatic characteristics (Steiger, Abegg, 2013). This means that the snow variance balance can be achieved with snowmaking, so long as the snow sports are practised on managed surfaces and the revenue generated is sufficient to make up for this extra investment. A parameter that is often used to define the variance of natural snow is snow reliability.

A ski area can be considered reliable if skiing is possible on at least 100 days per season for at least seven out of ten years (Abegg, 1996). Considering this, Austria ranks higher than Switzerland, Italy, and France regarding vulnerability, yet it is lower than Germany (Abegg and others, 2007). Figure 4 illustrates the reliability concept well.

Fig. 4 – *Climate change impacts on season length and snow reliability*

Indicators	1981–2010	RCP 4.5			RCP 8.5		
		2020–2049	2040–2069	2070–2099	2020–2049	2040–2069	2070–2099
Season length (days) with natural snow	80	64	56	45	63	44	19
Season length (days) with current snowmaking capacity	119	112	107	98	111	97	61
Season length (days) with improved snowmaking capacity (10 cm/day)	125	121	118	112	120	111	84
Share of snow reliable ski areas (100-day indicator) with current snowmaking capacity	90%	80%	72%	54%	78%	52%	11%
Share of snow reliable ski areas (100-day indicator with current snowmaking capacity) with improved snowmaking capacity (10 cm/day)	99%	93%	92%	83%	93%	80%	31%
Share of snow reliable ski areas (Christmas-New Year school break) with current snowmaking capacity	84%	65%	52%	37%	63%	33%	5%
Share of snow reliable ski areas (Christmas-New Year school break) with current snowmaking capacity (Christmas-New Year school break) with improved snowmaking capacity (10 cm/day)	98%	90%	80%	67%	92%	66%	15%

[RCP 4.5: Moderate scenario with relevant climate change mitigation measures, RCP 8.5: „Business-as-usual" scenario]
Source: Steiger & Scott, 2020.

Source: Steiger and others (2021, p. 4)

Also, geographically speaking, the future regional climate change patterns seem stable. Figure 5 shows that impacts can be more pronounced at the edges of the Alps while lesser in the inner regions.

Fig. 5 – *Projected snow reliability of ski areas in Austria*

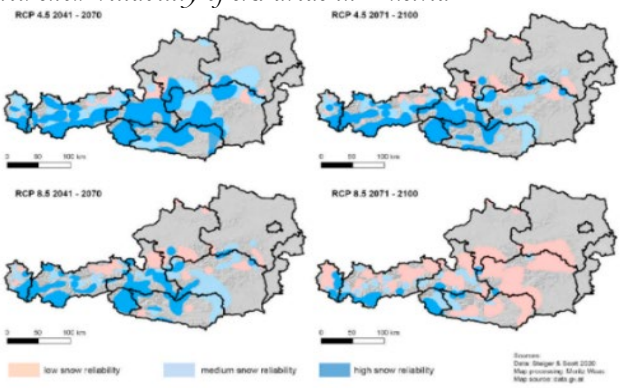


Fig. 3. Projected snow reliability of ski areas in Austria from (Steiger, Pröbstl-Haider, & Prettenthaler, 2020); licensed under CC BY 4.0.

Source: Steiger and others (2021, p. 5)

The conclusions that can be taken from these results are that several ski areas will be able to proceed with ski operations even up to the end of the 21st century once enough artificial snow investments are made. The other half of this outcome, though, is that more resources such as energy and water will be needed, and hence, the costs will increase, potentially affecting the lift prices. The second significant outcome will be the less profitable areas that cannot raise funds and resources to make up for decreased natural snow. This will potentially lead to a concentration and consolidation of the market and fewer ski areas. Concerning the touristic overnight stay, it was found that winter overnight stays in Austria had a positive relationship with natural snow depth. The absolute effect, though, was low and only significant for lower altitude ski areas under 2000m. Studies completed by Falk (2010) and Toeglhofer, Eigner, Prettenthaler(2011) found that the widespread use of natural snow is a likely answer to the declining dependence on natural snow. Much like the overuse of artificial snow, it has also been found that skiing on glaciers has been declining since the mid-1980s (Abegg, König, Maisch, 1994; Diolaiuti and others, 2006). In order to reach areas with more natural snow, skiers have redistributed the demand to higher altitude ski areas during low snow periods where a glacier ski area is within a 20-minute drive (Proebstl-Haider and others, 2015). Speaking always within this region, it was found that around 25% of holiday goers would abandon a skiing holiday if the snow conditions were deemed unreliable (Steiger and others, 2021; Unbehaun, Pröbstl-Haider, Haider, 2008). This risk of low snow not only shortens the season for other winter sports like cross-country skiing but affects the attractiveness of winter destinations (Landauer, Proebstl-Haider, 2008). This is because the landscape aesthetics of the "winter landscape" come into play and were found to be of great importance to customers. These physical risks at play were also observed in the study by Pede and others (2022).

This study considered the Italian Alps, which offer an excellent contrast to the previous Austrian reality. In this region, the tourist attractivity of the area will be affected to a different extent by climate change, especially when the distinction between winter and summer tourism is made (Proebstl-Haider and others, 2015). In the past decades, this area has experienced significant damage from climate change, and regional climate projections foresee further intensifying these trends by the end of the century (Gobiet, Kotlarski, 2020). To give an idea of the scale of global warming, the same

author previously cited Gobiet and others (2014) described how a warming of the 1.5 degrees increase expected in the first half of the 21st century is predicted to double for the second half to around 3.3 degrees.

The consequences of this risk will lead to accelerated retreats of glacier cover and permafrost, which will lead to natural hazards such as landslides, rock falls, debris flows, avalanches, and floods (Keiler, Knight, Harrison, 2010). Figure 6 summarises these hazards, which will, of course, have repercussions on the winter tourism of the local areas.

Fig. 6 – *Predicted natural hazards due to climate change and their potential impact levels on tourism*

Natural hazard	Description	Potential impact level	Sources
Desertification	Higher aridity of agricultural, forestry and pastoral areas with consequent rise in erosion and loss of organic matter in forest areas as a result of increased fire risk in connection with drought-related events.	Low	Corrado et al., eds., 2014 Matasci and Altamirano - Cabrera, 2010 Probst et al., 2013
Ecosystem changes (land and aquifer)	Changes in the phenological cycle and inland water and ecosystem transition (i.e. shift) due to habitat and soil mutations.	High	Beniston, 2012 Cannone et al. 2008 Cantonati et al., 2006 Ianni et al., 2015 Mourier et al., 2010 Revernmann et al., 2012 Wieser et al., 2008
Forest fires	Expected increase in the danger of forest fires throughout the year, mainly in the spring season.	Medium	Dupire et al., 2019 Moriondo et al., 2006 Moser et al., 2010 Schumacher and Bugmann, 2006 Wastl et al., 2012
Hydro-geological and hydraulic instability	Variation in seasonality and magnitude of phenomena associated with snow dynamics, instability of rock complexes, debris flows and surface landslides.	High	Ellena et al., 2020 Palladino et al., 2018 Probst et al., 2013 Prudent-Richard et al., 2008 Winkler and Reichl, 2014
Water scarcity	Decrease in the availability and quality of water resources related to the reduction of precipitation in winter and summer seasons.	Medium-high	Brunner et al., 2019 Hohenwallner et al., 2011 Klug, 2011 Mastrotheodoros et al., 2020 Zampieri et al., 2016

Source: Pede and others (2022, p. 27)

Such repercussions will lead to a distinction between 'winners' (positively affected) and 'losers' (negatively affected) in winter tourism (Elsasser, Messerli, 2001). Adaptation measures must be prioritised to stabilise the winners and losers in these future scenarios (Oppenheimer and others, 2014; Schindelegger, Kanonier, 2019). To further investigate precisely the characteristics of the mountain regions at risk in the Italian Alps region near Pinerolo Turin, the study by Pede and others (2022) identified a methodology that comprised the following risk factors related to climate change as a function of hazard (H), exposure (E) and vulnerability (V). These factors are operationalised explicitly through specific indicators

referred to tourism (Ellena and others, 2020; Zebisch, 2017; Oppenheimer and others, 2014). Figure 7 shows the details of the risk factors at a municipal level.

Fig. 7 – *Hazard, Exposure and Vulnerability indicators for winter tourism*

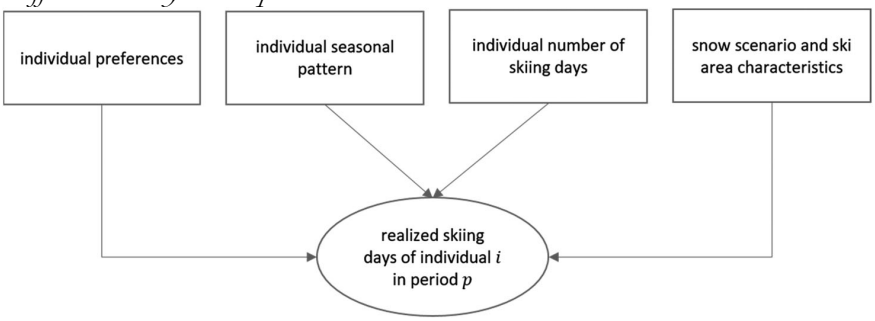
Source: Pede and others (2022, p. 32)

As mentioned in the previous study, artificial snow generation could be a remedy to maintain the attractiveness of winter tourism for the more at-risk areas. However, the issue is that there may not be enough water to fulfil the demand in the future. Melting glaciers may compensate for short-term hydrological scarcity (Hohenwallner and others, 2011). These primary effects might be increased by secondary effects of climate change, which may lead to a higher probability of extreme natural events in the high elevation points in the Italian Alps. Multi-level approaches may help respond to questions such as which municipalities require urgent intervention and which ones, on the contrary, present low levels of risk so that their tourist offer can be immediately promoted and valorised to support the overall attractiveness of the area (Pede and others, 2022) To conclude this area of analysis, further in-depth simulation of the effects of climate

change on winter tourism was studied by Robert Steiger and others (2023).

The revenue generated from ski tourism is known to be high, but this also fluctuates significantly during the non "best days" of snow. A case study in New England discovered that 30% of revenues are generated in the best 10% snow days (Hamilton, Brown, Keim, 2007). What can be deduced from this is that just one lost operation day in December has a higher impact on lift ticket sales than a lost operation day in November due to the differing use rates. The impact of climate change here was that the early and late seasons are more sensitive to climate warming, leading to a further loss of skiing days than during the primary season (Scott and others, 2019b). Further testimony of this phenomenon was seen by Steiger and others (2020) in that the willingness of a skier was significantly decreased with a lack of natural snow but with sufficient artificial snow on the slopes. Day-trip skiers are more vulnerable to not proceed with the ski trip in the case of low natural snow than overnight stayers (Gonseth, Vielle, 2019). Much in-depth investigation of this truth has still not been explored in literature. Figure 8 illustrates the potential steps that could comprise this investigation.

Fig. 8 – *Components for modelling winter tourism demand subject to snow conditions and differentiated by season periods*



Source: Steiger and others (2023, p. 2778)

This study concludes that climate change will impact the frequency of demand due to the deterioration of snow conditions (Scott and others, 2020). Snow is the most crucial factor for destination choice (Richards, 1996; Won, Bang, Shonk and others, 2008), and hence, many destinations will be at risk of closing if mitigation efforts are not made for alternative activities for tourists. To fully combat these strategies, it will be essential

to consider the physical characteristics that can be quantified using climate indices to correctly identify the locality's weak points.

Climate Indices. – A climate index known as the Holiday Climate Index (HCI) was designed to examine the climatic suitability of a touristic location more correctly. Indices have long been favoured to give meaning to tourism since the weather is known to be so complex. Before the HCI, the Tourism Climate Index (TCI) designed by Mieczkowski (1985) was used and designed to integrate the main climatic variables of tourism into a single numerical index. The following is the formula used by Mieczkowski:

$$TCI = 2\ x\ (4(CID) + CIA + 2(precipation) + 2(sunshine) + wind))$$

Where CID is the daytime comfort index, which is a combination of maximum daily temperature in degrees Celsius and minimum daily relative humidity (%); CIA is the daily comfort index, which is a combination of mean daily temperature in degrees Celsius and mean daily relative humidity (%), precipitation is measured in millimetres, sunshine in hours and wind in kilometres per hour or metres per second.

Its design was unique but criticised for several reasons (Moreno, Amelung, Santamarta, 2008; Rutty, Scott, 2010; Scott, Gössling, Hall, 2012; Gomez-Martin, 2005; Rutty, Andrey, 2014). The first deficiency was the subjective rating and weighting of climatic variables, followed by the neglect of the possibility of an overriding influence of physical, climatic parameters (e.g. rain, wind etc), low time resolution of climate data (i.e. monthly data) has limited relevance for tourist decision making, and lastly it lacks the varying climatic needs of major tourism segments and destination types such as beach, urban and winter sports tourism (Moreno , 2010; Rutty, Scott, 2010; Dubois and others, 2016; Hein, Metzger, Moreno, 2009; Scott, Gössling, De Freitas, 2008; Rutty, Scott, 2014). Fundamentally, the main weakness of the TCI is that the rating and weighting scheme of the sub-indices are subjectively based on Macknowski's opinion and not empirically tested against the preferences of tourists. It does not adequately show how poor the physical weather conditions can dominate. This is why the HCL was developed to assess the climatic suitability of destinations for tourism more precisely. The new index also aligned with the conceptual design De Freitas, Scott, McBoyle (2008) recommended.

Therefore, the overriding effect of physical variables (wind and rain) was considered while using daily data to estimate index ratings (chance of preferred and unacceptable conditions). This index also considers the different destination types with differing climatic requirements (Rutty, Scott, 2010; Scott, Gössling, De Freitas, 2008; Rutty, Andrey, 2014).

The HCI puts together all three areas (De Freitas, 2003) of climate important to leisure tourism activities. The formula that is a derivative of the TCI is as follows for the urban context:

$$HCI\ urban = 4(TC) + 2(A) + (3(precipitation) + wind)$$

TC is thermal comfort, a combination of daily maximum temperature in degrees Celsius and mean relative humidity (%); A is aesthetic cloud coverage, and P is physical, a combination of precipitation in millimetres and wind speed in kilometres per hour. The comparison between a TCI score and an HCI score can be seen in figure 9:

Fig. 9 – *Comparison of Tourism Climate Index (TCI) and Holiday Climate Index (HCI: Urban) rating systems*

TCI Score		HCI: Urban Score	
Score	**Descriptive Rating**	**Score**	**Descriptive Rating**
90–100	Ideal	9–100	Ideal
80–89	Excellent	80–89	Excellent
70–79	Very good	70–79	Very good
60–69	Good	60–69	Good
50–59	Acceptable	50–59	Acceptable
40–49	Marginal	40–49	Marginal
30–39	Unfavourable	30–39	Unacceptable
20–29	Very unfavourable	20–29	
10–19	Extremely unfavourable	10–19	
9–0	Impossible	9–0	Dangerous

Source: Scott and others (2016, p. 4)

It is important to note that the HCI index takes a unique approach, not ruling out any condition as 'impossible' for tourism. Some tourists seek adverse weather conditions for their specific activities (e.g. high winds for windsurfing, storm watching, etc). The lowest category is dangerous, as it can only be achieved with dangerous thermal conditions such as heat/cold stress, high winds or high precipitation. The HCI index maintains fairness and

objectivity by giving equal weight (40%) to the physical facets of precipitation, wind, and thermal comfort. This balance ensures that poor physical and climatic conditions do not overshadow pleasant thermal and aesthetic conditions, thereby maintaining the index's objectivity. This balance also reduces the emphasis on thermal comfort, which becomes less critical when physical variables dominate, providing a reassuring sense of objectivity.

Discussion. – The previously presented bibliographic research has made significant strides in understanding the dynamics of winter proximity tourism in mountainous regions, particularly in climate change. By employing climate indices such as the Holiday Climate Index (HCI) and the Climate Index for Tourism (CIT), it is possible to quantify the climatic suitability of various destinations for winter tourism. This quantitative approach allowed us to identify optimal periods for tourist visits, which can help manage tourist flows and reduce environmental impact. The practical implications of our research are significant, as we found that integrating these indices into tourism planning can significantly enhance the sustainability and attractiveness of proximity tourism destinations, ensuring a balanced influx of visitors throughout the year.

While this research has provided valuable insights, some areas require further focus to optimise the benefits of winter proximity tourism. Firstly, the development of adaptive strategies for climate change is crucial. Our findings indicate that mountainous regions, heavily reliant on snow-based activities, are vulnerable to climate variability. Thus, there is a need for investment in artificial snow production and diversifying tourist activities less dependent on snow conditions. Additionally, enhancing local infrastructure to support increased tourist numbers while maintaining environmental sustainability remains a priority.

Our research connects closely with the existing sustainable tourism and climate change literature. It builds on the works of Jeuring and Diaz-Soria (2017) and López Sánchez, Linares Gómez del Pulgar and Tejedor Cabrera (2021), who highlighted proximity tourism's significance in the post-pandemic era. Moreover, it aligns with the studies by Steiger and others (2021) and Scott and others (2019), which emphasise the impacts of climate change on winter tourism and the need for adaptive measures. By integrating climate indices into analysis, it is possible to offer a novel approach that complements traditional tourism planning and management methods.

The practical implications of our research are manifold. First, it provides policymakers and tourism managers with tools to forecast and manage tourist flows effectively, thereby reducing the adverse effects of overcrowding and environmental degradation. Second, insights into climate adaptability can guide the development of resilient tourism infrastructure, ensuring the long-term viability of winter tourism in mountainous regions. Lastly, our findings advocate for a holistic approach to tourism that considers environmental, economic, and social dimensions, fostering sustainable development in local communities.

Conclusion. – The literature review underscores the importance of strategic planning and adaptive measures in enhancing the sustainability of winter proximity tourism.

Future research should focus on several key areas to further enhance the understanding and management of winter proximity tourism in the context of climate change. Firstly, refining climate indices to capture local climates' nuances better is essential. This includes developing more localised and activity-specific indices to provide more accurate winter sports and activity predictions.

Secondly, expanding the scope of adaptive strategies to include a broader range of tourist activities and infrastructural improvements is crucial. This could involve exploring alternative winter activities less dependent on snow, such as cultural and wellness tourism, and investing in sustainable infrastructure that can accommodate tourists throughout the year.

The optimization of water resources could also directly address the consequences of climate variability on water availability. Repurposing ski resorts could also allow these areas to maintain tourist appeal, even in locations where skiing is no longer economically or climatically viable.

Reforestation projects and the promotion of sustainable infrastructures could represent a long-term structural response that reduces environmental impact and helps mitigate the effects of climate change, such as erosion and rising temperatures.

Additionally, more longitudinal studies are needed to assess the long-term impacts of climate change on winter tourism and the effectiveness of adaptive measures. These studies should consider various scenarios and include economic, social, and environmental effects to understand the challenges and opportunities comprehensively. Considering the climate

indices is also crucial. Seasonal planning with the TCI can help identify optimal periods for mountain activities based on weather, destinations can schedule events during favorable conditions and offer flexible packages that adjust to climate variations. Exploring other indices outside of the TCI and HCI, such as the Mountain Tourism Climate Index (MTCI), can help optimize artificial snowmaking and manage water resources efficiently by predicting the best times for snow production and water storage. Formulating customized local climate indices can also help monitor long-term climate effects to support sustainable resource use.

Finally, fostering greater collaboration between researchers, policymakers, and industry stakeholders is vital. Creating platforms for knowledge exchange and joint initiatives can help develop more effective and innovative solutions to ensure the resilience and sustainability of winter proximity tourism in the face of climate change.

In conclusion, this literature review underscores:

- the importance of strategic planning and adaptive measures in enhancing the sustainability of winter proximity tourism. By addressing the identified focus areas and pursuing future research directions, we can ensure that winter tourism thrives, benefiting tourists and local communities.
- the importance of studying a specific HCI for winter sports. This is not just a matter of academic interest but a crucial need to cater to winter tourists' diverse interests, ensuring that skiers and non-skier holiday goers can enjoy their winter holidays to the fullest. It is important to note that our research is not only academically significant but also has practical implications for the management of winter tourism.

REFERENCES

ABEGG B., "Klimaänderung und Tourismus: Klimafolgenforschung am Beispiel des Wintertourismus in den Schweizer Alpen", *Vdf,* Zurich, 1996.

ABEGG B., KÖNIG U., MAISCH M., "Climate change and glacier skiing tourism", *Geographica Helvetica*, 1994, 3, pp. 103–114.

ABEGG B. AND OTHERS, "Climate change impacts and adaptation in winter tourism", 2007, pp. 25–60.

ARORA S.K. AND OTHERS, "Using the wayback machine to mine websites in the social sciences: a methodological resource", *Journal of the Association for Information Science and Technology*, 2016, 67, 8, pp. 1904-1915.

BECKEN S., "A review of tourism and climate change as an evolving knowledge domain", *Tourism Management Perspectives*, 2013, 6, pp. 53-62.

BLASI S. SEDITA S.R., "The diffusion of a policy innovation in the energy sector: evidence from the collective switching case in Europe", *Industry and Innovation*, 2020, 27, 6, pp. 680-704.

BLASI S. AND OTHERS, "A network perspective of cognitive and geographical proximity of sustainable tourism organizations: evidence from Italy", *International Journal of Contemporary Hospitality Management*, 2024, 36, 2, pp. 478-504.

BUCKLEY R., "Tourism, COVID-19 and systemic transformation", *Journal of Sustainable Tourism*, 2020, 29, 4, pp. 1-9.

CALHEIROS A.C. AND OTHERS, "Sentiment classification of consumer-generated online reviews using topic modelling", *Journal of Hospitality Marketing and Management*, 2017, 26, 7, pp. 675-693.

CAPONE F., LAZZERETTI L., "The different roles of proximity in multiple informal network relationships: evidence from the cluster of high technology applied to cultural goods in Tuscany", *Industry and Innovation*, 2018, 25, 9, pp. 897-917.

DALE A. AND OTHERS, "Meeting the climate change challenge: Local government climate action in British Columbia, Canada", *Climate Policy*, 2020, 20, pp. 866-880.

DE FREITAS C. R., SCOTT D., MCBOYLE G. "A second generation climate index for tourism (CIT): Specification and verification", *International Journal of Biometeorology*, 2008, 52, pp. 399–407.

DE FREITAS C.R., "Recreation climate assessment", *International Journal of Climatology*, 1990, 10, pp. 89–103.

DE FREITAS C.R. "Tourism climatology: Evaluating environmental information for decision making and business planning in the recreation and tourism sector"*, International Journal of Biometeorology*, 2003, 48, pp. 45–54.

DIAZ-SORIA I., "Being a tourist as a chosen experience in a proximity destination", *Tourism Geographies*, 2016, 19, 1, pp. 96-117.

DIOLAIUTI G., AND OTHERS, "The recent evolution of an Alpine glacier used for summer skiing (Vedretta Piana, Stelvio Pass, Italy)", *Cold Regions Science and Technology*, 2006, 44, 3, pp. 206–216.

DUBOIS, G., AND OTHERS, "Weather preferences of French tourists: Lessons for climate change impact assessment", *Climatic Change*, 2016, 136.

ELLENA M., AND OTHERS, "Past and future hydrogeological risk assessment under climate change conditions over urban settlements and infrastructure systems: the case of a sub-regional area of Piedmont, Italy", *Natural Hazards*, 2020, 102, pp. 275-300.

ELSASSER H., MESSERLI P. "The vulnerability of the snow industry in the Swiss Alps", *Mountain Research and Development*, 2001, 21,4, pp. 335-339.

FALK M. "A dynamic panel data analysis of snow depth and winter tourism", *Tourism Management*, 2010, 31, pp. 912–924.

FIRGO M., FRITZ O., "Does having the right visitor mix do the job? Applying an econometric shift-share model to regional tourism developments", *The Annals of Regional Science*, 2017, 58,3, pp. 469–490.

GOBIET A., KOTLARSKI S. "Future Climate Change in the European Alps", *Oxford Research Encyclopedia of Climate Science*, 2020.

GOBIET A., AND OTHERS "21st century climate change in the European Alps: A review", *Science of the Total Environment*, 2014, 493, pp. 1138-1151.

GÖK A., WATERWORTH A., SHAPIRA P. "Use of web mining in studying innovation"*, Scientometrics*, 2015, 102,1, pp. 653-671.

GOMEZ-MARTIN M.B. "Weather, climate and tourism: A geographical perspective", *Annals of Tourism Research*, 2005, 32, pp. 571–591.

GONSETH C., VIELLE M. "A general equilibrium assessment of climate change impacts on Swiss winter tourism with adaptation", *Environmental Modeling & Assessment*, 2019, 24,3, pp. 265–277.

GÖSSLING S., SCOTT D., HALL C.M., "Pandemics, tourism and global change: a rapid assessment of COVID-19", *Journal of Sustainable Tourism*, 2021, 29, 1, pp. 1-20.

CHANG C.L., MCALEER M.J., RAMOS V. "The future of tourism in the COVID-19 era*", Advances in Decision Sciences*, 2020, 24, 3, pp 218-230.

HAMILTON L. C., BROWN C., KEIM B.D., "Ski areas, weather and climate: Time series models for New England case studies", *International Journal of Climatology*, 2007, 27,15, pp. 2113–2124.

HARRISON R. AND OTHERS, "Climate change and downhill skiing in Ontario", *Ontario Geography*, 1986, 28, pp. 51-68.

HEIN L., METZGER M.J, MORENO A., "Potential impacts of climate change on tourism: A case study for Spain", *Current Opinion in Environmental Sustainability*, 2009, 1, pp. 170–178.

HOHENWALLNER D., AND OTHERS, "Water Resources Management and Water Scarcity in the Alps: recommendations for water resources managers and policymakers", *University of Savoie*, 2011.

JEURING J., DIAZ-SORIA I., "Introduction: Proximity and intraregional aspects of tourism", *Tourism Geographies*, 2017, 19, 1, pp. 4-8.

JEURING J., HAARTSEN T., "The challenge of proximity: The (un)attractiveness of near-home tourism destinations", *Tourism Geographies*, 2017, 19, 1, pp. 118-141.

KEILER M., KNIGHT J., HARRISON S., "Climate change and geomorphological hazards in the eastern European Alps", *Philosophical Transactions of the Royal Society A*, 2010, 368(1919), pp. 2461-2479.

KIRCHMEIER-YOUNG M.C. AND OTHERS, "Attributing extreme fire risk in Western Canada to human emissions", *Climatic Change*, 2017, 144, pp. 365-379.

KIRCHMEIER-YOUNG M.C. AND OTHERS, "Attribution of the influence of human-induced climate change on an extreme fire season", *Earth's Future*, 2019, 7, 1, pp. 2-10.

LANDAUER M., PROBSTL-HAIDER U., "Klimawandel, Skilanglauf und Tourismus in Österreich", *Naturschutz und Landschaftsplanung*, 2008, 40, pp. 336–342.

LAZZERETTI L., CAPONE F., "Mapping and analysing local tourism systems in Italy, 1991-2001", *Tourism Geographies*, 2008, 10, 2, pp. 214-232.

LAZZERETTI L., PETRILLO C.S., *Tourism Local Systems and Networking*, London, Routledge, 2006.

LÓPEZ SÁNCHEZ M., LINARES GÓMEZ DEL PULGAR M., TEJEDOR CABRERA A., "Perspectives on proximity tourism planning in peri-urban areas", *European Planning Studies*, 2021, 30, 12, pp. 2456-2473.

MARASCO A. AND OTHERS, "Collaborative innovation in tourism and hospitality: a systematic review of the literature", *International Journal of Contemporary Hospitality Management*, 2018, 30, 6, pp. 2364-2395.

MARTINEZ-IIBARRA E., "The use of webcam images to determine tourist–climate aptitude: Favourable weather types for sun and beach tourism on the Alicante coast (Spain)", *International Journal of Biometeorology*, 2011, 55, pp. 373–385.

MASON C.W. & NEUMANN P. "The impacts of climate change on tourism operators, trail experience and land use management in British Columbia's backcountry", *Land*, 2024, 13, 69.

MCBOYLE, G., AND OTHERS, "Recreation and climate change: A Canadian case study", *Ontario Geography*, 1986, 23, pp. 51-68.

MERIGÓ J.M. AND OTHERS, "Scientific research in the tourism, leisure and hospitality field: A bibliometric analysis", *Anatolia*, 2020, 31, 3, pp. 494-508.

MIECZKOWSKI Z., "The tourism climate index: A method of evaluating world climates for tourism", *The Canadian Geographer*, 1985, 29, pp. 220–233.

MIHALIC T., KUŠČER, K., "Can overtourism be managed? Destination management factors affecting residents' irritation and quality of life", *Tourism Review*, 2022, 77, 1, pp. 16-34.

MIKOLOV T. AND OTHERS, *Efficient estimation of word representations in vector space*, 1st International Conference on Learning Representations, ICLR 2013 – Workshop Track Proceedings, 2013.

MISHRA R.K., UROLAGIN S., JOTHI A.A., "A Sentiment analysis-based hotel recommendation using TF-IDF Approach", *2019 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE)*, Dubai, United Arab Emirates, 2019, pp. 811-815 (doi:10.1109/ICCIKE47802.2019.9004385).

MORENO A., "Mediterranean Tourism and Climate (Change): A Survey-Based Study", *Tourism and Hospitality Planning & Development*, 2010, 7, pp. 253–265.

MORENO A., AMELUNG B., SANTAMARTA L., "Linking beach recreation to weather conditions: A case study in Zandvoort, Netherlands", *Tourism in Marine Environments*, 2008, 5, pp. 111–119.

NEPAL S.K., CHIPENIUK R., "Mountain tourism: Toward a conceptual framework", *Tourism Geographies*, 2005, 7, 3, pp. 313-333.

O'NEILL B.C. AND OTHERS, "The Benefits of Reduced Anthropogenic Climate Change (BRACE): A synthesis", *Climatic Change*, 2018, 146, pp. 287-301.

OPPENHEIMER M., AND OTHERS, "Emergent risks and key vulnerabilities", *Cambridge University Press*, Cambridge, UK, and New York, NY, USA, 2014, pp. 1039-1099.

ÖSTERREICH WERBUNG (https://www.austriatourism.com/tourismusforschung/studien-und-berichte/?tx_dwarticle_studylist%5Bpage%5D=2&no_cache=1#filter-314).

PEDE E., AND OTHERS, "Mountain tourism facing climate change: Assessing risks and opportunities in the Italian Alps", *TEMA*, 2022, 15,1, pp. 25-47. ISSN 1970-9870.

PRÖBSTL-HAIDER U., AND OTHERS, "Will climate change increase the attractiveness of summer destinations in the European Alps? A survey of German tourists", *Journal of Outdoor Recreation and Tourism*, 2015, 11, pp. 44-57.

RANTALA O. AND OTHERS, "Envisioning tourism and proximity after the Anthropocene", *Sustainability*, 2020, 12, 3948.

RANTALA O. AND OTHERS, "Proximity and tourism in the Anthropocene"*, Annals of Tourism Research*, 2024, 105, 103733.

RICHARDS G. "Skilled consumption and UK ski holidays", *Tourism Management*, 1996, 17,1, pp. 25–34.

RUTTY M., ANDREY J., "Weather forecast use for recreation". *Weather, Climate, and Society*, 2014, 6, pp. 293–306.

RUTTY M., SCOTT D., "Comparison of climate preferences for domestic and international beach holidays: a case study of Canadian travellers", *Atmosphere*, 2014, 5, 2, pp. 241-256.

RUTTY M., & SCOTT D., "Thermal range of coastal tourism resort microclimates", *Tourism Geographies*, 2014, 16, pp. 346–363.

RUTTY M., & SCOTT D., "Will the Mediterranean become "too hot" for tourism? A Reassessment", *Tourism and Hospitality Planning & Development*, 2010, 7, pp. 267–281.

SCHINDELEGGER A., KANONIER A., "Natural Hazard Risk Governance: Status Quo in the EUSALP Region", *EUSALP Action Group 8*, 2019.

SCOTT D. AND OTHERS, "Implications of climate and environmental change for nature-based tourism in the Canadian Rocky Mountains: A Waterton Lakes National Park case study", *Tourism Management*, 2007, 28, pp. 570-579.

SCOTT D., GÖSSLING S., DE FREITAS, C. R., "Preferred climates for tourism: Case studies from Canada, New Zealand and Sweden", *Climate Research*, 2008, 38, pp. 61–73.

SCOTT D., GÖSSLING S, HALL M., "International tourism and climate change"*, Wiley Interdisciplinary Reviews: Climate Change*, 2012, 3, 3, pp. 213–232.

SCOTT D., HALL M., GÖSSLING S., "Tourism and Climate Change: Impacts, Adaptation and Mitigation"*, Routledge*, 2012.

SCOTT D., AND OTHERS "An inter-comparison of the Holiday Climate Index (HCI) and the Tourism Climate Index (TCI) in Europe"*, Atmosphere*, 2016, 7, 80.

SCOTT D. AND OTHERS, "Climate change and tourism: Impacts, adaptation and mitigation", *Routledge Handbook of Tourism and Sustainability*, 2019, pp. 231-247.

SCOTT D., AND OTHERS, "Regional ski tourism risk to climate change: An inter-comparison of Eastern Canada and US Northeast markets", *Journal of Sustainable Tourism,* 2019b, 28,4, pp. 568–586.

SCOTT D., AND OTHERS, "Climate change and ski tourism sustainability: An integrated model of the adaptive dynamics between ski area operations and skier demand", *Sustainability*, 2020, 12,24, 10617.

SFORZI F. (ed.), *I sistemi locali del lavoro 1991*, Roma, Istat, 1997.

SPARKS B.A., BROWNING V., "The impact of online reviews on hotel booking intentions and perception of trust", *Tourism Management*, 2011, 32, 6, pp. 1310-1323.

STEIGER R. AND OTHERS, "A critical review of climate change risk for ski tourism", *Current Issues in Tourism*, 2017, 22, 11, pp. 1343–1379.

STEIGER R. AND OTHERS, "The impact of climate change on demand for ski tourism: A simulation study based on stated preferences", *Ecological Economics*, 2020, 170, 106589.

STEIGER R. AND OTHERS, "Climate change and winter outdoor activities in Austria", *Journal of Outdoor Recreation and Tourism*, 2021, 34, 100330.

STEIGER R. AND OTHERS, "Impacts of climate change on mountain tourism: a review", *Journal of Sustainable Tourism*, 2022 (https://doi.org/10.1080/09669582.2022.2112204).

STEIGER R. AND OTHERS, "Seasonality matters: simulating the impacts of climate change on winter tourism demand", *Current Issues in Tourism*, 2023, 26, 17, pp. 2777-2793.

STEIGER R., ABEGG B., "The sensitivity of Austrian ski areas to climate change", *Tourism Planning & Development*, 2013, 10, 4, pp. 480-493.

TOGLHOFER C., EIGNER F., PRETTENTHALER F., "Impacts of snow conditions on tourism demand in Austrian ski areas", *Climate Research*, 2011, 46,1, pp. 1–14.

UNBEHAUN W., PRÖBSTL-HAIDER U., HAIDER W., "Trends in winter sport tourism: Challenges for the future", *Tourism Review*, 2008, 63,1, pp. 36–47.

VENTURELLA L., SCIORTINO C., DE CANTIS S., "The impact of COVID-19 crisis on Italian proximity tourism: An origin-destination matrix approach", *DIEM – Dubrovnik International Economic Meeting*, 2023, 1, 7, pp. 105-120.

WON D., BANG H., SHONK D.J., "Relative importance of factors involved in choosing a regional ski destination: Influence of consumption situation and recreation specialization", *Journal of Sport & Tourism*, 2008, 13,4, pp. 249–271.

WORLD TRAVEL AND TOURISM COUNCIL, *Economic Impact of Travel and Tourism Report,* 2020 (https://wttc.org/About/About-Us).

ZEBISCH M., AND OTHERS, "Risk supplement to the vulnerability sourcebook. Guidance on How to Apply the Vulnerability Sourcebook's Approach with the New IPCC AR5 Concept of Climate Risk", *Giz*, 2017.
ZHANG J., "What's yours is mine: exploring customer voice on Airbnb using text-mining approaches", *Journal of Consumer Marketing*, 2019, 36, 5, pp. 655-665.

Indici climatici e turismo di prossimità invernale nell'ambiente montano: una revisione della letteratura. – Come ben noto, il turismo di prossimità guadagna terreno come trend emergente nell'era post-pandemica, con un numero crescente di persone che scelgono destinazioni a breve distanza dalle aree urbane. In questa dinamica, le zone montane e alpine diventano luoghi privilegiati per coloro che cercano un rifugio dalla città, spingendo gli addetti ai lavori a valutare con attenzione l'impatto di tali flussi sul tessuto economico e ambientale locale.

Al contempo, il cambiamento climatico presenta nuove sfide per il turismo montano, in particolare quello invernale, influenzando negativamente l'affidabilità delle stagioni e la disponibilità delle risorse naturali. Queste mutazioni richiedono una risposta strategica da parte delle destinazioni montane, che devono riconsiderare e adattare le proprie offerte turistiche alle nuove condizioni climatiche.

Risalta, in questo contesto, l'importanza di strumenti di misurazione come l'Holiday Climate Index (HCI) e il Climate Index for Tourism (CIT) utilizzati per valutare la propensione climatica al turismo di una certa località. Questi indici tengono conto di variabili quali temperatura, precipitazioni e vento per determinare la periodicità ideale delle visite turistiche, orientando di conseguenza i flussi di prossimità.

È altresì noto come per i ricercatori, i tecnici ed i "policy-makers", che si occupano della resilienza delle destinazioni montane nel nuovo scenario climatico globale, sia essenziale un rigoroso inquadramento bibliografico.

Questo articolo intende, quindi, catalizzare l'attenzione dei climatologi e degli esperti di turismo sostenibile sulle necessità di una rassegna della letteratura che sia quanto più accurata e approfondita e che indaghi l'interconnessione tra clima, indici di prossimità turistica e strategie future per l'economia montana. Si pone l'obiettivo di offrire una fotografia chiara degli strumenti disponibili, dei casi di studio rilevanti e delle opportunità che attendono il settore nel breve e medio periodo. Questa ricerca evidenzierà, infine, le principali aree di ricerca da sviluppare, gettando le basi per

politiche turistiche lungimiranti che assecondino l'evoluzione delle necessità turistiche e la tutela degli ecosistemi montani.

Keywords. – Indici climatici, Turismo invernale, Turismo di prossimità, Cambiamento climatico

Politecnico di Torino – Università di Torino, Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio (DIST)
francesca.tatulli@polito.it

Politecnico di Torino – Università di Torino, Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio (DIST)
alessandro.pezzoli@polito.it