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Implications of Climate Change for Rural Tourism in the Nordic Region

Abstract

In many rural regions, including those of the Nordic region, a former dependence on primary activities such as fishing, forestry, mining and/or agriculture has been superseded in recent decades by increasing involvement in the tourism sector. The purpose of this paper is to explore the potential implications of climate change for non-winter rural tourism in the Nordic region. Using the Tourism Climatic Index as an analytical tool, the paper highlights the range of potential conditions for outdoor tourism activity for three future time periods (the 2020s, 2050s and 2080s) under two scenarios of climate change (B1A and A1F). Findings suggest the possibility of substantially longer periods of desirable climatic conditions in future decades, particularly in the southern and eastern portions of the region. Implications of the findings are discussed in the context of the adaptive capacity of various tourism actors (tourists, providers and government) and in light of the particular vulnerabilities and assets of rural communities. The need for an integrated and multilevel approach that recognises the importance of the efficient coordination and integration of resources, products and services across multiple actor boundaries and levels is stressed.

Keywords

Climate change, impacts, Nordic region, rural tourism, Tourism Climatic Index

Implications of Climate Change for Rural Tourism in the Nordic Region

Introduction

The economic livelihoods and social constructions of rural communities are typically highly dependent upon and heavily influenced by their natural resource base. Rural communities also tend to share a common set of characteristics including relative and absolute physical remoteness, restricted access to resources and to basic services, limited economic diversity, increasing un- or under-employment, and an aging and/or declining population base. These characteristics have been posited to increase the vulnerability of rural areas to economic, societal and environmental transformations, including to the rising incidence of short-term weather variability and longer-term alterations to climate typical of the current era of climate change (Brouder, 2012; Hales et al. 2013; Lundmark, 2005).

In many rural regions, a former dependence on primary activities such as fishing, forestry, mining and/or agriculture has been superseded in recent decades by increasing involvement in the tourism sector. This shift has reflected declining prices and profits in many commodity markets as well as the perception of tourism as a relatively labour intensive yet clean and environmentally benign 'replacement' sector (e.g., Hall, Müller & Saarinen, 2009; Moscardo, 2005; Rinne & Saastamoinen, 2005; Schmallegger & Carson 2010; Zachrisson, Sandell, Fredman & Eckerberg, 2006).

The majority of rural enterprises are small and often family-owned and operated. The potential downsides of such enterprises are many, including limited local markets and infrastructure, high import/export transportation costs, limited linkages to complementary firms, lack of business acumen or of well-defined business strategies, limited access to capital, and, in the case of tourism, a limited local workforce with minimal if any hospitality training or skills. In contrast, small firms have also been identified as enjoying above average capacities for flexibility and innovation, thereby providing them with the opportunity to adjust to and capitalize on change more quickly and efficiently than larger firms (Baldacchino, 2005; Rauken & Kelman, 2012). Similarly, despite the variety of disadvantages associated with rural locations and the difficulties of the development of tourism therein, the rural tourism sector has also been identified as tenacious and dynamic and rural areas as sites of development against the odds (Brouder, 2012b).

In light of the above, the purpose of this paper is to explore the potential implications of climate change for non-winter rural tourism in the Nordic region. Nordic is defined here to include the nations and autonomous regions of Denmark, Finland, Greenland, Iceland, Norway and Sweden. The Faroe Islands and Åland Islands are not included due solely to the spatial resolution of the analysis conducted, as described under Methodology, below. The study employs two climate change scenarios, the A1F and B1A (IPCC 2000), described in more detail below.

Tourism and Rural Tourism in the Nordic Region

Though relatively small in relation to major destination nations such as France, Spain, China and the United States, the tourism industries in the Nordic region are nevertheless important contributors to national income and employment. Table 1 summarises the most recently available data regarding international tourism arrivals and receipts, and tourism as a contributor to gross domestic product and to national employment, for each of the Nordic countries focused on. Though the exact number of these travellers is harder to measure, domestic tourism is also important in each of these regions, and the ownership and use of second homes is especially prevalent (Hall, Müller & Saarinen, 2009). For example, it is estimated that the proportion of overnight stays made at collective accommodation establishments by domestic travellers in 2011 was 63% in Denmark, 73% in Finland and 76% in Sweden (BASTIS, 2013).

Insert Table 1 here

Other than the activities offered in their capital and other major cities, most tourism activity in the Nordic nations is centred upon nature and the outdoors, capitalizing on the expansive areas of pristine natural beauty, distinctive geophysical features and unique experiences such as the midnight sun and the northern lights that the countries share. This abundance of natural capital has been recognised both by the Nordic nations' tourism agencies (see their websites referenced in Table 1) as well as by tourism and rural researchers working in the region (e.g., Fyhri, Jacobsen & Tømmervik, 2009; Haukeland, Therkelsen, Furunes & Mykletun, 2010; Heberlein, Fredman & Vuorio, 2002; Rauken & Kelman, 2012; Tervo-Kankare, 2011), hence the relevance of focusing specifically on the rural tourism offering in this paper.

Climate and Climate Change in the Nordic Region

The climate in the Nordic region is best characterised as highly seasonal, with large temperature differences between the cold, dark winters and the mild, light summers. Intraregional differences are large, however. Table 2 highlights average monthly highs, lows and precipitation for Copenhagen, Denmark; Helsinki, Finland; Kristiansand, Norway; Qaqortok, Greenland; Reykjavik, Iceland; and, Stockholm, Sweden.

Insert Table 2 here

No climate change assessments prepared specifically for the Nordic countries as a group were found. These countries are, however, located in the southern part of the Arctic region, for which such assessments are available; an assessment of the Baltic Sea region also exists. The most recent Arctic Climate Impact Assessment (ACIA, 2004) reveals that regional warming in the Arctic (and the Antarctic) was greater than anywhere else in the world. Warming was concentrated both temporally, in the winter season, and spatially, in the polar region, Siberia, and western Canada and Alaska. Temperature changes in the Nordic countries of Norway, Sweden and Finland were relatively modest, whereas temperature decreases occurred in Iceland and southern and western Greenland (ACIA, 2004, p.3). The strong warming in the Arctic is projected to continue, even though there are large variations in projections between the different models used and between the various regions and seasons. The largest changes are projected for the polar region and for the winter season. Nevertheless, the average annual temperature change for the Nordic countries, projected by the five climate models used in ACIA is also significant, and clearly higher than the temperature projections for more southern European countries (ACIA, 2004).

The Assessment of Climate Change for the Baltic Sea Basin (BACC Author Team, 2008) reports that temperatures that have been steadily rising since the 1960s, in particular in spring. Daily minimum temperatures have increased more than daily maximum temperatures. Overall, the Baltics have become wetter, mainly in winter and spring. In summer, precipitation has decreased in the southern Baltic Sea Basin, but increased in the northern part. The assessment projects that temperatures in the area will change 50% more rapidly than the global mean, though uncertainties in regional warming are very significant. Warming is projected to concentrate in winter in the north, but in the summer in the south. Summer precipitation is projected to decrease sharply in the south; smaller changes are projected for the north, tending towards an increase. In winter, most of the Baltic Sea Basin is projected to become wetter.

With respect to wind speed, significant wave height and storm surge residual in the northern North Atlantic, Debernard and Røed (2008) project significant decreases in wind speed and significant wave height south of Iceland, in contrast to considerable increases in significant wave height and storm surge residual along the North Sea's east coast and in the Skagerrak. Such increases have considerable implications for the feasibility and safety of marine-based and coastal activities.

Prior Analyses of Tourism and Weather/Climate in the Nordic Region

The literature pertaining to the relationships between tourism and weather/climate in the Nordic region is limited, and no other comprehensive analysis of the suitability and attractiveness of the region for tourism under multiple scenarios of climate change – as is presented here – appears to exist. Table 3 summarises the studies that were located, and emphasizes the concentration of previous climate change analyses on the winter sector (the studies listed that focus on weather-tourism relationships are cited elsewhere throughout the text and thus are not expounded upon in full detail here). Saarinen and Tervo (2006) provide one of the few exceptions; their study focused on identification of the climate change-related perceptions and adaptation strategies of nature-based tourism entrepreneurs in northern and southeast Finland. Interviews with 19 entrepreneurs (including nine representatives of enterprises operating in winter/on snow in northern Finland and ten enterprises with operations based mainly in summer/on water in the Finnish Lake District) revealed that only half of the sample believed that climate change is a real phenomenon and that further, even amongst those who did believe in the reality of climate change, there was a relatively strong belief that even if such change does occur, it will not have any effect on their industry. Kaján (2014) focuses primarily on the winter season in her study of northern Finland, but briefly discusses changes in the other seasons including the community's expectation of a more attractive and longer summer season. The BACC alludes to improvements in summer conditions, but no empirical analysis or other evidence is presented (BACC Author Team, 2008).

In general, though, the Nordic-based literature has to date focused for the most part on the negative implications of warming winter temperatures and reduced natural snowfall on the ability of businesses to provide for, and individuals to partake in, traditional winter sports such as downhill skiing in specific regions of individual countries. While the winter season is without doubt important to Nordic economy and society (accounting, for example, for 10-20% of nights spent in tourist accommodations in the Scandinavian nations (Eurostat, no date)), the current study instead targets the other three seasons and takes a broader look at the Nordic region as a whole. The proportions of nights spent in tourist accommodations in summer, and in spring-summer-autumn, in the Scandinavian nations are as follows: Denmark: 50%, 89%; Finland: 37%, 80%; Norway: 46%, 84%; Sweden: 47%, 85% (Eurostat, no date; Iceland data not available). The study does not consider very particular cases such as Spitsbergen/Svalbard, Finnish Lapland or other high Arctic locations, all of which have been subject to consideration in prior studies. Further, it concentrates on impacts and adaptation; the topic of mitigation is beyond the scope of the discussion and that literature is not addressed.

Insert Table 3 here

Methodology

The Tourism Climatic Index (TCI)

The Tourism Climatic Index (TCI) was proposed by Mieczkowski (1985) as a composite measure of the climatic comfort and well-being of tourists. As one of the first climatic indices specifically designed to be applied to tourism, it was developed with the "typical" tourist in mind, one who engages in light-moderate outdoor physical activities such as sight-seeing, shopping, and relaxing. As such, the TCI indicates whether a particular climate is potentially suitable for general outdoor tourism activities. Tourism activities such as sunbathing, skiing and surfing, that require very specific climatic conditions to be feasible or enjoyable, are not covered by the TCI.

The TCI covers all three distinct aspects of the climate deemed relevant for tourism by de Freitas (1990), i.e., thermal, physical and aesthetic aspects, as it takes into account temperature (the thermal aspect), precipitation and wind (physical) and sunshine/cloud cover (aesthetic). The index is based on monthly means for seven climatic variables, namely: (i) maximum daily temperature; (ii) mean daily temperature; (iii) minimum daily relative humidity; (iv) daily relative humidity; (v) precipitation; (vi) daily duration of sunshine; and, (vii) wind speed. Some of these variables were grouped together by Mieczkowski to form sub-indices. The daytime comfort index is based on variables (i) and (iii), representing the warmest conditions of the day, whilst the daily comfort index is based on variables (ii) and (iv), representing conditions over a full 24-hour period. The sub-index for wind is based on the interplay between wind speed (vii) and temperature (i and ii). The sub-indices for precipitation and sunshine are based on single variables, (v) and (vi), respectively. The five sub-indices were then weighted by Mieczkowski to form the final index:

$$TCI = 8CID + 2CIA + 4R + 4S + 2W,$$

Where: CID = daytime comfort index (composed of maximum daily temperature and minimum daily relative humidity); CIA = daily comfort index (composed of mean daily temperature and daily relative humidity); R = precipitation; S = daily sunshine; and, W = wind speed. Each variable takes on a rating between -3 and 5, resulting in a maximum overall TCI score of 100. Mieczkowski suggested use of the scheme outlined in Table 4 to translate the overall TCI scores into qualitative judgments of climatic suitability for general tourism activity. The original paper (Mieczkowski, 1985) provides further details regarding the construction of the index.

Insert Table 4 here

Data

The analysis was based on a combination of two distinct datasets: one of historical observations and the other containing projections of climate change. The CRU CL 1.0 dataset was taken to represent the observed baseline conditions as it is one of the few available data sets that include all of the climate variables necessary to compute TCI values (in particular wind speed, which is often missing from other sets). Assembled by the Climatic Research Unit at the University of East Anglia, Norwich, UK (New, Hulme & Jones, 1999), it contains mean monthly climatology data for the period 1961 to 1990. The dataset includes interpolations from stations around the world (numbering between 3,615 for wind speed and 19,800 for precipitation) to a 0.5^{o} latitude by 0.5º longitude grid, covering all the world's land areas except for Antarctica. The data set covers the following variables: precipitation and wet-day frequency; mean temperature and diurnal temperature range; vapour pressure; sunshine; cloud cover; ground-frost frequency; and, wind speed. The CRU CL 1.0 dataset provides values for all seven of the variables of Mieczkowski's index, either directly or after some straightforward derivation. Maximum and minimum temperatures, for example, can be derived from values for mean temperature and the diurnal temperature range. This dataset formed the basis for the calculation of the baseline TCI values, covering the period 1961-1990 (hereafter referred to as the 1970s).

Future climate change projections were taken from integration of the Hadley Centre's HadCM3 Global Circulation Model (GCM) forced with a range of greenhouse gas emissions scenarios (Johns et al., 2003). Two specific scenarios were considered, namely the A1F and B1A scenarios, taken from the IPCC's Special Report on Emissions Scenarios (IPCC 2000). The A1F scenario is at the high-end of the spectrum of emissions scenarios and hence climate change projections. It pictures a world of rapid economic growth and a continuing high dependence on fossil fuels. The B1A scenario envisages a far greater emphasis on quality and sustainability, resulting in more equitable and resource-efficient economic development (IPCC, 2000). Together the A1F and B1A scenarios span a plausible range of emissions pathways and possible speeds and intensities of climate change. In this study, the climatic states for three future time periods were considered: 2010-2039 (the 2020s); 2040-2069 (the 2050s); and, 2070-2099 (the 2080s). These states were available as gridded data with a spatial resolution of 2.5º latitude by 3.75º longitude.

Findings

To maximise the range of findings and the resulting discussion of their potential implications, three sets of analyses were conducted. First, TCI scores for the four time periods (1970s, 2020s, 2050s and 2080s) and two climate change scenarios (B1A and A1F) under consideration were calculated and mapped for the summer season in the Nordic region (the months of June, July and August, JJA). Second, the numbers of months per annum exhibiting very good or better (TCI ≥ 70) climatic conditions for tourism activity were calculated and mapped for each time period and scenario. Third, charts illustrating TCI scores for the four time periods and two scenarios were constructed for six destination regions centred on Copenhagen, Denmark; Helsinki, Finland; Kristiansand, Norway; Qaqortok, Greenland; Reykjavik, Iceland; and, Stockholm, Sweden. The reader is reminded that the TCI scores represent large grid areas, of 0.5º latitude by 0.5º longitude; the labels applied (representing larger cities) are used solely to more quickly orient the reader to the approximate location being referred to which, while home to these urban areas, also includes large extents of rural landscape.

TCI Scores for June-August, 1970s-2080s

1970s. As shown in Figure 1, conditions in the northern hemispheric summer season have historically ranged from good/very good in the most eastern and southern portions of the Nordic region (all of Denmark, most of southern and coastal Sweden, and southern Finland) to acceptable throughout most of Norway to unfavourable for most of Greenland. Conditions in Iceland vary from acceptable on the western side of the county to unfavourable in the east.

2020s. Projected change in conditions by the 2020s is minimal according to the more moderate B1A scenario (Figure 2), with a scattering of regions in Denmark and southern Sweden potentially seeing ideal/excellent conditions according to the more aggressive scenario, the A1F (Figure 3).

2050s. By the 2050s, projected improvements are quite noticeable across southern Sweden and Finland, more so according to the A1F scenario (Figure 5) than the B1A (Figure 4). The unfavourable conditions across the eastern portion of Iceland could potentially shift into the acceptable range in this period.

2080s. The 2080s show the greatest potential for improvement. As anticipated, the extent of improvement is more substantial according to the A1F scenario (Figure 7) than the B1A (Figure 6). In the former case, Denmark, southern Sweden, the entirety of the Swedish coastline, and southern Finland could all enjoy ideal/excellent conditions. Conditions on the Norwegian coastline remain acceptable, and the zone of acceptable conditions across Iceland expands across most of the north and west of the country. The vast majority of Greenland remains unfavourable other than the slowly-expanding acceptable area on the western coast.

Insert Figures 1-7 here

Number of Very Good or Better Months, 1970s-2080s

1970s. (Figure 8). Currently, the incidence of very good or better conditions is confined to parts of Denmark, southern Sweden and southern Finland, with the lengthiest expanse of these conditions occurring in the southern tip of Sweden. No very good or better months are observed across Greenland, Iceland or Norway. ‘Very good or better months’ are hereafter referred to simply as ‘good months.’

2020s. The main beneficiary of the warming climate by the 2020s appears to be Finland, where the number of good months is projected to rise by one month across most of the country. No good months are projected to be observed across Greenland, Iceland or Norway under either scenario (Figures 9 and 10).

2050s. Though good months remain conspicuous by their absence across Greenland, Iceland or Norway into the 2050s, the length of good conditions across Denmark, southern Sweden, the Swedish coastline, and southern Finland is projected to visibly increase during the 2050s, with as many as four or five months of good conditions possible according to the A1F scenario (Figures 11 and 12).

2080s. The same trend prevails into the 2080s. Though good conditions fail to materialize for any extended period across Greenland, Iceland or Norway, good conditions across Denmark, Sweden and Finland are projected to last from two to five months in the average year (Figures 13 and 14).

Insert Figures 8-14 here

TCI Scores for Selected Regions, 1970s-2080s

Copenhagen, Denmark. As the most southerly of the six regions selected (at 56° north of the equator), it is not surprising that the region around Copenhagen demonstrates the longest period of pleasant conditions both historically and into the future. Already enjoying over three months of conditions with a TCI score in excess of 60 (good or better), the length of the summer season could extend to as many or five or six months by 2080 – depending on the climate change scenario employed – beginning as early as April and extending into October.

Helsinki, Finland. The three or more months of good or better conditions that Helsinki (60°N) currently enjoys could be extended to a four-five month period by 2080, beginning as early as April and extending into September.

Kristiansand, Norway. The two-month long summer season peak that Kristiansand (57°N) currently exhibits in June and July is projected to increase by up to two months according to the B1A scenario and up to three months by the A1F scenario by the 2080s, potentially extending from April-May through September.

Qaqortok, Greenland. Conditions in Qaqortok (at 60°N) remain in the unfavourable range throughout the year, regardless of the timeframe or emissions scenario considered. The distinctive difference between the prevalence of good months between Helsinki and Qaqortok, despite both being located at the same latitude, demonstrates the moderating impact of the ocean currents that warm the seas and oceans of northern Europe.

Reykjavik, Iceland. Though the absolute TCI scores are marginally higher here than in Qaqortok, and exhibit a slightly more pronounced pattern of seasonality – with higher scores from May through September – conditions in Reykjavik (64°N) remain in the unfavourable range regardless of timeframe or emissions scenario.

Stockholm, Sweden. The three-four month period of good or better conditions currently observed in Stockholm (59°N) could be extended by a month (according to the B1A scenario) or two-three months (A1F) by the 2080s.

Insert Figures 15-20 here

Discussion and Conclusion

The analyses presented offer a range of projections as to the likely attractiveness of the Nordic region for non-winter tourism activities under two scenarios of climate change through the end of the current century. It is clear that the southern and eastern portions of the region could potentially see dramatic increases in their climatic attractiveness given the projections of climate change employed. These improvements in conditions have implications for the volume and patterns of both domestic leisure travel and inbound international visitation.

It is critical to recall, of course, that the Nordic nations do already all possess established tourism industries, and that, as stressed by Denstadli, Jacobsen and Lohmann (2011), people do already travel to and around places such as these in spite of their adverse and/or unpredictable weather conditions. Expectations related to climate and weather are but one of a multitude of factors that influence travellers' decisions, choices and levels of satisfaction, and some travellers likely consider climate/weather more or less important of a factor than others. Similarly, for specific niche markets, specific weather variables may be more or less relevant, and there may be more important weather concerns for some than physical or thermal comfort. For visitors to Svalbard, for example, visibility was found to be much more important than temperature (Denstadli & Jacobsen, 2014).

In addition, the changing climate will not necessarily reduce the unpredictability of day-to-day weather conditions, and increasing variability is widely recognised as a key characteristic of climate change. Nevertheless, identification and interpretation of how expected conditions might change in the future is a useful endeavour so as to allow tourism stakeholders the opportunity to be proactive – in the advance identification of adaptive measures they might implement, both so as to capitalise on opportunities and minimise potential threats – rather than leaving them to react retroactively. At first sight, climate change perhaps seems of little relevance for a destination where "the weather is an element that must be dealt with rather than being complained about" (Rauken, Kelman, Jacobsen & Hovelsrud, 2010, p. 199) and where the weather is not perceived to be a major pull factor for international visitors (Lohmann & Kaim, 1999), but first impressions can be misleading and opportunities do exist. Førland et al. (2013), for example, found that a large majority of visitors to northern Norway would prefer 'rather warm' weather and a clear sky on a future summer season trip to the area over frequent rain and low visibility.

Adaptive capacity in the context of travel and tourism is a variable phenomenon. Consumers – the tourists – enjoy the highest levels of adaptive capacity. In an era of last-minute/online bookings and low cost airlines that have opened up formerly less accessible regions with regular in/outbound flights, tourists enjoy the ability to tailor their plans around any variety of anticipated and unanticipated changes in conditions at home or at their destination. Domestic travellers, who outnumber international visitors in all of the countries considered, may be especially adaptable and mobile, able to capitalise on (unexpectedly) good weather conditions very quickly and easily. At the same time, more and more tourists are looking for new and unique experiences, whether in what they consider to be ‘new’ or ‘undiscovered’ destinations or in ‘unusual’ activities; similarly, the notion of ‘last chance’ tourism is gaining in popularity, as travellers attempt to visit increasingly endangered locations and view similarly threatened species before they disappear (see, e.g., Jones & Phillips, 2011; Lemelin, Dawson & Stewart, 2011). Tour operators and travel planners also share relatively high levels of adaptive capacity. These entities tend to exhibit relatively low location-specific investments, thereby enabling them to alter the destinations that they offer to and encourage their clients to purchase quite quickly and easily.

However, unlike in those previous studies focused on winter tourism, in which the emphasis has been on how tourism businesses could or should respond to deteriorating conditions, multiple opportunities to capitalize on increasing attractiveness in the summer and shoulder seasons clearly exist. As noted by Tervo-Kankare (2011, p. 400, emphasis added), "tourism destination development in the age of changing climate calls for new and innovative approaches that reduce vulnerability and *help to gain from potential advantages*." Though winter might traditionally have been the greatest source of opportunity for rural tourism entrepreneurs in the Nordic region, future prospects in the summer season look extremely good, both in terms of improving absolute conditions across much of the Nordic region and the increasing attractiveness of this area and the wider northern European region relative to the rising heat projected for the countries of the Mediterranean coast (e.g., Amelung, Nicholls & Viner, 2007; Amelung & Viner, 2006; Nicholls & Amelung, 2008).

Thus, whilst characteristics common to rural regions – such as low populations and population densities, limited economic diversity, high dependence on natural resources, remote location, limited access, and lower levels of institutional capacity – may on the one hand be seen as disadvantages, and might be expected to increase the vulnerability of these regions to the negative implications of climate change, in the case of tourism in the Nordic nations projected changes in climate appear to offer real opportunities for rural areas. Indeed, Lundmark (2005, p. 41-42) specifically notes that, "For the tourism sector to be a viable alternative …, the tourism season needs to be prolonged in order for people to work on a full-time basis." The improvements in summer season conditions and the increase in the length of that season projected here bode well in this regard. Moreover, some of the characteristics of the smaller enterprises most typical of rural areas, such as above average capacities for flexibility and innovation, increase the likelihood of capitalisation on these prospects.

However, since research in Finland and in other areas has shown that small tourism businesses tend not to identify climate change as a particularly significant or relevant issue, especially given its long-term nature, the large amount of uncertainty associated with climate change science, and the volume of technical jargon employed by climate change specialists (Nicholls & Holecek, 2008; Saarinen & Tervo, 2006), a concerted effort by the appropriate economic development agencies and authorities, to raise awareness and understanding of these opportunities among rural tourism enterprises, is of critical importance. Similarly, the lack of a longer term planning horizon typical of most rural-based tourism enterprises, as noted by, e.g., Nicholls and Holecek (2008) and Rauken and Kelman (2012), represents a substantial obstacle to the most effective and efficient responses to the positive prospects that climate change potentially provides. Hall, Müller and Saarinen (2009) note the strong tradition of state involvement in regional development in the Nordic nations, as well as the importance assigned to tourism as a key element of the development mix in rural and peripheral Nordic regions; the presence of a stronger-than-average support network, in terms of these national-level rural development policies and the availability of assistance to rural regions, is a positive sign with regards to the potential for effectual adaptation. Brouder (2012a) highlights the importance of institutions in path creation within the rural tourism sector in a northern Swedish context. One area of useful focus and assistance on the part of such development agencies would be with regards to the deployment of information and communication technologies (ICT); a growing body of literature (see Polo Pẽna & Frías Jamilena (2010) and Polo Pẽna, Frías Jamilena & Rodríguez Molina (2012) for examples specific to rural settings) is identifying the business characteristics and other factors most conducive to the effective integration of ICT innovations so as to maximise competitiveness and reach.

The likelihood of successful capitalisation on ameliorating conditions would also be increased by adherence to the principles of destination development advanced by authors such as Haugland, Ness, Grønseth and Aarstad (2011), who advocate for an integrated multilevel approach that recognises the importance of the efficient coordination and integration of resources, products and services across multiple actor boundaries and levels. Individual actors in remote rural regions are unlikely to possess the range of resources and skills necessary to evolve and expand, whereas when entities collaborate and cooperate with an eye towards a shared vision of desirable and sustainable change and growth, the chances of long-term success are much improved. Similarly, Conway and Cawley (2012) have highlighted the benefits of networking in rural tourism development efforts, while Brouder (2012a) emphasises the value of sustained networking interactions, such that institutions and entrepreneurs co-evolve in a manner that slowly but surely embeds tourism development within a region.

It is also important to remember that rural areas are neither static nor homogenous. Rather, as portrayed by Cloke (2003), rural areas and the populations that inhabit them are complex and dynamic; similarly, the concept of rurality is not a fixed one, varying instead across both time and space. In the more specific context of response to climate change, Duerden (2004) emphasises the highly localised nature of human activity, the non-passive nature of community residents, and the conditioning of both climate change impacts and responses by local geography, economy, demography and culture. Recognition of these local variations by communities and agencies, and in their responses to climate change, is therefore vital. Again, given the strong interest and involvement of the state in regional development in the Nordic nations, they seem relatively well-prepared to respond in a favourable and timely manner to both the challenges and the opportunities presented by climate change.

Limitations of the TCI

Though having been applied by multiple authors (e.g., Amelung, Nicholls & Viner, 2007; Nicholls & Amelung, 2008; Perch-Nielsen,Amelung & Knutti, 2010; Scott, McBoyle & Schwartzentruber, 2004), the TCI has a number of limitations. A first perceived limitation is that the TCI is too coarse an indicator, being rather insensitive to the large variety of weather requirements preferred by tourists engaging in various activities. The option of tailoring the index to specific activities was explicitly put forward by Mieczkowski (1985) but this suggestion has yet to be widely implemented in practice. A second point of critique is that the TCI's empirical validation is relatively weak. Mieczkowski's rating and weighting schemes are largely based on expert opinion and the existing biometeorological literature, rather than revealed or stated tourist preferences. Alteration to the weighting scheme would of course impact the outcome of application of the index; however, to date, no superior weighting system has been proposed and employment of the original scheme allows for comparison with findings from other regions. In addition, the TCI is found not to account for potential overriding effects (e.g., of rain) or for potential intercultural and geographical differences in climate preferences. While progress has been made on each of these issues, e.g., de Freitas, Scott and McBoyle (2008), the TCI has yet to be tailored to a wider range of specific tourist activities. In addition, the activity-specific indices that have been developed have limited value for first-order assessments of the impact of climate change on tourism. As a first-order assessment tool the TCI is still very useful, and for that reason it was used in this study.

Future Research

The TCI allows for the identification of broad level changes – in time and space – in the distribution of climatically attractive conditions for general tourism activity. Such a meta-analysis should be seen as a starting point for finer-scale investigation of the potential implications of projected change in the context of individual regions, investigations that could more clearly recognise the variations in characteristics such as human and natural tourism resources and current tourism trends that exist between destinations. While these kinds of examinations have been conducted for a handful of winter Nordic activities and locations, this paper has demonstrated the utility of an increased focus on the summer season due to the opportunities that exist as a result of the potential lengthening of that time period.

Similarly, while the TCI allows for analysis of the impacts of projected changes in the key climate variables that directly impact the visitor experience on the supply of climatically attractive destinations, it does not account for the indirect or secondary effects of changing climate that indirectly impact the visitor experience. Changing climate will, for example, effect the natural environment in a variety of manners, leading to alterations in the distribution and composition of flora and fauna that serve as critical components of the product necessary to support wildlife/nature viewing and photography as well as consumptive activities such as hunting and fishing. The Artic Climate Impact Assessment (2004), for example, highlights the range of positive and negative impacts of climate change in that region, from the potential expansion of marine routes due to melting sea ice, to the shifting diversity, range and distribution of Artic flora and fauna, to increased exposure to storms. Similarly, Kaján (2014) identifies both positive and negative potential changes such as the earlier opening of hiking trails, the migration of the tree line, the loss of unique landscapes and habitats, and the emergence of more insects. Fyhri, Jacobsen and Tømmervik's (2009) analysis of tourists' landscape perceptions and preferences has direct relevance in this context. Further analysis of the potential behavioural responses of travellers to these kinds of indirect changes would be a useful follow-on to this study.

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Table 1. Tourism Statistics for Nordic Nations

Nation, Tourism Agency and Agency Website	**International Arrivals (2011)[a]**	**International Receipts (US$, 2011)[a]**	**Contribution to GDP[b*]**	**Proportion of Employment [b**]**
Denmark – Visit Denmark http://www.visitdenmark.com	7.36 million	6.58 billion	6.5%	7.6%
Finland – Visit Finland http://www.visitfinland.com	4.19 million	3.82 billion	6.5%	6.8%
Greenland – Visit Greenland http://www.greenland.com	Not available	Not available	Not available	Not available
Iceland – Visit Iceland http://www.visiticeland.com/	0.57 million	0.75 billion	19.5%	20.9%
Norway – Visit Norway http://www.visitnorway.com	4.96 million	5.23 billion	6.2%	8.4%
Sweden – Visit Sweden http://www.visitsweden.com/	9.96 million	13.76 billion	10.8%	12.3%

Source: [a] World Tourism Organization (UNWTO), 2013; [b] World Travel and Tourism Council, 2013; * indicates the total (direct and indirect) contribution of the travel and tourism economy to national gross domestic product in 2012; ** indicates total (direct and indirect) contribution to employment in 2012.

Table 2. Current Climate in the Nordic Nations – Monthly and Average Annual Highs, Lows and Precipit

	January	February	March	April	May	June	July	August	September	October	November	Dec
Copenhagen												
Av.High °C (°F)	1.9 (35.4)	2.0 (35.6)	4.8 (40.6)	9.5 (49.1)	15.0 (59.0)	19.2 (66.6)	20.4 (68.7)	20.3 (68.5)	16.7 (62.1)	12.1 (53.8)	7.1 (44.8)	
Av.Low °C (°F)	-2.0 (28.4)	-2.4 (27.7)	-0.6 (30.9)	2.3 (36.1)	7.2 (45)	11.3 (52.3)	12.9 (55.2)	12.6 (54.7)	9.8 (49.6)	6.7 (44.1)	2.7 (36.9)	
Prec. mm (in)	46.0 (1.8)	30.0 (1.2)	39.0 (1.5)	39.0 (1.5)	42.0 (1.6)	52.0 (2.1)	68.0 (2.7)	64 (2.5)	60 (2.4)	56 (2.2)	61 (2.4)	
Helsinki												
Av.High °C (°F)	0.0 (32.0)	-1.0 (30.2)	1.0 (33.8)	5.0 (41)	11.0 (51.8)	16.0 (60.8)	20.0 (68.0)	19.0 (66.2)	14.0 (57.2)	9.0 (48.2)	4.0 (39.2)	
Av.Low °C (°F)	-4.0 (24.8)	-6.0 (21.2)	-4.0 (24.8)	1.0 (33.8)	6.0 (42.8)	11.0 (51.8)	15.0 (59.0)	15.0 (59.0)	10.0 (50.0)	5.0 (41.0)	1.0 (33.8)	
Prec. mm (in)	42.0 (1.6)	35.1 (1.4)	32.5 (1.3)	33.0 (1.3)	30.3 (1.2)	51.1 (2.0)	56.9 (2.2)	65.8 (2.6)	46.0 (1.8)	73.3 (2.9)	59.5 (2.3)	
Kristiansand												
Av.High °C (°F)	1.0 (34.0)	2.0 (36.0)	5.0 (41.0)	10.0 (50.0)	15.0 (59.0)	19.0 (66.0)	21.0 (70.0)	20.0 (68.0)	16.0 (61.0)	11.0 (52.0)	6.0 (43.0)	
Av.Low °C (°F)	-5.0 (23.0)	-5.0 (23.0)	-2.0 (28.0)	2.0 (36.0)	6.0 (43.0)	9.0 (48.0)	12.0 (54.0)	11.0 (52.0)	8.0 (46.0)	5.0 (41.0)	1.0 (34.0)	
Prec. mm (in)	128.0 (5.0)	100.0 (4.0)	62.0 (2.0)	73.0 (3.0)	58.0 (2.0)	75.0 (3.0)	104.0 (4.0)	143.0 (6.0)	156.0 (6.0)	153.0 (6.0)	176.0 (7.0)	
Qaqortoq												
Av.High °C (°F)	-2.2 (28.0)	-1.7 (28.9)	-1.0 (30.2)	2.8 (37.0)	6.9 (44.4)	9.2 (48.6)	11.1 (52.0)	11.0 (51.8)	8.0 (46.4)	3.9 (39.0)	0.8 (33.4)	
Av.Low °C (°F)	-9.2 (15.4)	-8.8 (16.2)	-8.4 (16.9)	-4.4 (24.1)	-0.4 (31.3)	1.3 (34.3)	3.3 (37.9)	3.7 (38.7)	1.9 (35.4)	-1.7 (28.9)	-5.0 (23.0)	
Prec. mm (in)	57.0 (2.24)	51.0 (2.01)	57.0 (2.24)	56.0 (2.2)	56.0 (2.2)	75.0 (2.95)	97.0 (3.82)	93.0 (3.66)	92.0 (3.62)	72.0 (2.83)	78.0 (3.07)	
Reykjavik												
Av.High °C (°F)	2.5 (36.5)	2.8 (37.0)	3.4 (38.1)	6.1 (43.0)	9.7 (49.5)	12.4 (54.3)	14.2 (57.6)	13.6 (56.5)	10.9 (51.6)	7.0 (44.6)	4.1 (39.4)	
Av.Low °C (°F)	-2.4 (27.7)	-2.4 (27.7)	-1.9 (28.6)	0.5 (32.9)	3.8 (38.8)	7.0 (44.6)	8.8 (47.8)	8.4 (47.1)	5.7 (42.3)	2.2 (36.0)	-0.5 (31.1)	
Prec. mm (in)	80.6 (3.2)	85.9 (3.4)	81.4 (3.2)	56.0 (2.2)	52.8 (2.1)	44.2 (1.7)	52.7 (2.1)	68.6 (2.7)	71.8 (2.8)	74.3 (2.9)	79.5 (3.1)	
Sto.												
Av.High °C (°F)	-0.7 (30.7)	-0.6 (30.9)	3.0 (37.4)	8.6 (47.5)	15.7 (60.3)	20.7 (69.3)	21.9 (71.4)	20.4 (68.7)	15.1 (59.2)	9.9 (49.8)	4.5 (40.1)	
Av.Low °C (°F)	-5.0 (23.0)	-5.3 (22.5)	-2.7 (27.1)	1.1 (34.0)	6.3 (43.3)	11.3 (52.3)	13.4 (56.1)	12.7 (54.9)	9.0 (48.2)	5.3 (41.5)	0.7 (33.3)	
Prec. mm (in)	39.0 (1.5)	27.0 (1.1)	26.0 (1.02)	30 (1.18)	30 (1.18)	45 (1.77)	72 (2.83)	66 (2.6)	55 (2.17)	50 (1.97)	53 (2.09)	

Sources: Climatemps, 2013; Danish Meteorological Institute, 2013a, 2013b; Icelandic Met Office, 2013; National Air and
Association, 2013; World Weather Online, 2013.

Table 3. Summary of Published Literature Pertaining to Influence of Weather/Climate on Tourism in the Nordic Region*

Author and Year of Publication	**Geographic Setting**	**Context, Season(s) and Activity(ies) Analysed**
Brouder & Lundmark (2011)	Upper Norrland, northern Sweden	Perceptions of winter-oriented tourism entrepreneurs (accommodations, attractions and activities) regarding climate change
Denstadli & Jacobsen (2014)	Spitsbergen (Svalbard)	Summer tourists weather perceptions and tolerances
Denstadli, Jacobsen & Lohmann (2011)	Scandinavia	Summer tourists perceptions' of weather conditions
Førland et al. (2013)	Northern Scandinavia	Summer tourists weather preferences
Furenes & Mykletun (2012)	Norway	Preconditions for glacier tourism, including operators' perceptions of current/future challenges such as climate change
Kaján (2014)	Northern Finland	Vulnerability of mostly winter, nature-based activities (other seasons briefly discussed) to climate change
Moen & Fredman (2007)	Sälen, Sweden	Effects of climate change on winter downhill skiing
Rauken & Kelman (2012)	Senja and Vesterålen, northern Norway	Gap between actual impacts of weather/climate on the operation of tourism/hospitality-based small/medium-sized enterprises and operators' perceptions of these impacts (year-round; accommodations, attractions and activities)
Rauken, Kelman, Jacobsen & Hovelsrud (2010	Northern Norway	Tourism/hospitality-based small/medium-sized enterprise operators' perceptions of the effects of summer season weather and weather
Saarinen & Tervo (2006)	Northern and southeast Finland	Climate change-related perceptions and adaptation strategies of winter and summer nature-based tourism entrepreneurs
Tervo (2008)	Finland	Sensitivity of winter-operating, nature-based tourism operations to climate change
Tervo-Kankare (2011)	Finland	Snow-dependent/winter tourism stakeholders' perceptions of and reactions to climate change

* This summary relates to studies focusing on impacts and adaptation; contributions relating to mitigation are not included

Table 4. Tourism Climatic Index Classification Scheme

Numeric value of index	Description of comfort level for tourism activity
90 – 100	Ideal
80 – 89	Excellent
70 – 79	Very good
60 – 69	Good
50 – 59	Acceptable
40 – 49	Marginal
30 – 39	Unfavourable
20 – 29	Very unfavourable
10 – 19	Extremely unfavourable
Below 9	Impossible

Source: Mieczkowski, 1985.

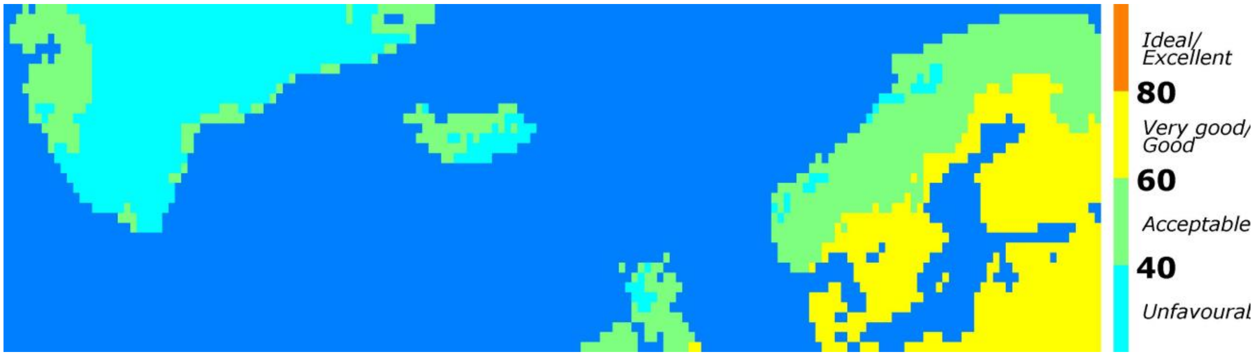

Figure 1. Tourism Climatic Index Scores for the Nordic Region, June-August, 1970s

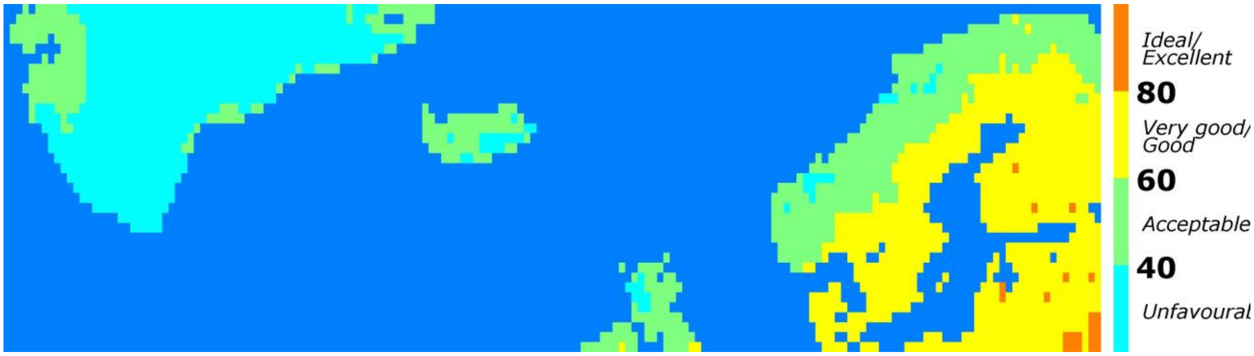

Figure 2. Tourism Climatic Index Scores for the Nordic Region, June-August, 2020s, B1A

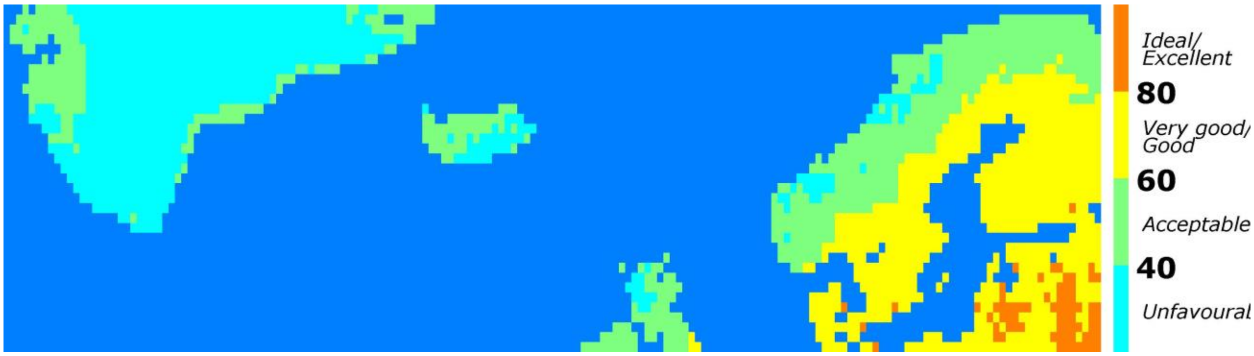

Figure 3. Tourism Climatic Index Scores for the Nordic Region, June-August, 2020s, A1F

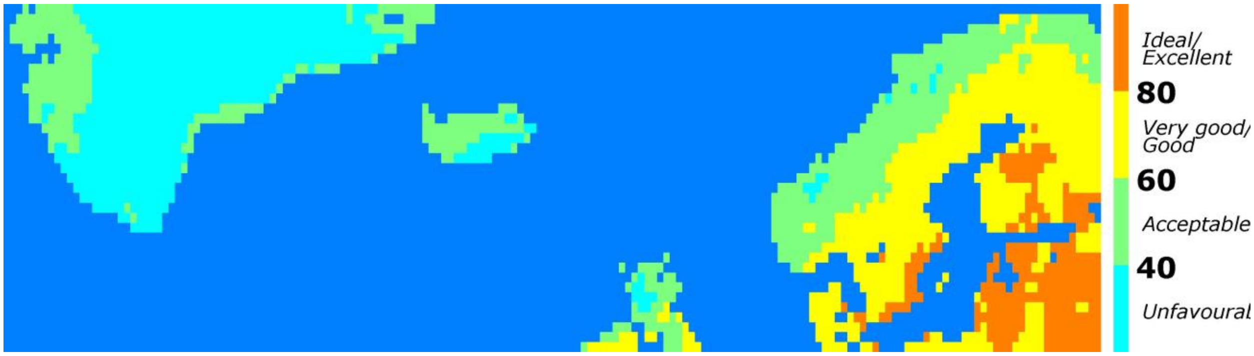

Figure 4. Tourism Climatic Index Scores for the Nordic Region, June-August, 2050s, B1A

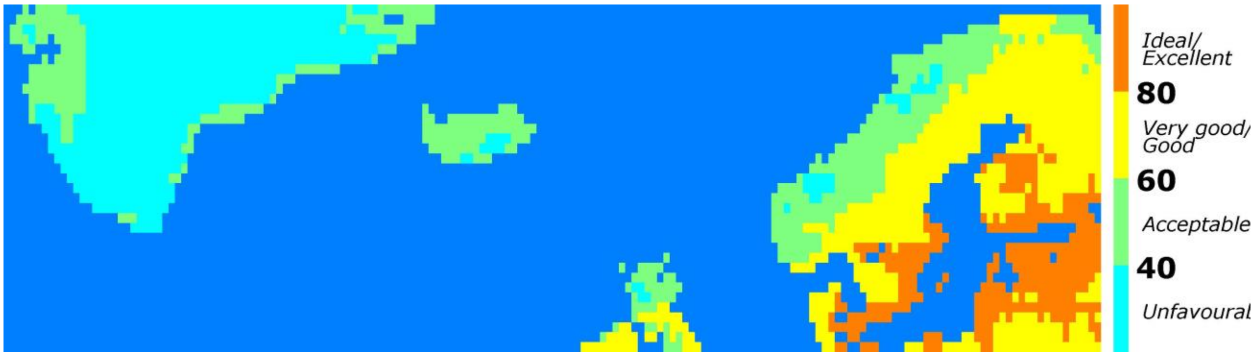

Figure 5. Tourism Climatic Index Scores for the Nordic Region, June-August, 2050s, A1F

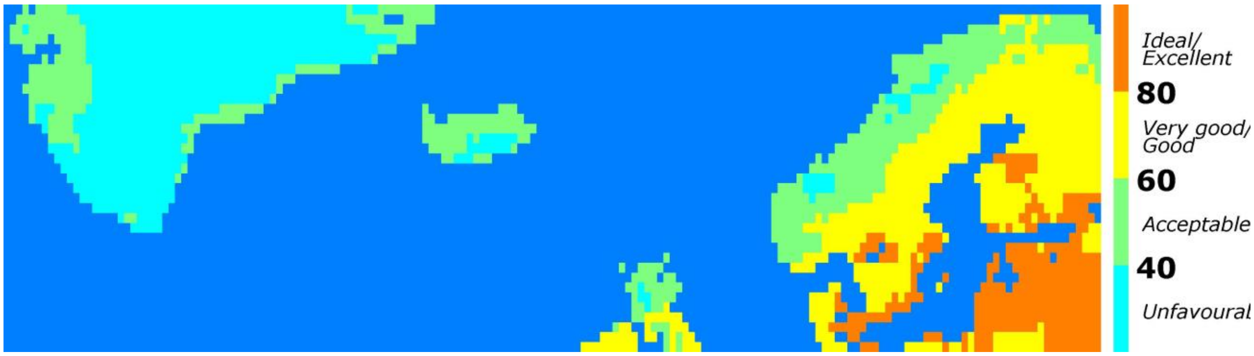

Figure 6. Tourism Climatic Index Scores for the Nordic Region, June-August, 2080s, B1A

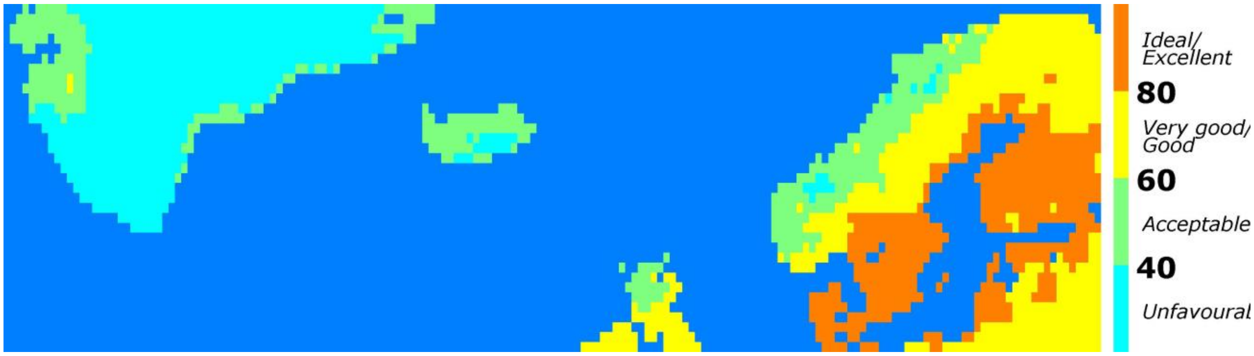

Figure 7. Tourism Climatic Index Scores for the Nordic Region, June-August, 2080s, A1F

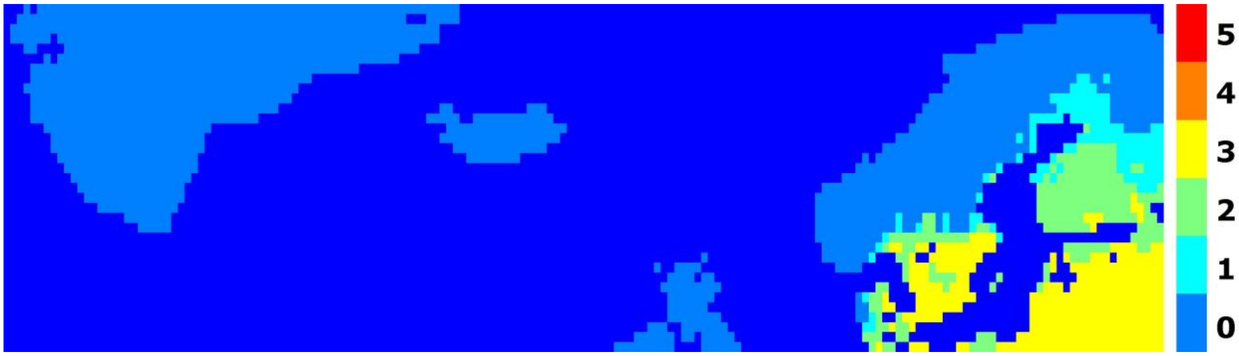

Figure 8. Number of Very Good or Better Months, 1970s

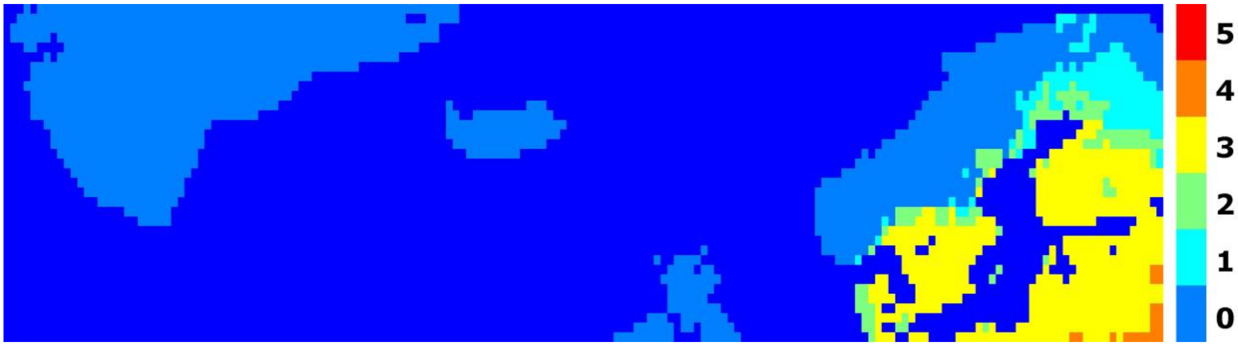

Figure 9. Number of Very Good or Better Months, 2020s, B1A

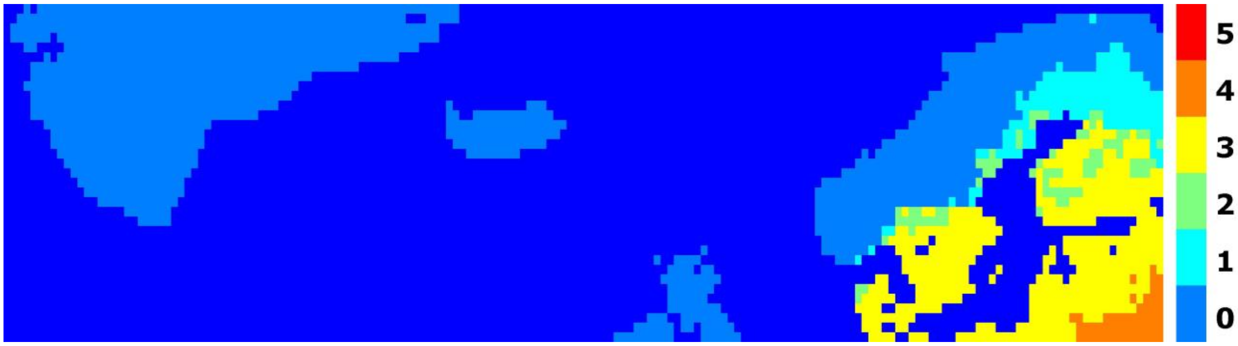

Figure 10. Number of Very Good or Better Months, 2020s, A1F

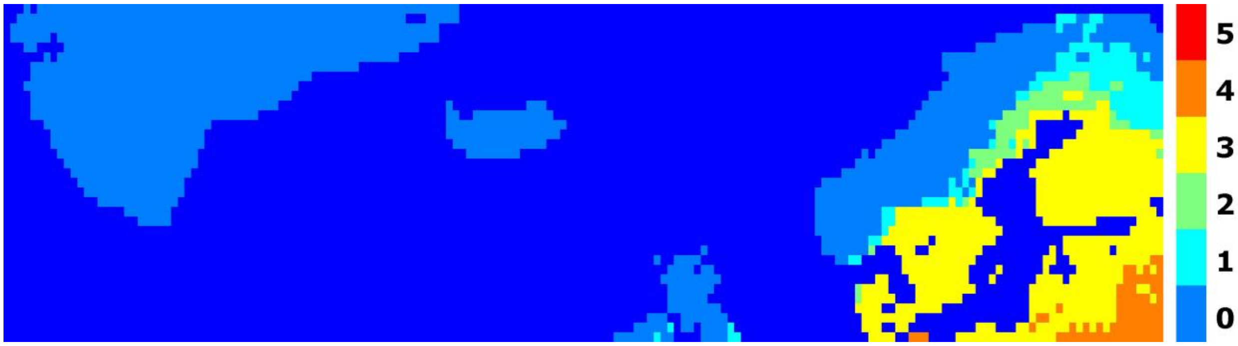

Figure 11. Number of Very Good or Better Months, 2050s, B1A

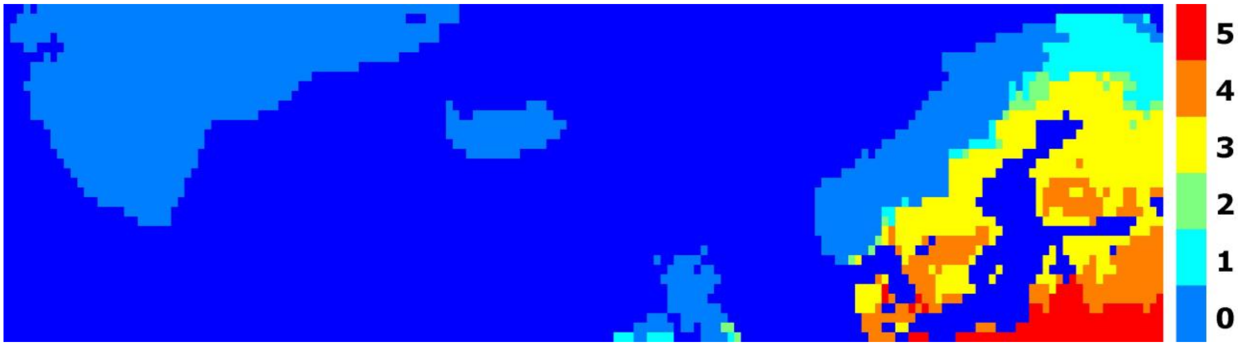

Figure 12. Number of Very Good or Better Months, 2050s, A1F

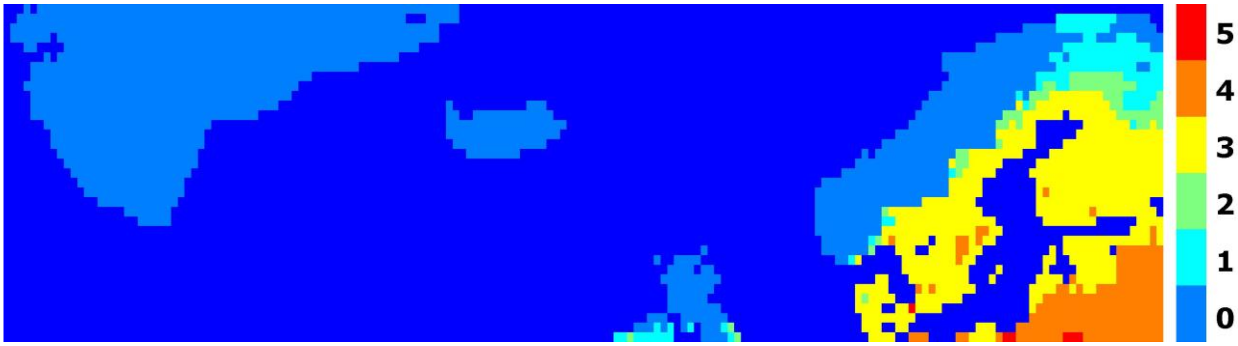

Figure 13. Number of Very Good or Better Months, 2080s, B1A

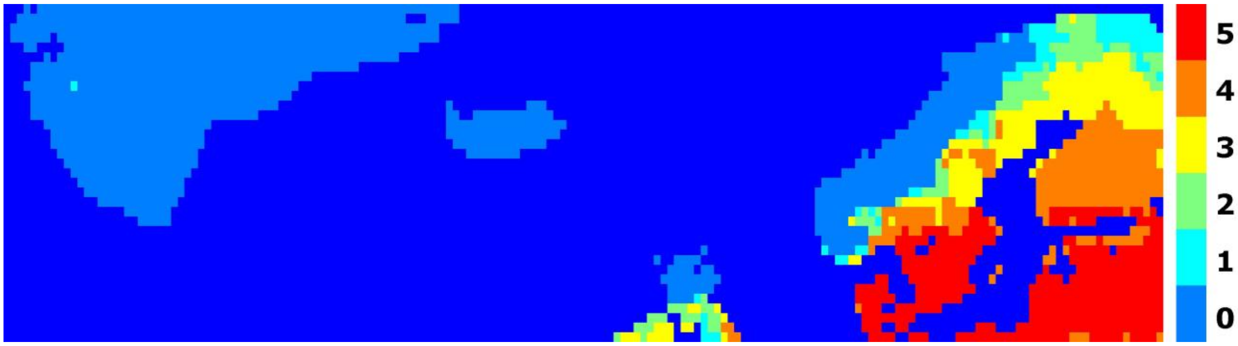

Figure 14. Number of Very Good or Better Months, 2080s, A1F

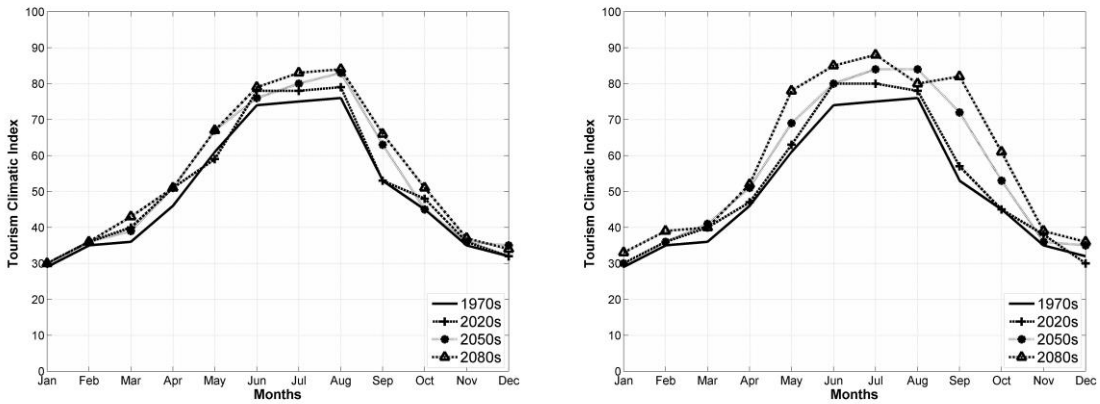

Figure 15. Tourism Climatic Index Scores for Copenhagen and Surrounding Area, 1970s-2080s, B1A (left) and A1F (right)

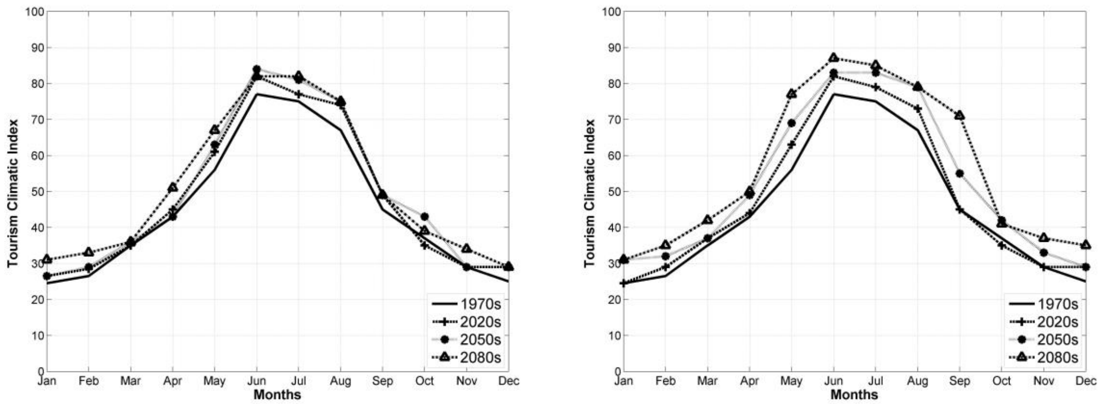

Figure 16. Tourism Climatic Index Scores for Helsinki and Surrounding Area, 1970s-2080s, B1A (left) and A1F (right)

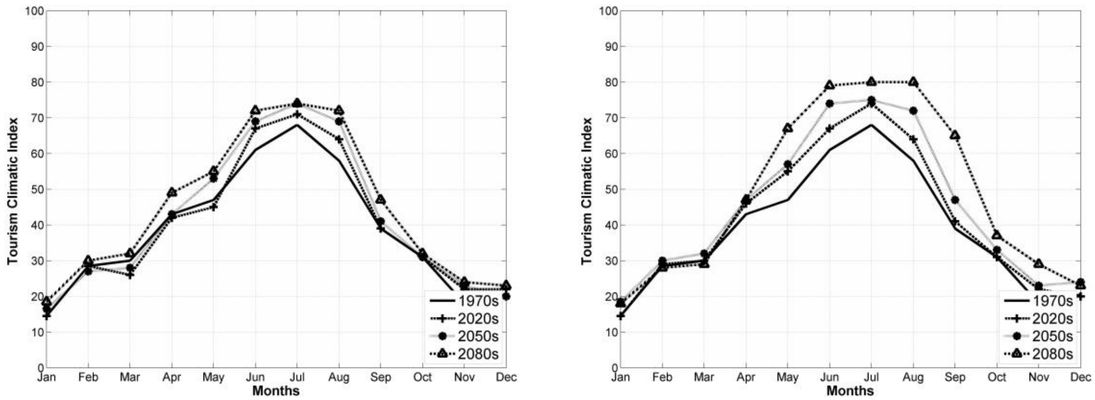

Figure 17. Tourism Climatic Index Scores for Kristiansand and Surrounding Area, 1970s-2080s, B1A (left) and A1F (right)

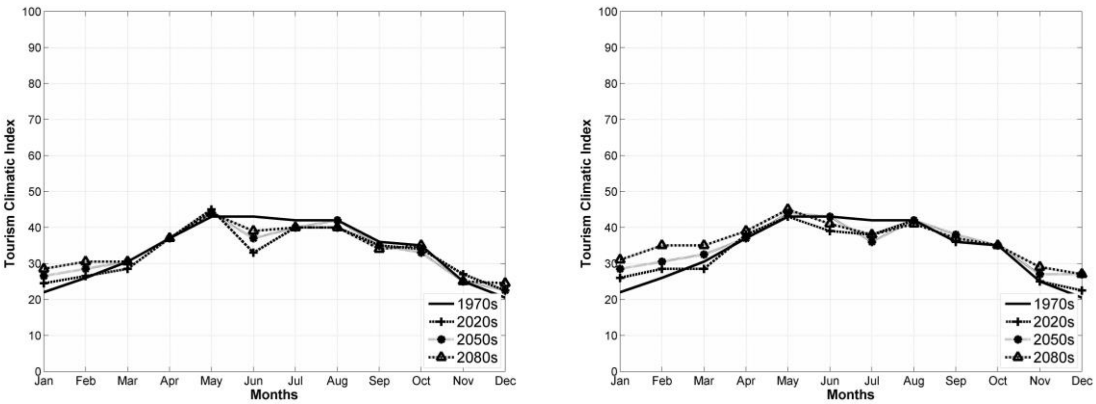

Figure 18. Tourism Climatic Index Scores for Qaqortoq and Surrounding Area, 1970s-2080s, B1A (left) and A1F (right)

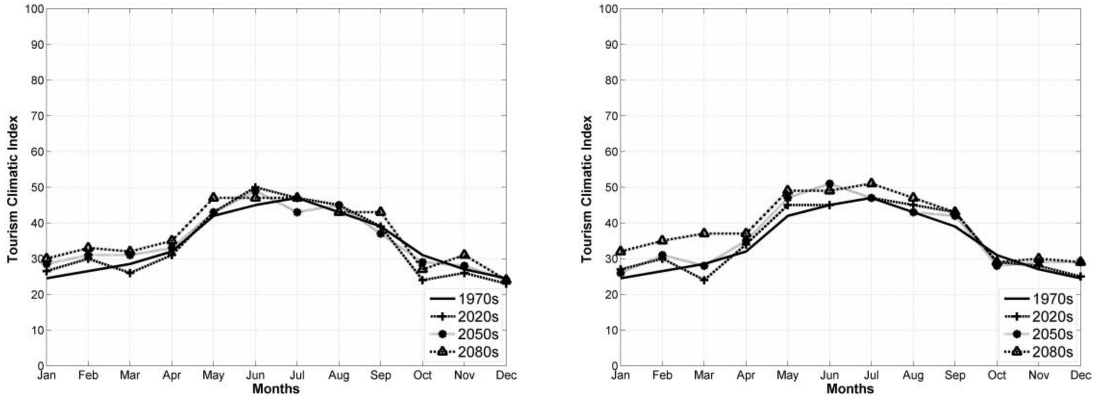

Figure 19. Tourism Climatic Index Scores for Reykjavik and Surrounding Area, 1970s-2080s, B1A (left) and A1F (right)

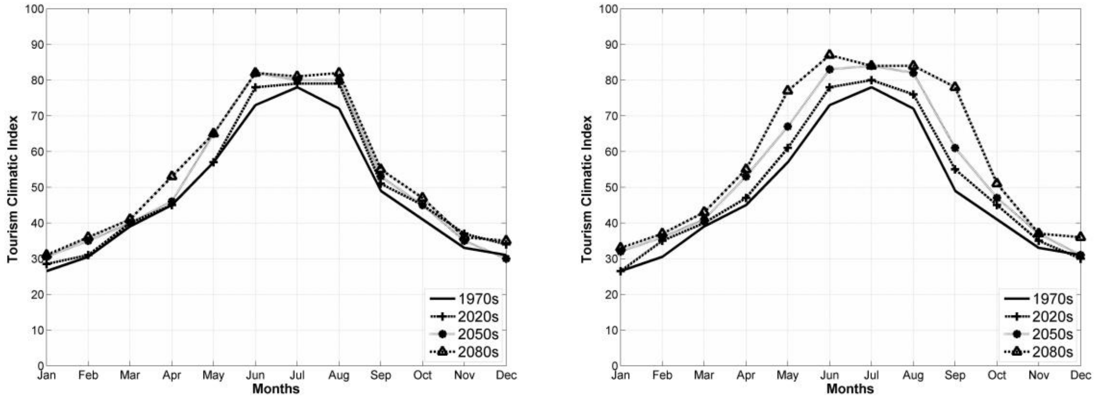

Figure 20. Tourism Climatic Index Scores for Stockholm and Surrounding Area, 1970s-2080s, B1A (left) and A1F (right)