PROCEEDINGS OF THE 4TH INTERNATIONAL CONFERENCE ON CLIMATE, TOURISM AND RECREATION

CCTR2015



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EDITORS
O. CENK DEMİROĞLU, CHRIS R. DE FREITAS,
DANIEL SCOTT, M. LEVENT KURNAZ, DİLEK ÜNALAN

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The Commission on Climate, Tourism and Recreation (CCTR) of the International Society of Biometeorology (ISB) was initiated during the 14th Congress of the ISB, in September 1996 in Ljubljana, Slovenia. The aims of the CCTR are to: a) bring together researchers from around the world to critically review the current state of knowledge in tourism and recreation climatology; and b) explore possibilities for future research. Two decades on, research in tourism climatology has developed and expanded due in large part to the initiatives and activities of the CCTR and several collaborative research projects run under the auspices of the CCTR. Recent CCTR meeting highlighted the fact that, although climate is an essential part of the resource base for tourism, which is one of the world's biggest and fastest growing industries, little is known about the effects of climate on tourists choices and broad demand patterns, or the influence climate has on the commercial prospects and sustainability of tourism operators and destinations.

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LIST OF CONTRIBUTORS

Ákos Németh	Hungarian Meteorological Service, Hungary
Anja Gujit	Wageningen University, the Netherlands
Attila Kovács	University of Szeged, Hungary
Azade Özlem Çalık	Ankara University, Turkey
Bas Amelung	Wageningen University, the Netherlands
Bruno Abegg	alpS – Centre for Climate Change Adaptation, Austria
	University of Innsbruck, Austria
Cana Tülüş	Istanbul Policy Center, Turkey
Carolien Kroeze	Wageningen University, the Netherlands
Caroline Larrivée	Ouranos, Canada
Chris de Freitas	University of Auckland, New Zealand
Clotilde Dubois	Météo France
Daniel Scott	University of Waterloo, Canada
Dede Krishnadianty	World Wide Fund for Nature Indonesia
Deniz Türkoğlu	Ankara University, Turkey
Diler Yılmaz	Istanbul University, Turkey
Duygu Erten	Istanbul Medipol University, Turkey
Elena Grigorieava	Russian Academy of Sciences, Russia
Enrique Moran-Tejeda	Pyrenean Institute of Ecology, Spain
Eric Jover	Snow and Mountain Research Center of Andorra
Eva Hagsten	Statistics Sweden
F. López-Martín	Gobierno de Aragón, Spain
Gabriella Szépszó	University of Szeged, Hungary
Ghislain Dubois	TEC Conseil, France
Gökhan Karaatlı	Valparaiso University, USA
Gürel Çetin	Istanbul University, Turkey
	Mid Sweden University, Sweden
İbrahim Birkan	Atılım University, Turkey
János Unger	Hungarian Meteorological Service, Hungary
Janto Simon Hess	ADAPTOUR, Germany
Jean Paul Ceron	University of Limoges, France
Johannes T. Welling	University of Iceland
Juan Ignacio López-Moreno	Pyrenean Institute of Ecology, Spain
Kate Germain	Université du Québec à Montréal, Canada
Ksenija Zaninovic	Meteorological and Hydrological Service, Croatia

Laurent Vanat	Vanat Consulting, Switzerland
Leandra Jaenicke	University of Innsbruck, Austria
Lidija Srnec	Meteorological and Hydrological Service, Croatia
Lyudmila N. Derkacheva	Far Eastern Federal University, Russia
M. Levent Kurnaz	Boğaziçi University, Turkey UN Sustainable Development Solutions Network Turkey
M. Tufan Turp	Boğaziçi University, Turkey
Marc Pons	Sustainability Observatory of Andorra Universitat Politècnica de Catalunya, Spain
Maria Dolores Frias	University of Cantabria, Spain Instituto de Física de Cantabria, Spain
Maria Gilaberte-Búrdalo	Universidad San Jorge, Spain
Martin Falk	Austrian Institute of Economic Research, Austria
Masatoshi Tanaka	Fukushima Medical University, Japan
Michelle Rutty	University of Waterloo, Canada
Mike Peters	University of Innsbruck, Austria
Musa Pınar	Valparaiso University, USA
Muzaffer Uysal	Virginia Polytechnic Institute and State University, USA
Natalya F. Soboleva	Far Eastern Federal University, Russia
Nazan An	Boğaziçi University, Turkey
Òscar Saladié	Rovira i Virgili University, Spain
Osman Cenk Demiroğlu	Istanbul Bilgi University, Turkey Istanbul Policy Center, Turkey Boğaziçi University, Turkey
Paul Stampfl	alpS – Centre for Climate Change Adaptation, Austria
Peter Johnson	University of Waterloo, Canada
Rainer Unger	alpS - Centre for Climate Change Adaptation, Austria
Raquel Santos-Lacueva	Rovira i Virgili University, Spain
Renata Sokol Jurkovic	Meteorological and Hydrological Service, Croatia
Robert Steiger	University of Innsbruck, Austria
Rosa Pino-Otín	Universidad San Jorge, Spain
Salvador Clavé	Rovira i Virgili University, Spain
Sixto Herrera	Instituto de Física de Cantabria, Spain
Stéphanie Bleau	Ouranos, Canada
Tuğba Öztürk	Işık University, Turkey
Viachaslau Filimonau	Bournemouth University, UK
Yüksek Güçlü	Sakarya University, Turkey

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FOREWORD

Chris R. de Freitas
Co-chair, International Society of Biometeorology (ISB) Commisson on Climate, Tourism and Recreation (CCTR)
School of Environment, University of Auckland, New Zealand.

Daniel Scott
Co-chair, International Society of Biometeorology (ISB) Commisson on Climate, Tourism and Recreation (CCTR)
Department of Geography & Environmental Management, University of Waterloo, Canada

The Commission on Climate, Tourism and Recreation (CCTR) of the International Society of Biometeorology (ISB) was initiated during the 14th Congress of the ISB, in September 1996 in Ljubljana, Slovenia by Chris de Freitas (University of Auckland, New Zealand) and Andreas Matzarakis (University of Freiberg, Germany). At the time the stated aims of the CCTR were to: a) bring together researchers from around the world to critically review the current state of knowledge in tourism and recreation climatology, and b) explore possibilities for future research. Two decades on, research in tourism climatology has developed and expanded due in large part to the initiatives and activities of the CCTR, including a 2009 White Paper for the World Meteorological Organization on Weather and Climate Information for Tourism and several collaborative research projects run under the auspices of the CCTR.

There have been four international meetings of CCTR, with the first in Halkidiki in northern Greece during October 2001. CCTR2015 is the fourth of these meetings, in all attended by delegates from Australia, Austria, Bulgaria, Canada, Croatia, Germany, Greece, New Zealand, Poland, United Kingdom, United States, Russia, Lithuania, Japan, Romania, and Switzerland and representing fields of expertise that include climatology, thermal comfort and heat balance modelling, climate change impact assessment, tourism marketing and planning, urban and landscape planning and economics of tourism climatology. The first CCTR meeting highlighted the fact that, although climate is an essential part of the resource base for tourism, which is one of the world's biggest and fastest growing industries, little is known about a) the effects of climate on tourists choices and broad demand patterns or b) the influence climate has on the commercial prospects and sustainability of tourism operators and destinations. The meeting identified several research themes that warrant attention:

- Better understanding of what climate-related information is required by tourists and the tourism industry.
- The need to explore the distinction between impacts of climate on tourists versus the impact on the tourism industry.
- The need to assess the role of weather and longer term expectations of climate on destination choices.
- To identify what climate related-criteria people use to make decisions about tourism choices.
- Determine how climate information products are currently used by the tourism industry.
- Identify the sort of climate information required by the tourism sector.
- The need for a tourism climate index that integrates all facets of climate, uses standard data, and is objectively tested and verified.

Figure 1: Current climate-tourism relationships: themes and issues

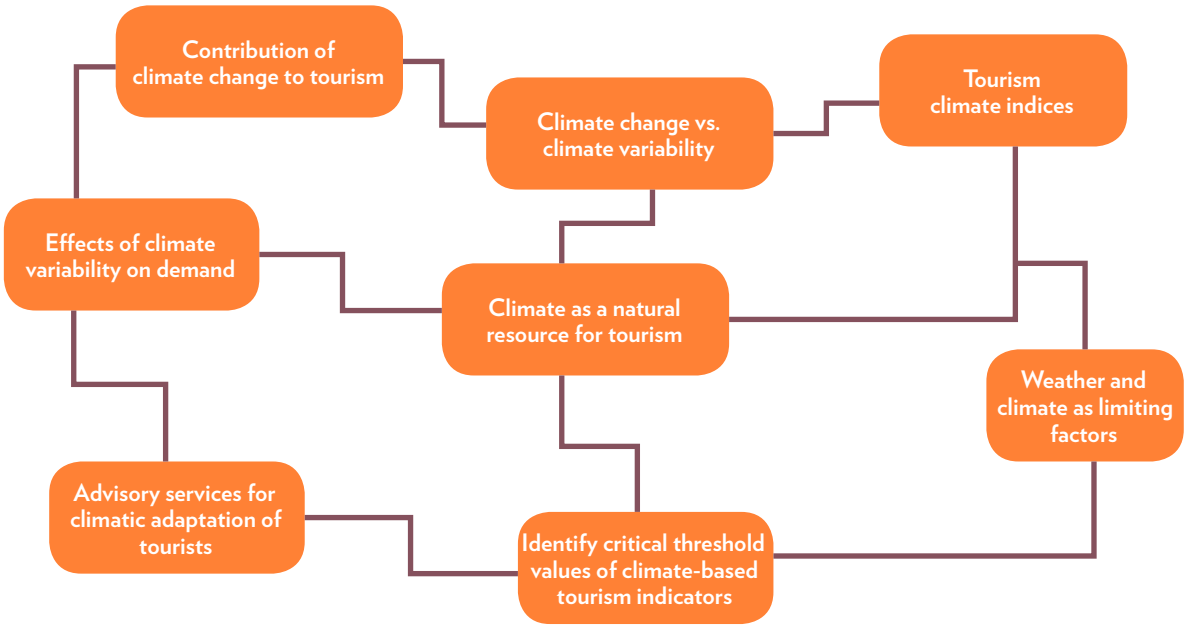


Figure 1 depicts the key themes conceptually.

The fourth meeting of the CCTR reveals that progress in understanding the complexities of these themes has advanced, but key knowledge gaps remain in each theme. The content of this volume showcases new perspectives and methods in studying climate–tourism relationships that have evolved since the CCTR was established. What stands out in this volume is the diversification of research that demonstrates how multidisciplinary the field of tourism climatology has become over the past two decades. A growing interest in knowledge mobilization and interaction with potential end-users is an important direction for research and practice. The new collaborations that have emerged from previous CCTR meetings and the impressive contributions from emerging scholars highlight the tremendous prospects for this rapidly advancing field of research.

WEATHER/CLIMATE AND TOURISM/RECREATION RELATIONSHIP

ACCLIMATIZATION THERMAL STRAIN INDEX FOR TOURISM (ATSIT): A MEANS FOR ASSESSING HUMAN HEALTH IMPACTS OF TRAVEL BETWEEN CONTRASTING CLIMATES

E. A. Grigorieva and C. R. de Freitas

Heat and cold stress can seriously affect a person's performance and health and potentially reduce tolerance for other environmental hazards. Assessment of thermal stress is important in many outdoor, work-related, sporting, and recreational situations and military scenarios. Travellers in particular are often exposed to thermal conditions that are quite different to those at home. There is an important period following arrival during which an unacclimatized individual experiences an adjustment process that can affect his/her physiological wellbeing. The consequences depend to a large degree on the magnitude and duration of the acclimatization.

During acclimatization to heat or cold, the body experiences additional thermally induced physiological strain. The first signs show up in the respiratory organs because respiration is a continuous heat exchange process in which the body is in close and direct contact with the ambient air. There are no behavioral or other adjustments to prevent the ambient air entering into the body's core area through the respiratory tract. The Acclimatization Thermal Strain Index (ATSI) was developed earlier to quantify the acclimatization thermal loading (ATL) on respiratory organs until full adaptation is achieved (de Freitas & Grigorieva, 2009, 2014). The aim here is to further develop the ATSI scheme to produce an index called the Acclimatization Thermal Strain Index for Tourism (ATSIT) to quantify the consequences for tourists. ATSIT is the standardized ratio of the difference between thermal strain at the traveler's home location to that experienced at the trip destination during a one to two week adjustment period. To illustrate the utility of ATSIT, the consequences for tourists travelling internationally between contrasting climates are examined. The relative adjustment stress is ranked across a range of travel destinations and seasons.

The potential adjustment cost in acclimatization cannot be accurately determined from a straightforward comparison of climatic conditions. ATSIT allows one to quantify the impact of adapting to changed conditions. The results show that the relationship is not straightforward. Adjusting to cold comes with greater physiological strain than adjusting to heat, with the biggest acclimatization impact coming with a change of location from hot-humid to cold-dry climatic conditions. It is possible that travelers may suffer serious consequences unless appropriate measures are taken to avoid severe discomfort or harm.

The approach used here has a variety of uses. ATSIT projections allow travelers to anticipate the degree of discomfort they might experience at a new location during acclimatization. The scheme could be employed to assess risks due to increases in short-term thermal variability in weather conditions such as encountered during heat waves and cold snaps. The information could be useful for assessing the need for public health services and measures that might be used to help mitigate impacts. The ultimate goal is to test the scheme over the full range of climatic types that occur globally and to develop the

results into a standardized typology of contrasting climatic groupings. It would provide a comprehensive coverage of different combinations and ranges of thermal-moisture climatic types with a view to identifying seasonal and geographical patterns globally.

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AN INTER-COMPARISON OF THE HOLIDAY CLIMATE INDEX (HCI) AND THE TOURISM CLIMATE INDEX (TCI) IN EUROPE

D. Scott, M. Rutty and B. Amelung

Much research has been devoted to evaluating climate as a resource or constraint for tourism, quantifying optimal or unacceptable climate conditions both generally and for specific tourism segments or activities. The most widely applied approach over the past 25 years has been the Tourism Climate Index (TCI), developed by Mieczkowski (1985). The TCI was designed to integrate the main climatic variables relevant to tourism into a single numerical index, providing a composite measure capable of facilitating a holistic interpretation of destination climate, which could be used to objectively compare destinations. Despite the TCI's wide application, it has been subject to substantial critique (de Freitas et al. 2008). A central limitation of the TCI is that the variable ratings and sub-component weighting scheme were subjectively based on Meiczkowski's expert opinion and are not empirically tested against the actual preferences of tourists (Scott & McBoyle 2001, de Freitas 2003, Gomez-Martin 2006). Because the TCI was devised to represent the weather conditions for "sightseeing," it is insensitive to the large variety of weather requirements of tourism segments in diverse destinations (e.g., beach, urban, mountain). The TCI was developed over 30 years ago before digital climate data was widely available, and so it utilized monthly climate means and did not adequately consider the variability or probability of key weather conditions. The TCI also over-emphasizes the thermal component (compared to tourist stated preferences) and neglects the possibility of the over-riding effect of physical (i.e., rain, wind) and aesthetic (i.e., sunshine, cloud cover) parameters (de Freitas et al. 2008, Scott et al. 2008, Rutty and Scott 2010, 2013). Despite these known limitations, a large number of TCI based studies continue to be undertaken around the world (see e.g. Nicholls & Amelung 2015, Amelung & Nicholls 2014, Perch-Nielsen et al. 2010).

To overcome the above noted limitations of the TCI, a Holiday Climate Index (HCI) was developed to more accurately assess the climatic suitability of destinations for tourism. The word "holiday" was chosen to better reflect what the index was designed for (i.e., leisure tourism), since tourism is much broadly defined as "a social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business/professional purposes" (UNWTO, 2008). A major advancement of the HCI is that its variable rating scales and the component weighting system are based on the literature of tourists' stated climatic preferences that has developed over the last decade (e.g., Scott et al. 2008, Moreno 2010, Rutty & Scott 2010, 2013). The HCI utilizes daily data and estimates both average monthly index ratings and probabilities of selected rating categories that are most important for tourist decision-making (i.e., excellent/ideal versus poor/unacceptable). The HCI is consistent with the conceptual design recommended by de Freitas et al. (2008) and thus accounts for the overriding effect of physical variables (wind and rain). The rating system of the HCI has also been designed to be highly interpretable by tourists, as well as facilitate scientific comparisons with existing climate indices for leisure tourism (including the TCI).

This paper will discuss the design of the HCI, including a summary of multi-national tourist climate preference surveys, and how the limitations of the TCI were overcome. It then presents the results of the HCI which was designed specifically for urban destinations (HCI-urban) and for beach destinations (HCI-beach) for a geographically diverse sample of European destinations (15 urban and 15 beach/coastal). The paper also compares the rating of climate resources by the HCI and the TCI (as originally specified by Mieczkowski 1985) at these study areas. The index inter-comparison illustrates how the HCI-urban rates the climate of many cities higher than the TCI, particularly in shoulder seasons and the winter months, which is more consistent with observed visitation patterns. The differential ratings by the HCI-beach and the TCI are far more pronounced for beach tourism, because the specific conditions sought by tourists are the foundation of the HCI-beach design, and thereby, the HCI-beach index is a more robust representation of coastal tourists perceptions and experiences. The results empirically demonstrate that use of the Mieczkowski (1985) TCI should be discontinued.

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TOURISM CLIMATE INDICES: UNCERTAINTIES AND RELIABILITY ISSUES

G. Dubois, J. P. Ceron, C. Dubois, M. D. Frias and H. Sixto

Abstract

Tourism climate indices (TCI) are commonly used to describe the climate conditions suitable for tourism activities from the planning, investment, or daily operations perspectives. A substantial amount of research has been carried out, in particular with respect to new TCI formulae adapted to specific tourism products and parameters and their weighting, taking into account surveys on the stated preferences of tourists, especially in terms of comfort. This paper illustrates another field of research that seeks to better understand the different sources of uncertainty associated with TCIs. Indeed, slight differences in formula thresholds, variations in computation methods, and also the use of multimodel ensembles create nuances that affect the ways in which TCI projections are usually presented. Firstly, we assess the impact of differences in preference surveys on the definition of TCI thresholds, in particular for thermal comfort. Secondly, we compare computation methods for France, showing the need to better specify detailed data sources and their use to ensure the comparability of results. Thirdly, using multimodel ensembles for the Mediterranean basin, we assess the uncertainty inherent in long-term projections, which are used in modelling the economic impact of climate change. This paper argues in favor of a more cautious use of tourism comfort indices, with more consideration given to the robustness of data (validation, debiasing, uncertainty assessment, etc.) and users' needs, from the climate services perspective.

Keywords

Climate, Tourism, Indices, Preferences, Mediterranean, Uncertainty, Downscaling, Climate Services

Acknowledgments

This paper was written by a team participating in the EU FP7 project CLIM-RUN "Climate Local Information in the Mediterranean Region, Responding to Users' Needs" (2011-2014). The CLIM-RUN project aimed at developing a better understanding of the interaction between users and producers of climate services in order to help define Mediterranean climate service networks. CLIM-RUN developed a bottom-up protocol directly involving stakeholders early in the process with the aim of identifying well defined needs on the regional and local scales. Improved modelling and downscaling tools were then used to respond to these specific needs in an optimal way.

HUMAN BEHAVIOR AS A MEASURE OF THE SIGNIFICANCE AND APPEAL OF CLIMATE FOR TOURISM

C. R. de Freitas

Introduction

From its inception, biometeorology has been concerned with the effects of climate (incorporating weather) on humans through physical processes that directly affect the body and through psychological processes that determine human perception of climatic conditions and, thus, human behavioral response to those conditions. One determinant of behavioral response relates to homeothermy, which determines that ultimately heat produced by the body equals heat lost to the environment over time. During this balancing process, net heat transfer can be radically influenced by voluntary behavior. Thus thermal perception drives behavioral response that in turn reveals human preferences. But humans respond to more than just the thermal bioclimate; consequently, what climatic preferences are can be hard to pin down. Individuals react to the thermal component of the climatic environment, embracing the combined effects of air temperature, wind, humidity, and solar radiation; others respond to variables that are entirely physical (e.g. rain) or aesthetic (e.g. cloud cover and "sunny skies"), while most respond to some combination of all three (de Freitas 1990). Objectively determining what the various climate limits are or how various facets of the atmospheric environment come together to give meaning to diverse and sundry arrays of weather types is not a simple matter. But understanding what they are is important as climate is a dominant attribute of a tourist destination and has a major effect on tourism demand and satisfaction.

Human behavior reflects an unwillingness to endure climatic conditions that are considered to be unpleasant. It also reflects what climate preferences are. This is especially useful given the multi-faceted nature of atmospheric environment and the complex way humans deal with these facets in combination.

Role of behavior

Weather is widely considered to influence people's behavior (Persinger 1980; Watson 2000), but research on the topic is surprisingly limited (Ciucci et al. 2013). Generally speaking, behavioral traits reveal how individuals adapt or adjust to changes in the atmospheric environment. They are learned reactions that are often easy to interpret. For instance, the amount of clothing worn is, to a point, an indicator a thermal environmental stress. The reciprocal is the insulation required to offset cold stress and maintain comfort. In the context of the atmospheric environmental conditions, behavioral choice is a learned reaction based on perception and experience that reveals preferences in so far as they are motivated by a desire to maximize satisfaction and pleasure.

On-site behavior and participation numbers can be used as a measure of human sensitivity to and satisfaction of weather and climate conditions (de Freitas 2003). The approach is an alternative to using an *ex situ* study of tourist climate preferences, where a questionnaire survey is administered in a controlled setting and respondents can express their perceived satisfaction with a wide range of climate conditions. The approach examines onsite actions of individuals experiencing conditions firsthand. It is a manifestation of how individuals

react, adapt, or adjust, which can be interpreted objectively. Compared to subjective verbal response (e.g. questionnaire) data, behavioral reactions to climate are separate and independent indicators of on-site experience. Auliciems and de Dear (1997: 71) describe this as field investigation using "real" people engaged in "real" tasks and interacting with "real" environments rather than highly contrived experiments.

Given that recreation and tourism are voluntary and involve pursuits in which individuals freely engage for personal satisfaction or pleasure, the behavior of those involved in leisure activity reflect climate preferences. Participation will only occur if the potential participant perceives the atmospheric condition to be suitable. The voluntary and discretionary nature of tourism means that participation will decrease as discomfort and dissatisfaction increase. Thus satisfaction affects participation, which can be taken as a measure of demand for the climatic resource, the so-called "demand factor" (de Freitas 2003). Examples of indicators of demand in this context are visitation or attendance numbers and hotel/motel occupancy or hotel "tourist nights."

The climate or weather circumstances to which the tourist may react or respond (i.e. those that affect decisions) are 1) conditions anticipated by the tourist (gleaned from weather or climate forecasts, travel brochures, etc.) and 2) on-site weather. They can be identified and assessed using "demand indicators" (de Freitas 2003). There are two categories of methods that have been used for assembling data on human response to climate and, thus, the demand for the climate resources: 1) assess conditional behavior by using, say, questionnaires or images to determine how people react or think, which includes assessing the influence or role of weather or climate forecasts; 2) examine onsite experience. Since individuals are experiencing conditions firsthand, this is a more reliable method than questionnaires and interviews. Ideally, the approach must be activity-specific. And it is best not to lump all tourism together but to deal with specific categories of activities, either a) active or b) passive.

In the current research, the focus is on highly climate-sensitive activities of "sun, sea, and sand" (3S) tourism. An ocean beach situation is selected for study not only because beach recreation is highly weather sensitive but also because beach users are normally concentrated in a relatively small area. For this reason, sample populations can be readily observed largely free of the problems associated with subjects confined to laboratories, classrooms, or artificial settings. The compact area also facilitates on-site monitoring of atmospheric and associated environmental variables representative of ambient conditions. Another important reason is that individual beach recreation occasions are, for large groups of participants, single purpose. For participants, recreational aims or objectives of the occasion are often similar. Also, for a wide range of common on-site behavioral adjustments to atmospheric conditions, there are only a few possible motives. From a research standpoint these characteristics offer a relatively controlled situation. The purpose here is to extend earlier work by examining behavioral responses that modify, enhance, or simply make manifest the effects of the atmospheric environment on people (de Freitas 2015). The data is then used to identify and interpret climate preferences.

Method

Biometeorological preference studies commonly use controlled groups of people. Reasons for this include ease of data collection where large samples are required or the need to control environmental conditions. Clearly, data drawn from naturally functioning systems is more desirable so as to avoid errors in data associated with the artificial nature of experimental or laboratory conditions. In the

current investigation, the beach provided a fixed, naturally bounded area for the implementation of sampling and monitoring procedures with the convenience of a controlled population but with the qualities of a naturally functioning system where data could be gathered easily and unobtrusively.

The study area is the Sunshine Coast, a tourist and recreational area in Southeast Queensland, Australia, located approximately 150 km north of the city of Brisbane. The climate is subtropical. The study site is the popular King's Beach (26°48' S, 153°9' E), Caloundra. On-site observations were made during the daylight hours of 48 weekdays over a 12-month period, with a minimum of three observation days for each month. Data from 179 observations were selected from this to obtain a cross-section of weather conditions. The atmospheric variables measured on site are solar radiation, longwave radiation, air temperature, vapour pressure, wind speed, cloud cover, type and amount, and sand surface temperature. Details of microclimatological instruments used, the monitoring schedule, the range of environmental conditions encountered during field observations, body-environment energy balance modelling procedure applied, and rationale for the scheme are given by de Freitas (1985, 1990, 2003). Details of the weather rating scheme employed, its theoretical basis, and testing are given by de Freitas et al. (2008).

There are at least six ways in which an individual can adapt, adjust, or react behaviorally: a) avoid areas of unfavorable weather-determined conditions; b) change activity to suit weather conditions so as to maximize enjoyment of the outdoor experience; c) extend or reduce length of stay; d) use structural or mechanical aids (shade umbrellas, wind breaks, etc.); e) adjust thermal insulation of body (clothing); and f) adopt passive acceptance. With these options in mind, data were collected for the variables in Table 1.

On-site behavioral data was assembled within two categories based on a fixed format observation schedule. Data within the first category was based on observations at approximately 30-minute intervals of characteristics of the total beach population. As is common in Australia, beach users located within a portion of the beach and water opposite delimited by code flags are provided with on-the-spot life-saving and shark watch services. Consequently, in excess of 90 percent of the beach user population was normally confined to a specific part of the beach providing a relatively compact area on which the observer could focus. It is relatively easy to scan other parts of the beach for details of the rest of the population. It is possible, therefore, to assemble data based on total population, even for large attendance numbers rather than that based on data gathered from sample sectors of the beach. The second category of observational data involved continuous monitoring of the behavioral patterns of selected beach users for the duration of their visit.

Results and Conclusions

The results show that behavior is a reliable indicator of the significance of weather conditions. Behavioral traits reflect how people react and provide objective response criteria for tolerances and thresholds to augment questionnaire and verbal response assessments. The results indicate that certain behavioral adjustments, most notably the use of shade umbrellas, windbreaks, and possibly increased frequency of swims taken, serve to reduce the beach user's sensitivity to on-site atmospheric conditions, although stated preferences as regards beach weather remain the same. In the absence of ideal conditions, an individual can create, to a point, a personal microclimate that is acceptable. Other adjustments such as the use of clothing insulation, reduced frequency of swims, and modified posture appear to be less acceptable since they offset the individual's enjoyment of the beach recreational experience (sunbathing, swimming, etc.).

The results illustrate that optimum thermal conditions for S3 tourism appear to be located in the zone of vasomotor regulation against heat ("warm" on the ASHRAE scale) rather than at the point of minimum stress or thermal neutrality. Sensitivity to thermal conditions appears to be greatest in the zone of moderate thermal stress. The immediate thermal environment of the beach user is the main contributing factor to assessments of the overall desirability of on-site weather conditions, followed by cloud cover and wind. Rainfall events of half-hour duration or longer have an overriding effect resulting in ratings dropping to their lowest levels. Cloud cover (sunshine) is the main aesthetic variable. High wind at speeds in excess of 6 m s^{-1} have a direct physical effect on the beachgoer as well as an indirect effect stemming from the annoyance caused by blowing sand. Generally, ideal atmospheric conditions are those that are "warm" in the presence of scattered cloud (0.3 cover) and with wind speeds of less than 6 m s^{-1}.

A large amount of recreation research has been concerned with assessing recreation "demand," mainly used to estimate the attractiveness of environmental attributes. The most commonly used demand indicator is attendance (visitation) data. The results here suggest attendance is likely a poor measure of demand. Allocation of leisure time, or time spent on site per visit (duration of visit), is a more accurate measure of user response and preference. Similar sensitivity associations are reflected in behavioral responses.

Behavioral characteristics and patterns are reliable indicators of the significance of "tourism climate." They provide objective response criteria to calibrate, supplement, and validate questionnaire (descriptive) response scales related to a wide range of atmospheric phenomena. The results show that climate conditions within the broad zone of acceptability are those that the beach user can readily cope with or effectively modify. Certain adjustments such as the use of shading devices, clothing, and windbreaks substantially affect the immediate thermal environment and, thus, the thermophysiological state of the individual. Optimal thermal conditions appear to be those requiring no specific adjustment or behavioral fine-tuning. In general terms, attendance levels reflect the outer limits of acceptability of the meteorological environment, while duration of visit enables calibration of levels of approval insofar as it reflects ratings of on-site conditions within the broad zone of tolerance.

In a broad theoretical sense, the results of this research add to an understanding of the relationship between weather and human behavior. The findings highlight the close relationship between weather and tourism, in particular those aspects that relate to tourist sensitivity to weather. Weather preferences are clearly identified and some light is shed on the merits of using attendance figures as indicators of demand. Clearly, behavioral data is to be preferred over subjective assessments of user satisfaction and preferences. Collectively, this information is potentially useful in effective tourism management and planning. Information proved by studies such as this could be used for forecasting the level of beach-use during the year to prepare for the provision of tourist resources and facilities, water safety services, and site conservation. The results imply that tourism planning should incorporate more than simple, general descriptions of climate and weather. The same applies in the case of communicating climate information and descriptions used in weather forecasts. Various authorities may have to improve their networks of meteorological observatories and data gathered and provide better access to information. The focus should be on the climate, a particular place or space, functionality of the destination, the level of satisfaction to be achieved, and the influence on future visits.

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THE CLIMATE COMFORT CONDITIONS IN TERMS OF TOURISM IN TURKEY'S GÖLLER (LAKES) DISTRICT

Y. Güçlü

Introduction

Climatic conditions have an important impact on tourist activites. Climate is, in fact, one of the most important tourist attractions. Thus, climate provides disadvantages and advantages for tourism resorts. In certain seasons of the year, tourism becomes more intense than in other times. The length of the most popular season, known as high season, varies according to the respective local climate conditions.

Climate conditions that may be accepted as ideal, depending on the tourist activity, have vital importance for the competitiveness of a tourism resort. Both tourism enterprises and tourists do not prefer areas with climatic disadvantages as much as those with ideal climates. Since climate conditions are the basis of natural resources and attraction of tourism resorts, climate can be the main reason that tourists select a certain destination.

Since tourism predominantly depends on climate conditions, the first issue while examining the tourism potential of a place is to detemine the annual climate characteristics of a resort. In this context, the climate comfort of the resort area should be understood. Climate comfort is defined as the satisfaction level of tourists within the climate conditions of the respective tourism environment.

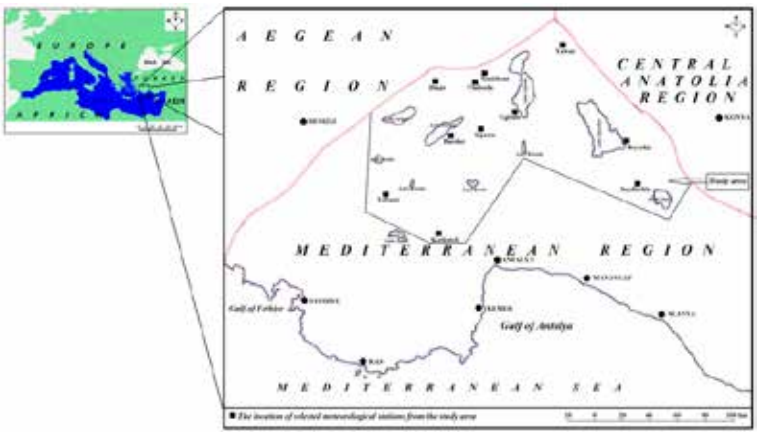
This study aims to examine climate comfort conditions in the Göller District in Turkey by means of the visitors generally participating in outdoor tourism activities in order to determine the most suitable timeframes in which the required conditions to sustain such activities healthily and in comfort are situated.

Indeed, the climate comfort status in tourism resorts must be considered to enable tourists of all ages to perform outdoor tourism activities healthily and comfortably, provide tourists with all the expected benefits of the tour, protect the participants from the possible climate risks, and allow tourism planners and marketers to plan realistic activities according to climate conditions. Considering that tourism activities may not always be limited to inside air-conditioned places such as buildings and vehicles, the importance of climate comfort may be understood even better. Moreover, it is thought that examining climate comfort conditions will contribute to the understanding of the real tourism potential of case study area, the Göller District.

Study area

The Göller (Lakes) District is located in the Antalya Section of Mediterranean Region in Turkey (Figure 1). This area takes its name from the number of lakes in the region, including Acıgöl, Eğirdir, Beyşehir, Burdur, Suğla, Salda, Yarışlı, and Kovada. With the natural, historical, and cultural attractions that it possesses, the region shelters many locations appropriate for tourism and recreational activities (Korkmaz, 2001; Bingöl, 2004; Yılmaz, 2007; Alpar & Erdem, 2007; Güngör & Polat, 2007; Öztaş & Karabulut, 2007; Dinç & Öztürk, 2013). Besides, it is near the Southern Aegean and Western Mediterranean coasts, which are some of the most important 3S tourism destinations in Turkey and in the world, and it is located on the route that many local and foreign tourists use to reach these areas via roadway. However, in spite of this huge tourism potential, the Göller District cannot gain adequate shares of tourism.

Figure 1: Location map of the study area



Methodology

In the study, data from 11 meteorology stations (Table 1) selected from the Göller District has been used. The length of observation periods, positions, and existence of insolation measurements have been affective for selecting these stations. Required data were obtained from the Ministry of Forestry and Water Affairs and the Turkish State Meteorological Service.

Table 1: Some features of selected meteorological stations for this study

Meteorology station	Elevation (m)	Latitude	Longitude
Beyşehir	1141	37.6777	31.7463
Burdur	957	37.7220	30.2940
Dinar	864	38.0598	30.1531
Eğirdir	920	37.8377	30.8720
Isparta	997	37.7848	30.5679
Korkuteli	1017	37.0565	30.1910
Senirkent	959	38.1047	30.5577
Seydişehir	1129	37.4267	31.8490
Tefenni	1142	37.3161	29.7792
Uluborlu	1025	38.0860	30.4582
Yalvac	1096	38.2830	31.1778
Mean	**1022.5**		

The data from the aforementioned selected meteorology stations has been assessed using the Tourism Climate Index – TCI (Mieczkowski, 1985). This index determines climate comfort conditions in order to understand the effects of climate on tourist flows and establish what is considered as the tourism season. This index is the most commonly integrated index. The climate factors considered in the index are sunshine duration, temperature, relative humidity, precipitation, and wind.

TCI index is calculated by using the formula; TCI=2[4(CID) +CIA+2(R) +2(S) +W]. Whereas, CID represents the Daytime Comfort Index and has a 40% weight in TCI index. CIA in the formula represents the Daily Comfort Index and has a 10% weight in TCI index. R in the formula represents the Rainfall Index, which has a 20% weight in TCI index. S in the formula represents the Sunshine Index and has a 20% weight in the TCI index. W in the formula represents the Wind Index and has a 10% weight in TCI index. The results obtained from the indices are evaluated according to the classification scheme on Table 2.

Table 2: Classification scheme for TCI of Mieczkowski

Numerical value of indices (%)	Descriptive category
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
9- -9	Impossible
–20- -10	Impossible

Source: Mieczkowski, 1985, p. 229.

Table 3. The mean monthly, annual and certain period S values of the stations selected from the Göller District of Turkey (1987-2011 period)

Meteorological stations	Mean monthly *S* values (%)												Mean Annual *S* values (%)	Mean *S* values in May-September period (%)	Mean *S* values in June-August period (%)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Beyşehir	6	8	12	14	18	20	20	20	18	12	12	6	13.8	19.2	20
Burdur	6	8	10	12	16	20	20	20	18	14	10	4	13.2	18.8	20
Dinar	8	8	12	12	16	20	20	20	18	12	10	6	13.5	18.8	20
Eğirdir	8	8	12	12	16	20	20	20	18	14	10	6	13.7	18.8	20
Isparta	8	8	12	12	16	20	20	20	18	14	10	6	13.7	18.8	20
Korkuteli	10	10	14	14	16	20	20	20	18	14	12	8	14.7	18.8	20
Senirkent	4	8	12	12	16	20	20	20	18	12	6	4	12.7	18.8	20
Seydişehir	6	8	12	14	16	20	20	20	18	12	8	6	13.3	18.8	20
Tefenni	6	8	12	14	16	20	20	20	18	12	8	4	13.2	18.8	20
Uluborlu	6	8	12	14	18	20	20	20	18	12	10	6	13.7	19.2	20
Yalvaç	8	8	10	12	16	20	20	20	18	12	10	6	13.3	18.8	20
Beyşehir	6	8	12	14	18	20	20	20	18	12	12	6	13.8	19.2	20
Mean of the study area (%)	6.8	8.6	11.8	13	16.5	20	20	20	18	12.7	9.8	5.7	13.5	18.9	20
Ideal R value (%)	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

Results and Discussion

Sunshine Index (S) findings

The mean monthly S values vary between 4% (Burdur, Senirkent and Tefenni in December, Senirkent in January) and 20% (at all stations in summer months). The mean annual S values are 13.2 to 14.7% (Table 3).

In the May-September period, the sky is generally clear, the weather is dry/less rainy and the S values vary between 16% and 20%. In summer, mean S value is 20% (Table 3). When we consider the ideal S value in TCI as 20%, it may be said that the S values contribute very importantly to the overall TCI values and increase the tourism climate comfort.

Table 4: The mean monthly, annual and certain period R values of the stations selected from the Göller District of Turkey (1987-2011 period).

Meteorological stations	Mean monthly *R* values (%)												Mean annual *R* values (%)	Mean *R* values in May-September period (%)	Mean *R* values in June-August period (%)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Beyşehir	14	14	14	14	14	18	20	20	18	14	12	10	15.2	18	19.3
Burdur	16	16	14	14	16	18	18	20	18	16	16	12	16.2	18	18.7
Dinar	16	16	14	12	14	18	18	20	20	16	14	14	16	18	18.7
Eğirdir	8	6	8	10	14	18	20	20	18	14	10	2	12.3	18	19.3
Isparta	14	14	14	14	14	18	18	20	18	16	14	12	15.5	17.6	18.7
Korkuteli	14	16	16	16	16	18	20	20	20	16	16	14	16.8	18.8	19.3
Senirkent	12	10	10	10	12	16	18	20	18	14	10	8	13.2	16.8	18
Seydişehir	8	8	10	12	14	18	20	20	18	12	6	2	12.3	18	19.3
Tefenni	14	14	16	14	16	18	18	20	20	16	14	12	16	18.4	18.7
Uluborlu	14	12	12	12	14	16	18	20	18	14	12	10	14.3	17.2	18
Yalvaç	14	14	14	12	16	16	18	20	18	14	14	12	15.2	17.6	18
Mean of the study area (%)	13.1	12.7	12.9	12.7	14.5	17.5	18.7	20	18.5	14.7	12.5	9.8	14.8	17.9	18.8
Ideal R value (%)	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

Rainfall Index (R) findings

The annual mean of R values changes between 12.3% (Eğirdir and Seydişehir) to 16.8% (Korkuteli) (Table 4) in the study area. The monthly R values vary between 2% (in Eğirdir and Seydişehir in December) to 20% (in Beyşehir, Eğirdir and Seydişehir in July and August; in Dinar and Tefenni in August and September; in Korkuteli in summer months; at all stations in July). On the other hand, the mean of the R values is about 17.9 % in May-September period and 18.8% in summer (Table 4).

While calculating TCI values, the ideal R value is 20%; thus, it can be said that the precipitation makes high level positive contribution to tourism by means of climate comfort. R values contribute highly and positively to TCI values in May-September period (especially in summer months) in the Göller District of Turkey.

Table 5: The mean monthly, annual and certain period W values of the stations selected from the Göller District of Turkey (1987-2011 period)

Meteorological Stations	Mean monthly *W* values (%)												Mean annual *W* values (%)	Mean *W* values İn May-September period (%)	Mean *W* values in June-August period (%)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Beyşehir	8	8	9	9	5	3	3	3	5	4	10	8	6.3	3.8	3
Burdur	8	8	8	6	6	2	2	2	3	5	8	8	5.5	3	2
Dinar	7	7	7	6	6	2	2	2	2	6	8	8	5.3	2.8	2
Eğirdir	6	6	7	6	8	8	1	1	8	8	7	6	6	5.2	3.3
Isparta	8	8	8	8	6	6	2	3	5	5	8	8	6.3	4.4	3.7
Korkuteli	8	8	8	6	6	2	2	3	5	5	9	9	5.9	3.6	2.3
Senirkent	8	8	8	6	6	2	2	2	5	5	9	8	5.8	3.4	2
Seydişehir	6	8	8	6	6	6	2	2	6	5	8	8	5.9	4.4	3.3
Tefenni	8	9	9	5	5	3	3	3	5	4	10	10	6.2	3.8	3
Uluborlu	6	8	7	8	6	6	2	2	6	6	7	8	6	4.4	3.3
Yalvaç	8	8	8	8	6	6	2	2	6	6	8	8	6.3	4.4	3.3
Mean of the study area (%)	7.4	7.8	7.9	6.7	6	4.2	2.1	2.3	5.1	5.4	8.4	8.1	6	3.9	2.8
Ideal W value (%)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Wind Index (W) findings

The annual mean of W values varies between 5.3% (Dinar) to 6.3% (Isparta and Yalvaç) (Table 5). In the May-September period, in which tourism activities become intense, the mean W values fall under the annual mean.

The mean May-September of the W values is 3.9% and falls back to 2.8% in summer season. On the other hand, the monthly W values vary between 1% (in Eğirdir in July and August) to 10% (in Tefenni in November and December). Accordingly, the contribution of W values to the TCI values lessen in July and August in the study area. Thus, the wind generally affects positively the climate comfort in the Göller District. However, in May-September period and summer, its contribution to climate comfort decreases (Table 5).

Table 6: The mean monthly, annual and certain period CID values of the stations selected from the Göller District of Turkey (1987-2011 period)

Meteorological stations	Mean monthly *CID* values (%)												Mean annual *CID* values (%)	Mean *CID* values in May-September period (%)	Mean *CID* values in June-August period (%)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Beyşehir	20	20	32	40	40	32	24	24	36	40	32	20	30	31.2	26.7
Burdur	20	20	40	40	36	24	16	16	28	40	40	20	28.3	24	18.7
Dinar	20	24	40	40	36	24	16	16	28	40	40	24	29	24	18.7
Eğirdir	20	20	32	40	40	28	24	24	32	40	32	20	29.3	29.6	25.3
Isparta	20	20	36	40	40	28	16	20	28	40	40	20	29	26.4	21.3
Korkuteli	20	24	36	40	40	28	20	20	28	40	40	24	30	27.2	22.7
Senirkent	20	20	36	40	40	28	20	20	32	40	36	20	29.3	28	22.7
Seydişehir	20	20	32	40	40	28	20	20	32	40	36	20	29	28	22.7
Tefenni	20	24	36	40	40	28	20	20	32	40	40	20	30	28	22.7
Uluborlu	20	20	36	40	40	32	24	24	32	40	36	20	30.3	30.4	26.7
Yalvaç	20	20	36	40	40	28	20	20	32	40	36	20	29.3	28	22.7
Mean of the study area (%)	20	21.1	35.6	40	39.3	28	20	20.4	30.9	40	37.1	20.7	29.4	27.7	22.8
Ideal CID value (%)	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40

The Daytime Comfort Index (CID) findings

The mean annual CID values are about 29% and vary between 28.3% (Burdur) to 30.3% (Uluborlu) (Table 6). High values of maximum temperatures decrease the CID values significantly in May-September period. Especially in summer months, the CID values are quite under the ideal value (40%).

The highest CID values are seen in spring and autumn seasons and the lowest CID values in winter and summer seasons. The May and October months are transition periods. The general mean of CID values in May-September period, in which tourism activities become intense, is about 27.7%, and in summer, it is 22.8%. The most suitable periods by means of CID values in the Göller District are March-May and September-November periods.

Table 7: The mean monthly, annual and certain period CIA values of the stations selected from the Göller District of Turkey (1987-2011 period)

Meteorological stations	Mean monthly *CIA* values (%)												Mean annual *CIA* values (%)	Mean *CIA* values in May-September period (%)	Mean *CIA* values in June-August period (%)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Beyşehir	2	3	3	4	5	8	10	10	7	5	4	3	5.3	8	9.3
Burdur	3	3	4	5	6	10	10	10	9	5	4	3	6	9	10
Dinar	3	3	4	5	6	10	10	10	9	5	4	3	6	9	10
Eğirdir	3	3	4	5	6	10	10	10	8	5	4	3	5.9	8.8	10
Isparta	3	3	4	5	6	10	10	10	8	5	4	3	5.9	8.8	10
Korkuteli	3	3	4	5	6	10	10	10	9	5	4	3	6	9	10
Senirkent	3	3	4	5	6	10	10	10	9	5	4	3	6	9	10
Seydişehir	3	3	4	5	6	10	10	10	9	5	4	3	6	9	10
Tefenni	3	3	6	5	6	10	10	10	8	5	4	3	6.1	8.8	10
Uluborlu	3	3	4	5	6	9	10	10	8	5	4	3	5.8	8.6	9.7
Yalvaç	3	3	3	5	6	9	10	10	8	5	4	3	5.8	8.6	9.7
Mean of the study area (%)	2.9	3	4	4.9	5.9	9.6	10	10	8.4	5	4	3	5.9	8.8	9.9
Ideal CID value (%)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

The Daily Comfort Index (CIA) findings

In the study area, the mean annual of CIA for the selected stations is 5.9%, which ranges from 5.3% (Beyşehir) to 6.1% (Tefenni) (Table 7). The CIA values demonstrate the lowest values in winter and the highest values in summer. The lowest CIA value in a year is 2% and the highest value is spotted as 10%. CIA is ideal or nearly ideal in June, September and October months, and decreases slightly in June and August. Accordingly, in June and August, in which the mean temperatures and relative humidity are high in the area, the CIA values decrease but are generally close to the ideal value in May-September period.

The mean CIA values in May-September period vary between 8% (Beyşehir) to 9% (Burdur, Dinar, Korkuteli, Senirkent, Seydişehir). The lowest CIA value is 5% (in Beyşehir in May) and the highest is 10% (at all the stations in summer, except for Uluborlu and Yalvac in June). The CIA values decrease 2% to 6% in the October-April period, especially in the winter period, due to decreasing temperatures.

The Tourism Climate Index (TCI) findings

The annual general mean of the TCI values in the Göller District of Turkey is 69.6% (good category), and varies between 66.6% (good in Seydişehir) to 73.4% (very good in Korkuteli) (Table 1 & 8). Annually, Beyşehir, Isparta, Korkuteli, Tefenni, and Uluborlu may be regarded as having very good tourism climate comfort values, whereas the other stations demonstrate good category TCI values.

Table 8: The mean monthly, annual, and certain periods TCI values and categories for the selected stations in Göller District of Turkey (1987-2011 period)

Meteorological Stations	Mean monthly *TCI* values (%)												Mean annual *TCI* values (%)	Mean *TCI* values in May-September period (%)	Mean *TCI* values in June-August Period (%)
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Beyşehir	50	53	70	81	82	81	77	77	84	75	70	47	70.6	79.3	78.3
Burdur	53	55	76	77	80	74	66	68	76	80	78	47	69.2	72	69.3
Dinar	54	58	77	75	78	74	66	68	77	79	76	55	69.8	71.5	69.3
Eğirdir	45	43	63	73	84	84	75	75	84	81	63	37	67.3	79.5	78
Isparta	53	53	74	79	82	82	66	73	77	80	76	49	70.3	75.8	73.7
Korkuteli	55	61	78	81	84	78	72	73	80	80	81	58	73.4	76.8	74.3
Senirkent	47	49	70	73	80	76	70	72	82	76	65	43	66.9	74.5	72.7
Seydişehir	43	47	66	77	82	82	72	72	83	74	62	39	66.6	77	75.3
Tefenni	51	58	79	78	83	79	71	73	83	77	76	49	71.4	76.5	74.3
Uluborlu	49	51	71	79	84	83	74	76	82	77	69	47	70.2	79.3	77.7
Yalvaç	53	53	71	77	84	79	70	72	82	77	72	49	69.9	76.3	73.7
Mean TCI value of the study area (%)	50.3	52.8	72.3	77.3	82.1	79.3	70.8	72.6	80.9	77.8	71.6	47.3	69.6	76.2	74.2
İdeal TCI value (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Unfavourable	Marginal	Acceptable	Good	Very good	Excellent

Source: Calculated and organized according to the data of the Ministry of Forestry and Water Affairs, Turkish State Meteorological Service.

TCI values demonstrate the lowest general mean 47.3% (acceptable), in December and highest 82.1% (excellent) in May. The ideal TCI values are spotted in May and September throughout the year, and the lowest values are detected in December-January-February throughout the year. On the other hand, TCI values are in the good category in May-September and June-August periods. Due to the increased atmospheric activity in winter months, the sunshine duration lessens; rainfall, relative humidity, and wind speeds increase; temperature values fall; and, accordingly, the TCI values are generally low. The lowest TCI value in this period is 37% in Eğirdir (December-unfavourable), and the highest TCI value is 61% in Korkuetli (February-good).

TCI values lessen in December due to the rainfall, short sunshine duration, and low temperatures. The highest TCI value in this month is acceptable (Korkutli and Dinar), and the lowest TCI values are unfavorable (Eğirdir and Seydişehir). All the stations other than the aforementioned ones demonstrate marginal category TCI values (Table 1). In January, TCI values are marginal in Eğirdir, Senirkent, Seydişehir, and Uluborlu and acceptable in other stations. The highest TCI value in February is seen in Korkuteli in the good category. The TCI values in Eğirdir, Senirkent, and Seydişehir are in the marginal category; meanwhile, other stations are in acceptable category in this month.

In spring, the rainfall lessens, sunshine duration increases, temperatures rise, and relative humidity starts to fall in the Göller District, and accordingly TCI values start to rise. The highest TCI value in March is 79% (Tefenni), and the lowest TCI value is 63% (Eğirdir). In March, which is the first month of this season, TCI values vary between good category (Eğirdir and Seydişehir) and very good category (in other stations). By March, due to the lessening of frontal activity, atmospheric activity also lessens and sunshine duration starts to increase temperatures causing relative humidity to fall (till the beginning of summer). These conditions cause TCI values to increase significantly. In April, excellent TCI values are seen in Beyşehir and Korkuteli, and very good in other stations. In May, excellent TCI values are seen in the study area (except Dinar-very good category)

In the period from June to September, the Göller District of Turkey is under the effects of the tropical air mass and out of the effective area of frontal formation. In this period, both the sunshine duration and the falling angles of sunlight increase. Accordingly, the study area becomes much hotter and relative humidity values decrease. Under these conditions, S, R, and CIA demonstrate ideal values; however, CID and W values lessen. The highest TCI values are spotted in Beyşehir (78.3%), and the lowest values are spotted in Burdur and Dinar (69.3%) for the period. Again in this period, very good category measurements are spotted in other stations.

In the first month of summer i.e. June TCI values fall in the excellent and very good categories. July is the month in which the TCI values are the lowest throughout summer season. Particularly due to the high temperatures, CID and hot climate based W values lessen, and TCI values also fall. The highest TCI value is spotted in Beyşehir (very good, and the lowest TCI values are spotted in Burdur, Dinar, and Isparta (good); the other stations demonstrate very good category TCI values. The August conditions are similar to July. However, the TCI values are a little higher. In August, TCI values demonstrate rise (when compared to July) in the study area. The highest TCI values in this month are in Beyşehir (very good), and the lowest are in Burdur and Dinar (good). In August, other stations demonstrate good TCI values.

The atmospheric circulation is ever increasing with fall when the values of S, R, and CIA begin to decrease where the values of W and CID happen to increase. In September, in general excellent and very good TCI values are spotted. In the Göller District of Turkey, the month of October provided very good TCI values in general. In this month, Burdur, Eğirdir, Isparta, and Korkuteli demonstrate excellent TCI values while other stations demonstrate acceptable TCI values. In November, TCI values are lower than in October in the study area (except Korkuteli). This is a result of decreasing S, R, CID, and CIA values. Korkuteli is in excellent conditions; Eğirdir, Seydişehir, Senirkent, and Uluborlu are good; and the rest of the stations demonstrate very good TCI values in November.

Conclusion

The months with the best climate comfort for tourism are May and September. May has nearly ideal conditions by means of thermal comfort conditions. When considered that the TCI values in June are in the very good and excellent categories, it can be said that the conditions are generally suit-

able for tourism activities. However, by this month, the daytime thermal comfort starts to lessen due to high temperatures, and the possibly suffocating environment should be taken into account.

By means of climate comfort, July and August may cause problems for activities other than sunbathing. This is because the thermal comfort, and accordingly the climate comfort, lessens significantly in these months due to high temperatures and low wind speed. TCI values are generally in the very good and good categories in these months, where July is the month in which the lowest climate comfort is experienced during the tourism season. August also demonstrates features similar to July.

By September, temperatures begin to fall, and climate comfort rises when compared with August. In this month, climate comfort with very good and excellent TCI values is experienced. The conditions in this month are suitable for nearly all tourism activities. In October, the stations demonstrate very good and excellent climate comfort. This month is suitable for many tourism activities. However, since it is a transition month, the possibility of precipitation increases, temperature begins to decrease, sunbathing times lessen, and the length of tourism activities may be problematic.

In the May-September period, and especially in the summer, climate comfort conditions are suitable for most tourism activities. In periods in which the climate comfort decreases in terms of summer tourism, which gets dense especially in the Southern Aegean and Western Mediterranean coasts, the study area, which takes place in close proximity to these areas, can be an important alternative area for tourism. Especially because of the high altitude, this area exhibits more comfort climate characteristics when compared to the coasts in the summer period. In such time under this context, the improvement of the roads that connect the study area to the coastal belt and the accommodation opportunities should be considered.

Tourism activities may spread through spring, summer, and autumn. Thus, about an eight month period is suitable for most tourism activities.

This study attempted to determine the climate comfort conditions of tourist activities by considering the health and comfort of tourists. Thus, it would be useful to perform detailed analyses of climate conditions for each tourism area by means of tourism activities in the study area. However, such studies and analyses may only be possible if stations capable of performing climate comfort parameter measurements in relation with summer tourism are established in suitable areas. Moreover, the instant and periodic climate comfort data to be obtained from these stations should inform tourists via common mass communication tools and meteorological information.

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INDOOR AIR QUALITY, AIR TEMPERATURE AND HUMIDITY IN NARROW/AIRTIGHT SPACES

M. Tanaka

Introduction

Indoor thermal conditions are almost constant regardless of outside conditions, climate change, weather, season, and so on. But, air quality often becomes poor in narrow/airtight spaces such as vehicles (automobiles, trains, and airplanes), temporary housing, and smoking rooms. In this study, we researched thermal conditions and air quality in living spaces with narrow/airtight areas.

Methods

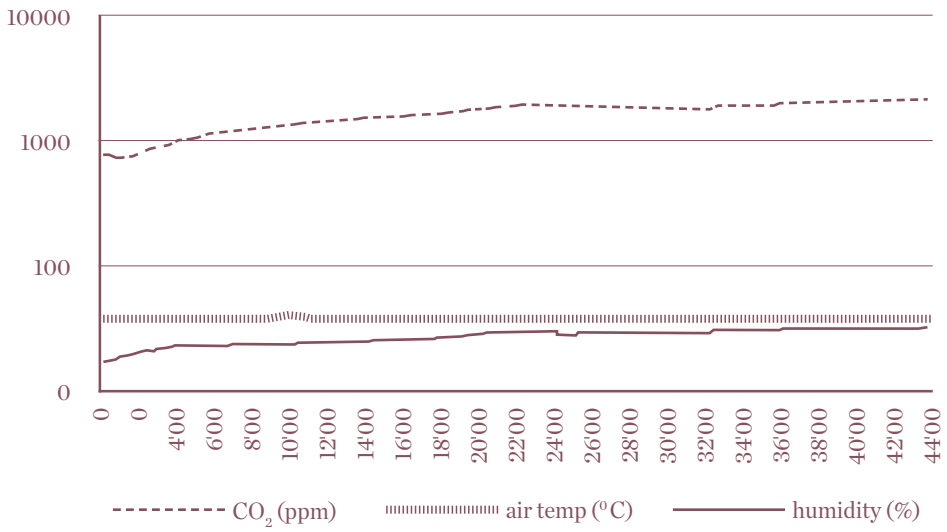
We measured carbon dioxide (CO_2) in order to measure the index of indoor air quality and air temperature and humidity for indices of thermal conditions in narrow/airtight spaces such as automobiles, temporary housing, and smoking rooms. We used a thermo recorder and CO_2 recorder with automatic recording system (T&D Corporation, Japan) as our measuring devices.

Results

The case of ordinary vehicles

The measuring device was set on the passenger seat of our test vehicle. A recording interval time of every 30 seconds was established in order to measure carbon dioxide, air temperature, and humidity while driving on ordinary roads. One person drove a car on the road for 35 kilometers within the time-span of about 45 minutes.

Figure 1: Carbon dioxide, air temperature and humidity while driving the car



While the windows were closed and the ventilation ducts of the car were opened, the values of CO_2, air temperature, and humidity were kept close to the same levels while driving as in the starting condition. Likewise, while the windows and ventilation duct of the car were both closed, air temperature was almost kept at the same levels while driving as in starting conditions. However, the levels of CO_2 and humidity increased gradually: the level of CO_2 was initially 500ppm and increased to over 2000ppm, and the level of humidity was 17% at first and increased finally to 33% (Fig.1).

The case of smoking rooms

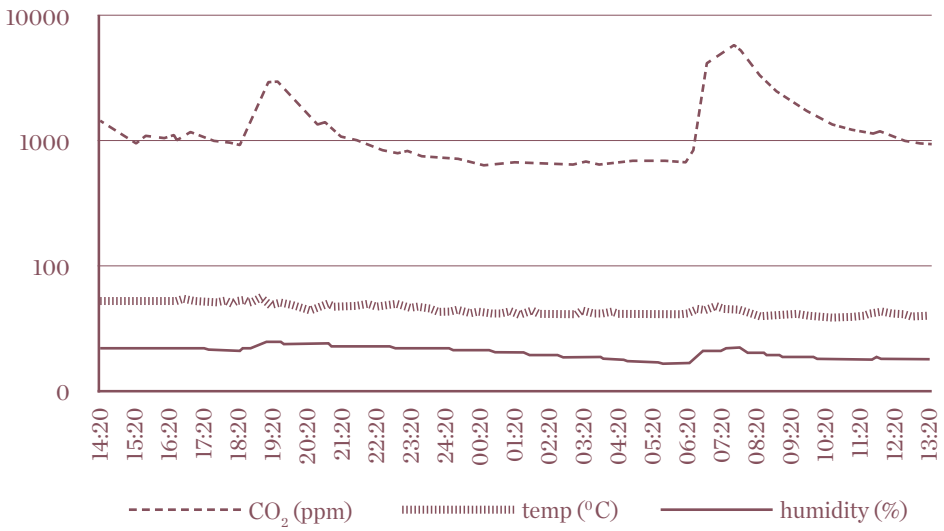
In Japan, smoking is prohibited in trains, offices, schools, hospitals, and many public facilities. Smokers use smoking rooms to smoke, usually during office hours. We measured the carbon dioxide, air temperature, humidity, and concentration of dust in about 30 smoking rooms in offices. The ventilation devices were set up in these smoking rooms.

The average concentration of dust was over 0.4mg/m^2 inside the smoking rooms. Comparing CO_2 concentration inside smoking rooms, near rooms, and near office desks, the level of CO_2 inside smoking rooms was the highest, over 900ppm, and the level of CO_2 near smoking rooms was the lowest. The level of CO_2 at office desks was rather high, because of the respiration of workers. Air temperatures inside smoking rooms, near rooms, and near office desks were almost the same, but humidity at the office desks was rather low.

The case of temporary housing in summer

Summer season is from June to August in Japan. August is the hottest month. The basic material of temporary house structures is light-weight steel. Room air temperatures using air conditioners in the housing were set from 19-32°C. Setting the room air temperature at 28°C comprised the highest frequency at 45%, and the next setting of room air temperature at 25°C was 15%. Rooms were comfortable with the use of the air conditioner and

Figure 2: CO_2 concentration, air temperature, and humidity using an oil heater in the kitchen of one house in January



uncomfortable without it. Natural ventilation was not satisfactory.

In one case, in the living room of a temporary house with an air conditioner in August, the air temperature was 24-25ºC and humidity was rather high at night. During the daytime, the air temperature was 26-27ºC and the humidity level was 40-50%.

The case of temporary housing in winter

Winter season is from December to February. January is the coldest month. In much of the temporary housing, an air conditioner and double windows were added to prevent coldness in winter. The room temperature of air conditioners in the housing was set from 14-30ºC. Setting the room temperature at 25ºC comprised the highest frequency at 35%.

In one case, CO_2 concentration using an oil heater in the kitchen of one house in January was measured. At night, the CO_2 level was 600 ppm. During the daytime the CO_2 level was high, over 2000ppm. The air temperature was 18-20ºC at night, and during the daytime the air temperature was 20-25ºC and humidity was 40-50% (Fig. 2).

According to Japanese standards regarding levels of CO_2, the concentration of less than 700 ppm is excellent, 1.000 ppm is generally permitted, 1.500 ppm is permitted in the space with a ventilator, 2.000-5.000 ppm is not so good, and a level of over 5.000 ppm is considered to be bad for daily life.

Conclusion

In Japan, inside thermal conditions are adequate for people to carry out their daily activities. But CO_2 levels have come to be too high. Poor air quality occurs frequently inside airtight and narrow spaces; therefore, adequate ventilation in the room is needed to keep good air quality. The thermal condition of living spaces and healthy air must be seriously considered.

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WEATHER-CLIMATIC CONDITIONS AS A RISK FACTOR IN MEDICAL AND HEALTH TOURISM AND MEASURES OF PREVENTION OF ADAPTIVE LOADS DURING INTERREGIONAL MOVEMENTS

Derkacheva L. N. & Soboleva N. F.

In recent years there has been a steady shift of the world's centers of medical tourism to countries in South and Southeast Asia, which are located in humid and hot tropical and subtropical climate zones. The popularity of such destinations has also recently skyrocketed amongst the people of Russia (Merchenko 2013, *Medical Travel Today*).

The work of numerous services, ranging from medical services, accommodation services, and services of tour operators, is crucial for maintaining the health and safety of visitors. However, despite the fact that physiological research has shown that when crossing time and climate zones acclimatization reactions can reduce the quality of recreation and treatment (Matiukhin & Razumov 1999), representatives of the tourism industry pay insufficient attention to these issues.

The aim of this work is to investigate not only the factors of weather and climatic risks in inter-regional movements of tourists but also the approaches of the tourism industry to reduce climate-related risks when planning and organizing health-improving tours.

To assess the potential risk of acclimatization reactions, indices of "weather-climatic contrast" (WCC) and "muggy weather" are proposed.

To calculate this we used the equation developed by Rusanov (1987; Derkacheva & Rusanov, 1990);

$$WCC=C_1-C_2/13 \times 100$$

where C_1 and C_2- insulation of clothing in units of "Chloe" provide thermal comfort to a person in comparable climates. Thirteen is the difference between the amount of thermal insulation of clothing, which provides thermal comfort in extremely cold and hot climates.

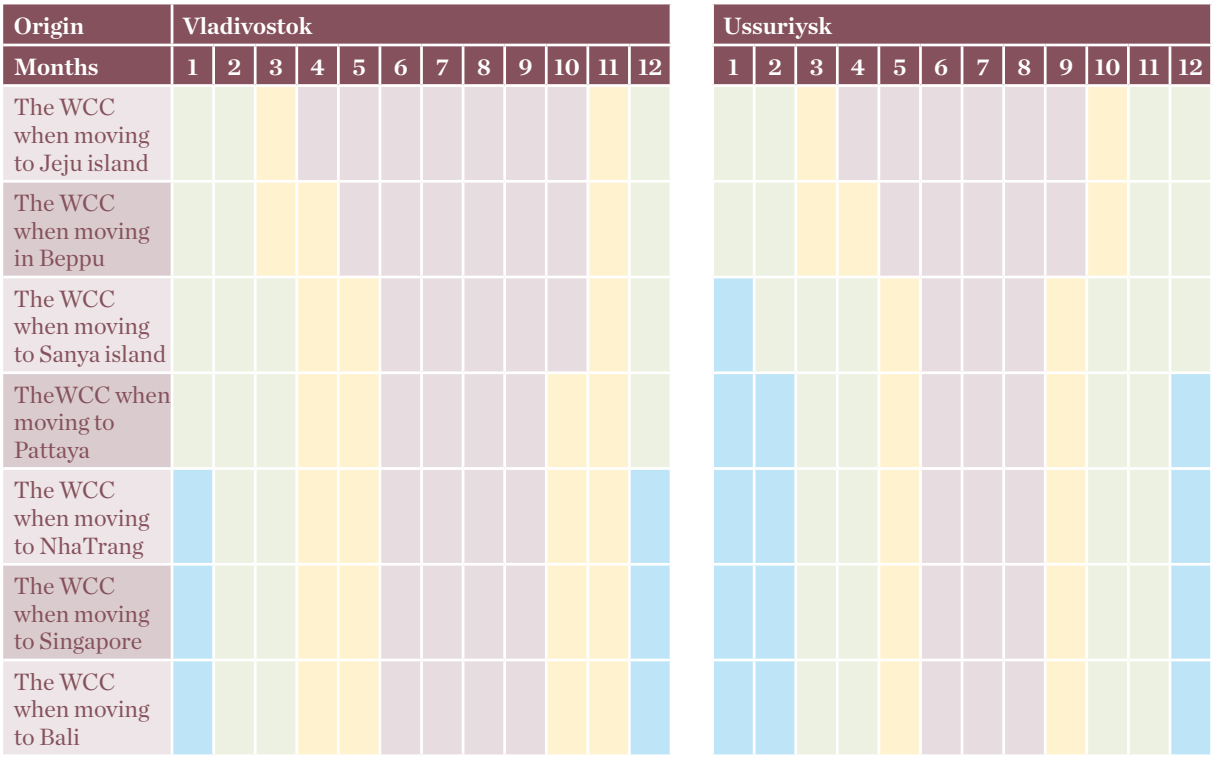
Calculations of the climatic contrasts between Vladivostok and the most visited countries of South and Southeast Asia (Thailand, Singapore, the southern provinces of China, Vietnam, Malaysia) are close to the "sharp" (WCC=26-30.7%) and "sharp" (WCC=30.8-32.5%) acclimatization load on the system of adaptation. The value of the weather-climatic contrast index shows the risk of increasing adaptive responses during flight.

The index increases with flights of tourists from areas with more continental and sharply continental types of climate, especially those from Far Eastern regions.

A sharp temperature drop can cause not only a sharp decline of metabolism but also even more serious complications.

Steady shift of the world's centers of medical tourism in the Asia-Pacific region and the increased interest to this region of the residents of the Far East and especially of the Primorsky territory dictate the need to develop recommendations to reduce the potential risk for tourists travelling primarily in these regions. Calculations of the climatic contrasts between Vladivostok, located in the South of Primorsky Region, and Ussuriysk, located 150 km

Figure 1: Indices of weather climatic contrast between the southern and northern districts of Primorsky Region (Russia) and the resort areas of the Asia Pacific region



WCC and acclimatization load

1 – optimal (WCC=0.0-7.6%).

2 –weak (WCC =7.7-15.3%).

3 – moderate (WCC =15.4-30.7%).

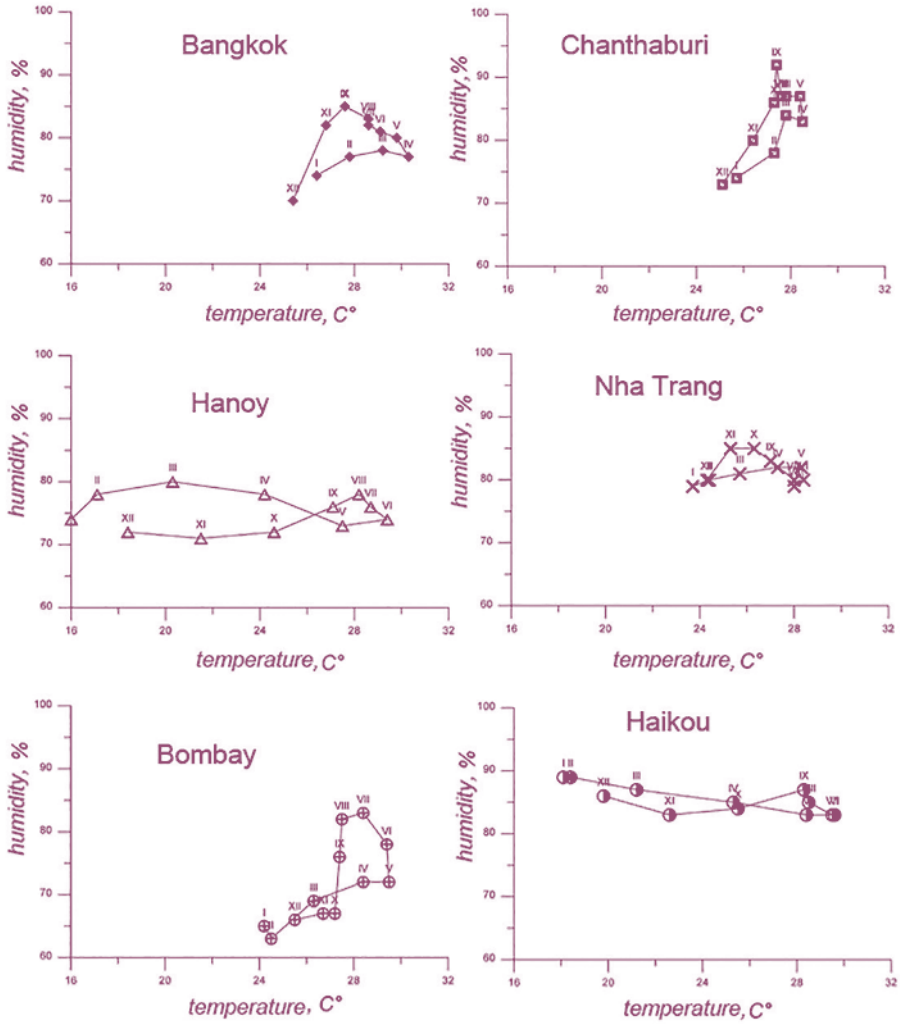
4 –sharp (WCC =30.8-46.2%).

to the North, and the countries of South and South-east Asia, which are the destinations of potential tourists, showed that the maximum load on the adaptation systems occur in winter months – the most popular period to visit these countries ("the journey from winter to summer") and are determined primarily by temperature factors (Fig. 1).

The second climatic parameter provoking the emergence of acclimatization reactions is "stuffy weather" during excessively wet summers and wet winters. Such weather, combined with humidity levels above 80% and temperatures above 25°C, is especially difficult for non-adapted tourists.

As the above figure shows, in summer the WCC is within the "optimal values" because the difference in the temperature regime is not very sufficient. Nevertheless, analysis of the combination of high humidity (above 80%) and temperatures above

Figure 2: Climatograms of temperature and humidity conditions of the individual stations of the Southern and Southastern Asian countries



25°C shows the formation of stuffy weathers of high intensity. Such weathers can trigger acclimatization reactions for not only older people but also young and healthy people. Regional analysis of individual weather stations is shown in Figure 2.

Although acclimatization to the warm climate is easier than to cold, extremely muggy weather with temperatures close to human skin temperature (31-33°C) and high humidity (more than 80%), impeding the evaporation of moisture from the skin

surface, could make overheating of the body and thermal shocks more possible.

The weather-climatic contrast provides general information about the climate of any country in the world. For tour operators such quantitative characteristics of the weather-climatic contrasts can serve as a basis for the development of recommendations for prevention of possible acclimatization loads for tourists in connection with flights. For tourists such information can be the basis of decision-making for trips to resorts and clinics in various regions around the world, which are often located in areas with different weather conditions from the place of visitors' permanent residences.

In order to reduce climate-related risks during inter-regional movements of tourists, the Department of Service and Tourism of School of Economics and Management at Far Eastern Federal University developed the module "Features of world climates and prevention of adaptive loads while moving in contrasting climatic conditions" (Derkacheva, 2014).

In the framework of theoretical training, the students study the features of world climates and possible acclimatization loads of tourists in extremely cold and hot climates, in high mountainous climates, and in sea (ocean) climates. Students work independently on a country of their choice and travel through it as a "virtual tourist" to study the peculiarities of its climate, the development of methods of climatic risk assessment, and the identification of the factors determining such an assessment.

The practical implementation of the module aims to develop recommendations to reduce the risk of the acclimatization load of Russian tourists traveling to different regions of the world with contrasting climatic conditions.

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EXAMINING DOMESTIC VS. INTERNATIONAL CLIMATIC PREFERENCES FOR COASTAL TOURISM

M. Rutty and D. Scott

Coastal tourism is the largest segment of global leisure tourism and it is firmly linked to a destination's natural resources – with climatic resources chief among them. Increasing research has underscored the importance of weather and climate for tourism, with studies indicating that climate is a primary motivation for leisure tourism (e.g., Kozak 2002, Lohmann & Kaim 1999), while also influencing the timing of travel (e.g., Eugenio-Martin & Campos-Soria 2009, Hill 2009), the destination(s) chosen (e.g., Kozak 2002, Hamilton & Lau 2005, Moreno 2010), in-stu spending patterns (e.g., Agnew 1995), and overall trip satisfaction (e.g., Williams et al. 1997, Becken & Wilson 2013, Tervo-Kankare et al. 2013). Major regional tourism demand patterns highlight the influence of climate for coastal tourism, with millions of North Americans travelling south to the warm and sunny coasts of the Caribbean, including 2.5 million Canadians annually (Statistics Canada, 2013).

Through observations and survey responses of beach users, studies have begun to evaluate climatic resources for coastal tourism by quantifying optimal and threshold conditions (de Freitas 1990, Morgan et al. 2000, Gomez-Martin 2006, Scott et al. 2008, Moreno et al. 2009, Moreno 2010, Rutty & Scott 2010, 2013, 2014, 2015, Martinez-Ibarra 2011, Gomez-Martin & Martinez-Ibarra 2012). However, these studies have not taken into consideration that different forms of beach holidays, such as daytrips, short trips, main annual holiday, or the "once-in-a-lifetime" trip may have varying degrees of resilience to climatic conditions (Hall 2005, Scott & Lemieux 2010). An international beach holiday with a high degree of planning and financial commitment prior to travel may subsequently result in different climatic preferences or satisfaction with the weather experienced compared to a short domestic beach trip. To examine this gap, this study surveyed the climatic preferences and thresholds of Canadian coastal tourists travelling domestically in Canada versus travelling internationally to the Caribbean.

The study is based on the primary data collected through in-situ surveys of Canadians visiting domestic beaches in Ontario (Grand Bend, Kincardine, Toronto) (n = 359) and international beaches in the Caribbean (Barbados, Saint Lucia, Tobago) (n=120). Key findings include statistically significant differences ($p \leq .05$) between the two sample groups for every climate variable examined (temperature, rain, wind, cloud cover). With respect to temperature, Canadian beach tourists travelling internationally prefer warmer conditions and are less tolerant of cooler conditions compared to Canadians travelling domestically (Figure 1). Ideal temperatures for the domestic beach travellers was between 25-28°C, with Canadians travelling internationally preferring 27-30°C, which is statistically different ($\chi(1) = 36.324$, $p = .01$). Statistically significant differences were also recorded for unacceptably cool thresholds ($\chi(1) = 69.803$, $p = .000$), with temperatures <21°C too cool for Canadians travelling domestically and >23°C too cool for Canadians travelling internationally. Unacceptably hot temperatures differed by 1°C, with Canadians travelling domestically less tolerant of high temperatures compared to Canadians travelling internationally (34°C and 35°C, respectively), but this difference was not statistically significant ($p = .087$).

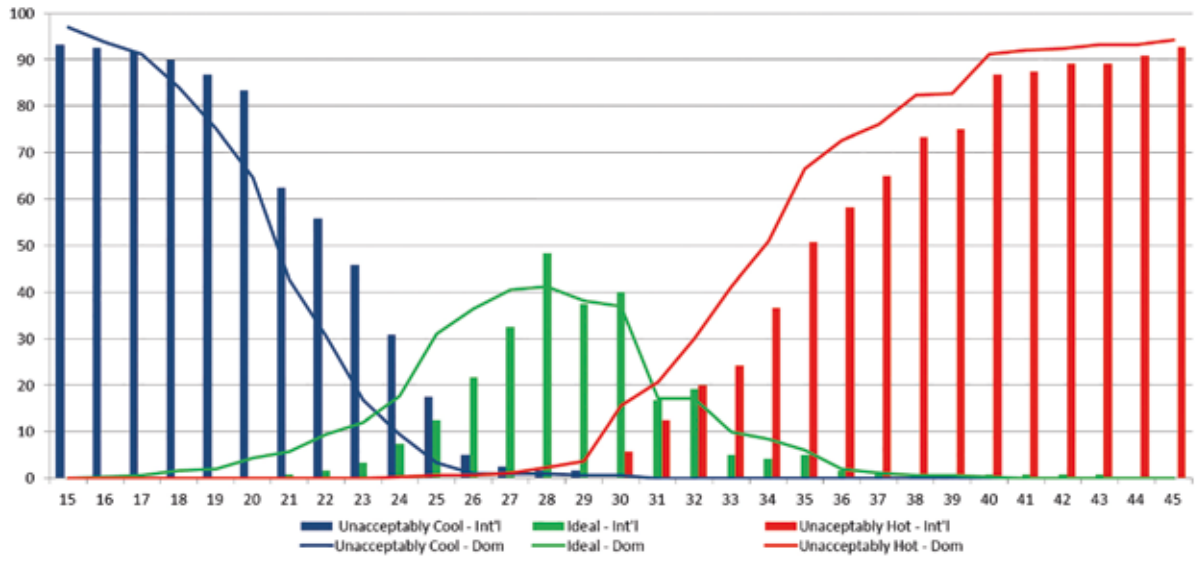
Statistically significant differences were also recorded for rain preferences ($\chi(1) = 211.839$, $p = .000$). The majority of domestic beach tourists indicated no rain as ideal for their beach holiday (91%), while the majority of Canadians travelling internationally indicated ≤15 minutes of rain as ideal (48%) (Table 1). Rain thresholds were similarly different, with domestic travellers statistically less tolerant of rain compared to international travellers (≤15min $\chi(1) = 57.777$, $p = .000$; 30min-1h $\chi(1) = 83.367$, $p = .000$; 2-4h $\chi(1) = 26.443$, $p = .000$).

Statistically significant differences were also recorded for wind preferences ($\chi(1) = 30.647$, $p = .000$), with domestic tourists preferring less wind while at the beach (93% stated no wind or a light breeze) and international tourists preferring windier conditions (99% stated a light breeze or moderate wind) (Table 2). International travellers were statistically less tolerant of no winds ($\chi(1) = 4.864$, $p = .027$) and more tolerant of higher wind speeds, particularly with respect to moderate (30% vs. 45%) ($\chi(1) = 8.105$, $p = .004$) and strong (83% vs. 75%) wind speeds, although the latter was not statically significant ($p = .060$).

Cloud cover preferences also differed significantly ($\chi(1) = 24.393$, $p = .000$), with domestic Canadians preferring less cloud cover than Canadians travelling internationally (Table 3). In terms of unacceptable cloud conditions, both sample groups were similar, with the majority of both domestic and international beach tourists indicating 75% cloud cover as the threshold of acceptability, with no statistically significant differences recorded ($p \geq .000$).

Overall, this research indicates that tourists' climatic preferences and thresholds for a beach holiday can differ depending on whether the holiday is domestic or international, shedding new insight into the complexities of assessing climate resources

Figure 1: Temperature preferences and thresholds for Canadian beach tourists travelling internationally and domestically



for tourism. With the inextricable dependency between coastal tourism and favorable weather conditions, it is important to both understand how tourists perceive and evaluate climatic resources, particularly those that are most preferred or avoided, and how weather can differentially influence travel behavior. These results have important implications for rating both current and future climate resources for tourism, providing relevant new insight into existing climate indices, demand models, and climate change assessments.

Table 1: Ideal and unacceptable daily rain conditions (% of respondents)

	No Rain	≤ 15min	30min - 1 h	2-4 h	≥5 h
Ideal					
International	28	48	24	0	0
Domestic	91	5	2	1	1
Unacceptable					
International	10	5	27	60	97
Domestic	3	43	43	83	94

Table 2: Ideal and unacceptable daily wind conditions (% of respondents)

	No Wind	Light Breeze	Moderate Wind	Strong Wind	Very Strong Wind
Ideal					
International	1	77	22	0	0
Domestic	9	84	7	0	0
Unacceptable					
International	19	1	30	75	93
Domestic	11	2	45	83	94

Table 3: Ideal and unacceptable cloud cover according to the percent of sky cover (% of respondents)

	Percent of Cloud Cover				
	0	25	50	75	100
Ideal					
International	13	76	11	0	0
Domestic	35	54	9	2	0
Unacceptable					
International	7	2	23	64	89
Domestic	4	5	32	65	89

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IMPORTANCE OF EARLY SNOWFALL FOR SWEDISH SKI RESORTS: EVIDENCE BASED ON MONTHLY DATA

M. Falk

Introduction

The major ski markets of the world are reaching a point of stagnation or decline (Vanat, 2014). After a long period of increased demand and expansions (Boden, 2010; Nilsson, 2001), this also holds true for Swedish ski resorts. Following historical record winters 2008/2009 and 2009/2010, the number of skier visits declined according to the SLAO. A similar picture is obtained when output of ski lift companies is measured as lift ticket sales. Overall, this may indicate that the Swedish alpine industry has followed the international pattern and entered the stagnation stage of the tourism life cycle as described by Butler (1980).

Although stagnation is apparent, the main factors influencing the demand for skiing in Sweden are not fully disentangled. One hypothetical explanation is the cost of skiing. In the last 20 years lift ticket prices have increased considerably faster than the inflation rate. Another explanation is that skiing is no longer a growth activity, with lift ticket sales rising less disproportionally to economic growth. This may indicate a low income elasticity. Tourism demand is generally characterized by high income elasticities indicating that tourism is a luxury good (Peng et al., 2014). In particular, this holds for international rather than domestic tourism demand. The increasing occurrence of snow poor winters, particularly in the early season, may contribute to the stagnation of lift ticket sales. Besides economic factors and weather conditions, a general shift in leisure preferences towards other activities over time may also have an impact on lift ticket sales.

In this study we examine the relationship between the inter-annual variation of lift ticket sales and snow depth using monthly data. The model is estimated using a first difference specification by the seemingly unrelated regression model (SUR). This approach makes it possible to account for the correlation of the error terms across the different winter months. In the empirical model the change in lift ticket sales relative to the same month the previous winter season is related to the corresponding changes in snow conditions, real GDP, relative prices, and control variables (e.g. early Easter holidays). An important feature of the model is that the economic factors are restricted to be identical across the winter months while the snow conditions and calendar effects (early Easter holidays) are allowed to differ.

Currently, there are approximately 70 downhill ski areas or facilities in operation in Sweden. With about 6.6 million skier visits in the winter season 2013/2014 (based on the 50 most visited ski establishments according to SLAO), Sweden is ranked much below the leading countries in Alpine skiing—the United States, France, Austria, Japan, Italy, and Switzerland (Vanat, 2014). The Swedish ski areas are concentrated to the West and to the North, and many of them are small.

Numerous studies have examined the determinants of snow based winter tourism (for Austria see Pickering, 2011, Steiger, 2011 and Damm et al., 2014; for France Falk, 2014; for Japan Fukushima et al., 2002; for Switzerland Gonseth, 2013; for the United States Hamilton et al., 2007, Shih et al., 2009, Dawson et al., 2009 and Holmgren & McCracken, 2014). Lift

ticket sales, skier visits, or number of passengers transported uphill are commonly employed as measures of winter tourism demand. Income, relative prices, temperatures, and snow depth are found to be significant determinants of winter tourism demand.

Currently, there is no consensus about the role of weather conditions for skiing demand, particularly when it comes to the impact of natural snowfall in the early winter season. To the best of our knowledge, this is the first study investigating the impact of snow conditions in the economically important Christmas and New Year holiday season on lift tickets sales of ski lift companies.

The main contribution of this study is the investigation of the impacts of snow condition on skiing demand for the early, mid, and late winter seasons, based on a new and unique dataset. It is often argued that early snowfall is particularly important for the output of ski lift companies. Monthly aggregated output data for the Swedish ski industry is combined with detailed data on snow depth from several mountain weather stations. We argue that the use of monthly data gives a more detailed picture of the relationship between weather and snow based winter tourism demand. Another contribution of the paper is that we use the price of lift tickets as a measure of the price variable rather than proxy variables such as the consumer price index. To the best of our knowledge, this is the first study investigating the determinants of lift ticket sales for Swedish mountain destinations.

Empirical model

Rather than measuring average snow depth for a total season, the distribution of snowfall during the winter is of high importance (Burroughs, 2000). A poor start to the winter season with a lack of snow during the Christmas and New Year holiday period may have a disproportionately negative impact on the output and profits of the industry (Elsasser & Bürki, 2002). Following the literature the number of visitors to ski areas or lift ticket sales may be modelled as a function of relative lift ticket prices, GDP in constant prices, average snow depth in the ski area, and the time trend. Given the availability of monthly data, the model can be specified for each month separately. This makes it possible to separate out sub-seasonal factors. It is well known that tourism demand is strongly influenced by seasonal factors where the intra-annual variation in tourism demand is considerably higher than the inter-annual variation (see for instance Becken 2013). In Sweden, the largest number of visitors to ski resorts can be observed in February. Specifying a separate model of each month makes it possible to focus on the relationship between the inter-annual variation in winter tourism demand and snow conditions. Based on the monthly data, the empirical model consists of *m* regression equations:

$$\ln YCP_{mt} = \alpha_{0m} + \alpha_{1m} \ln PS/CPI_t + \alpha_{2m} \ln GDPcp_t + \alpha_{3m} SNOW_{mt} + \alpha_{4m} t_t + \varepsilon_{mt}$$

where m=1,..,5 months (Nov-Dec, Jan, Feb, Mar, and April-May) and time period t= seasons 1992/1993 to 2013/2014. The prefix ln denotes the natural logarithm and t represents the time trend. YCP reflects lift ticket sales (net of value added tax) deflated by the price index of ski lift tickets. PS is the price index of ski lift tickets measured as the deflator of lift ticket sales. CPI denotes the consumer prices index with a fixed base year and GDPcp represents Swedish GDP in constant prices. Note that prices and GDP refer to the year when the season starts (e.g. season 2013/14 uses 2013 values). The reason for this is that lift ticket prices are set in the summer and do not change during the upcoming winter season. SNOW stands for average monthly snow depth based on information from several mountain weather stations in the winter months m (Nov-Dec, Jan, Feb, Mar, and April). The empirical model is

estimated by the seemingly unrelated regression (SUR) model where the economic factors are assumed to be identical across the different winter months. This is a reasonable assumption given relative prices and the fact that income does not vary within a given winter season.

Empirical results and conclusions

Using seemingly unrelated regression models estimated for five months we find, as expected, that lift ticket sales depend significantly negatively on lift ticket prices and significantly positively on real GDP (see Table 1 in appendix). Both income and price elasticities are quite low in absolute terms. A new empirical result is that a decline in snow depth in the early season has a strong negative impact on lift ticket sales. The effect is also much more pronounced than the impact of economic factors. In particular a reduction in snow depth by one standard deviation leads to a drop in growth of lift ticket sales by nine and five percent, respectively. However, there is a strong decline in lift ticket sales from the season 2010/2011 onwards when controlled for relative prices, real income, and

Table 1: Seemingly unrelated regression estimates of the determinants of growth of lift ticket sales for Swedish ski areas

Dep. var.: year to year change in lift ticket sales (compared to the same month in the previous year)									
	November-December			January			February		
	coeff.		t	coeff.		t	coeff.		t
Change in log average snow depth in mountain destinations	0.14	**	2.50	0.11	***	2.95	0.05		1.07
Change in log GDP in constant prices	0.88	***	3.37	0.88	***	3.37	0.88	***	3.37
Change in (deflator lift ticket sales/ CPI)	-0.68	**	-2.03	-0.68	**	-2.03	-0.68	**	-2.03
Dummy time period 2010-11 to 2013-14	-0.08	***	-4.28	-0.08	***	-4.28	-0.08	***	-4.28
Constant	0.04		0.90	0.03		1.22	0.03		1.29
	March			April-May					
	coeff.		t	coeff.		t			
Change in log average snow depth in mountain destinations	-0.03		-0.76	-0.04		-0.69			
Change in log GDP in constant prices	0.88	***	3.37	0.88	***	3.37			
Change in (deflator lift ticket sales/ CPI)	-0.68	**	-2.03	-0.68	**	-2.03			
Dummy time period 2010-11 to 2013-14	-0.08	***	-4.28	-0.08	***	-4.28			
Early Easter	0.33	***	12.10	-0.49	***	-5.80			
Constant	-0.11	***	-4.60	0.18	***	2.67			

***, ** and * denote significance at the 1, 5 and 10 percent levels. The average R2 across the five equations is 0.25. Estimates rely on small sample statistics.

snow depth. A tentative explanation is that the fall of lift ticket sales is caused by an exogenous shift in leisure preferences towards other activities. Another reason for the decreasing growth rate of lift ticket sales is that prices of lift tickets have been growing faster than the inflation rate during several consecutive years.

When the entire winter season is considered, the results indicate that the underlying key causes of the stagnation of lift ticket sales are low income elasticity, the exogenous shift in leisure activities from the 2010/11 season onwards, and the significant price sensitivity of skiing demand. The future prospects for Swedish ski lift operators are poor given moderate growth in real domestic income and further price increases in lift tickets following huge investments in snow making and new lifts, and the expected increase in green early winter seasons following global warming. However, due to latitude and climate zone, the prospects for snowy winters may still be far better than for the European Alps, and while the latent demand for alpine skiing is calculated to be low in Sweden (Fredman et al., 2012), attracting a larger group of international skiers might be one way for ski resorts to try to break the phase of stagnation.

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WEATHER PREFERENCES AND SENSITIVITY OF ALPINE SKIERS

R. Steiger, M. Peters & B. Abegg

Introduction

Weather and climate provide important natural resources for tourism, influencing destination choice, tourist behavior, and satisfaction (Scott & Lemieux, 2010). Snow is an essential resource for winter tourism products in mountainous areas, e.g. skiing, but with high inter-annual variability. Winter tourism demand is affected by the presence or absence of snow, consequently affecting tourism businesses' profitability. Snowmaking has reduced inter-annual variability and increased snow reliability (Scott, McBoyle, & Mills, 2003).

Climate change will deteriorate the availability of natural snow, as well as snowmaking, which is dependent on sufficiently cool temperatures. The ski areas' change of snow reliability was the first and the most studied aspect of climate change impacts on tourism, with more than 30 studies in 13 countries (Scott, Hall, & Gössling, 2012), e.g. in the European Alps (Steiger, 2010, Steiger & Abegg, 2013), North America (Scott et al., 2003, Scott, Dawson, & Jones, 2008), and Australasia (Hendrikx, Zammit, Hreinsson, & Becken, 2013, Hennessy et al., 2008; for an overview see Scott et al., 2012). From these studies, it can be concluded that snow-poor winter seasons will become more frequent; the degree of impact on ski areas can vary considerably, even within small provinces, due to the altitudinal distribution of ski areas and the heterogeneous climate in mountain areas; and deteriorating natural snow reliability can be offset by snowmaking to some extent in the upcoming decade(s), depending on the specific region.

Tourists' perception of winter seasons with below average snow conditions and changes in behavior were investigated to assess climate change induced demand changes. The majority of these studies used standardized guest surveys in situ (Behringer, Bürki, & Fuhrer, 2000, Dawson & Scott, 2010, Dawson, Havitz, & Scott, 2011, Dawson, Scott, & Havitz, 2013, König, 1998, Pickering, Castley, & Burtt, 2010) and ex situ, i.e. online (Luthe, 2009). Results of these surveys are not directly comparable, because different scenarios of future snow reliability were used to find out the tourists' intended behavior; however, they revealed a high willingness to give up destination loyalty in favor of better snow conditions and indicated that respondents are likely to ski less in the future.

Dawson & Scott (2010) did not investigate intended behavior in future hypothetical snow poor seasons but referred to specific years with bad snow conditions in the Northeast United States that tourists were able to connect to a real, experienced situation. Dawson et al. (2011) found that respondents clustered as "medium involvement group" were most likely to change their behavior, the low involvement group the least likely. Specialization (skiing skills) also influences adaptation behavior. Experts were found to substitute ski activity more often than beginners or intermediate skiers, i.e. experts are more likely to ski less often or to stop skiing and less likely to substitute spatially (Dawson et al., 2013).

Rutty et al. (2015) built on the approach to ask how respondents acted in the past in clearly defined snow-poor winter seasons and also asked respondents to quantify the change of skiing days in three categories (25%, 50% and 75% less often). Results indicate that only 3% would perform an activity substitution and 36% would ski less often if the resort closed permanently; a majority of 78% would

reduce their skiing days by at least 50%. Spatial substitution was chosen by 61% in case of a permanently closed ski area, with 83% staying within the province of Ontario.

Although major improvements have been made in the last years assessing the importance of weather and snow for winter tourists, previous studies could not give information on acceptance thresholds of snow conditions, i.e. what kind of snow conditions are perceived as not acceptable and the resulting behavior of tourists. This paper wishes to address this limitation by investigating skiers' perception thresholds of weather and snow conditions based on a sample of skiers in Austria, Southern Germany, and Northern Italy.

Methods

A skier survey with standardized questionnaires in German and English was conducted at the end of the 2013/14 winter season in 22 ski areas in Western Austria, Southern Germany, and Northern Italy. In Austria, 2013/14 was the second warmest winter season since weather records began (+2,7°C compared to 1981-2010). Ski areas in the northern regions suffered from a lack of natural snow and bad conditions for snowmaking, whereas ski areas in the southern regions experienced one of the snowiest winters of the last decades.

The questionnaire consisted of 28 questions in four thematic sections, i) socio-demographic information and guest profile, ii) factors important for travel decisions/destination choice, iii) perception of the 2013/14 season and iv) skiers' acceptance thresholds for snow conditions and behavioral adaptation. Questionnaires on weather preferences by Rutty & Scott (2010) and Rutty et al. (2015) were adopted for this survey and were supplemented by questions addressing the central research objectives of this paper.

In total, 2,468 valid questionnaires could be used for the analysis. The sample consists of vacationers (66.1%) as well as day-trippers (33.9%). The international mix is dominated by Germans (48.4%), followed by Austrians (26.5%) and Italians (5.9%), which is reasonable considering that Germany is the most important source market of the surveyed ski areas. The average age in the sample is 37.5 years, which is younger than the average skier in Austria (42.6 years; Österreich Werbung, 2012). Of the respondents, 43% are female (versus 47% in a nationwide survey in Austria; Österreich Werbung, 2012) and 57% are male.

Results

Snow quality and snow reliability were rated as the most important factors for destination choice (4.53 and 4.49 respectively on a 5-point scale). Conversely, "a lot of snow guns" was ranked last (3.26) of 16 factors. Snow quality was also most important (4.31) for the number of skiing days per season, followed by "good weather" (4.26) and "snow depth at the ski destination" (4.10). The snow depth (3.27) and "white landscape" (3.14) at the place of residence were considerably less important for the number of skiing days.

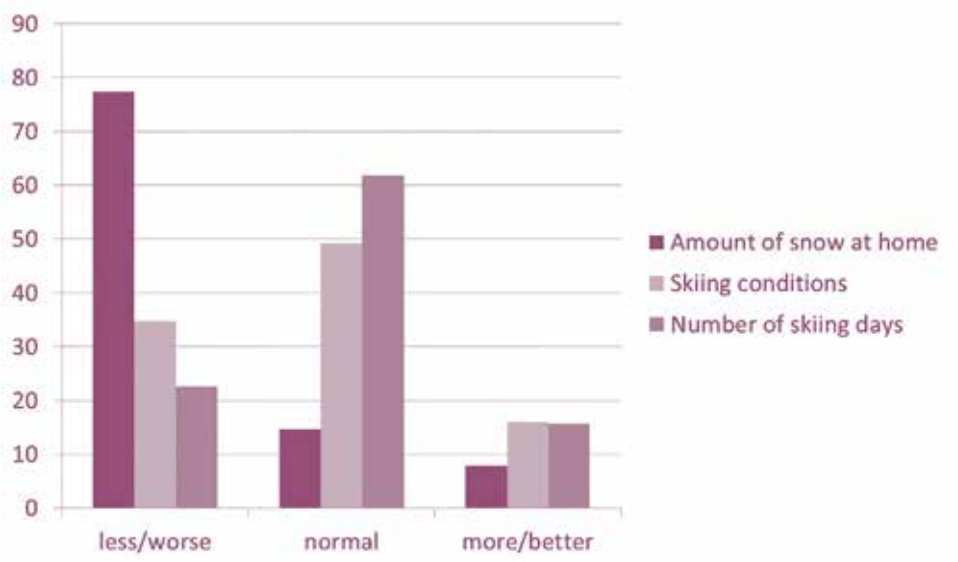
When asked if certain weather conditions prevent respondents from going skiing (5-point Likert scale), rain was rated the most important, followed by strong winds and fog (Table 1). A highly significant negative relationship was found between skiing skills and the rating of all weather variables, meaning that beginners are more likely to not go skiing in case of unfavorable weather compared to intermediate and expert skiers. A highly significant positive relationship was found between age and weather sensitivity, meaning that older respondents are more likely not to go skiing due to the weather than younger skiers, except for the variable "no fresh snow." Respondents with kids only showed a higher sensitivity to fog than respondents without kids, while no difference of sensitivity could be identified for the other weather variables.

Table 1: Weather conditions as reason not to go skiing

	Mean (5-point Likert scale)	Relationship between		
		Skiing skills (beginners, intermediate, experts)	Age (<25, 25-49, 50+)	With kids
		and rating of weather variable		
Rain	3.93	–**	+**	0
Strong winds	3.39	–**	+**	0
Fog	3.31	–**	+**	+*
Snowfall	2.66	–**	+**	0
Too warm/too cold	2.50	–**	+**	0
No fresh snow	2.46	–**	0	0
Cloud cover	2.41	–**	+**	0

– denotes a negative relationship, + a positive relationship, 0 no relationship
* denotes "significant" (p<0:05)
** denotes "highly significant" (p<0.01)

Figure 1: Perceived snow conditions at home and during skiing trips and change of skiing days in the 2013/14 season



The majority of respondents (77.4%) stated that the amount of snow at home was considerably less than usual (Fig. 1). But, only 34.7% experienced worse than normal snow conditions during their skiing trips, reducing the number of skiing days for only 23% of respondents (at average 8.3 less skiing days than usual). Expert skiers were more sensitive and had a higher average decline of skiing days than beginners or intermediate skiers (not significant), which is consistent with findings from Dawson et al. (2013). Note that the sample currently consists of vacationers, day-trippers, and locals in snow-poor as well as snow abundant ski areas. Therefore, in the next step the sample will be grouped by place of residence in snow poor/snow abundant ski areas to account for such inaccuracy.

In case of bad snow conditions, ski areas have to reduce the open skiing terrain. But so far it is unknown what extent of reduction is perceived as unacceptable and translates into behavioral adaptation in ski vacations and/or planning of day trips. Approximately 11.8% of skiers are very sensitive to reduction of supply, not going on a skiing trip if the ski slope to the bottom of the village is closed. Another 25.1% would not go skiing if less than half of the ski area is open. The remaining 62.1% have a low sensitivity, with 29.8% stating that one-fourth of skiing terrain open is not acceptable, and 32.3% would even ski as long as the ski area is open, no matter how much skiing terrain is available.

If available skiing terrain is perceived as not acceptable, the reaction differs considerably between vacationers and day-trippers. Day-trippers would most likely not have a skiing trip (50.5%), whereas 26.9% of vacationers would decide not to go on a skiing holiday. Spatial substitution (i.e. skiing at a different place) is an option for 38.3% of vacationers and 29% of day-trippers, respectively. Activity substitution (i.e. doing something else at the planned holiday/day-trip destination) is an option for 29.1% of vacationers and 14.6% of day-trippers.

Discussion

The findings of the survey confirm the importance of snow quality and reliability as a decision factor in choosing a skiing destination. Although more than three-fourths of surveyed skiers stated that snow conditions at home were worse than normal, only about one-third experienced worse than normal snow conditions during ski trips in the 2013/14 winter season. Nevertheless, 22.6% indicated that they skied 8.3 days less than usual, pointing to the fact that snow scarce winter seasons pose a financial risk to ski areas. This finding is supported by a reported 6.8% decline of skier days in Austria in 2013/14 compared to the previous year (WKO 2014).

This study revealed a high sensitivity of skiers to a reduction of open skiing terrain, with 37.9% of respondents declaring that it is unacceptable if more than 50% of the skiing terrain was closed. The results also show that the ranking of weather factors for skiing are different for mountain activities in the summertime. Rain, strong winds, and fog were the highest ranked weather-related reasons not to go skiing, whereas for summer activities, Scott et al. (2008) identified rain, temperature, and sunshine as the most important factors. The reason for the lower ranking of temperature in winter might be the highly functional clothing of winter sports tourists that allow for activities at a broader temperature range. It might also be that the activity of "skiing" is so dominant amongst winter sports activities that weather aspects become less important as long as the activity itself is not hampered (e.g. by fog, strong winds, or rain).

One limitation of this research is due to its design as an in-situ study. We only surveyed people who decided to go on a skiing holiday or day trip at the end of the 2013/14 season. Skiers that decided not to go on a skiing holiday because of bad snow conditions could of course not be surveyed. On the

other hand, this extraordinary season allowed for the immediate retrieval of skiers' perceptions of that winter. Another limitation to date is the mixed sample of respondents from snow scarce and snow abundant source markets and/or destinations, as well as respondents being surveyed in regions with snow deficiency and abundancy. This will be considered in a further analysis of the data set, as well as a geographic analysis of re-bookings from ski holidays due to a lack of snow.

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IMPACT OF SNOW CONDITIONS ON OVERNIGHT STAYS IN CROSS-COUNTRY SKIING AREAS

M. Falk and E. Hagsten

The last 40 years in Scandinavia have shown a decrease in the number of days with acceptable snow conditions for cross-country skiing (defined as snow coverage of more than 25cm) by 50 percent (Aall et al. 2005). According to climate scenarios, the boundary of the appropriate winter snow coverage will shift to the north or to higher elevations. In comparing different snow based winter sport activities, Loomis and Crespi (1999) found that the number of visitor days of cross-country skiing areas is among the most sensitive to global warming.

As a response, providers of cross-country skiing areas started to invest in snowmaking facilities and at the same time introduced an entrance fee for the tracks. However, snowmaking is still less widespread than in downhill ski areas. In Sweden presently there are 1,160 providers of cross-country ski tracks, of which 110 are equipped with snowmaking facilities (according to the Swedish association of cross-country skiing areas). The reason for the low coverage of snowmaking is that cross-country ski tracks are often run by small-scale operators, and when the establishment is larger it could instead be stretched over extensive, sometimes protected, land areas (i.e. national parks).

While there are several studies investigating the relationship between skier visits or overnight stays on the one hand and snow conditions for downhill skiing on the other, few studies have explicitly looked at cross-country ski areas. Previous studies have found that participation and motivation for cross-country skiing activities depend on many individual, socioeconomic, and demographic characteristics (Landauer et al. 2012, 2013). Overall participation in cross-country skiing activities was considered to be stagnating in the early 2000s (Heberlein et al. 2002; Fredman and Heberlein 2003) but might have picked up more recently (Svenska skidförbundet, 2015). Sælen and Ericson (2013) find that willingness to pay for cross-country skiers is strongly dependent on snow conditions.

Given that snowmaking is less widespread among providers of cross-country ski areas, it might be expected that these areas are more dependent on natural snow than downhill ski areas, where snowmaking is widespread even in the Nordic countries. In general, cross-country ski areas are vulnerable to weather variability because the majority of sites are located in the south of Sweden. The largest areas can be found in the provinces of Dalarna and Jämtland: Popular large cross-country ski areas include Bruksvallarna, Fjällnäs/Strandgården, Funäsdalens all in Härjedalen /Jämtland, and the Malung-Sälen and Mora region in Dalarna.

This paper investigates the relationship between guest nights in accommodation establishments and weather factors such as snowfall and temperatures in typical cross-country ski areas using annual data for the 2001/2002 to 2012/2013 winter seasons. The key question is whether the presence of snowmaking facilities reduces the sensitivity in the demand for overnight stays. In addition, we investigate which types of accommodation establishments and locations suffer the most from weather variability.

In Sweden cross-country skiing frequently takes place on prepared ski tracks close to home areas.

Only the largest cross-country ski areas attract overnight visitors. Heberlein et al. suggests that approximately 2% of the winter visitors make overnight cross-country ski trips in the mountains.

The main contribution of this paper provides a first investigation into the impact of snow conditions on the actual number of guest nights in cross-country ski areas. We use unique accommodation establishment data together with information from the nearest weather station to investigate the link. The data is sourced from the Swedish accommodation register, including monthly census information on hotel, hostel, cottage, and camping establishments, although the camping sites are excluded due to shorter coverage over time. An establishment is defined as a hotel if it has either five rooms or nine beds. No threshold is used for hostels, and holiday cottages are included if the establishment has at least five cottages or 20 beds. The database contains information on the number of overnight stays for domestic and foreign visitors, number of domestic and foreign arrivals, and revenues. In addition, the database provides information on the zip code, location (municipality), county, and the type of accommodation establishments classified as city hotels, tourist hotels, cottages, or hostels. Location is used for the classification of the accommodation establishment. In typical ski resorts the winter season accounts for about 80 percent of overnight guests.

Information on the zip code of the accommodation establishments makes it possible to link the data with the information for snow depth provided by the nearest weather stations. In particular we use data from about 25 weather stations located in the provinces of Dalarna, Jämtland, Värmland Västernorrlands, and Norbottens. Daily information is aggregated to seasonal averages or to the average of the early season. In addition snow conditions are measured as the number of days with at least 30 cm of snow coverage.

The empirical model relates change in overnight stays to changes in snow depth, size, age, price range and presence of snowmaking, and location. The regression equation is specified as follows:

$$\Delta \ln Y_{it} = \alpha_0 + \alpha_1 \Delta SD_{it} + \alpha_2 \Delta SD_{it}^2 + Z_{it}\beta + \varepsilon_{it}$$

where i denotes the accommodation establishment (i,....,200) and t the time with t=2002,....2011 and Δ is the difference operator.

Y denotes overnight stays (alternatively arrivals, length of stays); SD denotes snow depth in cm; Z denotes vector of control variables including size, age, price range, and location of establishment.

In addition we allow for a non-linear relationship by including the squared term of snow depth. The regression equation can be estimated by OLS. The main hypothesis is that the occurrence of snow poor winter seasons leads to a strong decline in overnight stays at hotels in cross-country ski areas. This holds true also for cross-country ski areas equipped with snowmaking facilities. Given the results several other adaptation strategies are discussed such as snow farming and non-snow based winter sport activities (Pouta et al. 2009; Dawson and Scott 2013).

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TEMPORAL ANALYSIS OF CLIMATIC AND SNOW VARIABLES RELATED WITH SKI RELIABILITY IN THE CENTRAL PYRENEES (SPAIN AND ANDORRA)

M. Gilaberte-Búrdalo, J. I. López-Moreno, F. López-Martín, E. Moran-Tejeda and R. Pino-Otín

In the last 30 years, there has been strong growth in mountain tourism, especially related with skiing, which has become very economically important at the local, regional, or even national level. The major weakness of this economic sector is the strong dependency on annual variability and long-term trends of climate and snow conditions.

The study and understanding of how mountain climate and snowpack has evolved in recent decades and how this can influence ski tourism is of great importance and can help also to understand the future evolution of ski reliability. However, the lack of appropriate data in mountain environments hampers this task. Moreover, most of studies on climate and snow tourism have considered only the thickness of snowpack and, in some cases, the length of the ski season as the only driving factors of ski reliability. It has been proven that there are other climatic elements that have a significant influence on the time of going or not to ski, for example, anticyclonic days, rainy days, or days with excessive wind.

This research uses the outputs of a mesoscale climate model (MM5) to simulate climatic variables and snowpack using a snow energy balance model to derive different climate indices that may influence the likelihood that skiers will visit ski resorts in Spain and Andorra. With this information we aim:

1.) to assess the reliability of simulated climatic and snow data for the specific purposes of this study.

2.) to analyze the trend over the second half of the 20th century (1960-2006) in a set of climatic and snow variables closely related to skiing, snow depth and duration, wind, occurrence of rain precipitation, hours with conditions for snowmaking production, and days with extremely low wind-chill temperatures in 11 ski resorts in the Pyrenees.

3.) to classify the considered ski resorts in the study based on trends and identify possible geographic patterns using a principal component analysis (PCA).

This study is focused on the Pyrenees, the mountain range located in the northeast of the Iberian Peninsula that runs over 450 km from the Cantabrian Sea to the Mediterranean Sea. Elevations often exceed 2,000 m.a.s.l. and reach 3,404 m.a.s.l. at the Aneto peak. Figures 1 and 2 show the 11 ski resorts analyzed in this study.

In the first step of the study, this model had been validated using data from the State Agency of Meteorology for the variables of temperature, relative humidity, wind, and precipitation. The snow depths have been validated by mountain automatic meteorological stations. Our analyses show a very good fit between simulated data of MM5 model and the data from weather stations, especially in temperature and precipitation variables, with very little discrepancy in relative humidity and wind.

Subsequently, we have calculated the trends of seven climate variables as shown in Table 1. Afterwards the annual values of each analyzed parameter are obtained for each ski resort, and the Mann-Kendal test and linear regressions are used to check the existence of statistically significant trends and the magnitude of the change respectively.

Figure 1: Ski stations location

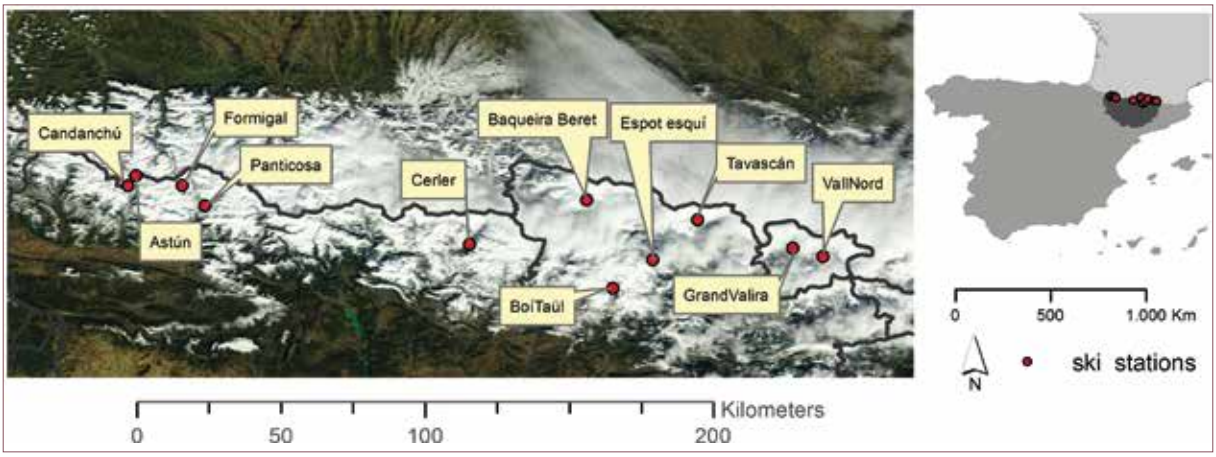
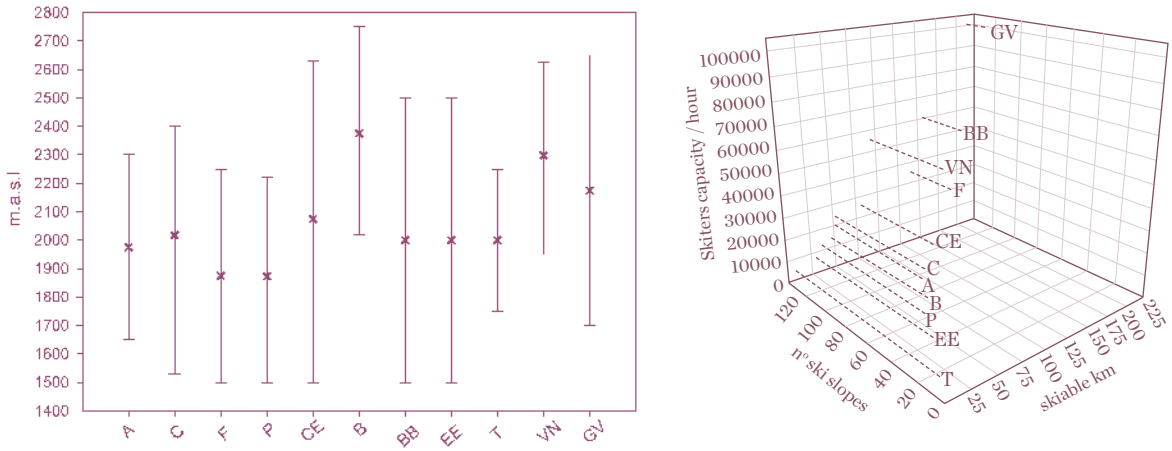


Figure 2: Characteristics of ski resorts



A= Astún; C= Candanchú; F= Formigal; P= Panticosa; CE= Cerler; B= Boí Taül
BB= Baqueira Beret; ES= Espot esquí; T= Tavascán; VN= Vallnord; GV= Grandvalira

Overall, there is a decrease in snow depth and the duration of the ski season in the majority of the ski resorts. Moreover, there is a decrease in the potential number of hours to produce artificial snow, which has also decreased the number of days with extremely low wind-chills. The rain trends are not as clear, and we can find ski resorts that have increased their rainy days per season and others in which the number has declined. Finally, the number of days with strong wind (exceeding the 80th percentile) has declined in almost all ski resorts.

Table 1: Summary of the methodology

Parameters analyzed	Selection criteria	Variable measures	Input	Source data
Number of days with enough snow depth at medium elevation	>30 cm	Snow depth	Temperature Humidity Wind Precipitation	MM5
Day start the season at low elevation	count from Oct. 1	Snow depth	Temperature Humidity Wind Precipitation	MM5
Day end the season at low Elevation	count from Oct. 1	Snow depth	Temperature Humidity Wind Precipitation	MM5
Number of days with heavy rain at medium elevation	>10 mm	Liquid precipitation	Temperature Precipitation	MM5
Number of hours with possibility of snowmaking at low elevation	<2°C	Wet-bulb temperature	Temperature Humidity Air pressure	MM5
Number of days with excessive cold (based on wind-chill) at medium elevation	<-20°C	Wind-chill	Temperature Wind	MM5
Number of days with excessive wind	> Percentile 80	Wind speed	Wind	MM5

The results show that although ski resorts generally have similar behavioral trends, there are two distinct groups of ski stations. A group of stations located closer to seas and at higher elevations showed moderate declines in skiability conditions. In these stations, despite increases in temperature good snow depths and a long ski season were observed. However, another group of stations, more inland and at lower altitudes, has shown a sharper decline in the number of days with enough snow and, hence, a shorter ski season length. These resorts have also clearly reduced their capability for producing artificial snow.

In view of the results, we can conclude that climate has evolved towards conditions that reduce snow accumulation and its duration, as well as lower capability for producing artificial snow. Additionally, there are other variables that affect the practice of skiing such as sunny days, rainy days, and excessive wind, which should be considered in a fuller assessment between climate and tourism.

WEATHER PREFERENCES OF SUMMER TOURISTS IN MOUNTAIN ENVIRONMENTS: A CASE STUDY IN THE BAVARIAN ALPS, GERMANY

L. Jänicke, B. Abegg & R. Steiger

Weather and climate are important factors for travel decision-making and overall tourist satisfaction (de Freitas 2003). As central motivators for destination choice, they directly and indirectly influence demand patterns and can be a resource and limitation for tourism at the same time (Hamilton 2004, Eugenio-Martin & Campos-Soria 2010). Over the last few years, research on interactions between weather/climate and tourism has expanded rapidly, mainly concentrating on the changing attractiveness of tourism regions in the context of climate change (Scott et al. 2003, Moreno 2010). Furthermore, correlation between specific climate preferences and socio-demographic variables has been investigated for various tourism environments (Denstadli et al. 2011, Rutty & Scott 2013, Hewer et al. 2014).

While several studies have explored the climatic preferences of beach tourists (Gomez-Martin 2006, Moreno & Amelung 2009, Rutty & Scott 2010) and urban tourists (Scott et al. 2008, Ceron et al. 2009, Rutty & Scott 2010), there is limited understanding of the climatic preferences of tourists in mountain regions. However, there are studies indicating that the preferred climate conditions of tourists differ between major tourism environments (beach, urban, mountains).

In an ex-situ survey, Scott et al. (2008) found a significantly lower optimum temperature for mountain tourism (20.5°C) than for urban (22.5°C) or beach tourism (26.8°C). Physically demanding activities, for which lower temperatures are preferred, were discussed as a reason for these differences. For mountain environments the absence of rain was identified as the most important climate parameter followed by temperature, sunshine, and wind. In addition, results of Ceron et al.'s (2009) ex-situ survey indicated a lower temperature threshold perceived as "too hot" for mountain tourism (30°C) compared to other tourism types (urban 32°C, beach 33°C). Regarding the threshold perceived as "too cold," 9°C was reported for mountain and urban, whereas 17°C was reported as "too cold" for beach holidays. Moreover, Ceron et al. (2009) identified significant correlation between age and temperature-thresholds, as well as between activities and temperature thresholds.

These two studies give a first impression of weather preferences of mountain summer tourists but are subjected to various limitations. Both studies were ex-situ surveys that rely on participants' imaginations of the tourism environments. In addition, Scott et al. (2008) used a convenience sample (university students only), while Ceron et al.'s (2009) sample was relatively small with regard to the number of people planning mountain holidays. Furthermore, Scott et al. (2008) looked at optimal temperature (but not at thresholds), whereas Ceron et al. (2009) looked at thresholds (but not at optimal temperature). Surveying specific temperatures can be difficult, because people often perceive a range of temperatures as optimal rather than a specific value (Rutty & Scott 2010).

Due to tourism being of major importance in the European Alps, more in-depth data on specific climate preferences of tourists in this region is needed. Thus, with reference to the current state of knowledge, this study aimed to investigate the following questions regarding summer tourists in the Alps:

- What is the relative importance of single weather parameters, and which one is the dominant factor?
- What are the ideal conditions (temperature, cloud cover) and temperature thresholds ("too hot," "too cold"), as well as the acceptable number of days of rain?
  - » Do these preferences differ between age groups, frequency of visits, and activities?

To answer these questions, an in-situ survey was conducted in the Bavarian Alps (Germany) over three days in August 2014. A total of 744 tourists were interviewed. The ATS-region *(Alpenregion Tegernsee-Schliersee)* was chosen as the study area, because tourism is predominantly concentrated in the summer season (70% of annual overnight stays). Therefore, the region can be regarded as representative of alpine summer tourism.

A standardized questionnaire was applied to examine climate preferences by directly measuring the stated tourist preferences. A pre-test of the questionnaire was conducted and resulted in minor wording modifications to improve the clarity of some questions. The survey contained questions about the relative importance of climate parameters (temperature, sunshine, rain, wind), which were evaluated by using a 5-point-Likert-Skala. In addition, referring to Rutty & Scott (2010), respondents were asked about the temperature ranges they perceived as "ideal," "too hot," and "too cold" for mountain summer holidays. Finally, they were asked to state how many days with summer thunderstorms and how many days with continuous rain they would accept during a one-week stay.

This novel approach to query the variable "precipitation" aims to assist respondents in estimating conditions by avoiding the need to quote numeric values (mm, min). The same strategy was applied to identify the cloud cover perceived as ideal by using images of different cloudiness conditions instead of percentages.

The 744 participants are on average 53 years old (range 11-88 years), 51.2% are male, and 23.6% travel with children. 94.7% of the tourists are from Germany, 2.4% are from Austria, and the remaining respondents are from other EU and non-EU countries. Given these characteristics our sample is highly representative of the overall tourist population in the area (Tegernseer Tal Tourismus GmbH 2014).

Selected Results

The most important weather parameters are (1) little rain, (2) sunshine, (3) pleasant temperaturesand (4) no strong wind (Table 1).

This confirms the importance of little rain in mountain environments. In comparison to Scott et al. (2008) temperature is even less important (ranked third instead of ranked second), supporting earlier findings of temperature not being the dominant climate variable. Age significantly affects the parameter "pleasant temperatures" (p=0,000), with older people attaching lower importance than younger respondents.

Table 1: Relative importance of single weather parameters for mountain summer tourism (1 = not important; 5 = important)

Little rain	Sunshine	Pleasant temperature	No strong wind
4.33	4.20	4.16	3.17

Figure 1: Temperature preferences and thresholds for mountain summer tourism (too cold: n=712; ideal: n=730; too hot: n=716)

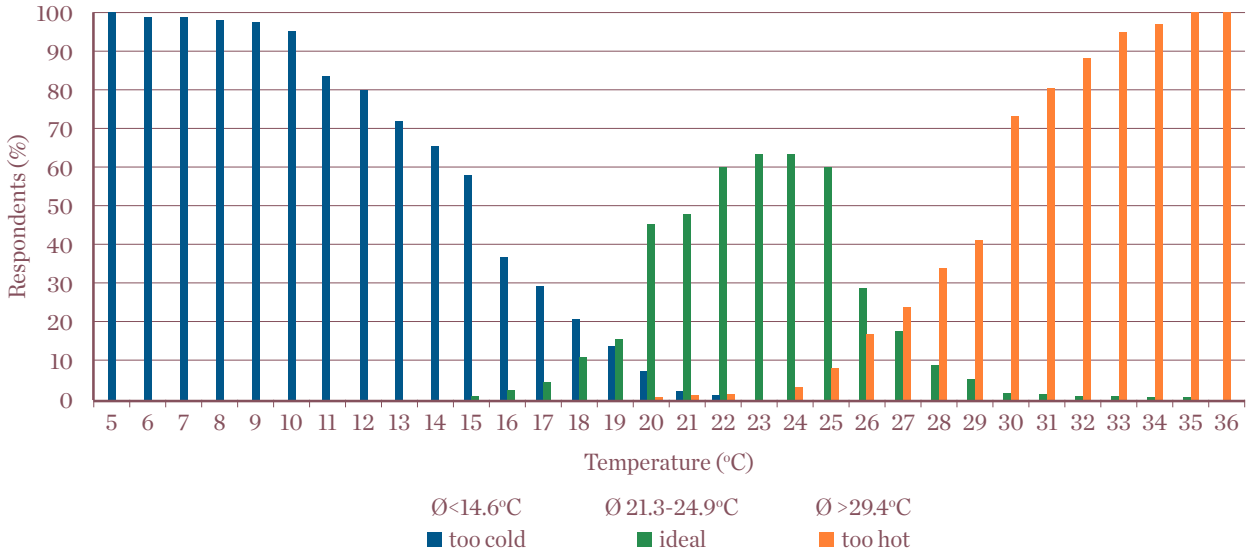
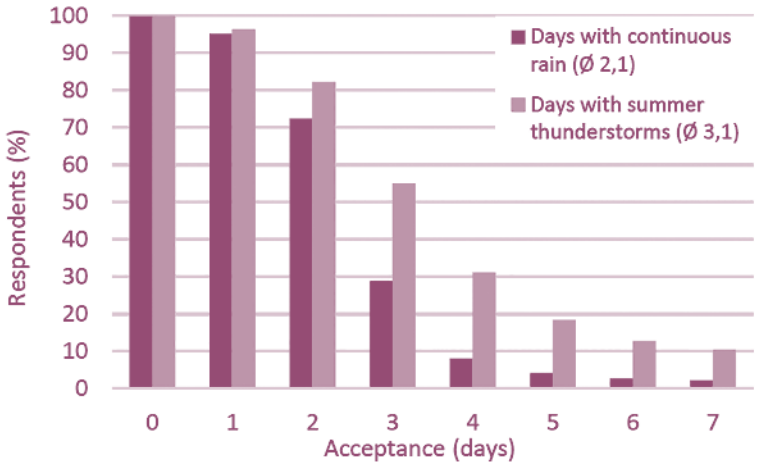


Figure 2: Acceptance of days with summer thunderstorms (n=699) and days with continuous rain (n=716)



The average preferred ideal temperature is 23.1°C, which is 3°C higher than the optimal temperature in the survey by Scott et al. (2008). The average individual range of ideal temperatures varies between 21.3°C and 24.9°C. The average temperature thresholds are 29.35°C ("too hot") and 14.6°C ("too cold") and thus slightly lower (30°C) and higher (9°C) than those by Ceron et al. (2009), respectively (Fig. 1).

Age significantly affects the preferred ideal temperature (p=0.003) and the threshold "too hot" (p=0.001), with older people preferring colder temperatures. Furthermore, tourists whose main focus is doing sport activities significantly prefer (p=0.004) lower ideal temperatures than people who are not focused on sports during their holiday. Moreover, the threshold "too hot" is significantly affected by the frequency of visits (p=0.027), with first-time visitors preferring higher temperatures than regular guests.

On average, more days with summer thunderstorms (3.07) than days with continuous rain (2.14) are accepted (Fig. 2).

Age significantly (p=0.001) affects the acceptance of days with summer thunderstorms, with younger respondents accepting higher numbers than older people. Furthermore, the frequency of previous visits significantly affects the acceptance, with regular guests accepting higher numbers of days with continuous rain (p=0.049) and days of summer thunderstorms (p=0.046) than first-time visitors. Moreover, tourists who are not focused on sports during their holiday accept ahigher numbers of days (p=0.034) with continuous rain than people whose main focus is doing sports activities.

Conclusion

This study contributes to the understanding of weather preferences of tourists in mountain environments, overall and depending on age, as well as their frequency of visits and activities. Further research should focus on temperature preferences depending on frequency of visits, travel motives and activities, because there is still insufficient data on these interactions. In addition, there should be more focus on the acceptance of rain during mountain summer holidays, because rain is the dominant weather parameter. Finally, it is important to study age-specific preferences of tourists and to incorporate them into tourism and supply planning, especially when considering complex issues such as demographic change and seasonal adjustments triggered by climatic changes.

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IMPACTS OF CLIMATE CHANGE ON TOURISM AND RECREATION

ADJUSTMENT OF TOURISM CLIMATOLOGICAL INDICATORS FOR THE HUNGARIAN POPULATION IN ASSESSING EXPOSURE AND VULNERABILITY TO CLIMATE CHANGE

A. Kovács, J. Unger & G. Szépszó

Introduction

The demand for tourism is sensitive to climate variability and climate change, and impacts will vary geographically and seasonally. Sea level rise, ocean acidification, and extreme weather events have negative effects on the touristic potential and infrastructure of coastal and urbanized regions. Temperature increase in wintertime reduces the operation period of ski centers, while summer warming negatively influences the health and thermal comfort of tourists. In particular, urban centers that are major tourism destinations may suffer when the weather becomes excessively hot, and this may lead to a loss of revenue (IPCC, 2014).

When considering Europe, climate change is very likely to increase the frequency and intensity of heat waves, particularly in Southern Europe, which is highly vulnerable to climate change. The most adverse implications will occur in the tourism sector, as well as in the infrastructure, energy, and agriculture sectors (Kovats et al., 2014).

By identifying the quantitative impacts of climatic conditions and climate change on tourism, the development of objective strategy building, the decision-making process, and adaptation strategies related to the impact assessment of climate change can be facilitated. Several tourism climatological indicators and evaluation tools have been developed for this purpose; however, there have not been harmonized approaches for studying climate and climate change impacts on the tourism sector yet. To prepare targeted and sustainable adaptation strategies in response to climate change, it is indispensable to expand an objective approach helping quantify the exposure, sensitivity, and adaptive capacity of the tourism sector. Moreover, this should be differentiated on the basis of the vulnerability of the various stakeholders and areas.

National Adaptation Geo-Information System (NAGiS)

In the course of 2015, several tourism climatological indicators will be established in the dataset of the National Adaptation Geo-Information System (NAGiS) in Hungary (National Adaptation Geo-Information System, 2015). This database aims at supporting strategic planning and decision-making on the adaptation to climate change through development and operation of a multipurpose, geo-information database, which merges several data sources. The establishment of the database focused initially on the evaluation of the negative effects of climate change regarding hidrology, natural ecosystems, and agriculture (National Adaptation Geo-Information System, 2015). In the framework of the new initiative of the program entitled "Adaptation to climate change in Hungary," NAGiS will be extended to include indicators of exposure, sensitivity, and adaptive capacities in the tourism sector, as well as in critical infrastructure sectors. The new program initiative (Vulnerability and impact studies with a focus on tourism and critical infrastructures; CRIGiS) is based on the study of excess human mortality related to heatwaves and the impact and vulnerability assessment of

road accidents within extreme weather events. The tourism-related sector of the project will focus on the investigation of climatic conditions on tourism based on three indicators: the well-known and relatively simple Tourism Climatic Index (TCI; Mieczkowski, 1985), the recent Climate Index for Tourism (CIT; de Freitas et al., 2008), and an adjusted form of the TCI (Kovács et al., 2015) that will be detailed in the subsequent section.

These indicators will be used to assess the exposure due to climate change. The evaluation tools will be quantified, on the one hand, based on past and present observational data, and on the other hand, based on projected regional climate model outputs (for the periods of 2021–2050 and 2071–2100). The ALADIN-Climate model used at the Hungarian Meteorological Service (HMS) will be applied for this purpose as this provides the required meteorological data in temporal detail. The climate indicators will be calculated for the area of Hungary on a 10 km horizontal resolution grid of the climate model (Fig. 1). The results will then be aggregated for sub-regions with a statistical method as this provides more beneficial results for the users, such as tourists and tourism professionals.

The vulnerability to climate change will also be determined by comparing the tourism climatic indicators with some tourism economic measures, such as hotel occupancy rate, visitors in spas or in events. These results will refer to some popular Hungarian tourist destinations or regions.

Adjustment of tourism climatic indicators used in NAGiS

It is widely accepted that tourism climate evaluation tools should be adjusted to the tourists' perceptions and preferences, or to the local climatic conditions to which the population has become accustomed. This has been emphasized by a number of studies (e.g. de Freitas, 2003; Scott et al., 2004, 2008; de Freitas et al., 2008), yet few studies have focused on this subject. Lin and Matzarakis (2008) rescaled the thermal thresholds used in the Climate-Tourism/Transfer-Information Scheme (CTIS; Matzarakis, 2007). Bafaluy et al. (2013) adapted the CIT to specifically evaluate some outdoor recreational activities, such as cycling, cultural tourism, football, or sailing. Nevertheless, these were expert-based and subjectively assessed and, thus, have not yet been empirically tested (Bafaluy et al., 2013).

Figure 1: The area of ALADIN-Climate model involved in the study (Szépszó, 2015)

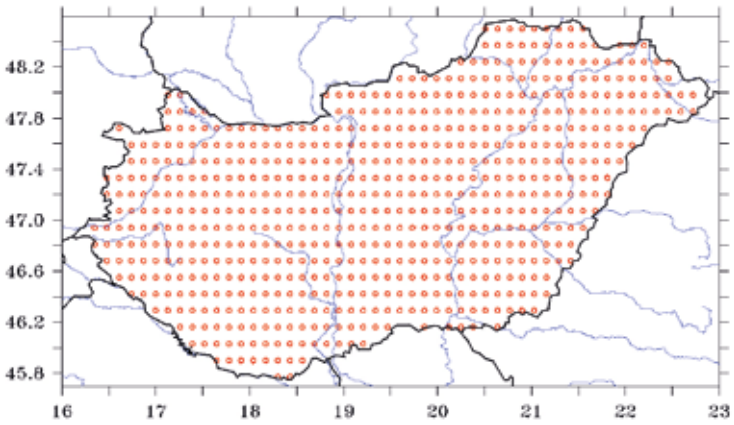
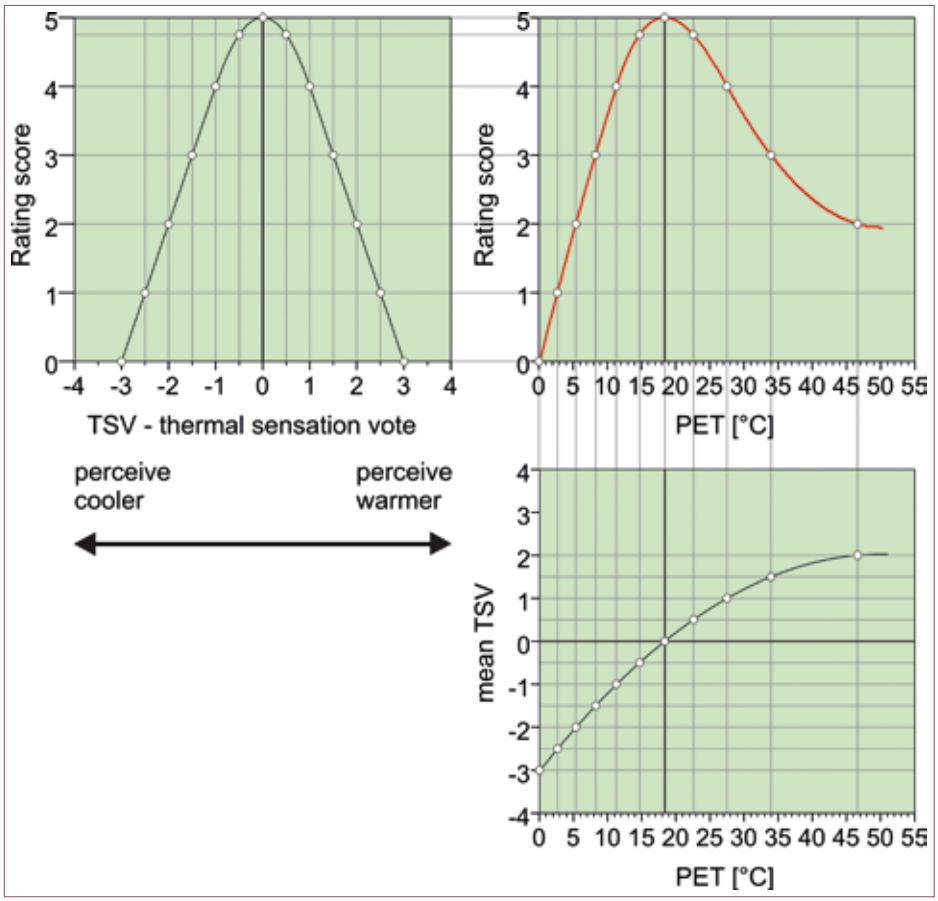


Figure 2: The process of assigning rating scores to PET necessary to the TCI (upper right chart) with the use of Thermal Sensation Vote (TSV) vs. rating score (upper left chart) and PET vs. mean TSV regression relationships (bottom right chart). The latter can be derived through a thermal comfort survey with local population (Hungarians in this case), which involves on-site micrometeorological measurements and simultaneous questionnaire surveys (Kovács et al., 2015).

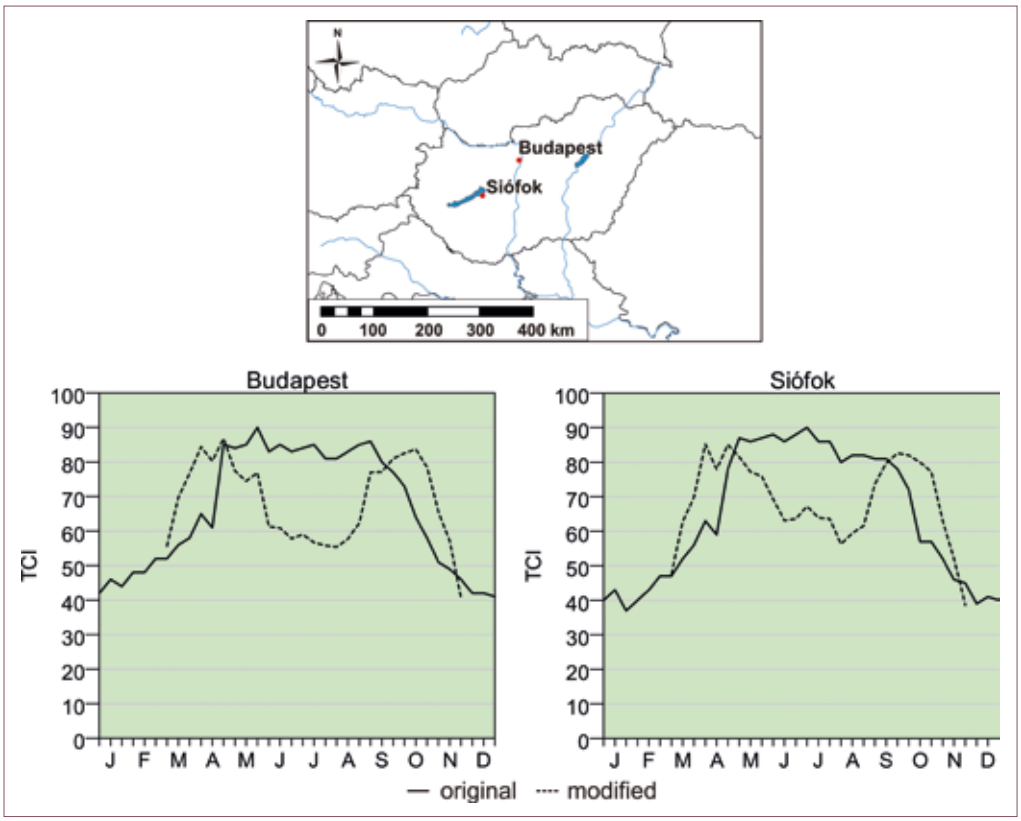


Adaptation of the available evaluation tools has recently begun among the Hungarian population (Kovács and Unger, 2014a, 2014b; Kovács et al., 2015). This process focuses on the adjustment of the thermal parts of TCI and the regionalization of the thermal components of CTIS as such in order to express the subjective thermal assessment of the Hungarian population. We proposed a methodology for the integration of new, seasonal, perception-based Physiologically Equivalent Temperature (PET) rating systems into the thermal comfort sub-indices (daytime and daily comfort sub-index) of the original TCI (Kovács et al., 2015). This modification improves the potential of TCI to evaluate the thermal aspects of climate. This was performed by incorporating the widely used PET while consid-

ering the seasonal thermal assessment patterns of Hungarian residents (Fig. 2). The modified daytime and daily comfort sub-indices were derived utilizing the calculated daily maximum and daily average PET values. Furthermore, new seasonal perception-based PET category thresholds were derived and applied in the CTIS to become consistent with the subjective thermal evaluation of Hungarians (Kovács et al., 2015).

An effective way to reveal subjective thermal assessment patterns is through questionnaire surveys and simultaneous meteorological measurements in the open air and then through the pairing of the data. In our analysis, we utilized data from a 3-year-long outdoor thermal comfort campaign, conducted on 78 days in 2011, 2012 and 2015 in Szeged. The interviews and the meteorological measurements were carried out during spring, summer, and autumn in six public spaces. We recorded the thermal perception of people on a thermal sensation vote (TSV) scale and paired with the recorded weather data. The applied TSV scale ranged from −4 to 4, corresponding to the perception of very cold to very hot conditions. The data collected contained 6764 datasets of completed questionnaires and corresponding meteorological measurements.

Figure 3: Geographical location of the studied tourist destinations and the annual courses of the original and modified TCI for the period of 1996–2010



Adjusted TCI – Preliminary Results

In order to demonstrate the utility of the modified TCI, we show now some preliminary results concerning two popular Hungarian tourist destination areas. One of the tourist destinations is Budapest, the capital, the largest city of Hungary and the most popular tourist destination of the country. The other is Siófok, situated on the southern shore of Lake Balaton and is one of the most popular beach resorts in Hungary (Fig. 3). Meteorological data for the period of 1996–2010 were obtained from the measured data of the HMS for the selected locations. Fig. 3 presents the annual variations of the modified TCI for the two locations based on the derived rating scores. Also, the annual courses of the original TCI are illustrated. As shown, a summer peak was obtained in case of the original TCI at all locations, however, a bimodal distribution of TCI was found in case of the modified TCI. Namely, the most pleasant conditions occur in summer and in late spring (with TCI>80) in case of the original TCI, while this occurs in spring and early autumn (with TCI>70 or 80) in case of the modified TCI. In this case, the conditions are less favorable in summer when the TCI remains around 60 in both cities, signaling only 'good' conditions according to the evaluation scale of TCI (Fig. 3).

Conclusion

Because of the high-quality information provided by NAGiS, it is possible that further users (researchers, decision-makers) can apply the information based on the same (i.e. consistent) input data. The methodology to be prepared in the framework of the project can also be adapted to other studies as well. Outcomes of the objective impact studies point to specific actions to be taken in order to mitigate or exploit climate change impacts. The developed and included tourism-related indicators in the CRIGiS project provide significant support for touristic related services, and they will foster the development of adaptation strategies and objective decision-making to prevent climate change. Finally, we emphasized that it is important to consider the differences that exist between the subjective assessment patterns of individuals when evaluating climate resources for tourism and also climate change issues. Therefore the adjustment of the climatic indicators to the local climatic conditions is also of key importance.

Acknowledgement

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OBSERVED CHANGES IN THE TOURISM CLIMATE POTENTIAL OF THE LAKE BALATON REGION BASED ON THE SECOND GENERATION CLIMATE INDEX FOR TOURISM (CIT)

Á. Németh

Introduction

In addition to its rich natural and cultural heritage, the Lake Balaton Region is known primarily for tourism, and for decades has made a significant contribution to tourism receipts in Hungary. The main resources of the region include Lake Balaton, the reserves of medicinal water, and the natural features of the Balaton Upland National Park, but the region is particularly rich in monuments, castles, and stately homes, too. Lake Balaton is the largest lake in Central Europe, with a length of 77 km and a breadth varying between four and 14 km. The first bathing resort appeared at the lake in the 1730s utilizing medicinal waters. Today the name Balaton has become synonymous with taking a holiday in the traditional sense.

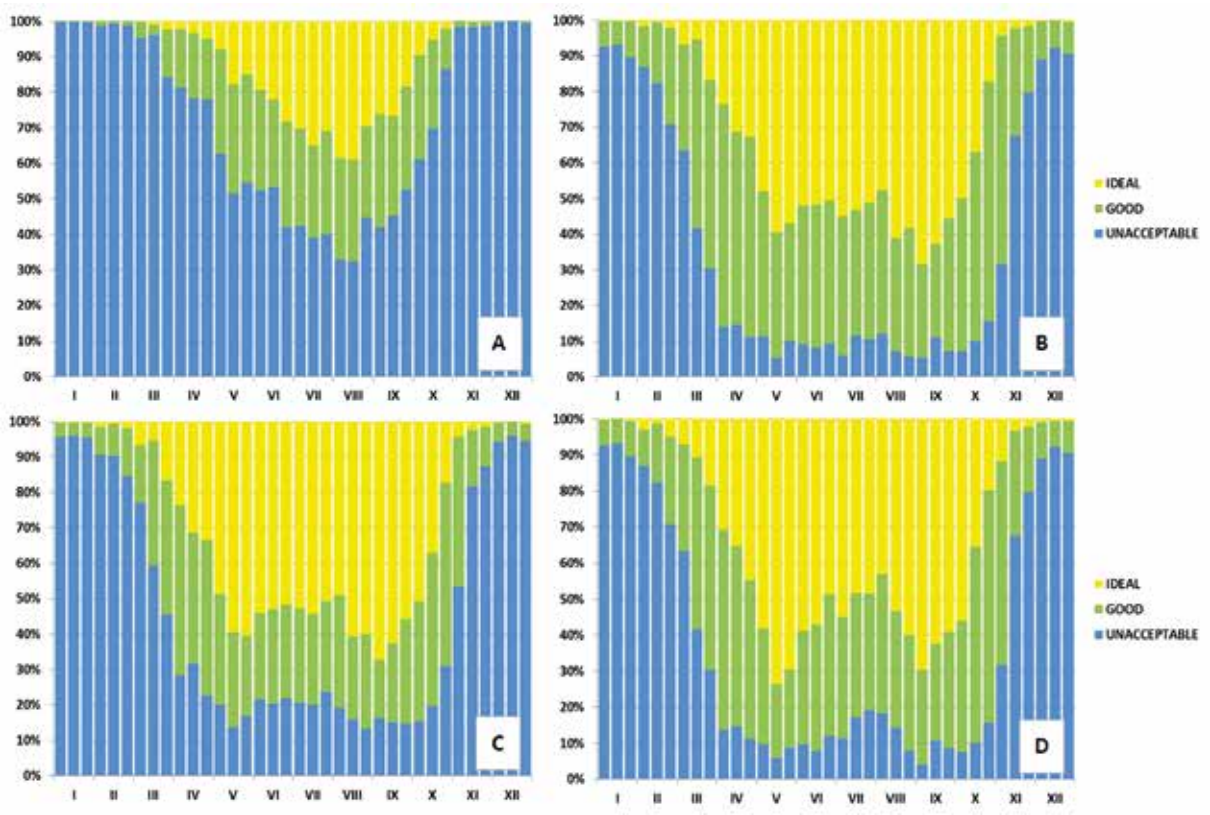
Currently, important tasks for tourist product development include broadening the range of features offered by the region, lengthening tourism season, and reaching new target groups. The regional climate is a natural attraction for tourists; however, the climate is what fundamentally defines what type of tourism activity can be practiced in the given region. Thus, the mapping of climatic conditions and analysis of the tourism climate potential of the destinations is key for the tourism sector. By examining tourism, climatology tools can show how climate changes the tourism climate potential of a particular area in parallel with climate change.

Materials and methods

To obtain quantitative estimations of the tourism climate potentials of various kinds of tourism, the second generation Climate Index for Tourism (CIT) was used (de Freitas et al, 2008). By using CIT, weather and climate can be classified depending on whether it is "unfavorable," "acceptable," or "ideal" for tourism. The CIT combines the thermal (T), aesthetic (A), and physical (P) facets of tourism climate on the basis of the following relationship: CIT= f[(T,A)*P]. It was found that CIT assumes that the integrated effect of certain climatic variables cannot be expressed as a sum of the parameters but as a non-linear function of three tourism climatological factors. If the physical factors (rainfall, wind speed) exceed certain thresholds, they override the effect of other variables. The determination of CIT requires the use of the so-called weather typological matrix. The matrix includes a climate-satisfaction rating scale from one to seven.

In this study measured meteorological data from the Storm Warning Observatory in Siófok (46°54'N, 18°02'E, 108 m.a.s.l.) was used. Measurements have been taken at the same location since the 1950s, so the data series do not have displacement-caused inhomogeneity. This is particularly important for analysing the long-term data series. The meteorological station is located right at the lakeside; thus, it is ideal for tourism climatology. In the calculations the following measured data (for the period 1961–2010) were utilized: hourly air temperature, relative humidity, wind speed, cloudiness, daily precipitation sum, and daily sunshine duration.

Figure 1: Average 10-day frequencies of CIT categories in Siófok for 1961-1990



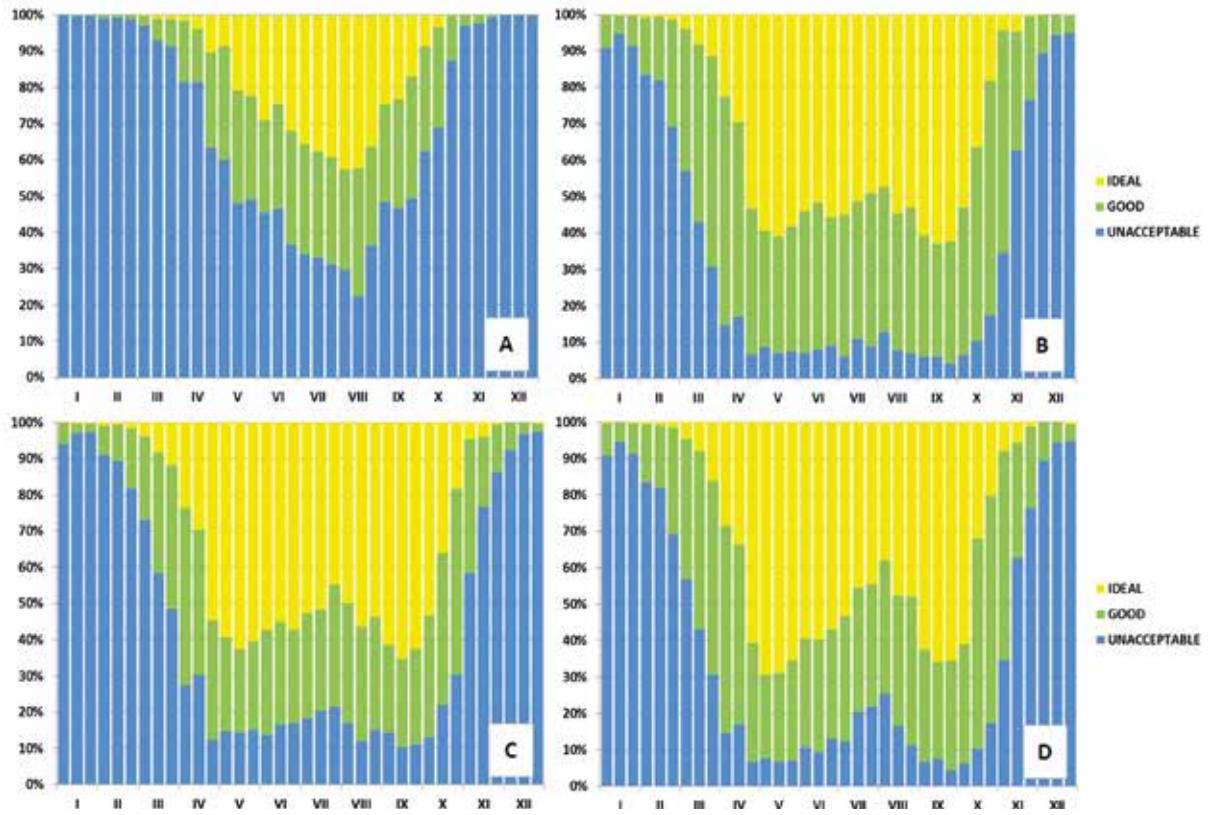
The thermal component was estimated using the physiologically equivalent temperature (PET). For the PET calculation RayMan software was used (Matzarakis et al, 1999, 2007). Changes in tourism climate potential were estimated by changes of CIT in the two standard 30-year periods, 1961-1990 and 1981-2010. The CIT values were determined each day and then were calculated in 10-day relative frequencies (Fig. 1 and Fig. 2).

The CIT was calculated for the beach, for cultural tourism, and for cycling and hiking. The weather typological matrix, which is essential for calculating the index, originally was determined only for 3S tourism. To determine CIT for other tourist activities, the matrices by Bafaluy et al. (2014) were used.

Results and Discussion

After calculating daily CIT data at Siófok, the climate potential for various kinds of tourism over the last 50 years was assessed. According to de Freitas et al. (2008), the following categories are used to simplify subsequent discussions: CIT=1, 2, 3: unacceptable; CIT=4, 5: acceptable; and CIT=6, 7: ideal conditions.

Figure 2: Average 10-day frequencies of CIT categories in Siófok for 1981-2010
A-beach; B-cultural; C-cycling; D-hiking



Comparing two 30-year periods (Fig. 1 and Fig. 2), the main results for the examined tourist activity are as follows:

- Beach tourism: The frequency of "good" and "ideal" days (hereinafter called favorable period) will rise to over 50% from mid-May to late September in the period 1981-2010. This was observed from late June to mid-September only in the previous 30-year period. The frequency of "ideal" days in the summer months increased around 5-6% in the last 50 years. Simultaneously, the ratio of "unacceptable" days reduced on average 3-6% from late April to late August. This is a positive change.
- Cultural tourism: The frequency of favorable period will rise over 50% from mid-March to the beginning of November. From this perspective there is no difference between the two examined periods. However, it was found that the ratio of "ideal" days from the end of April to May increased about 15-20% in the last period. At the same time a negative change in the thermal conditions had resulted in a 5-7% reduction in the occurrence of ideal days at the beginning of August and September.
- Cycling: The favorable period lasts from late March to the end of October, and it has remained practically unchanged over the examined half century. The frequency of "unacceptable" days

Figure 3: Changes in the seasonal means of relative frequencies (%) of CIT categories. (The upward arrow indicates if the changes are positive and significant for the given tourist activity. Similarly, the downward pointing arrow indicates the significant negative changes.)

IDEAL	Spring	Summer	Autumn	Winter	Year
hiking	→ 0.8	↓ -2.2	→ 0.3	→ -0.9	→ -0.5
cycling	↑ 3.2	→ -0.8	→ 0.8	→ -0.2	→ 0.8
cultural	↑ 3.1	→ -1.0	→ 0.4	→ -0.2	→ 0.6
beach	→ 1.7	↑ 5.2	↓ -1.2	→ 0.0	→ 1.4
GOOD	**Spring**	**Summer**	**Autumn**	**Winter**	**Year**
hiking	→ 0.2	→ -0.4	→ 0.8	→ 0.7	→ 0.3
cycling	→ -0.9	↑ 3.6	→ 0.5	→ 0.3	→ 0.9
cultural	↓ -2.0	→ 1.3	→ 0.9	→ 0.0	→ 0.1
beach	→ 0.2	↑ 1.9	→ 0.7	→ -0.1	→ 0.7
UNACCEPTABLE	**Spring**	**Summer**	**Autumn**	**Winter**	**Year**
hiking	→ -1.0	↓ 2.5	→ -1.1	→ 0.2	→ 0.2
cycling	↑ -2.3	↑ -2.8	→ -1.3	→ -0.1	→ -1.6
cultural	→ -1.1	→ -0.3	→ -1.4	→ 0.2	→ -0.6
beach	↑ -2.0	↑ -7.1	→ 0.5	→ 0.1	↑ -2.1

decreased almost a whole year in the examined period on average by 2-3%.

- Hiking: The favorable period lasts from mid-March to the beginning of November. The ratio of "unacceptable" days increased temporarily between mid-July and mid-August, but only within the last 30 years did it exceed 20%.

In addition to the 10-day examinations, seasonal analysis was performed. The relative frequencies of CIT categories were calculated for each season for two 30-year periods. Next, we examined how this changed these frequencies.

According to Figure 3, the changes that occurred in the last half century are significant to only a few cases. In *spring*, the climatic conditions of cultural tourism and cycling improved particularly. In *summer*, the climatic conditions of beach tourism specifically are better than in the previous 30 years. In addition, we also experienced favorable changes in cycling. However, climatic conditions of hiking have worsened this time of year. In *autumn* and *winter*, there is no significant change in the tourism climate potential.

Conclusion

The main tourist attraction in the Lake Balaton Region is the lake itself. However, tourist season, which is based on beach tourism, is short, less than three months. Therefore, it would be extremely beneficial from an economic perspective to prolong the tourism season. Possible ways to do this are to develop cycling and nature tourism. To be successful in these improvements, one must determine that the tourism climate potential of the area is adequate. This research has been going on for some years. Results have already been used in other tourism climatological evaluation systems (Németh, 2013). This study could take a step forward as the climatic conditions of some tourism activities were analyzed separately and have examined the observed changes over the last half century. Based on results, the climatic conditions of cycling and cultural tourism have improved, which are the basis for stretching the spring tourist season. However, it is clear that the Lake Balaton region continues to be the ideal venue for beach tourism.

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HOW WILL CLIMATE CHANGE AFFECT THE CLIMATE POTENTIAL OF TOURISM IN CROATIA?

K. Zaninovic, L. Srnec & R. S. Jurkovic

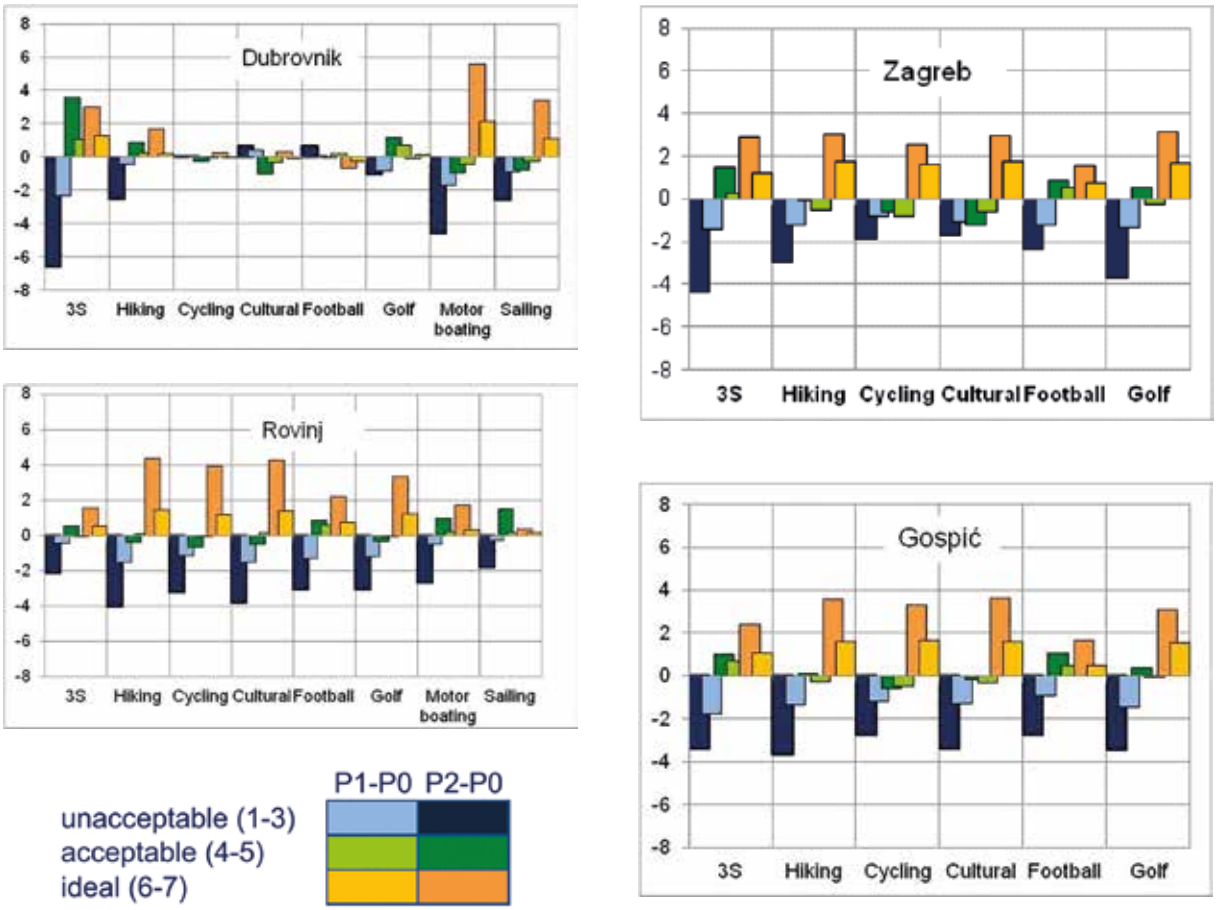
This paper analyzes the suitability of the climate conditions and the impacts of climate change on climate potential for different types of tourist activities in Croatia. Although beach tourism is one of the most important economic sectors, due to its geographical diversity Croatia also has the potential for a wide range of tourist activities and leisure such as cultural tourism, cycling, hiking, football, golf, sailing, and boating. Different types of tourist activities require different weather conditions. For quantitative estimations of the climate potential of different kinds of tourism, the climate index for tourism (CIT) is used. CIT integrates thermal, aesthetic, and physical facets of atmospheric environment and, therefore, is suitable for estimations of climate satisfaction that range from very poor to very good. The thermal component is estimated using the physiologically equivalent temperature (PET). In this paper, CIT is analyzed for different kinds of tourist activities: cultural tourism, beach tourism, cycling, hiking, football, golf, sailing, and boating.

Changes in the climate potential of tourism in Croatia are estimated by changes in the climate index for tourism within two future 30-year periods, 2011-2040 and 2041-2070, which are compared to a referent 30-year period, 1961-1990. For future climate, two randomly chosen simulations from the global atmosphere-ocean circulation model ECHAM5-MPIOM under the IPCC emission scenario A2 were downscaled using the regional climate model RegCM3. The integration domain covered almost the whole of Europe with the 35-km horizontal resolution.

Generally for all types of tourism, there is an increase of ideal climate conditions in future climates, mostly on account of the reduction of unacceptable conditions. These differences are up 2% in the period 2011-2040 and up 6% in the period 2041-2070. In the southern Adriatic the differences are mostly pronounced in 3S tourism, boating, and sailing, while very small for other types of tourism (Fig. 1). Looking at a monthly analysis, the changes are greater (in some cases up to 30%), and a similar pattern of changes occurs for all regions; but, there are some differences in periods of changes. An increase of ideal conditions will appear in future climates for 3S tourism, as well as in Adriatic boating and sailing, from April until October—only in the southern Adriatic is there a decrease during summer (JJA). For other types of recreation, the climate conditions will improve in future during spring and autumn, while become worse in summer. On the Adriatic, better climate conditions can be expected in March-April and October-December in the south, and in March-May and September-November in the north. In the continental part, more favorable climate conditions can be expected in future from February to May and from September or October to November. This will lead to the more pronounced bimodal distribution of ideal conditions in the future.

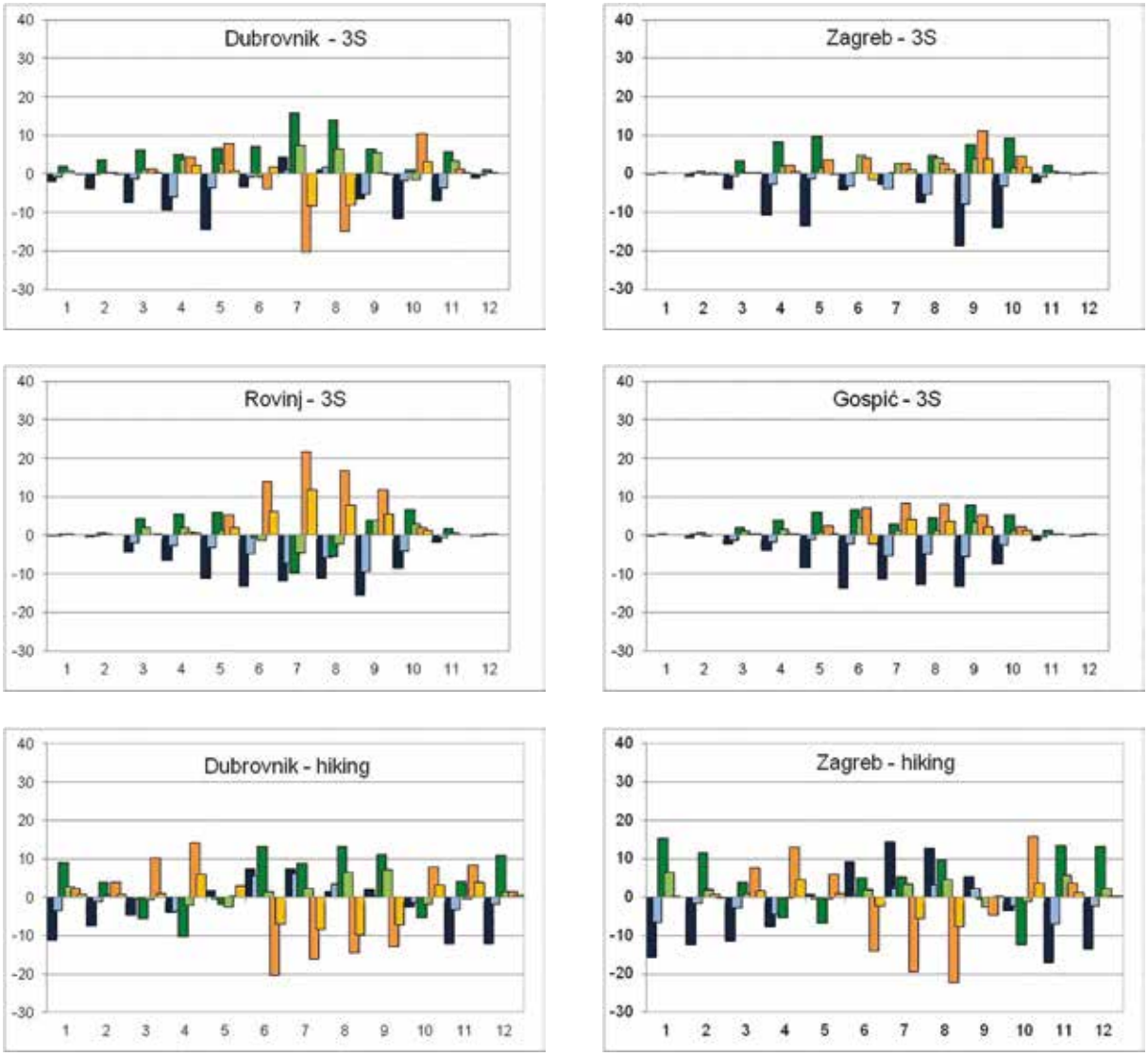
The results point to a shift in the most suitable seasons for most types of activities, moving from summer to spring and autumn. The season of 3S tourism will be prolonged, but in the south a reduction of ideal conditions for 3S tourism appears during summer. The analysis of the future

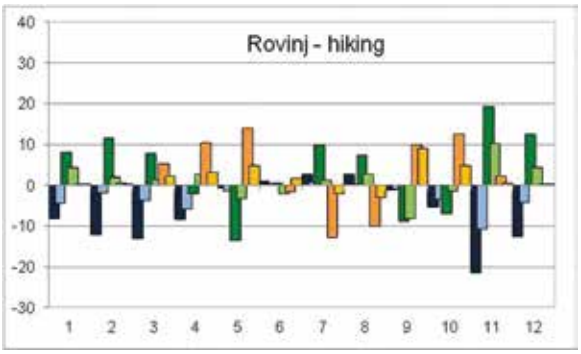
Figure 1: Annual differences between occurrences of unacceptable, acceptable and ideal climate conditions for different types of tourism according to CIT between future (P1 for 2011-2040, P2 for 2041-2070) and present (P0) climates at southern (Dubrovnik) and northern (Rovinj) Adriatic and continental lowland (Zagreb) and highland (Gospić)

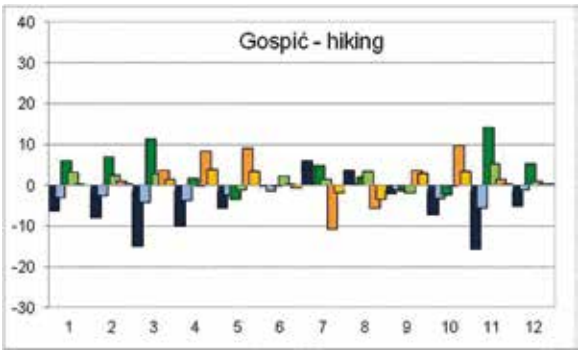


conditions for different parts of the day enables a comprehensive overview of the climate potential for tourism in the future. It would enable all involved actors in the tourism sector to adapt to climate change (Scott et al., 2009), providing changes and improvements are eventually realized.

Figure 2: Differences between occurrences of unacceptable, acceptable and ideal climate conditions for 3S tourism (above) and hiking (below) according to CIT between future (P1 for 2011-2040, P2 for 2041-2070) and present (P0) climates at southern (Dubrovnik) and northern (Rovinj) Adriatic and continental lowland (Zagreb) and highland (Gospić)







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GLACIER TOURISM AND CLIMATE CHANGE: PERCEPTION AND ADAPTIVE RESPONSES TO CLIMATE CHANGE FROM GLACIER TOUR OPERATORS OF THE VATNAJÖKULL REGION, ICELAND

J. T. Welling

Introduction

Cryosphere environments are among the most vulnerable environments to climate change (IPCC, 2013). However, at the same time they attract millions of visitors every year to enjoy and experience snow and ice for multiple purposes. During the previous decades, many glaciers worldwide grew to become popular tourist destinations. These majestic, intimidating, and fairly uncommon landscapes now form the basis for a broad array of tourist activities, services and products in many different countries. However, glacial environments are also extremely sensitive to global warming, and glaciers and icecaps have been receding in size and volume at an accelerated pace in many parts of the world. The worldwide recession of icecaps and glaciers is often considered to be one of the most tangible and high confidence level indicators of global climate change. Tourism enterprises operating in glacial environments, such as glacier tour operators, encounter the impacts of climate change in their daily business and can therefore be considered as actors that encompass lived, valuable experiences of climate change induced phenomena. Gaining insight into such local actors' experiences, perceptions and responses to climate change induced impacts provides an important opportunity to study climate change as embedded in society. Within this context the main goal of this study is to investigate the glacier tour operators' perceptions and attitudes towards climate change induced impacts and examine their adaptive responses and capabilities to cope with these impacts.

Literature

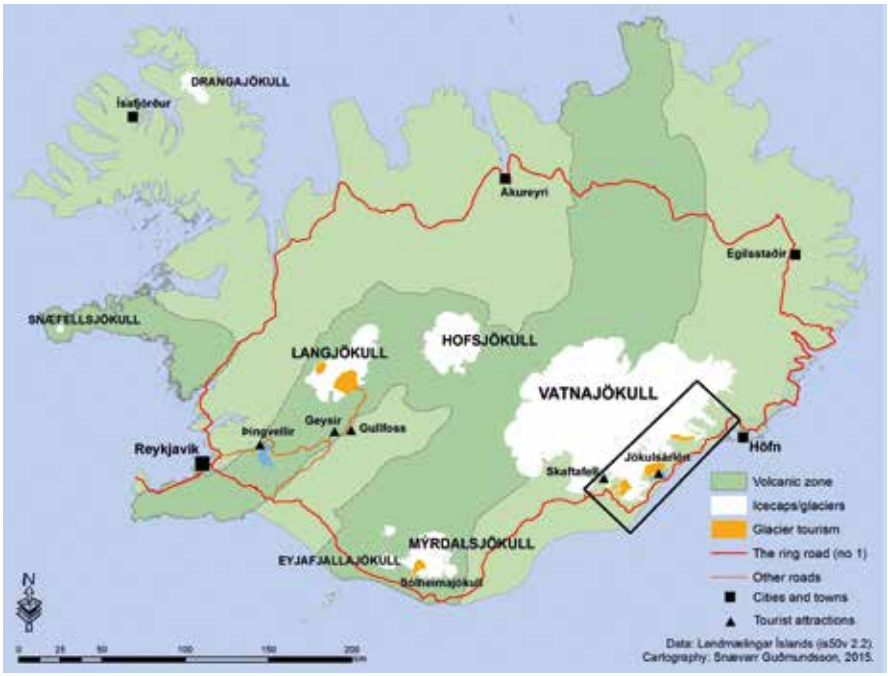
Research into the relationship between climate change and tourism in cryosphere environments has a strong focus on snow based winter sports tourism. A growing body of literature has investigated tourism supply-side perceptions on and adaptive responses to climate change implications that have occured in mountain-based winter sport destinations during the past decade (e.g. Scott & Boyle, 2007; Wolfsegger, Gössling and Scott, 2008; Rixen et al., 2011; Trawöger, 2014). On the contrary, research on climate change impacts and adaptation of tourism entrepreneurs operating in glacial environments is relatively new and have been sparsely examined (Welling et al., 2015). A few studies point out that the climate change induced thinning and recession of glaciers have has several significant impacts on tourism operations in those areas such as the increase in the occurrence of natural hazards (Smiraglia et al., 2008; Brandolini & Pelfini, 2010), the reduction of the accessibility to glaciers or within glacier sites (Ritter, Fiebig & Muhar, 2012; Purdie, 2013), and change of landscape scenery (Yuan, Lu, Ning and He, 2006; Scott, Jones & Konopek, 2007). Despite this, a few studies on glacier tourism operators' perceptions indicate some indifference to climate change among entrepreneurs, as they consider recent glacier recession more as a product of local precipitation and summer temperatures than global climate change (Furunes & Mykletun, 2012; Espiner & Becken, 2014). A number of studies examined different adaptation strategies to climate induced

impacts in glacial environments such as measures to diminish the occurrence of hazards which included the calculation of safe distances (Kohler, 2009), development of specific map symbols (Brandolini and Pelfini, 2010), and implementing safety zones and closing of specific areas (Wilson, 2012). Other studies indicate adaptation initiatives that address climate induced impacts on glacier sites' accessibility which included reducing ice ablation through the employment of chemicals, additives or physical protection covers (Fisher et al., 2011), as well as the use of new transportation means such as helicopters (Purdie, 2013) or new trail routes or infrastructure (Ritter et al., 2012). As most of these initiatives are anticipated, implemented or applied by local authorities and area managers, there is a clear dearth of knowledge regarding the adaptation strategies from the tourism industry itself.

Study area

Glaciers in Iceland have been visited by foreign travelers for centuries, but it is only in the last few decades that some of these have become highly popular tourist destinations on which a broad array of guided tour activities, ranging from soft to hard adventure, are now performed. Approximately 12% of the tourists that visit Iceland during the summer season of 2014 participated in a glacier or snowmobile tour. The interest in these forms of tourist activities has grown rapidly in recent years, which has in turn led to the formation of many new tour companies specializing in this field, as well as increased overall product diversity. Although Iceland has over 260 glaciers, including 16 major icecaps, covering in total roughly 11% of Iceland's terrestrial surface, the large majority of glacier tourism activities take place on just four of these glaciated areas, most of

Figure 1: Map of glacier sites in Iceland and the study area, the Vatnajökull region (rectangle)



which are situated along the south coast of Iceland (Figure 1). The Vatnajökull icecap, along with some of its outlet glaciers, is particularly important for glacier-based tourism services, both motorized and non-motorized, due to its easy and safe accessibility, as well as its proximity to highway nr. 1, the ring road which connects the capital to the rest of the island, and other popular nature destinations such as Skaftafell and the glacier lake Jökulsarlón (Welling & Árnason, 2016).

The study area is the southeast part of the Vatnajökull icecap (Figure 1), which has been marketed as the Vatnajökull region (www.visitvatnajokull.is). In the last two decades this rural part of Iceland has developed from an agricultural region to an area where tourism activities have become an important economic sector. The Vatnajökull icecap, the largest glacier in Europe, plays a central role in the regional tourism sector. Approximately a quarter of all the tourism enterprises situated in the Vatnajökull region are operators that provide tours on or in the direct vicinity of the different outlet glaciers of the Vatnajökull icecap (16 companies in 2014). These tours include guided glacier walks, hikes and glacier traversing, ice-climbing, motorized tours with super-jeeps or snowmobiles on icecaps, boat and kayak tours on glacier lakes, photography tours in ice caves, training sessions for climbers, and scenic flights by plane. In addition, most of the lodging companies, approximately 55% of the total tourism sector of the Vatnajökull region, are indirectly dependent on the Vatnajökull glacier through marketing, the scenic background, and provision of overnight stay facilities to visitors in the different glacier sites in the region.

Icelandic icecaps and glaciers are all categorized as being temperate or warm-based and are highly dynamic and sensitive to climate variation, resulting in rapid responses (advance or retreat) to changes in temperature and precipitation (Björnsson & Pálsson, 2008). Glacier recession has been especially pronounced since the 1990s, with all monitored icecaps retreating and thinning at an unprecedented pace (Björnson & Pálsson, 2008, Hannesdottir et al., 2010). Different outlet glaciers southeast of the Vatnajökull icecap such as Virkisjökull–Falljökull have shown an exceptionally fast retreat since 2007 (Bradwell et al., 2013). Dynamic glacier models coupled with future climate scenarios predict that the Vatnajökull icecap will lose 25-35% of its 1990 volume and most of its outlet glaciers completely before 2040 (Björnsson and Pálsson, 2008). Future projections of glacier recession indicate that glacier lakes will become longer and wider and gradually replace the outlet glaciers of the Vatnajökull icecap totally (Magnússon et al., 2012).

Methodology

This study employs an inductive qualitative research approach that starts with gathering and analyzing empirical data from individual cases to find corresponding patterns, which can finally lead to input for new theory. Data was collected by means of glacier site observations, a literature study and semi-structured in-depth face-to-face interviews with tour operators situated in the study area from which an important part of the tour assortment consists of glacier tour activities (i.e. activities that take place in glacier areas or have glacier areas as the main attraction of the tour). In the study nine interviews were conducted with company owners, general managers or senior employees of different tour operating enterprises ranging from small family run companies to relatively large enterprises with 30-50 fulltime employees and a seasonal staff in the summer of more than 100 people (Table 1).

Table 1: List of Interviewees

	Interviewee	Tour specialization	Year of establishment	Number of employees[1]	Number of tour costumers 2014-2015[1]
1	Owner	Super-jeeps tours	2009	3-2	1,500 - 2,000
2	Owner	Glacier walking, ice-cave tours	1994	4-3	2,000 - 2,500
3	Owner	Ice-cave tours, glacier lake kayaking	2011	2-1	3,000 - 4,000
4	Owner	Glacier walking, ice-cave tours	2011	1-1	4,000 - 5,000
5	Owner	Glacier walking, ice-cave tours	2013	2-3	5,000 - 6,000
6	Owner	Snowmobiles, Super-jeeps tours	1996	7-2	17,000 - 20,000
7	Senior employee	Glacier walking, ice-climbing	2006	80-30	20,000 - 25,000
8	Manager	Glacier walking, ice-climbing	1993	150-70	35,000 - 40,000
9	Manager	Amphibian boat and zodiac tours	1989	50-3	100,000 - 110,000

[1] Summer – winter season

Results

The empirical results show that all respondents consider climate change to be a real phenomenon that affects their present daily operations, referring to first-hand experiences such as the recession and thinning of the outlet glaciers of the Vatnajökull icecap. According to the respondents climate change induced impacts on the enterprises' current operations are mostly related to accessibility problems to and within glacier sites and changes in the occurrence of natural hazards. However, a large majority of the respondents do not perceive these impacts as a significant burden to their current tour operations which they believe they can continue without major alterations for the next decade. The entrepreneurs in motorized glacier tours stated that the immediate perceived weather conditions on site such as fog, heavy rain, and strong wind have a much more severe impact on their business than the gradual recession, thinning, and fragmentation of glaciers. Respondents' attitudes towards future climate change impacts ranged from forms of defeatism or indifference to a pro-active stance where some entrepreneurs saw future business opportunities, e.g. in the inclusion of climate change real life experiences as part of the tour, or by combining a glacier hike with a boat tour on the ever growing glacier lakes. The adaptive responses named by the respondents were diverse and can be divided into reactive or anticipated responses on the one hand, and technical or organizational adaptation strategies on the other (Table 2). The majority of respondents installed planned adaptation measures mostly in the form of tour diversification, site monitoring, cooperation with other operators, or specialization in ice-cave tours during the winter period. However, the majority of the anticipated responses were autonomous or unintended climate change related adaptation measures that have been implemented primarily as a reaction to other recurring natural phenomena such as sub glacial volcanic eruptions, glacial lake outburst and extreme weather events; or as a response to experienced and projected developments in the Icelandic tourism market.

Table 2: Adaptive responses named by respondents

	Reactive responses	
Technical	Use of removable bridges, install metal steps special terrain vehicles, safety gear, communication devices, trails adjustments	New transport means (boats), monitoring sites, mapping area, new sites inventory
Organizational	Changing routes, reorganize staff, tour modification/cancellation	Extent tour portfolio, generate off-tourism income, corporate cooperation, outsourcing, training & education, including "climate change info" in tours, specialization

Further, the results point out that the location of glacier sites, the size of the company (in generated revenues and staff size) and the type of provided activities have significant influence on the kind of adaptation measures that have been implemented or envisaged by the entrepreneurs. In addition, availability of local knowledge of terrain and glacial processes, presence of leadership cooperation and area related institutions, and access to financial and technical resources characterize the current glacier tour operators' ability to adapt successfully to the impacts of climate variability and change and contribute to the reduction of their vulnerability towards such implications.

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THE COMBINED IMPACT OF CLIMATE CHANGE AND EUTROPHICATION ON SOUTHEAST ASIA'S SUITABILITY FOR COASTAL TOURISM

A. Guijt, B. Amelung & C. Kroeze

Benign climatic conditions and an acceptable bathing water quality are important resources for coastal tourism. Both tourism resources have been studied to a limited extent but never in combination. The reality and prospects of climate change (IPCC 2014), in combination with the continued eutrophication of many coastal waters (see e.g. Strokal et al. 2014 for China), provide a strong rationale for integration. This paper reports on a first-order integrated assessment, based on the combination of published analyses of 1) changes in climatic resources for tourism as expressed by the Tourism Climatic Index, TCI (Mieczkowski 1985) and 2) changes in eutrophication risks as expressed by the Indicator for Coastal Eutrophication Potential (ICEP) from the Global NEWS-2 (Nutrient Export from WaterSheds, version two) model (Mayorga et al 2010). The assessment focuses on Southeast Asia, a region characterized by strong increases in eutrophication risk and rapidly expanding demand for tourism and recreation.

The analysis is based on TCI and ICEP datasets underlying published papers (Amelung et al 2007; Mayorga et al 2010). Both datasets are gridded using the same grid. ICEP values are annual, while TCI values are monthly. To compare the two, the TCI values are converted to an annual measure: the number of months per year with a TCI score exceeding a minimum threshold.

The results indicate a general decline in the region's suitability for coastal tourism, albeit with considerable variation. The band of suitable climatic conditions shifts to the north. The risk of eutrophication and algae bloom increases in many areas, in particular in the coastal areas of South Korea, southern China, and Taiwan. Pockets with good climatic conditions and acceptable water quality remain. The analysis suggests that a large number of coastal areas could substantially increase their attractiveness by improving water quality, pointing to possibly important economic benefits of reducing nutrient loading of rivers.

A number of promising avenues for further research are identified. Key methodological improvements include using climate indicators that are tailored to coastal tourism requirements and adding seasonal detail in the indicator for eutrophication potential. Research into the (cleaning) costs of improving water quality versus the (tourism) benefits is highly recommended.

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CLIMATE CHANGE AND CULTURAL HERITAGE

D. Yilmaz, T. Ozturk & M. L. Kurnaz

Cultural heritage is the patrimony of Turkey. Above its intrinsic value, cultural heritage is a major driver of the Turkish economy. But this invaluable heritage is fragile. Climate change is one of the most important issues of the 21st century. As a result of the increase in the concentration of greenhouse gases released into the atmosphere since the Industrial Revolution, the world's average temperature has risen by 0.85°C over the last century. According to the report published by The Intergovernmental Panel on Climate Change in 2013, the projected global average temperature increase by 2100 will be between 1.5 to 4.0°C (IPCC, 2013). As the effects of global climate change can be seen in the economic and social fields, it is inevitable that we will experience these effects within our natural and historical environment in the near future. Heritage sites and open air museums in Turkey are the cultural areas that will experience these impacts most significantly. Ephesus, which is located near the city of Seljuk in Izmir, is an example of such an open air site. The Temple of Artemis, which is one of the Seven Wonders of the Ancient World, is situated on the edge of this small town. The city, which was situated at the beginning of the Persian Royal Road, has survived enough to enable us to understand the ancient way of life in Ephesus. The city played an impressive role in the beginnings of Christianity and during its period of proliferation (Basilica of St. John and the House of the Virgin Mary). It contains one of the most spectacular examples of religious architecture during the Seljuk Period. However, climate change is becoming a very important damaging factor for the sites at Ephesus. Mitigating and adapting to the impacts of climate change through policies and on-site practices requires extensive research.

In this study, projected future changes for the period of 2016-2035 in mean air temperature and precipitation climatology and variability over Ephesus (Izmir) were studied. Climate Model (RegCM4.4.1) of ICTP (International Centre for Theoretical Physics) was used for projections of future climate conditions. HadGEM2 (Hadley Global Environment Model 2) global climate model of Met Office Hadley Centre was downscaled for Ephesus (Izmir) and its surrounding region. In this study, RCP 4.5 and RCP 8.5 emission scenarios were studied in order to investigate future changes of some climate variables in Ephesus.

CLIMATE CHANGE VULNERABILITY OF SKI RESORTS IN THE PYRENEES AND ADAPTATION STRATEGIES: FROM THE LOCAL PERSPECTIVE TO THE REGIONAL SCALE

M. Pons, E. Jover & J.I. López-Moreno

The Pyrenees, which encompasses the mountain area of the south of France, the north of Spain, and the small country of Andorra (Figure 1), hosts one of the largest ski areas in Europe after the Alps. In this region, winter tourism is one of the main sources of income and a driving force of local development within these mountain communities (Lasanta et al., 2007). However, this activity was identified as one of the most vulnerable to future climate change (Scott et al., 2012). In this context, the NIVOPYR project intended to analyze the vulnerability of the Pyrenean ski resorts to the projected changes on snowpack under different future climate scenarios. Both local and regional scales were considered. On the one hand, local features of the resorts such as aspect, elevation distribution, and steepness were considered, as well as the effect of technical management of the slopes (grooming and snowmaking). On the other hand, the regional scale analysis was permitted to include the effects of a potential redistribution of skiers based on the differentiated vulnerability of the resorts and the differentiated destination attractiveness. Different vulnerability levels were identified based on both geographical and socioeconomic features of each ski resort. Finally, the analysis permitted us to set the basis for the design and implementation, jointly with the ski resorts and the local administration, of an adaptation strategy to future climate change for each type of ski resort.

Figure 1: The Pyrenees region and the location of the alpine ski resorts (The size of the dots represents the average of the yearly attendance from 2009 to 2012.)

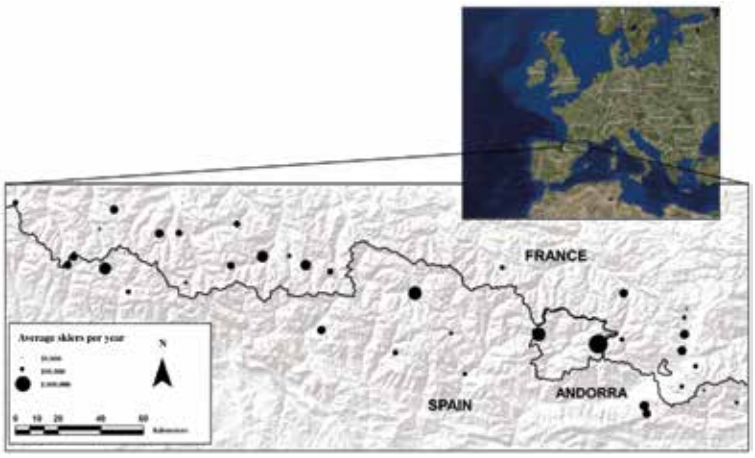
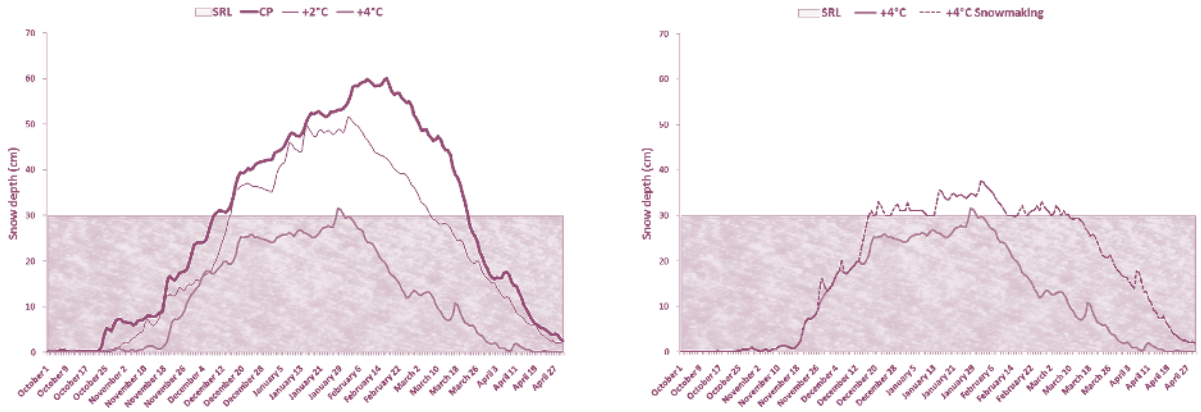


Figure 2: Projected changes on the natural snowpack at the mean elevation of a ski resort in the central-eastern part of the French Pyrenees in a medium (+2°C increase of the mean winter temperature) and high-climate change scenario (+4°C)



The analysis from the local scale permitted us to assess the vulnerability of each ski resort based on expected changes on the snowpack at each location and the potential of snowmaking systems to enhance the natural snowpack. Figure 2 shows the projected changes on the snowpack in a ski resort in the central-eastern part of the French Pyrenees in two different future climate change scenarios and the effect of the snowmaking systems.

During this first stage, ski resorts showed to have a very different vulnerability within the same resort based on the geographic features of the area. Different areas inside the same ski resort could have very different vulnerability to future climate change based on aspect, steepness, or elevation. Furthermore, the technical management of ski resorts, such as snowmaking and grooming were identified to have a significant impact on the response of the snowpack in a warmer climate. In this line, two different ski resorts were deeply analyzed, taking into account both local geographical features as well as the effect of the technical management of the runs. Principal Component Analysis was used to classify the main areas of the resort based on the geographic features (elevation, aspect, and steepness) and identify the main representative areas with different local features. Figure 3 shows the classification of ski resorts in the main areas with similar local geographic characteristics to a ski resort of Andorra.

Snow energy and mass balance were simulated in the different representative areas using the Cold Regions Hydrological Model (CRHM) assuming different magnitudes of climate warming (increases of 2°C and 4°C in the mean winter temperature). Figure 4 shows the expected decrease of days with at least 30 cm of snow in a ski resort of the central part of the Spanish Pyrenees.

The first results showed how the vulnerability changes based on the local geography of the resort and the management of the ski runs, showing the importance of including these variables when analyzing the local vulnerability of a ski resort and the potential adaptation measures in each particular case.

Figure 3: Classification of a ski resort surface in different groups with similar geographic characteristics (elevation, aspect, steepness). (Green dots represent the location of temperature and humidity sensors used to study the specific temperature elevation range within the resort.)

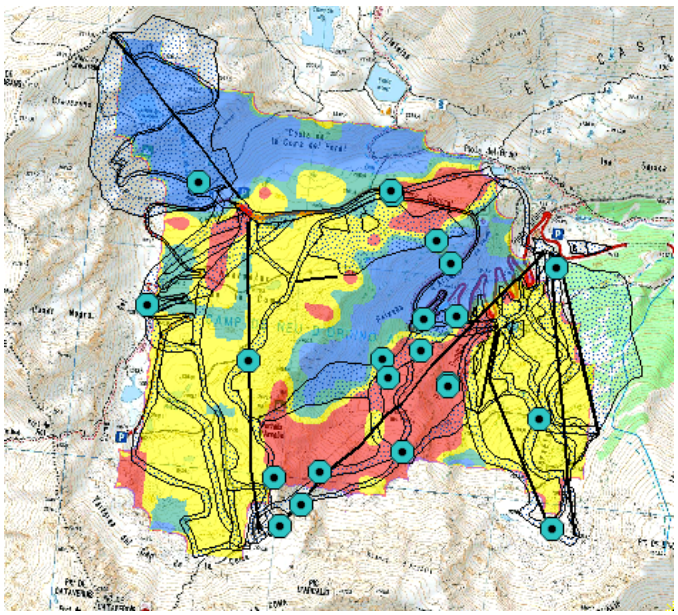


Figure 4: Decrease in the number of days with at least 30 cm snow (reliability criteria) based on altitude and aspect (NW and SE) in two different climate scenarios (+2°C and +4°C), analyzing the effect of grooming and snowmaking (technical snow) in a ski resort of the central part of the Spanish Pyrenees

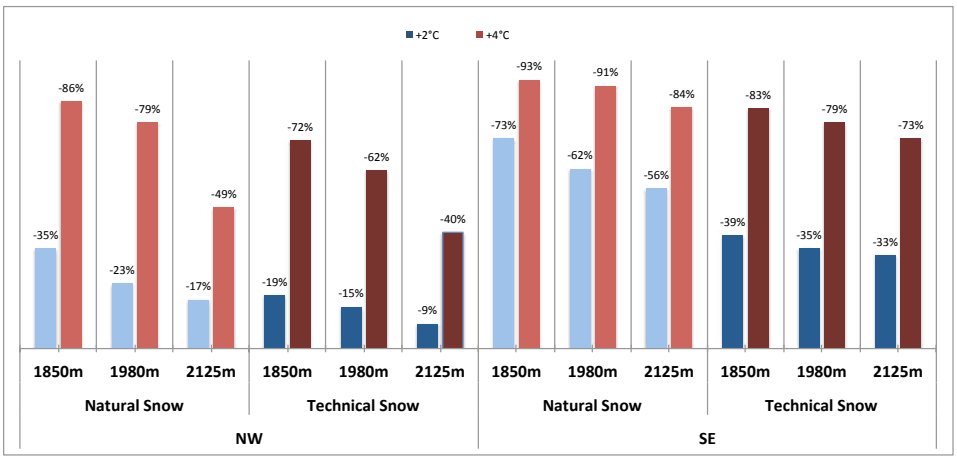
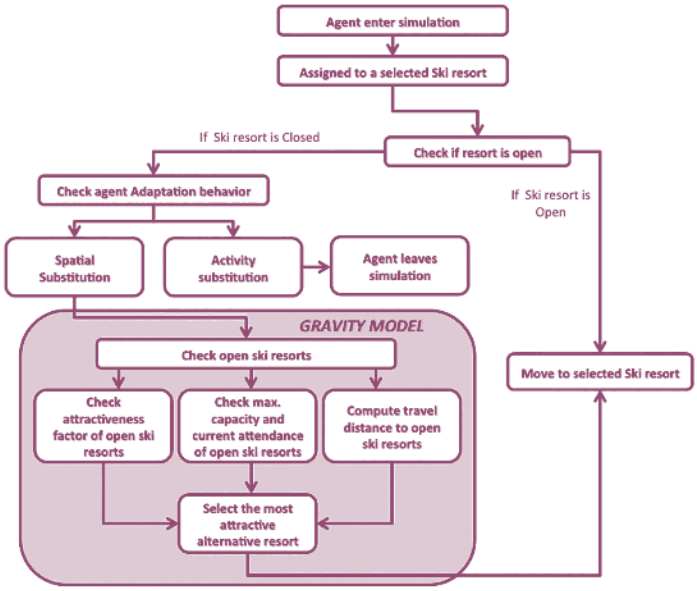


Figure 5: Flowchart of the coupled agent-based and gravity model



Finally, ski resorts are not isolated entities in the territory but take part in a regional market, attracting regional and foreign tourists and competing with other resorts in the region. In the first stage of the project, high heterogeneity was found in the level and temporality of the vulnerability of different ski resorts in the Pyrenees. This would lead to a different impact on the future competitiveness and supply capacity of each ski resort (Pons et al., 2014). Moreover, many studies have worked on the adaptive capacity of tourists to future climate change, identifying the possibility of spatial, temporal, and activity substitution based on the changing snow conditions of ski resorts (Behringer et al., 2000; Unbehaun et al., 2008; Dawson et al., 2011; Dawson et al, 2013). These facts lead us to form the hypothesis that climate-induced changes on the snowpack have led to a potential redistribution of skiers in the region. To study this issue a coupled Agent Based Model (ABM) with a gravity model (Pons et al., 2014) was used to simulate this potential redistribution of skiers based on both the physical vulnerability of ski resorts to climate change and their tourist attractivity (based on socioeconomic variables).

By means of this approach we explored shifts in skier distribution amongst resorts at a regional scale due to changes in local snow conditions as a result of future climate change projections.

The inclusion of this issue, complementing the physical vulnerability with socioeconomic factors such as the touristic attractiveness of each ski resort, permitted us to reach an integral assessment of the local vulnerability at each ski resort and the regional effect on the Pyrenean tourism industry. Based on the results, we have classified the ski resorts in three different groups of vulnerability. A first group consists of highly vulnerable ski resorts that will suffer a reduction of their visitor

attendance in both mild and strong climate change scenarios. This group is usually characterized by geographical conditions that make it difficult to ensure a snow-reliable season, such as low elevation, south oriented areas with a predominant Mediterranean influence, and a low touristic attractiveness compared to other nearby competitors.

A second group consists of low vulnerability ski resorts that will suffer a reduction in attendance under a strong climate change scenario, but not in a mild one, where these resorts would keep their current level of skier attendance or even increase it. This group is usually characterized by ski resorts with medium capacity to assure enough snow and a medium attractiveness factor to capture skiers from other closed ski resorts. Lastly a third group consists of resilient ski resorts, with good conditions to assure future snow availability (high elevations, north oriented slopes, more Atlantic influence, and with a high attractiveness factor, which makes them able to offer longer ski seasons than their competitors and to attract skiers from closed ski resorts. Ski resorts classified in this group will increase their skier attendance in both mild and high climate change scenarios. In this context, technical adaptation strategies such as slope management, cloud seeding, or snowmaking could be suitable for the most resilient ski resorts and for those less vulnerable in a mid-climate change scenario. However, these adaptation measures could not be enough for those more vulnerable in any future climate change scenario and in a more intense climate change scenario for the less vulnerable resorts. In this case, structural adaptation strategies such as activity and revenue diversification with more summer-oriented activities should be considered and implemented as soon as possible.

The framework and the results presented, analyzing from the local perspective to the regional scale the vulnerability of a ski resort, will be used to design the most suited adaptation strategy for each ski resort in the Pyrenees. The next step to the NIVOPYR project is intended to design, apply, and monitor an adaptation strategy for some selected ski resorts in the region. In this context, three ski resorts with different physical and socioeconomic characteristics, and therefore with different vulnerability, are being studied in detail in order to design and apply, jointly with the local administrations and the ski resort managers, a specific adaptation strategy for each particular case.

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IMPACT OF CLIMATE CHANGE ON SKI RESORTS IN THE BALKANS, THE MIDDLE EAST AND THE CAUCASUS: A PRELIMINARY ASSESSMENT FOR SKI TOURISM IN NORTHEAST TURKEY

O. C. Demiroglu, M. T. Turp, T. Ozturk, M. L. Kurnaz

Introduction

Climate change poses a threat to all aspects of life, with the tourism industry as one of the most vulnerable sectors of the economy. Within the tourism industry, snow sports tourism is "the most directly and the most immediately affected" subsector and has been "the first and the most studied aspect" embedded in the "geographically and methodologically diverse literature" (Scott et al., 2012: 201-202). Such literature (Demiroglu, 2011; Demiroglu et al., 2013) cites more than a hundred peer-reviewed articles regarding climate change impact assessment and adaptation of snow sports tourism in 30 countries. Most of these studies have been centered on the Alpine countries and North America, but Turkey has also been on the agenda in recent years (Ceber et al., 2013; Demiroglu & Lundmark, 2013; Ozturk et al., 2014) owing to its emergence as a major competitor in the international market. Such emergence is even more pronounced nowadays with the launching of a macro project that aims to develop 100 ski resorts and four million snow sports enthusiasts within the country over the next 12 years. Turkish authorities are certainly enthusiastic that they will achieve success, projecting 11 billion Euros of annual revenues and 500,000 jobs in return for a 12-year investment plan worth 49 billion Euros (Hayırlıoğlu, 2015).

The impacts of climate change need to be assessed thoroughly before the aforementioned budget gets diverted into the development of snow sports tourism in Turkey. Therefore, snow reliability analyses need to be implemented for the sake of a careful site selection procedure. Such research would also be a positive contribution to the literature by breaking through Alpino- and Amero-centrism and filling in the spatial gaps. In this study, we aim at improving previous works by Ozturk et al. (2014) and Demiroglu et al. (2015) where snow reliability of ski resorts have been attempted to be examined through projections based on regional climate model outputs downscaled from various GCMs for different concentration scenarios. The ultimate domain of the research in progress here has been limited to the Balkans, the Middle East, and the Caucasus, wherein lie more than 200 ski areas.

Methodology

In the modelling part of this study, we employed the regional climate model, RegCM4.4. RegCM4.4 is a hydrostatic regional climate model developed by the Abdus Salam International Centre for Theoretical Physics (ICTP). Dynamic structure of RegCM4.4 consists of the hydrostatic version of the model MM5 (the mesoscale model) (Grell et al., 1994) of the National Center for Atmospheric Research (NCAR) of Pennsylvania State University. BATS1E (Biosphere-Atmosphere Transfer Scheme) (Dickinson et al., 1993) model is used for the processes about surface and, likewise, the Community Land Model (CLM) version 3.5 is also in the dynamic structure of the code as an option. Radiative transfer was modelled using NCAR Community Climate Model, version CCM3 (Kiehl, 1996) radiation pocket in RegCM regional climate

model. Solar radiation transfer was modelled using δ-Eddington (Kiehl, 1996) approach. Three parameters, the amount of cloud cover, liquid water content of the cloud, and effective droplet radius, were used in the cloud radiation part of the model. Planetary boundary layer-PBL scheme based on the concept of non-local diffusion developed by Holtslag (1990) has been used in the model. Convective rainfall systems of the model are calculated by choosing one of the three schemes including modified-Kuo scheme (Anthes, 1977), Grell scheme (Grell, 1993), and MIT-Emanuel scheme (Emanuel, 1991; 1999). This regional climate model system has been effectively used in climate change studies for the last 10 years.

In order to generate the historical and future outputs for the calculations of desired indicators, firstly HadGEM2 global climate model of the Met Office Hadley Centre was dynamically downscaled to 50 km for the ski resort regions via RegCM4.4. Secondly, the RegCM4.4 was driven at a 10 km resolution by applying double-nested method to the outputs of 50 km resolution simulations. In this step of the modelling, the first run outputs, with 50 km resolutions, were employed as a forcing data to RegCM4.4. In other words, in order to represent the ski areas' climate more accurately, the RegCM4.4 was once again run with the previous model outputs, and thus all the regions were dynamically downscaled to 10 km resolution. The mid-range, RCP4.5, greenhouse gas concentration scenario (van Vuuren et al., 2011) outputs of the global model were used for future model forecasts to display a relatively optimistic future.

The double nested downscaling of the GCM HadGEM2 by RegCM4.4 has provided us with daily outputs on snow water equivalent (SWE), snow melt (SMELT), maximum wind speed (SFCWINDMAX), and the three hourly outputs on near surface temperature (TAS) and near surface relative humidity (HURS) for the 1971-1999 and the 2021-2049 periods according to the optimistic CO_2 concentration scenario, RCP 4.5, of the IPCC. Based on a count of the "net SWEs," which are calculated as SWEs minus the related SMELTs, converted into snow depths through reference snow density values (Sorman & Beser, 2013) within respective climatic zones and seasons, we have applied the "100 Days Rule" of natural snow reliability (Witmer, 1986), which states that in order for a ski resort to be viable it needs to operate for at least 100 days in a year with minimum snow depths of 30 cm for sufficient conditions (NSR30), 50 cm for good conditions (NSR50), and 70 cm for excellent conditions (NSR70). Regarding technical snow reliability, we have utilized the TAS and the HURS outputs in obtaining wet bulb temperatures (Stull, 2011), for which a count has provided us with snowmaking conditions where the minimal WBT threshold is set at -4 °C for total capacity (TSR-T) and at -7 °C (TSR-G) for good quality and the minimum number of desired production hours is 120 (Steiger 2008). Last but not the least, we have introduced the wind threshold by setting it to a maximum of 50 km/h (W50) for chairlift and gondola operations with reference to risk limits in common practice.

Preliminary Results and Discussion

Hereby, we introduce the preliminary results from four more ski resorts in Northeast Turkey with enriched indicators in regards to the previous works (Ozturk et al., 2014; Demiroglu et al., 2015). The table below displays the changes for the climatic indicators. A generally declining trend for all values is observed for the 2021-2049 period with respect to the historical period of 1971-1999, despite the optimistic RCP4.5 pathway that stabilizes radiative forcing at 4.5 W/m^{-2} throughout the 21st century. Below, we distinguish the declining trend among the four ski resorts and elaborate on the findings in terms of thresholds.

Table 1: Past/Future Changes for Climatic Indicators of Ski Resort Sites in Northeast Turkey

Ski Resort	NSR30	NSR50	NSR70	TSR-T	TSR-G	W50
1	108/85	92/64	74/50	2,124/1,551	1,140/735	6/3
2	134/128	124/114	116/97	1,785/1,227	846/495	18/15
3	126/104	107/87	88/67	2,469/2,073	1,524/1,146	0.7/0.4
4	132/113	113/90	92/70	2,607/2,019	1,581/1,107	2/1.5

Ski Resort 1 seems to be the most troubled among the four resorts with the natural snow reliability deteriorating severely at all thresholds. Yet the critical quality snowmaking capacity especially needed for base layer formation will still be available for at least 30 days, reduced from the previous 1,140 hours. High winds, on the other hand, are to decrease by 50%, saving the resort three more days on average during the future seasons. Still, it might be a better idea to extend the resort to its adjacent higher terrain where the vertical drop could be improved by 400 m.a.s.l.

Ski Resort 2 would maintain top position for natural snow reliability, probably owing to its Black Sea climate, which brings the area plenty of snowfall through a mechanism similar to lake-effect snow in the Northeastern United States. However, the same maritime climate, as opposed to the continental character of the other three, places the resort at the bottom of the list due to high humidity that maximizes wet bulb temperatures. Nonetheless, both the future snowmaking capacity and natural snow sufficiency seem to be enough for the survival of the resort that is currently under planning. Yet one thing the planners should take into consideration is the windiness as the positive impact of climate change on this indicator will still not be enough to beat the high number of days the aerial cable lifts might get shut down.

Ski Resorts 3 and 4 show similar trends, where natural snow reliability deteriorates severely in good and excellent conditions whilst the snowmaking capacities still largely exceed the desired 120 hours of production and probably make up for the loss in natural snow, owing to the dominant Siberian High Pressure that accounts for cold, dry days around the northeasterly and continental region of these two resorts. Likewise, the pressure system will continue to provide the area with stable weather that minimizes risks from high winds.

Conclusion

Hereby, we have managed to improve the previous works by a better natural snow reliability indicator, i.e. snow depth instead of snow water equivalent, and the introduction of the wind threshold. Next, we will also develop a new indicator for visibility, based on cloud fractional cover (CL) outputs, customized for ski resort altitudes, which will help us understand the impact of climate change in fog events. Furthermore, the preliminary study will be spatially broadened by a larger domain encompassing the Balkans, the Middle East, and the Caucasus with a better resolution by interpolation, e.g. kriging. Finally, in order to provide the beneficiaries with alternative outlooks, we will employ more GCMs such as MPI-ESM-MR, and GFDL-ESM2M, as well as more concentration pathways such as RCP2.6, RCP6, and RCP8.5.

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QUESTIONING WITMER'S 100 DAYS RULE FOR SNOW RELIABILITY ANALYSES

O. C. Demiroglu & N. An

Introduction

In order to assess the snow reliability of snow sports tourism facilities in light of a changing climate, most studies have utilized the "100 days rule" without much modification on its initial postulation, which states that "in order to have a economically viable investment in winter sports areas, among others, the installed facilities need to be utilized for at least 100 days per season (Dec. 1 - Apr. 30), which is only possible with a snow cover of sufficient thickness" (Witmer, 1986: 193). Although some attempts have been made to distinguish the method with a consideration on factors such as snowmaking (Scott et al., 2006; Steiger & Mayer, 2008) and intra-seasonal timing (Scott et al., 2008; Schmude & Berghammer, 2014), no research has dug into the actual financials of ski resorts that would have otherwise provided empirical evidence for the said viability. Moreover, the snow depth factor has also generally been taken as is, based on an even more outdated study realized for just one single field, Davos (Eckel, 1938), which has suggested minimum snow depths of 30 cm, 50 cm, and 70 cm as adequate, good, and excellent conditions, respectively.

Minimal and ideal snow conditions, including thickness, have been re-questioned by recent studies in different countries, yielding consumer desired threshold values of 74 to 82 cm (Demiroglu et al., 2014; Demiroglu, 2015). Therefore, more up-to-date and comprehensive evaluations of the "thickness input" can be made available for the refinement of the 100 days rule. Yet the actual weakness of this capital methodology would still be present should one not break through its highly outdated and generalized structure. Therefore, we take the challenge of breaking through this structure here and redefine the rule by inductive reasoning that bases its conclusions on empirical data from four resort establishments in Northeast Turkey. Although the establishments are scattered around the same ski area, they are diverse by type, as two of them could be categorized as chain resort hotels and the others as a deluxe and a budget hotel.

Methodology

The financial statements obtained confidentially from the establishments are used for determination of the "breakeven days" (BED), in terms of number of room nights sold, as an indicator of the threshold point where the establishment starts profiting during the ski season (December-April) of 2013-2014, and checks how they fit with the 100 Days Rule. BED values are treated as a function of "average daily room rates" (ADR) and "room nights sold" (RNS), "other revenues" (OR), "fixed costs" (FC) and "variable costs" (VC), according to the formula derived below:

$$BED = FC/(((ADR+(OR/RNS))-(VC/RNS))$$

Results

BEDs are 68 and 122 days for the chain resort hotels, 93 days for the deluxe hotel, and 105 days for the budget hotel. Taking December 1, 2013, as the season start; the establishments start profiting on February 6, 2014, April 1, 2014, March 3, 2014, and March 15, 2014, respectively. In other words, two of the establishments can bear a ski season that lasts less than 100 days, whereas the other two would financially be distressed even if the conventional duration threshold were present. These results show how misleading the 100 days rule could become when specific to individual businesses.

Conclusion

The preliminary findings could set forth a departure point, combined with the efforts on redefining the snow depth thresholds, on further research for a new bottom-up generalization of Witmer's 100 Days Rule by distinguishing the involved business types, sizes, locations, and timeframes. It is well acknowledged that obtaining data based on private financial statements is a major collection challenge for researchers. Therefore businesses need to be informed about the beneficial outcomes on their side for a stronger motivation towards collaboration. Moreover, if access to longer term financial data or even feasibility predictions are provided, then the breakeven years (BEY) along the payback period could be assessed. Such an approach could even be more critical, as fixed costs would be radically increasing due to the additional contribution from snowmaking to the POMEC (property operations, maintenance, and energy costs) item, thus stressing the breakeven levels, and the terminal values, which are crucial to the return of highly fixed hospitality investments, could become more questionable as the businesses may lose attractivity towards the end of the their life cycles under a changing climate.

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MISUNDERSTANDING AND OBFUSCATION OF SNOW RELIABILITY AND SNOW GUARANTEE

O. C. Demiroglu

Introduction

The increasingly negative effects of climate change on the ski tourism industry have become common in impact assessment studies and have lead to the adoption and development of various adaptation strategies (Scott & McBoyle, 2007). At first, previous studies focused on the changes in the "natural snow reliability" of ski resorts for the sake of thorough impact assessments, whilst such attempts have recently been coupled by calculations on snowmaking capacities in order to determine the "technical snow reliability." Complementary to snowmaking as some of the most prominent technical adaptation options, other soft measures such as "snow guaranteed marketing," sometimes backed up by innovative weather derivatives and index insurance (Scott & Lemieux, 2010), have also popularly emerged onto the scene. With so many developments taking place for the sake of climate change adaptation, a terminological mix has also evolved, leaving practical gaps in communicating the relatively new concepts and definitions, especially at emerging destinations. This paper focuses on the current situation across the globe and at Turkish ski resorts, where diffusion of snowmaking investments has just recently started to take place.

Methodology

In order to operationalize research, the definitions of "snow reliability," "snowmaking," and "snow guarantee" are given firstly, based on scientific and industrial references:

- snow reliability (i.e. "natural snow reliability") refers to certain thresholds on snow cover, such as a minimum depth of 30 cm and a duration of 100 days, that would ensure financial viability for the ski resorts (Abegg et al., 2007);
- snowmaking (i.e. "technical snow reliability") refers to "man-made snow reliability" (Steiger & Mayer, 2008); and
- snow guarantee refers to an assurance for compensation to the consumer in case of lack of snow as evidenced from worldwide practices (Morris, 2014; Killington/Pico Ski Resort Partners LLC, 2015; Mt Buller, 2015; SkiStar AB, 2015; Val Thorens Office de Tourisme, 2015).

In the next step, a brief content analysis on the usage of the term "snow guarantee" by Turkish ski resorts is performed by a web search on the keywords "kar garantisi/garantili (snow guarantee/guaranteed)." Then, I refer to the partial preliminary results of an ongoing survey on climate change perception and adaptation of Turkish ski tourists (Demiroglu, 2014), where one of the questions directly asks the respondents about their understanding of the phrase "snow guarantee" with multiple answer options including "natural snow reliability," "natural snow reliability powered by snowmaking facilities," and/or "provision of a certain warrant, such as a refund or a gift voucher, in case of lack of snow for the ski trip purchased." Altogether, both findings were used for a mutual evaluation on the understanding and the conveying of aforementioned terms by demand and supply players in the global and the Turkish ski tourism markets.

Results and Discussion

A survey on how the "snow guarantee" concept is presented by various ski resorts and tour operators has shown that differentiated or obfuscated practices take place as opposed to what is given in the above definition. For instance, for a large integrated Alpine resort the guarantee is promoted through the fact that the ski areas have high snow reliability due to 75% coverage by snowmaking and the existence of high altitude glaciers (Zillertal Tourismus GmbH, 2014).

In Turkey, only recently have three out of the 51 ski areas (Demiroglu, 2011) invested in snowmaking. Two of these have followed a similar attitude to that of their Alpine counterpart, by claiming snow guarantee with (over)confidence in their snowmaking systems but without assurance (Özyürek, 2014; Hürriyet Ekonomi, 2014).

It is a technically known fact that the common snowmaking technology is only able to produce snow at certain temperatures depending on relative humidity. In dry areas, warmer temperatures can be sufficient. However, the warmest it can get would be -2° C without any additives, most of which are banned in developed countries (Demiroglu et al., 2015). Therefore, investment in snowmaking could be promoted as part of an increase in reliability but never a complete assurance or guarantee. In fact, one of these two Turkish ski resorts had to postpone its "snow guaranteed" season opening for December 2014 as advertized full page in the mainstream media since there was no sufficient natural snow depth nor ambient wet bulb temperatures enough for snow production there. This incident led the ski resort to put an "asterisk" in its next ads, which noted the fact that the guarantee was only available below certain temperatures and offered an immediate refund or rebooking for customers later in the season. The customers, on the other hand, do not seem to be much informed about the snow reliability and guarantee terms either. The preliminary survey results show that those respondents who associated snow guarantee with technical snow reliability (TSR) accounted for the largest group (n=116), followed by those who opted for natural snow reliability (NSR) (n=89). Surprisingly, the number of respondents who embraced the above operationalized definition of snow guarantee (SG) was the smallest (n=83). Results on the subsets of selected options also seemed to favor technical snow reliability as the synonym for snow guarantee.

Conclusion

In many languages, and especially in Turkish, the words "reliability" and "guarantee" have very close meanings. Therefore, consumers may easily misperceive what is being offered. Moreover, some suppliers may mislead the consumers unintentionally, or sometimes on purpose, through play on words.

The terms snow guarantee and snow reliability should be distinguished in a clearer manner within the ski tourism industry. Tour operators and travel agencies could play a vital role here for the international clarification and standardization of the snow guarantee concept. Finally, a better defined concept could also lead to a healthier integration of weather derivatives and insurance that would result in a further guarantee for the ski resorts during periods of low snowfall.

Table 1: Subsets of Turkish Ski Tourists' Definitions for Snow Guarantee

	TSR	NSR	SG	TSR+SG	NSR+SG	TSR+NSR	TSR+NSR+SG	None
n	51	32	25	19	11	7	39	0

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ASSESSING THE FUTURE CLIMATE VULNERABILITY OF UNITED STATES SKI TOURISM REGIONS USING AN ANALOGUE APPROACH

M. Rutty & D. Scott

Winter sports tourism is a major market segment considered highly vulnerable to climate variability and change. With its reliance on temperature and snowfall conditions, inter-annual climate variability impacts the length and quality of ski seasons and thereby skier visits and associated revenues. Importantly, inter-annual climate variability is anticipated to become more pronounced under future climate change (IPCC 2013), posing an increased risk for the ski tourism industry. These risks have been widely studied in the tourism literature (Scott et al. 2012), with results from every regional market assessment (Alps, Australasia, North America, Eastern and Western Europe, Japan) indicating shorter and more variable ski seasons, increased snowmaking requirements, and a contraction in the number of operating ski areas (Scott et al. 2003; Scott et al. 2006; Abegg et al. 2007; Hamilton et al. 2007; Scott et al. 2007; Hennessy et al. 2008; Scott et al. 2008; Dawson and Scott 2013; Steiger 2010; Hendrikx et al. 2013; Steiger and Stötter 2013; Pons et al. 2014).

To date, the majority of climate change and ski studies have used modeling-based approaches, which do not capture the specific demand-side implications (i.e., how skiers change their visitation patterns in response to marginal ski conditions) and often neglect to consider the wide-range of adaptation strategies already being implemented by ski operators to compensate for changes in natural snow conditions. As a result, the risk that climate change scenarios pose to ski area operators may be overestimated in some of the literature. Temporal analogues, which use past and present experiences and responses to climate variability and extremes, can offer new insight into future vulnerability by focusing on the observed responses of the entire ski tourism marketplace to real climatic conditions while capturing the integrated effects of simultaneous supply- and demand-side adaptation (Scott et al. 2012).

To better evaluate the relative climate vulnerability of the United States ski tourism regional markets, this study used an analogue approach to examine how ski area performance indicators were affected by anomalously warm winters. The record warm winter season that has occurred within the past 10 years across each of the five U.S. ski regions (Northeast, Southeast, Midwest, Pacific West, Rocky Mountains) represents the average climate conditions anticipated for 2040-69 under mid- to high-range emission scenarios. Ski area performance indicators were compared between the record warm winters and climatically normal winters (average for the 1981-2010 period) in each region to examine the supply (i.e., season length) and demand-side (skier visits) impacts of anomalously warm temperatures.

The results reveal that the Northeast, Southeast, and Midwest regions are the most vulnerable to future climate variability and change, even though they have the most extensive snowmaking capacity and are likely to experience the earliest and most acute impacts. For example, during the exceptionally warm season of 2011/12 in the central and eastern United States, skier visits declined 24% in the Southeast compared to those in the previous season, followed by the Northeast (21%) and the

Midwest (18%). The results also underscore differential vulnerability within each regional ski market, with smaller ski areas at greater risk to marginal seasons compared to the large ski area operations with greater capital and snowmaking capacity. For example, during the 2013/14 season, 100% of the nationwide small resorts (< 3 million skier visits) reported an unplanned midseason closure compared to just 24% of large resorts (>12 million skier visits). In all cases, at least some ski areas in each region appear able to operate profitably under record warm, climate change analogue conditions. Determining which destination communities are able to provide a reliable ski tourism product in the decades ahead will be important for tourism development and investment decision-making.

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AN INTEGRATED ASSESSMENT OF THE RESILIENCE OF ONTARIO (CANADA) SKI TOURISM TO CLIMATE VARIABILITY AND CHANGE

D. Scott, M. Rutty, M. Pons, R. Steiger, P. Johnson, E. Jover

The multi-billion dollar global ski industry is one of the tourism subsectors most directly impacted by climate variability and change. In the decades ahead, the scholarly literature consistently projects decreased reliability of natural snow cover, shortened and more variable ski seasons, as well as increased snowmaking requirements and, thereby, costs (e.g., Scott et al. 2003, Scott et al. 2006, Abegg et al. 2007, Hamilton et al. 2007, Scott et al. 2007, Hennessy et al. 2008, Scott et al. 2008, Dawson and Scott 2013, Steiger 2010, Hendrikx et al. 2013, Steiger and Stötter 2013, Pons et al. 2014). These studies also indicate a reduction in the number of operating ski areas, which would have implications for community tourism and economic development, including altered ski tourism revenues and seasonal employment, as well as declining real-estate values of vacation properties. However, this literature has major limitations, including a poor understanding of the demand-side (i.e., skiers) climate sensitivity and adaptive capacity. The overarching goal of this research is to develop an integrated systems model that is capable of assessing the simultaneous impact of climate change on skier responses to changes in ski conditions and the availability of ski areas.

In order to develop the coupled ski tourism supply and demand model for the Ontario market (which represents approximately 18% of Canada's ski market), the research utilized multiple methods, including an in-situ survey of over 2,400 skiers, daily operations data from ski resorts over the last 10 years, climate station data (1981-2013), an updated SkiSim model (building on Scott et al. 2003; Steiger 2010), and an agent-based model (building on Pons et al. 2014). Daily ski operations (supply) for all ski areas in southern Ontario were modeled with the updated SkiSim model, which utilized current differential snowmaking capacity of individual resorts, as evaluated by daily ski area operations data. Snowmaking capacities and decision rules were informed by interviews with ski area managers and daily operations data. Model outputs were validated with local climate station and ski operations data.

Demand response to varied ski conditions was modeled through a two-part process. First, a self-administered survey using iPads was distributed to skiers at 10 Ontario ski resorts in February and March 2014.The survey examined respondents' ski resort preferences (e.g., the importance of factors for deciding where to ski), behavioral responses to poor snow conditions (e.g., spatial, temporal, and activity substitutions if the ski resort was to be closed temporarily or permanently), as well as demographic and ski participation profile. These results provide new insights into skier participation constraints and thresholds of behavioral adaptation, answering key questions related to the role of individual actors in climate change adaptation and the potential for declining ski demand. These new insights were then used to develop the decision rules within an Agent Based Model (ABM) that simulates ski tourist responses to variable snow conditions and ski area closures.

The coupled SkiSim-ABM model was run with historical weather data for seasons representative of an anomalously cold winter and an average winter for the 1981-2010 period, as well as the record warm winter in the region (2011-12). The impact on total

skier visits and revenues, and the geographic distribution of skier visits were compared. Implications for crowding during anomalously warm winters when some ski areas were closed was an important finding.

The coupled model was then used to explore the potential implications of socio-economic and climatic change on this ski tourism market. Ski tourism industry projections for a low growth and stimulated growth scenario were used to compare the range of anticipated business conditions acting on the ski tourism industry in this region (i.e., population growth, ageing, new immigration from non-skiing countries, economic growth). These alternate ski demand scenarios were run against four types of winters (cold and average for 1981-2010, observed record warm winter of 2011-12, and a winter considered anonymously warm under projected climate change for mid-century). The implications of further climate adaptation (i.e., improving the snowmaking capacity of all ski areas to the level of leading resorts in the region) were also explored.

This novel integrated model reveals the spatial dynamics of climate-driven market shifts, which is essential for understanding differential community economic impacts (e.g., crowding and development pressures versus employment loss) and developing effective adaptation strategies for the Ontario regional ski tourism market.

Overall, this research advances system modelling within the tourism literature and improves our understanding of the risks and opportunities climate variability and change poses for the ski tourism industry in Ontario. This innovative integrated systems model approach can be exported to other major ski tourism markets (e.g., Canada, United States, Western and Eastern Europe, Australia, Japan) to facilitate global comparative assessments of ski tourism vulnerability to climate change, establishing the standard for ski tourism vulnerability assessments and advancing scholarly work on sustainable tourism and climate-compatible development in mountain communities.

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TOURISM, RECREATION AND CLIMATE CHANGE ADAPTATION

INCLUDING TOURISM ENTERPRISES TO FINANCE CLIMATE CHANGE ADAPTATION: EXPLORING THE POTENTIAL IN SMALL ISLAND DEVELOPING STATES

J. S. Hess

The Small Island Developing States are a group of low-lying coastal countries that are particularly susceptible to climate change and form under the framework of the Alliance of Small Island States (AOSIS), a negotiation block in international climate change conferences. The United Nations Framework Convention on Climate Change (UNFCCC) defines SIDS as "51 small island developing states that, in spite of their geographical and cultural diversity, share similar economic and sustainable development challenges including low availability of resources, a small but rapidly growing population, remoteness, susceptibility to natural disasters, excessive dependence on international trade and vulnerability to global developments." Many SIDS are highly dependent on their tourism industries, which generate a major share of their GDP, for example, 47.8% of the GDP in the Maldives or 72% in Anguilla. Alternatives to tourism are often limited as the countries face significant constrains on exports through market entry barriers, high transportation costs, and little political power in international trade negotiations, leaving the tourism industry as a key development option. However, tourism markets are particularly vulnerable to external shocks, such as perceptions of political unrest and violence, or natural disasters covered by media. Among other impacts, climate change is perceived to intensify and increase the frequency of extreme weather events and cause sea level rise, coastal flooding, and erosion in SIDS. Adaptation to and recovery from these impacts will put a significant financial burden on governments.

At the UN climate negotiations, developed nations pledged to mobilize $100 billion of climate finance per year from 2020 onwards in order to support developing countries in climate change mitigation and adaptation efforts. Particularly vulnerable countries such as SIDS, who were declared to receive prioritization in funding for adaptation, will receive these funds to support climate smart development processes and increase their social and economic resilience towards the impacts of climate change. The $100 billion is allegedly coming from both public and private sources. However, the private sector involvement remains particularly unclear and creates challenges, such as difficulty in tracking private climate investments. As a consequence, an increasing number of scholars and organizations are investigating the potential to involve the private sector in adaptation finance.

Considering the high dependency of the SIDS tourism sector on destination attributes such as an intact natural attractiveness or functioning infrastructure, it can be claimed that the sector has a vested interest to adapt to changes that might otherwise disrupt tourist flows. This generates the following question: in what way can the tourism industry in SIDS be involved to finance and participate in adaptation measures, consciously or otherwise. Furthermore, it is interesting to investigate how multinational tourism corporations operating in SIDS can be involved in adaptation finance, as their investments could theoretically be attributed to the $100 billion climate finance target. This paper addresses these two questions and explores a range

of policy and financial instruments such as adaptation taxes, Public-Private Partnerships (PPPs), risk transfer mechanisms, and local, national, and regional funds to financially involve the industry. The study is based on an extensive literature review and nine expert interviews.

Overall the explorative investigation has shown that there are a range of instruments and focal points to involve the tourism sector into adaptation finance in SIDS. Table 5 provides an overview of the findings. For each category, state driven, tourism driven, and mixed approaches, a number of instruments were identified.

Concerning the "state driven" instruments, the adaptation funds appeared to be the most promising instrument both regarding its overall feasibility and its potential to attribute the investments to the $100 billion target. Adaptation funds were widely acknowledged by the interviewees as a feasible and effective instrument to gather funds. In particular, the possible shared management by the public and private sectors appeared to present major advantages compared to taxes or levies. Disadvantages of taxes and levies could include that they create barriers for foreign investments in the tourism sector or lead to a decreasing number of tourists in the specific island state. Even if the interviewees indicated that taxes are an effective instrument to gather funds, it could be difficult to attribute the funds to international climate finance as money collected from MNTCs and local enterprises are hard to differentiate. Comparable barriers could be identified for attributing the funds invested because of building codes and regulations as interventions are difficult to differentiate. Despite the high potential of such codes and regulations to reduce vulnerability, tourism demands to stay close to the shoreline are likely to lead to implementation issues and neglect adaptation needs.

Two major "tourism driven" instruments were identified: water use management and risk transfer mechanism. Water use management was considered to be cost effective and thus likely to get accepted and implemented by the accommodation suppliers. However, the potential for attributing investments in water effective measures to international climate finance appeared to be very difficult as finance is hard to track and investments in water secure regions would not necessarily be considered to be adaptation. Payments of MNTCs in risk transfer mechanisms, on the other hand, could easily be tracked and insurance companies could transfer the data to UNFCCC bodies. Their feasibility can also be ranked as high, and they may enable firms to operate in risk prone destinations. Only slow-onset risks, such as sea level rise, might be too expensive to be covered by insurance schemes at a certain level of risk.

Of the three instruments categorized as "mixed approaches," PPPs seem to have the highest potential. It would be easy to attribute investments made by the industry if PPPs are set up with major donor organizations. Furthermore, PPPs also seem to be feasible as they are applicable in multiple forms, incentivize private sector action, and are compatible with development aid goals. The downsides identified are that trust issues and unclear goal settings could reduce the effectiveness of interventions of PPPs. DRM measures appeared to be cost effective, but it is expected that the funds raised from the industry may be limited as the industry representatives indicated that, from their perspective, the major share of the costs for DRM activities should be covered by governments. The ability to attribute DRM measures to adaptation finance is similarly tricky as tracking and categorizing interventions can be difficult. In contrast, funds in international adaptation finance schemes appear to be easy to track, and thus, attributing them to the $100 billion goal should be feasible. However, an adaptation finance scheme may be the most difficult instrument to realize because of its complexity in tracking vulnerability reductions and amount

of stakeholders involved. Furthermore, there are little incentives for the tourism industry to engage in such a scheme as they are currently unable to use adaptation actions for effective advertising. Therefore, only enforced participation appears to be feasible.

Despite these promising results of the investigation, involving the tourism industry for adaptation finance in SIDS will be a challenge. Varying incentive structures, the overall price sensitivity of the sector, and the flexible nature of tourism, are the main hindering factors of a successful involvement. Thus, governments will need to set up appropriate incentive and policy frameworks to encourage action.

Table 1: Overview of instruments to involve the tourism industry in adaptation finance and accountability to international adaptation finance[1]

Category	Instrument	Overall feasibility of instrument		Accountability to international adaptation finance[2]
State Driven	Building codes and regulations	+	Effective to reduce vulnerability	Difficult to track finance, as interventions can be hard to distinct.
		- - -	Enforcement of regulations difficult Can be expensive Tourists demand to stay close to the shoreline opposes adaptation needs	
	Adaptation taxes or levies	+	Effective to receive extra funding	Difficult to differentiate, incoming money from MNTCs and local tour operators.
		- - -	Trust and transparency issues Risk of creating barriers for investments by MNTCs Risk of decreasing demand	
	Adaptation funds	+ + + +	Effective to gather funding Widely acknowledge as a good instrument by interviewees Transparent Shared management of public and private sector possible	Payments by MNTCs could easily be tracked and clearly categorized as adaptation finance.
		- -	Involving all MNTCs Gathering sufficient funding	

1 The color system [red= complicated to use; orange= medium challenges; green=feasible] is not based on strict quantitative criteria, rather on qualitative findings derived from the interviews and insights the author gained during the research project.

2 This column indicates the feasibility to account the finance to the $100 billion climate finance target.

Table 1: Overview of instruments to involve the tourism industry in adaptation finance and accountability to international adaptation finance (continued)

Category	Instrument	Overall feasibility of instrument		Accountability to international adaptation finance[2]
Industry driven	Water use management	+	Cost effective	Difficult to track finance and attribute investments in water secure regions to adaptation.
		+	Easy to communicate benefits to industry	
		-	Little incentive when water is available for "free" for hotels	
	Risk transfer mechanisms	+	Allows operating in disaster prone areas	Insurance companies could gather data on finance and transfer them to UNFCCC bodies.
		+	Decreases investment risks	
		-	Might too expensive at a certain level of risk or slow-onset risks	
		-	Might prevent action to reduce vulnerability	
Mixed approach	Public private partnerships	+	Applicable in multiple forms	Finance by MNTCs easy to track, if PPP partner is a major donor organization.
		+	Incentivizes action by firms	
		+	Compatible with development aid goals	
		-	Trust issues and unclear goals of partners	
	Disaster risk management	+	Coordinated interventions could be cost-effective for firms	Difficult to track financial investments & attribute them to adaptation.
		-	Perception is that the government should cover costs for DRM activities	
	International adaptation finance scheme	+	Could include MNTCs into funding	Easily to track the financial flows contributed by MNTCs.
		-	Complicated to realize	
		-	Lack of incentives for private sector to engage	

CHALLENGES IN CLIMATE CHANGE ADAPTATION: THE CASE OF ALPINE WINTER TOURISM

B. Abegg & R. Steiger

Introduction

There is a fast growing body of scientific literature on climate change and tourism (Scott et al. 2012). A large proportion – about 40 % of the peer-reviewed articles (Weaver 2011) – is dedicated to ski tourism. While some scholars consider the knowledge on climate change and ski tourism as adequate (e.g. Hall 2008), others qualify this knowledge as still being very limited, particularly in terms of understanding its market implications and for informing appropriate adaptation strategies (e.g. Scott 2008). This is surprising given the fact that climate change is usually portrayed as a serious challenge – an issue that calls for an in-depth examination and immediate action. In the industry, however, climate change has received only scant consideration (e.g. Scott and McBoyle 2007), and Kaján and Saarinen (2013: 167) conclude that "while the need to adapt to climate change is imperative, this need is still not fully understood in the tourism sector."

There is, obviously, a perception gap between science and industry regarding the urgency of climate change. This gap will be explored using the example of alpine winter tourism. Possible reasons for the science-industry gap are explored, and suggestions are made for how to overcome this gap.

Reasons for the science-industry perception gap

Skepticism

"We are confronted with conflicting opinions. A few years ago they said we would have less snow. We had a lot of snow and they told us it was an exception. We had five exceptions in a row. They also said it would get warmer and then we had a freezing cold winter. That doesn't increase our confidence in studies. We can't estimate the long-term effects of climate change from the results we have received so far." (Austrian ski industry representative in Trawöger 2014: 344)

Skepticism among ski industry representatives is widespread. Attitudes range from doubts in the validity of available research to blatant denial of climate change. Many stakeholders refer to the various uncertainties related to climate change research. Some acknowledge climate change and expect global but not local impacts; others see impacts only as a result of natural climate variability and deny human-induced climate change. Some stakeholders also refer to the limitations of existing research on climate change and winter tourism. Earlier studies, for example, did not incorporate snowmaking. A major critique, however, is that the existing models are basically too coarse to capture the local realities of individual ski areas (Steiger 2010).

A distanced threat

"Alpine areas are one of the barometers of climate change ... we acknowledge that in the medium to long term, there will be potential impacts on the quantity of water available and snow cover. We think that on the large scale, there will be impacts, but on a microscale, on our little plots of land that is our little resorts, they may not necessarily have as great an impact as in the greater scheme of things." (Australian ski industry representative in Morrison & Pickering 2013: 7)

Timeframes of climate change scenarios and associated impacts on ski tourism are seen to be incompatible with conventional business planning. As a consequence, climate change is often regarded as an issue to be principally aware of (Roman et al. 2010) but has a (very) low management priority. Interestingly, climate variability (i.e. the unpredictability of natural snowfall) is seen as a current risk; climate change, however, is a distanced threat. Perceiving climate change as a distanced threat removes a personal sense of agency, leads to reactive behavior, and dismisses the urgency of climate change. In other words: anticipatory climate change adaptation is only seldom (if ever) part of mid- and long-term strategic planning (Bicknell and McManus 2006, Scott and McBoyle 2007, Trawöger 2014).

Faith in technology

"In fact we don't need snow, we make snow. Too much natural snow is bad for our business, because it means higher costs for slope grooming. Skiers only complain about natural snow pistes. They want smooth slopes that we can only provide with the help of machine-made snow. It sounds absurd, but the best scenario for us is less natural snow, low temperatures for snow production and lots of sun." (Austrian ski industry representative in Trawöger 2014: 345)

Faith in technology, particularly snowmaking, is a common theme in the literature. Snowmaking is the most important adaptation measure to deal with current climate variability, and many ski area operators believe that with constantly improving snowmaking techniques they are well-prepared for the challenges that lie ahead (Abegg et al. 2008, Wolfsegger et al. 2008, Trawöger 2014). Critical voices within the industry are seldom and more often to be found in other stakeholder groups (Morrison & Pickering 2013). Research suggests that the ski area operators' confidence in snowmaking might be overly optimistic as not only the technical possibilities must be taken into account but also potential barriers such as resource use, financial costs, and social acceptance (e.g. Pickering and Buckley 2010, Steiger and Abegg 2013).

It's not us, it's them

"It seems like their [Australia's] situation is way more marginal than ours, it seems like they are affected more so than us so that kind of works in our favour because, because it is so unpredictable over there and it is, even though I consider Queenstown to be inconsistent, it is a hell of a lot more consistent than Australia, so it definitely has benefits for us." (New Zealand ski industry representative in Hopkins et al. 2013: 453)

Individual perception usually goes beyond a single ski area and includes national and international competitors. While acknowledging some level of vulnerability, many ski area operators are quick to point out other ski areas that are thought to be much more vulnerable. The "it's not us, it's them" attitude refers to the concept of relative vulnerability. Relative vulnerability, however, is not only dependent on relative snow-reliability but also on the optimism of tourism representatives who already see themselves as potential "winners" of climate change. Such vulnerability could be perilous if it leads to complacency and/or inaction (Hopkins et al. 2013).

Calculated optimism

"If we acknowledged problems caused by climate change, we would be pegged as prophets of doom who foul our own nest. So, even if we already faced problems, I doubt that these would be discussed offensively for the time being." (Austrian ski industry representative in Trawöger 2014: 346)

The media seems to be the most important information source for ski tourism stakeholders (Abegg et al. 2008, Wolfsegger et al. 2008). There is, however, a wide gap between the risk perception of the ski industry and what is portrayed in the

media. The media has repeatedly pronounced the impending doom of the ski industry. Many of these reports are of limited quality. Some ski industry representatives perceive media coverage (and to a lesser extent science and policy reports, too) as a threat to their businesses, arguing that such coverage has the potential to negatively influence financial institutions (e.g. lower credit rating) and policy makers (e.g. less governmental support) and may also stop tourists from skiing (e.g. Scott et al. 2012). The tourism industry is very image-sensitive and, therefore, very cautious about even acknowledging concerns about climate change: "Rather than emphasizing their vulnerability to attract assistance, these businesses emphasize their resilience in order to maintain a perception of low credit risk" (Bicknell and McManus 2006: 394). This may explain why ski area operators display some sort of calculated optimism (Trawöger 2014).

Suggestions for bridging this gap

Temporal and spatial resolution of snow-reliability assessments

Many ski industry representatives call for more accurate assessments. Future studies could integrate ski area topography (e.g. full altitudinal range including aspect and slope) and combine snow-reliability modelling with resource use (i.e. water, energy, costs). Such assessments, however, are only possible with the ski area operators' help as a series of data (e.g. energy consumption) is required to conduct this modelling. Unfortunately, this kind of data is often treated as confidential and, therefore, not available for research.

Ski industry representatives also expressed a desire to have more short-term assessments. Modelling short-term impacts (i.e. the next 10-20 years) harbors the risk of downplaying the real risks of climate change, as the *average* warming will only be minor in this short timeframe. The nature of climate change, however, is that warm and snow scarce years will become more frequent, and cold and snow abundant years will become less frequent. This frequency chance has already started. A more practically oriented approach to deal with extremes (instead of focusing on 30-year averages) could be to conduct some kind of "stress-test" for the ski areas' ability to cope with extraordinary seasons.

Relative vulnerability

Ski areas differ in many respects, and so does their vulnerability to climate change. Future assessments have to be both more site- (see above) and context-specific. The concept of relative vulnerability (e.g. Hopkins et al. 2013) may help as long as it goes beyond snow-based comparisons. To facilitate comparisons between competing ski areas, it is suggested to combine the snow-reliability modelling with additional factors such as ski area size, accessibility, and market potential (Steiger and Abegg 2015). Furthermore, a series of external factors contribute to the future vulnerability of ski tourism, including demographic and social changes, economic trends, and technical innovations (Dawson and Scott 2013). Hopkins et al. (2013) are probably right in arguing that ski industry representatives may overlook important factors when they vocalize a sense of security due to enhanced snowmaking only.

Tourism system approach

Ski areas play a dominant role in alpine tourism. However, alpine winter tourism goes beyond skiing, and there are various stakeholders involved to produce the experience called winter tourism. Stakeholders other than ski area operators may have a different perception of climate change, and vulnerability may change whether one looks at the company, community, or destination level. Wyss et al. (2014), for example, use social network analysis to assess the structural strengths and weaknesses of Alpine tourism systems in the face of climate change.

Focusing on selected actors (e.g. ski area operators) may result in capitalist-orientated adaptation studies (Weaver 2011) highlighting adaptation measures to secure the future economic sustainability of affected businesses. Additional snowmaking can be highly profitable from a ski area's point of view. But it might be neither environmentally (e.g. resource use) nor socially sustainable (e.g. social acceptance). A more holistic approach in adaptation studies is therefore needed – an approach "that reflects the broader 'triple-bottom' idea of sustainability in tourism" (Kaján and Saarinen 2013: 169).

Trans-disciplinary research

In order to build up mutual trust and to avoid mistakes in the conceptualization of research that may occur due to scientists' limited knowledge of e.g. everyday business decisions, it is recommended to involve key stakeholders. Scientists and practitioners alike will benefit from a trans-disciplinary research approach (Strasser et al. 2014).

Nonetheless, there is a latent danger that practitioners are only seen and misused as data providers, or that scientists are exploited for lobbying and/or marketing purposes of the industry. This is a balancing act, but it is necessary that science goes beyond traditional knowledge generation if such complex and urgent challenges like climate change are meant to be successfully dealt with.

Communication

Climate change is a highly media-effective topic as much attention can be raised with spectacular stories (Scott et al. 2012). However, this is not necessarily in the interest of science. Bearing in mind that media reports may be more damaging to the destination's reputation than actual climate change, tourism stakeholders' concern about media coverage is understandable. Science, therefore, has to keep an eye on communication and play a more active role in disseminating research results.

More generally, impact research often identifies threats and challenges (Kaján and Saarinen 2013) but very rarely proposes solutions to effectively cope with climate change or arising opportunities for tourism stakeholders and destinations. A more positive approach towards adaptation investigating opportunities without neglecting the existing challenges could increase stakeholders' willingness to engage in projects and would also facilitate communication of results.

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RETURNS ON INVESTMENT IN SNOWMAKING FACILITIES: EVIDENCE FOR FRENCH SKI LIFT OPERATORS

M. Falk & L. Vanat

French ski lift companies have invested heavily in snowmaking facilities. Between 1993 and 2014, the 100 largest ski lift companies invested €1.4 billion (cumulated), 60 million per year on average (Montagne Leaders). Managers of ski lift companies argue that snowmaking is an important factor for the performance and survival of ski business operations. In particular, massive investment in snowmaking equipment has made the ski business largely independent of variations in natural snow fall.

This paper presents the first empirical evidence on the impact of investments in snowmaking based on the output of French ski lift companies. In particular, we investigate whether and to what extent investment in snowmaking facilities has reduced the dependence of winter tourism due to variations in snowfall and temperatures. The data is based on the annual survey conducted by Montagne Leaders, including information on skier visits and investment in both snowmaking and new ski lifts for the 100 largest French ski lift companies.

Studying the returns on investment in snowmaking for French ski lift companies is interesting for several reasons. First, the French ski business is one the largest ski markets in the world. Second, the French ski market has reached a point of stagnation or decline after a long period of increased demand and expansions (Vanat, 2014). Third, while there are several studies analyzing the relationship between winter tourism demand or skier visits and weather, the effectivess of investment has been largely overlooked.

Previous research has mainly focused on the relationship between winter tourism and weather conditions and climate variability (for Australia see Pickering, 2011, for Austria see Steiger, 2011 for France Falk, 2014; for Japan Fukushima et al., 2002; for Switzerland Gonseth, 2013; for the United States Hamilton et al., 2007, Shih et al., 2009, Dawson et al., 2009 and Holmgren & McCracken, 2014). Another strand of the literature has investigated the role of elevation of ski areas for growth of ski lift companies. These studies agree that low-lying ski areas have been considerably more affected by warm winter seasons than by high elevation ski areas (Bark, Colby and Dominguez 2010, Steiger, 2011; Hamilton et al. 2003). For instance, in the case of the New Hampshire ski industry Hamilton et al. (2003) find many low-elevation ski areas in the southern part of the state have been abandoned in favor of ski areas at higher elevations in the north.

Few studies have investigated the effectiveness of snow production. An exception is the study of Damm et al. (2014) who investigated the costs and benefits of snowmaking under future climate change scenarios for Austrian ski areas. The authors find that costs of snowmaking will increase considerably under future climate change scenarios with an acceleration of the price increase of ski lift tickets. At the same time skier visits will decrease because of reduced snow depth.

While studies agree that climate change will have negative consequences for low-elevation ski resorts (Agrawala 2007), it is likely that the negative impacts are different for small and large ski areas. Scott and McBoyle (2009) suggest that small ski

areas located at low elevations are most likely to experience the greatest impact from future climate change.

To the best of our knowledge, this is the first study investigating the relationship between output of ski lift companies, investment in snowmaking and new ski lifts, and initial size and elevation of ski areas. Knowledge of the main determinants of performance during snow-poor and mild winter seasons is relevant for policy makers, managers, and stakeholders for a number of reasons. Insights on the role of elevation and size are important for local government authorities because some ski lift companies are partially under public ownership or supported by public funds.

The empirical model relates growth of skier visits to the initial level of ski visits, investment in snowmaking and new ski lifts, elevation, and dummy variables for location:

$$[\log(SV_{i,t'})-\log(SV_{i,t})]/D = \alpha_0+\alpha_1\log(SV_{i,t})+\alpha_2\log E_{i,t}+$$

$$\alpha_3 INVSNOW_{i,t}+\alpha_4 INVNEWLIFT_{i,t}+\sum_{i=1} b_i X_i+\varepsilon_i$$

where i denotes the ski area and t denotes year and d=t'-t stands for the number of years for which output growth is measured. The dependent variable is an approximation of the average annual growth rate of skier visits compared to a benchmark period. It is calculated for the different estimation samples spanning the winter seasons 2003-2004 to 2013-2014. We use the average over three previous seasons (2003-04, 2004-05, 2005-06) and (2010-11, 2011-12, 2012-13) in order to get a benchmark of skier visits at the beginning of the period in winter seasons with average temperatures and snow conditions. The target winter seasons are 2006-07 and 2013-14, which can be classified as extraordinary warm and snow poor.

The explanatory variables are defined as follows:

E: elevation of the ski areas (maximum or average elevation),

SV: number of ski visits at the beginning the period,

INVSNOW: cumulated investment in snowmaking,

INSNEWLIFT: cumulated investment in new ski lifts.

X: control variables including dummy variables for the region (Pyrénées, Massiv central, Jura etc.)

The growth equation can be estimated by OLS and the robust regression method in order to account for the possible impact of influential observations. To account for neighborhood affects we also introduce the spatial lag of the growth of neighboring ski areas. The reason for this is the evolution of output to that of neighboring ski areas is not independent since they are often linked by lift or ski bus or are part of a larger ski alliance. We provide separate estimation results for small and large and for low and high lying ski areas. It can be expected that large ski areas have a better growth potential because of their greater market power. In contrast, small ski lift operators are under pressure because of low investments in snowmaking and new ski lifts.

OLS and robust regression models show that the cumulated investments in snowmaking have a significant and positive impact on change in skier visits between mild and normal winter seasons. This indicates that the larger the investment in snowmaking, the lower the decline in skier visits during mild winter seasons. However, the effect of past investment in snowmaking on skier visits is relatively small. Furthermore, we find that invest-

ment in snowmaking has not completely reduced the sensitivity of ski visits to the occurrence of mild winter seasons. Skier visits in the French Alps decreased by one percent on average in 2013/14 as compared to the three past seasons (measured as median). As expected, elevation of the ski areas is a critical factor in determining performance of ski lift companies in mild and snow poor winter seasons such as 2006-2007 and 2013-14. The higher the elevation of the ski, the lower the decline in the number of skier visits. This also holds true for ski areas that invested heavily in snowmaking facilities. Several policy conclusions can be drawn from the findings. One option is to close sections at lower elevations and expand development in higher elevations. However, the availability of high elevation terrain in the French Alps is limited.

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PREPARING TOURISM ACTIVITIES FOR CLIMATE CHANGE ADAPTATION IN QUEBEC, CANADA

S. Bleau, C. Larrivée & K. Germain

This paper presents an integrated collaborative approach to adaptation for Quebec's tourism sector. As provincial supply extends over the entire southern portion of the territory, opportunities and risks will arise from climate variability and conditions that are extreme in terms of magnitude, frequency, and intensity, particularly in major economic regions like the Eastern Townships and Laurentian regions. As a highly climate-dependent industry, tourism will be significantly affected by global warming (Becken and Hay 2012). One key way to reduce the impact on operating costs is adaptation (REDD 2011). However, knowledge of socio-economic implications induced by climate change (CC) on sensitive tourism activities at a local and regional level is still very scarce.

Indeed, the changing hydrological cycle and related physical and environmental effects (e.g., regional water and snow scarcity) trigger cascading repercussions on local businesses, destinations, and regions offering seasonal product (e.g., golf, alpine, and cross-country skiing, snowmobile trails, and parks). Recent circumstances call for new sustainable operational and management skills (McBean 2012; IPCC 2012; Ministère du Tourisme du Québec 2012 – PACC 2013–2020). Despite the fact that environmental impacts can affect the value and supply chain and natural assets (McBean 2012; NRTEE 2012; Gössling et al. 2012; Felmate et al. 2012; Vescovi et al. 2009; Scott and Jones 2006a, 2007), the tourism industry still does not fully grasp the need to adapt (Weaver 2011; see Bramwell and Lane 2008).

Knowledge of appropriate adaptation mechanisms for specific outdoor recreation and tourism sub-sectors is limited (Agrawala 2007; Scott and McBoyle 2007; Pelling 2011; Berrang-Ford L et al. 2011, Bleau et al, 2014) or else restricted to specific regions. Consequently, the best way to involve partners in adaptation strategies is to create a long lasting partnership between local and regional associations, universities, and different levels of the government, thereby combining tourism expertise with the latest climate science knowledge.

Ouranos – a consortium on regional climatology and adaptation to climate change – tourism stakeholders and academics in socio-anthropology, economy and tourism joined forces in an initial research effort, to develop a trans-disciplinary approach providing a framework to pin point adaptation responses relevant to important tourism regions. Participatory action research process (PAR) through social analysis tools and techniques (SAS2 : www.sas2.net) have now led to better comprehension of perceived changes and business realities, recognition of climate risks and identification of actions to manage CC related risk.

This process established an environment for dialogue, transparency, progressive learning, and awareness for spatial and temporal repercussions for sub-sectors and regions. Consequently, growing concerns relate to the need to plan adaptation solutions by combining them with other significant business challenges. Interests now focus on feasible adaptation responses to the current effects and projected climate, along with its interrelated socio-economic risks.

The aim was to outline a more personalized approach by encouraging business driven solutions,

in such a manner that it can be used as a model to other tourism regions in the province of Quebec. Furthermore, potential adaptation options have been proposed and regional management measures have been implemented. Today, more than 300 tourism stakeholders have been implicated in this process.

The outcome of this process calls into questioning the old economic development model and puts forward a new model that repositions the industry with a focus on combined economic growth and sustainability. The tourism sector also expects guidance in the adaptation process. Pilot regions and subsector leaders wish to use existing synergies and identified potential adaptation responses to make further progress. This buttom-up approach has led to drafting a climate and tourism research program to better prepare Quebec's tourism environment.

While Quebec's tourism sector is inherently dynamic and flexible, it also foresees the need to mobilize more regions and get the provincial government involved. In the future, Ouranos will play a key role in tourism research and development to ensure knowledge advancement and transfer to support seasonal activities in the adaptation process. By covering certain research gaps, this new research cycle (2015-2019) will focus on scenarios of climate change and projections, vulnerability and impact assessments for new regions, economic analysis and co-benefits of adaptation, communicating climate change, education, and capacity building through continuous collaborative work with the industry (Ouranos, 2014).

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CAN STAKEHOLDERS PERCEPTIONS DETERMINE DESTINATIONS VULNERABILITY TO CLIMATE CHANGE? THE CASE OF RIVIERA MAYA

R. Santos-Lacueva, S. A. Clavé & Ò. Saladié

Introduction

Despite the rise of the popularity of the vulnerability concept over the last decades in global change research, the task of evaluating vulnerability is still not easy. It is a wide concept that integrates several components and can be studied from many theoretical scopes that serve diverse purposes (Füssel and Klein 2006; Füssel 2007, 2010; Hinkel 2011; Huebner 2012; Thywissen 2006, among others). On the one hand, the inclusiveness of both independent human and natural systems and the possibility of bonding between different dimensions, as well as the potential to forecast impacts, make this concept quite attractive for framing research. On the other hand, aforementioned features complicate the methodological and research assignments structured within the idea of vulnerability (Polsky, Neff, & Yarnal, 2007).

The diversity of theoretical frameworks proposed by academics reveals huge differences between vulnerability assessments, for example, Calgaro, Lloyd, & Dominey-Howes (2013), Moreno & Becken (2009), Füssel, (2007), Polsky et al. (2007), and Schröter, Polsky, & Patt (2005). Such differences are appreciated by academic evaluations related specifically to coastal areas such as Cinner et al. (2012), Huebner (2012), Scott, Simpson, & Sim (2012), Bosom & Jiménez (2011), Moreno & Becken (2009), and Scheyvens & Momsen (2008).

Notwithstanding, some scholars have already reviewed the evolution of approaches from biophysical impact climate change linked to mitigation policies and risk hazards towards analysis focused on adaptation strategies from economic policies and resilience scope (Eakin & Luers, 2006; Füssel & Klein, 2006). Some challenges for vulnerability research are enhancing integrated methodologies able to couple socio-ecological system synergies, including perceptions of risk and governance studies, and increasing the participation of stakeholders and the focus on the local scale, both recognized as key factors for successful assessments (Füssel, 2007; Moreno & Becken, 2009; Schröter et al., 2005, among others).

In this context, the main goal of this paper is to analyze the importance of stakeholders' perceptions in determining destinations' vulnerability on a local scale and how these perceptions influence decision-making and, consequently, policies, plans, and strategies that affect destinations' adaptation and mitigation capacities.

To exemplify the aforementioned thinking, we have chosen the Riviera Maya for our case study: not only because it is one of the most famous coastal destinations in the world but also because of its valuable and fragile natural resources that attracted more than 4,400,000 tourists in 2014 (Riviera Maya Destination Marketing Office, 2015). Its sociopolitical peculiarities have also been taken into account.

Methodology

Firstly, an exhaustive bibliography and statistical review was carried out. Then, the research was conducted through sixteen interviews with key stakeholders from both the tourism and the environmental sector. Interviews were conducted in Riviera Maya from November 2014 to January

2015. Participants have been selected according to different criteria. First, participants were selected based on the stakeholders' role at the destination, his or her position, and affiliation. Table 1 shows the characteristics of participants according to these issues.

Table 1: Position and affiliation of selected participants

Position	Affiliation
Founder and Director	Sustainable Riviera Maya
General Director	Riviera Maya Destination Marketing Office
General Manager of Sustainable Hospitality Initiative of MARTI (Mesoamerican Reef Tourism Initiative)	Riviera Maya Hotels Partnership
Executive Director	Riviera Maya Hotels Partnership
Full-time Professor, Sustainable Tourism Department	Caribe University
Director	Amigos de Sian Ka'an
Sub-director of Climate Change Programme	Amigos de Sian Ka'an
Chief of the Environmental Risk Department	Impact and Environmental Risk Institute, Government of Quintana Roo State
Director of Tourism Planning and Development	Secretary of Tourism, Government of Quintana Roo State
Director of Climate Change and Environmental Management	Secretary of Ecology and Environment, Government of Quintana Roo State
Director	ZOFEMAT (Federal Maritime Land Area), PROFEPA (Federal Attorney for Environmental)
General Director of Economic Development and Attracting Investments	Government of Solidaridad Municipality
General Director of Tourism	Government of Solidaridad Municipality
General Director of Environmental and Urban Planning	Government of Solidaridad Municipality
Director of Tourism	Government of Tulum Municipality
General Director of Urban Development and Ecology	Government of Tulum Municipality

On the other hand, another four criteria were considered in order to reach proportionality as often as possible. Concretely, we have taken into account the policy area (tourism or environment), the administrative level (Quintana Roo State, Riviera Maya destination, Solidaridad Municipality, or Tulum Municipality), the stakeholder's profile (lobby or politic), and gender equality (female or male in each position).

It must be noted that representatives from Solidaridad Municipality double the number of representatives from Tulum. That two municipalities are involved is due to Riviera Maya's geography. The former enjoys much more relevance than the latter, for example, because of its extension, population, and accommodation capacity. Finally, the last criteria has not been adequately assessed as a result of gender inequality at certain positions. Table 2 summarizes proportionality achieved attending aforementioned features.

Interviews were designed by combining open and closed questions in order to make data analysis and comparisons easier between different cases. Questions were grouped in six blocks of information: climate change and tourism, adaptation, mitigation, obstacles to successful adaptation and mitigation, the role of stakeholders related to adaptation and mitigation, and decision-making coordination between tourism and environmental administrations.

Table 2: Proportionality of criteria to select the participants

Criteria	Category	Number of interviews/total	Total %
Policy area	Tourism	9/16	56.25%
	Environment	7/16	43.75%
Administrative Level	Quintana Roo State	6/16	37.5%
	Destination Riviera Maya	4/16	25%
	Solidaridad Municipality	4/16	25%
	Tulum Municipality	2/16	12.5%
Profile	Lobby	7/16	43.75%
	Politics	9/16	56.25%
Gender	Female	5/16	31.25%
	Male	11/16	68.75%

Table 3: Location of participants

Location	Number of interviews (% total)	Distance from Playa del Carmen
Playa del Carmen	8 (50%)	-
Tulum	3 (18.7%)	65 km
Cancun	2 (12.5%)	68 km
Chetumal	3 (18.7%)	313 km

All interviews were conducted in person at the location of the participant as is shown in Table 3, despite the fact that the research headquarters were set in Playa del Carmen, which is our main focus in Riviera Maya. The duration of interviews varied from one participant to another, but most took one to two hours on average.

Results

The main results of this research can be summarized as follows:

- Riviera Maya is a renowned sun, sand, and sea destination that attracted more than 4,400,000 tourists in 2014 (Riviera Maya Destination Marketing Office, 2015). Its valuable natural resources motivate demand from all over the world. Nevertheless, both physical and geographical characteristics intensify Riviera Maya's fragility and exposure to climate change. Hence, it is vital to improve knowledge and promote actions to combat this situation (SECTUR, ANIDE, CESTUR, & CONACYT, 2013a, 2013b; SEMARNAT & PNUMA, 2006).
- Riviera Maya has been recognized as a destination committed to promoting sustainability criteria in tourism planning. In fact, it had been recognized by the Global Sustainable Tourism Council in 2014 as one of the fourteen Early Adopter destinations in the world. Most of the implemented actions benefit adaptation and mitigation indirectly; however, there are just a few strategies designed expressly to deal with climate change or to mitigate the influence of tourism activity on it.
- Climate change can be attributed to several causes. It is accepted that stakeholders condition it because they determine decision-making and, consequently, policies, plans, and strategies concerning this issue. Concretely, what we reveal are perceptions, opinions, awareness, and the role of stakeholders in this destination in order to understand what is being done and why, as well as how this can be improved.
- The role of non-governmental actors in initiating and promoting significant strategies is noteworthy, which later, and only occasionally, has become institutionalized by public authorities. An example is the Planning, Design and Sustainable Construction in the Mexican Caribbean Guide (2011) encouraged by Amigos de Sian Ka'an and MARTI. This guide resulted in the creation of Mexican law nmx-aa-157-scfi-2012 concerning requirements and sustainability in order to develop new tourism urbanizations, including placement, design, building, management, and cessation of activity.
- There are greater implications for governmental actors in the environmental area than for actors in the tourism sector concerning climate change.

According to the administration level, the State's stakeholder role is predominant in comparison to the local administration. This can be attributed to a wider range of competences or a longer experience in the field. Even though the Riviera Maya Destination Marketing Office is not a governmental office, it is a key actor in promoting and initiating actions in favor of sustainability.

- On a five-point scale (0 being the minimum and 5 being the maximum), interviewed stakeholders perceived that climate change influences tourism in Riviera Maya at a level of 4.13. The most serious impacts of climate change would be extreme meteorological events, sea level rise, and reef bleaching. Additionally, most stakeholders consider that all of these impacts are already generating negative effects on tourism activity at the studied destination.

- The most negative impacts are the loss of beach quality, mostly as a result of sea level rise, and the rise of risk perception of tourists interested in traveling to Riviera Maya due to the increase of both intensity and frequency of extreme meteorological events.

- Nevertheless, aforementioned awareness does not always result in decisions or actions. It might be due to current obstacles to success in adaptation and mitigation. In fact, all participants, with the exception of one, perceived that there are a great number of handicaps to achieving effectiveness. There is a general agreement about difficulties regarding the scarcity of economic resources, the lack of awareness, and the poor coordination between public administrations, as well as between authorities and the private sector.

- When participants were asked about coordination between tourism and environmental administrations, more than 80% considered that both areas are coordinated in some aspects. However, more than 60% thought that this level of coordination does not work properly. In spite of this, environmental authorities watch out slightly more for tourism than the other way around.

Conclusions

Stakeholders' perceptions reveal key points for understanding power dynamics, leadership, priorities and difficulties, etc., that condition destinations' vulnerability to climate change. The better we know about what is being done and why, the better solutions and alternatives will be selected. Moreover, the proposed framework and methodology can be implemented in different coastal destinations, allowing comparison and enriching the results in order to deal with common difficulties and similar challenges.

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STAKEHOLDER VIEWPOINTS ON CLIMATE CHANGE AND SKI TOURISM DEVELOPMENT IN TURKEY

O. C. Demiroglu, C. Tulus & G. Cetin

Turkey is one of the most-visited countries in the world, having developed its tourism industry rapidly within the past 30 years. Such an achievement has been realized through state-to-sector led policies on utilizing the country's various tourism resources, such as sun-sea-sand and heritage (Goymen, 2000). However, these major products have concentrated tourism within certain regions of the country, limiting the chances of product diversification and revenue enhancement. In response to this, Turkey is on the verge of developing another major latent resource, the snowy mountains that cover around 140,000 km^2 of Anatolia and the 100 ski resorts therein that are anticipated to be worth 49 billion euros within the next decade (Demiroglu, 2014). However, physical science research (Ozturk et al., 2014; Demiroglu et al., 2015) does not have good news for the ski industry as scientific results predict that climate change due to warming led decreases in snow cover depth and duration and snowmaking capacity will result in industry losses. Therefore, this study seeks to explore climate change awareness and the responses of political actors, businesses, non-governmental organizations, and consumers through surveys and a focus group study, following a similar methodological sequence to that of Behringer et al. (2000) and capitalizing on related research on the supply side (Bicknell & McManus, 2006; Wolfsegger et al., 2008; Tervo, 2008; Helgenberger, 2011; Hoy et al., 2012; Morrison & Pickering, 2013) and the demand side (Unbehaun et al., 2008; Landauer et al., 2009; 2013; Pouta et al., 2009; Pickering et al., 2010; Dawson et al., 2011). Regarding the analysis on the supply side, a focus group meeting was held on May 22, 2015, involving representatives from various state institutions and the ski industry who nowadays heavily deal with the double nested development of snow sports and tourism. The consumer survey, on the other hand, has already been initiated through online and on-site contacts, currently reaching a total of 270 respondents. The preliminary findings reveal some interesting results. Snow conditions are the most important factor for travel decisions, with a score of 4.7 on a Likert Scale of 1 to 5, followed by leisure time and financial availability, each factor scoring 3.6. The minimum snow depth found as sufficient for snow sports is 74 cm, and only as low as a snow depth of 59 cm should equipment be rented. This result is much higher than the sufficiency threshold of 30 cm set by Witmer (1986) based on Eckel (1938), which is frequently referred to within the literature of ski tourism and climate change research (Demiroglu et al., 2014). Moreover, artificially made snow is not welcome by the respondents, scoring a satisfaction level of only 2.35 out of 5. These two findings could be the result of the fact that most of these respondents chose snowboarding as their favorite snow sport. Therefore, we have thought to distinguish the demand according to the snow sports type, other than just between alpine skiing and cross-country skiing. Climate change awareness among these respondents is quite high (4.3/5), with 71% acknowledging the common fact that the major cause of change is the anthropogenic greenhouse gas emissions (IPCC, 2013). 74% state that Turkish ski resorts are already negatively affected by climate change, and 15% believe that such effects will be felt within the next 15 years. Tendencies

for substitution behavior are primarily seen to be spatial shifts within Turkey away from the usual favorite ski resort and secondarily as temporal shifts in the time of visit to these usual favorite ski resort in Turkey or spatial shifts to resorts abroad. Focus group results, on the other hand, indicate a highly contrasting acknowledgement of and adaptation to climate change by the industry representatives, but a more positive comprehension and willingness for adaptation action by the policymakers, who, in cooperation with the scientific experts, should communicate their understanding and approach to climate change impacts and adaptation more with the industry, especially at the dawn of the aforementioned development and investment thrust.

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TOURISM, RECREATION AND CLIMATE CHANGE MITIGATION

CARBON LABELLING OF RESTAURANT MENUS AND ITS IMPACT ON CONSUMER DECISION-MAKING

V. Filimonau

Tourism is an important contributor to global climatic changes. The carbon intensity of the industry is expected to further grow given the anticipated rise in the number of international tourist arrivals in the near future. To facilitate progress of the tourism industry towards the goal of environmental sustainability, urgent measures are required to reduce its carbon impacts. While tourist transportation generates the largest share of the greenhouse gas (GHG) emissions from tourism, the importance of the carbon footprint produced by other sectors of the industry alongside its mitigation should not be overlooked.

Dining out is an essential element of tourism and an integral part of the tourist experience. While food production and consumption have a number of sustainability implications, including the GHG emissions, little is known about sustainable food management in the context of the tourism industry, particularly from the standpoint of carbon footprint generation, assessment, and mitigation in restaurants. There is evidence to suggest that consumers in this sector have started gradually changing their behavior towards more environmentally friendly food and drink choices. These include not only preference for local food but also the willingness to select foodstuffs with lower carbon impacts. To achieve market advantage and enhance competitiveness, restaurant management should strive to address these emerging trends in consumption.

The number of restaurants that have adapted business practices committed to reducing the carbon intensity of the food and drinks provided is growing. Carbon labelling of menus can serve as a tool to enhance consumer awareness of the carbon implications of food and drink consumption in the restaurant sector. The broader implementation of this tool is hampered by the limited knowledge of the impact it has on consumer decision-making. There is a need for better understanding of how restaurant visitors perceive information on the carbon intensity of foodstuffs and if they integrate it into decision-making concerning which food and drinks to consume.

This study aims to shed light on the role played by carbon labelling of foodstuffs in restaurants in consumer decision-making. It reports on the outcome of a quantitative study (n=300) conducted among visitors to a restaurant in Bournemouth, UK. The restaurant has labelled the items on its menu with carbon intensity indices and displayed them to consumers. The effect of the carbon intensity values as attributed to different menu options in food choices has been evaluated.

The study reveals that while most consumers pay attention to the values of the carbon intensity, they do not prioritize those over other factors affecting menu selection, such as price, taste, and familiarity. Despite this negative finding, the majority of visitors perceive carbon labelling of foodstuffs favorably; most importantly, it positively impacts their willingness to return. This demonstrates that while carbon labelling does not yet play a crucial role in affecting consumer behavior towards more sustainable choices with regard to food and drink selection, it has significant marketing potential and should therefore be more broadly adapted by restaurants. Further research into this topic targeting different restaurant types, consumer categories, and geographies is required.

HOTELS WITH GREEN BUILDING CERTIFICATIONS: CASE STUDIES FROM TURKEY

D. Erten

Global climate change has already had observable effects on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted, and trees are flowering sooner. Taken as a whole, the variety of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time (Ref1). The hotel industry should play a role in mitigating climate change by reducing carbon emissions. Hotels are high energy and water consumers within the building sector. One solution hotels can offer to combat climate change is to be eco-focused from design to operation.

In Turkey, eco-focused hotels have recently gained popularity among hotel developers. These hotels are among top-tier hospitality brands offering environmentally-mindful features and practices including green roofs, electric vehicle charging stations, and complimentary parking for electric and hybrid vehicles. The hotel buildings themselves incorporate many sustainable design and construction features, while the hotel teams include sustainability professionals to oversee environmental practices throughout the buildings.

Eco-focused hotels use internationally recognized green building certification systems with recognized measures of performance, which are set against established benchmarks, to evaluate a building's specification, design, construction, and use. The measures represent a broad range of categories and criteria from energy to ecology. They include aspects related to energy and water use, the internal environment (health and well-being), pollution, transport, materials, waste, ecology, and management processes. Two of the certifications used in hotels in Turkey are LEED and DGNB.

Leadership in Energy and Environmental Design (LEED) is a set of rating systems for the design, construction, operation, and maintenance of green buildings. Developed by the U.S. Green Building Council (USGBC), LEED is intended to help building owners and operators be environmentally responsible and use resources efficiently. Since 1993, it has been a popular system all around the world.

DGNB is the "German Sustainable Building Certification" established in 2007. The "German Sustainable Building Certification" is based on the three classic columns of sustainability: ecology, economy, and social aspects. In addition to these, two cross section categories were created for targeting aspects of the technique and of the process. The location is assessed in an extra grade.

In conclusion there now six topics: Ecological Quality, Economical Quality, Socio-cultural and Functional Quality, Technical Quality, Quality of the Process, and Quality of the Location.

In Turkey, Fairmont Hotel in Mecidiyeköy, İstanbul (pre-certified with DGNB Gold), Rixos Bademlik Hotel in Eskişehir (certified with LEED-GOLD), CARYA Hotel at Belek (certified with LEED-GOLD), and HILTON Güneşli in İstanbul (LEED-GOLD) are the four hotels the author wishes to present.

The environmentally-mindful features and practices that these hotels have generally adopted are as follows:

The hotel buildings use 25-35% less energy than a conventional hotel through the use of ultra-efficient materials and the latest construction technology. The hotels also work with green power suppliers to purchase 35% of the building's electricity use for its first two years of operation.

Guest room air quality is optimized by circulating large amounts of outside air into rooms and suites, and interior use of low-emitting volatile organic compound (VOC) paints, adhesives, and carpets consistently reduces indoor air contamination.

Water usage is reduced by at least 35% through the use of high-efficiency plumbing fixtures. Additionally, all irrigation for hotel plants utilize captured rainwater. 70-80% of the construction waste was recycled, diverting thousand of kilograms of debri from area landfills.

Constructing green hotels and certifying them with green building certification systems is one of the greatest strategies for combating climate change for the hotel industry. Certification helps building managers, investors, owners, and guests reduce the running costs and improve the environmental performance once hotels begin operation. Independent certification process provides a clear and credible route map to improving sustainability credentials of existing hotels.

This paper will analyze the showcases for hotel owners' efforts in advocating and adopting green practices for their buildings and highlight the strong business case and energy savings potential for green hotels.

EFFECTIVENESS OF THE UNFCCC'S PROGRAM OF ACTIVITIES IN SHAPING GREEN TOURISM: THE CASE OF BALI, INDONESIA

D. Krishnadianty

The tourism sector plays an important role in enhancing the economic growth of a country. In the year 2013, 9% of Indonesia's GDP was from travel and tourism. This is equal to 81 billion USD, ranking tourism as the fourth largest contributor to Indonesia's national GDP. Aside from that, 3,042,500 Indonesians were employed in this sector, which is equal to 2.70% of total employment.

Natural landscape and the country's originality are the main core of Indonesia's tourism sector. High dependency on natural resources has made Indonesia's tourism prone to the impacts of climate change (CC) such as disaster occurrence related to high intensity of rainfall, floods, landslides, the rising ocean water level, and scarcity of drinking water. However, tourism sector growth also has a significant impact on the environment and Indonesia's natural resources. The growth of the Indonesian tourism sector, 7.2%, surpassed the growth of the global tourism sector, 4.7%. Confident that this rate will continue to grow, the government of Indonesia (GoI) has set an ambitious target to increase national GDP from 9% (2013) to 15% in 2019, with an expected total foreign exchange of 240 trillion Indonesian rupiah, which would employ 13 million in the tourism sector alone. These massive targets and the future growth of this industry will deteriorate the environment in term of its energy demand, waste generation, and land use change for development of modern infrastructures. As a consequence, the production of greenhouse gas emission (GHG) will soar.

Currently Indonesia ranks 125th, the lowest amongst ASEAN member countries, in environmental sustainability. This shows the Indonesian government's lack of attention to the importance of preserving natural landscape and its supporting ecosystem. The ranking will definitely plummet if GoI does not develop proper mitigation and adaptation measures to overcome the environmental problems caused by tourism growth. The concept of green tourism is extremely important as a national mitigation measure.

Yayasan WWF Indonesia carries out the Tourism Energy Efficiency Investment Program (TEEIP). The program aims to formulate green economy actions through energy conservation and trust funds generated from energy savings and carbon offset. The objective of the program is to develop a comprehensive analysis in order to develop a mitigation framework for energy efficiency measures in hotels and/or resorts in the tourism industry and an assessment for the UNFCCC CDM Program of Activities (PoA) and Nationally Appropriate Mitigation Action (NAMAs). This paper will examine the significance of CDM PoA or NAMAs as a form of climate change mitigation in Indonesia. It will discuss potential carbon revenues and savings generated from energy efficiency measures conducted in objects of study.

The project used data collected from energy audits and desk study analysis. The project found that PoA under UNFCCC is inefficient and cost intensive compare to NAMAs. This is due to its high operational cost, which is incomparable to its low carbon revenues. The TEEIP-NAMAs is preferred because it is aligned with the Indonesian national GHG emission reduction target. In addition, TEEIP-NAMAs is considered to have a sustainable development potential benefit and will support green economy in tourism through higher demand in energy efficient products and services. The analysis of the findings will be used as material for a policy brief that will shape Indonesia's national policy in energy conservation and tourism.

A HOLISTIC APPROACH TO MODELLING ENERGY CONSUMPTION AND THE CARBON FOOTPRINT OF AN ALPINE TOURISM DESTINATION: THE CASE OF ALPBACH, AUSTRIA

R. Unger, B. Abegg, P. Stampfl

The presented study aims to develop the mountain municipality of Alpbach into a future "role model" for competitive and sustainable year-round alpine tourism, following the vision of an energy and resources-optimized tourism destination. The objective is to analyze–within a holistic system analysis–the destinations' energy demand and Greenhouse Gas (GHG) emission patterns and the potential of renewable energy sources in the region, as well as to initiate a process of developing an optimized and autonomous energy supply system.

Therefore, it is crucial to assess the status quo of energy consumption and GHG emissions within tourism destinations on different spatial and temporal scales for varying spatial entities, sectors, and administrative boundaries.

Within a system analytic approach, the alpine tourism destination is understood as the superordinate system encompassing three modules, which are referred to as subsystems, respectively: 1. "Alpbach Skiing & Recreational Area," 2. "Mobility & Transport," and 3. "Residential Area."

Subsystem "Alpbach Skiing & Recreational Area" involves all energy consumption and GHG emissions assignable to the ski resort, including all buildings, ski-lifts, the vehicle fleet (incl. snow groomers), and technical snow production. "Mobility & Transport" contains all transportation modes to and from the destination, intra-community transportation, commuting employees, local population transport, individual or public traffic, etc. In order to disaggregate between tourism and non-tourism induced emissions, secondary data sources have to be used to factor out the effects of tourism. Therefore, the local population and a sample group of visitors are questioned on their personal modes of transport to and within the destination. Within the subsystem "Residential Area" all buildings of the municipality, classified into building category, construction period, usage type, etc. are considered, hence, enabling a high-res analysis of the existing building stock.

Each individual subsystem is then assessed for energy sinks and potential areas for energy and resource efficiency, and the potential for renewable energy production. Therefore, a set of key indicators and indices for system description and comparison is being developed.

Based on the status quo assessment, possible future development scenarios are simulated:

1. A "pragmatic" scenario suggesting potential reductions on emissions and energy consumption by implementing "best practice" measures on energy saving and efficiency.
2. A "normative" scenario focusing on considerations concerning how the municipality of Alpbach could be transformed into a self-sufficient or even carbon-free alpine tourism destination.

The holistic approach of the study implies that not only a technical assessment of energy consump-

tion and GHG emission (scenarios) but also the integration of locals and visitors into the process of energy transformation, as well as resources, optimized tourism. Therefore, two surveys (winter and summer) of tourist attitudes and perceptions towards sustainability and application of renewable energy production in alpine tourism destinations are carried out. In addition to the surveys, a communication concept for stakeholder involvement and increased public awareness during the project run time is being developed.

The methodological approach of the analysis is based on a PostGIS database that was established for the subsystem "Residential Area." The prime source of data is the "Address, Buildings and Dwellings Register" by "Statistics Austria," which provides a detailed compilation and description of all buildings in Austria including information on construction epoch, use category (from family home to hotel), heating/energy system, building height, and xyz-coordinates. Based on further input data, similar to a climate model, a digital elevation model, or building layouts, energy demand (heat and electricity) and associated GHG emissions based on the calculation criteria defined by the Austrian energy performance certificate can be estimated (energy sinks of the module). Potential sources of renewable energies – e.g. a solar cadaster or multiple usages of water reservoirs – are assessed as well.

The PostGIS geodatabase is currently being built up to integrate, homogenize, and generate the required datasets. Software modules are developed to calculate GHG emissions and energy consumption. Due to the geo-database structure, system boundaries can be extended dynamically, and energy consumption and GHG emissions can be calculated for single entities like buildings, skilifts or snow groomers, the defined sub systems "Skiing & Recreational Area," "Mobility & Transport," and "Residential Area," or be aggregated to generate the "big picture" for the whole municipality of Alpbach. Visualization of results is done through the open source Geographic Information System "QGIS."

The focus of the presentation will be on methodological and technical issues, like database design and system boundaries. The preliminary results will be presented first.

CURRENT AND FUTURE GHG EMISSIONS OF TOURISM FROM BRAZILIANS

J. P. Ceron & G. Dubois

Abstract

This research aims to contribute to the assessment of greenhouse gas (GHG) emissions from tourism in emerging countries now and in the future. It stems from the dual idea that tourism currently contributes significantly to GHG emissions and in the future such emissions will grow while emerging countries continue to emit a much larger amount. This work examines GHG emissions in Brazil.

Current emissions

The first task is an assessment of the current emissions from the tourism sector of the Brazilian population, within the country and internationally. The assessment is based on statistics concerning flows (tourist numbers and distances: p.km) that are split according to means of transport and multiplied by the corresponding emission coefficients. An assessment of the emissions from accommodation was also done.

The evaluation of current emissions from tourism is dependent upon the metrics used: 32 or 34 million tons when considering CO_2 only or CO_2 equivalent, 55 million tons if an uplift factor taking into account the specific features of aviation (in terms of radiative forcing) is used.

The interpretation of such results strongly depends on the specificity of Brazilian emissions, i.e. the importance of the emissions linked to land use change and forestry (LUCF). In 2010, tourism represented about 3.2% of national emissions (1,034 million tons CO_2 equivalent), LUCF excluded. The corresponding world average is 4.9% percent. If an uplift factor for aviation is included, this share reaches 5%.

Future emissions

Next, the research deals with future emissions, using a more refined approach than a mere correlation with GDP. It stems from a detailed analysis of the main driving forces of Brazilian tourism. Nearly 10 variables are retained. Some of these variables, for example income distribution, reflect strong Brazilian specificities.

Reference scenario

A reference scenario is then built for two horizons: 2030 and 2050. It combines the most commonly retained hypotheses (or the central hypotheses) for the driving forces found in the literature, or those governmental and international institutions use, according to what is available and seems reasonable.

Sensitivity tests

Alternative hypotheses are then defined for the driving forces so as to explore more extreme outcomes. The results of these sensitivity tests show that the outcomes of some scenarios are almost as sensitive to the distribution of income as to the evolution of GDP. The modifications of the length of stay have a comparable impact on the two previous variables. Lastly the introduction of biofuels in aviation will have a very significant impact in 2050. The impact of the alternative hypotheses made on the other variables is less significant, notably regarding the evolution of modal shares or the introduction of biofuels in terrestrial modes of transport.

Alternative scenarios

Lastly, alternative scenarios are built by combining the overall set of variable hypotheses for change that do not contradict each other. The main goal

is to assess to what extent such combinations can reduce the emissions comparatively to the reference scenario.

Three scenarios reflecting three growth perspectives are built. At last we have built a worst-case scenario, which seeks to assess the maximum emissions that could be reached. It combines high growth with an inegalitarian distribution of income and the most unfavorable hypotheses for the other variables.

Compared to the national reference scenario, which reflects the international commitments of Brazil to 2030, the emissions of the reference scenario for tourism would represent 9.7% of emissions (roughly 15% including an uplift coefficient for aviation). The emissions of the medium growth scenario would represent 7% of national emissions.

No scenario for the national emissions of Brazil in 2050 is available. It is nevertheless clear that national emissions should continue diminishing to abide by the 2°C guardrail. With that in perspective, the emissions of the different scenarios for tourism in 2050 pose a serious problem: they lead to an increase of emissions by a factor ranging from 1.65 to 2.3 relative to 2030.

Whether in emerging or developed countries, the prospects of GHG emissions from tourism in the long term are troublesome.

PERCEPTIONS OF CLIMATE CHANGE ON THE TOURISM INDUSTRY: COMPARISONS OF BLUE FLAG VS. NON-BLUE FLAG HOTELS IN TURKEY

M. Pınar, İ. Birkan, M. Uysal & G. Karaatlı

There is substantial research that supports the concept that global climate change occurs as a result of all human activities. Regardless of its originating setting, every human activity leaves a footprint on the fragile ecosystem. In response to the recent climate change and environmental concerns, the Blue Flag program has been introduced to promote a clean and sustainable environment and create differentiation for its designated members. This type of labeling falls under the domain of eco-labeling in the field of tourism and hospitality. Since the tourism industry as a whole could be heavily impacted directly or indirectly, it is important to understand how managers perceive the potential impact of global warming and climate change on the hotel industry. Therefore, this study intends to examine the extent to which the perceptions of hotel managers would show variation depending on whether their property has a Blue Flag designation or not regarding the expected impact of global warming and climate change at the personal and industry levels, as well as their commitments to actions to combat and mitigate the effects of these changes.

The specific objectives are: 1) to examine the hotel managers' perceptions of global warming and climate change's impact on personal well-being and on the tourism industry, and the commitment to actions within the tourism industry intended to mitigate these potential impacts of global warming and climate change during the next 10 years, 2) to compare the perceptions of hotel managers from Blue Flag and non-Blue Flag hotels regarding the impact of global warming and climate, as well as their performances, and 3) to discuss the managerial implication of the findings.

To accomplish the study objectives, the survey included questions dealing with (a) the potential (negative) effects of global warming and climate change on the well-being of managers and tourism industry, and (b) commitment to actions within the tourism industry to combat these potential negative consequences of global warming and climate change. There are questions to measure a firm's relative overall performance, profitability and customer retention. All questions are measured on a five-point Likert scale, where 1=strongly disagree and 5-strongly agree. Finally, the survey included some demographic questions. The survey administered to managers of hotels with both Blue Flag and non-Blue flag hotels. After several follow ups, we received a total of 274 useable responses for analyses, where 139 have no Blue Flag and 135 have Blue Flag designations. These surveys are then used to accomplish each of our research objectives.

The general findings of the study reveal that although managers seem to express a great deal of concerns regardless of their property designation over climate change and its anticipated negative impacts on the hotel sector / tourism, the significant differences seem to be accentuated with respect to the statement of "if climate change will have a noticeably negative impact on my economic and financial situation" ($p=.001$). Managers with Blue Flag designated hotels express more negative concerns on this issue than their counterparts do. In terms of commitment to environment, again, Blue Flag designated hotel managers had higher

concerns with respect to the statements of "The firms/organizations that emit carbon dioxide to environment should pay tax in proportion to their emission of carbon dioxide" and "The buildings with environmental-friendly certificate could have a positive effect on the firms' image and marketing campaign." The differences were significant at the 0.00 probability level, signifying that hotel managers with Blue Flag designations are more environmentally sensitive to the perceived impacts of climate change on different domains of business. In terms of performance measure, Blue Flag designated hotel managers believe that this practice or designation would also allow them to be more profitable compared to their competitors who do not have Blue Flag designations. The difference was also statistically significant at the 0.01 probability level. It is suggested that as destinations are impacted gradually by global warming and climate change, managers of destinations and hotels could also remain proactive in their mitigation efforts and develop strategies that would lead to innovative and creative solutions around which they could also rally employees. This type of attitude supported by both managers and employees should be part of any vision and mission statements.

WHAT TO DO ABOUT CLIMATE CHANGE FOR SUSTAINABLE TOURISM: THE CASE OF TURKEY

A. Ö. Çalık & D. Türkoğlu

Introduction

Climate change is threatening the world and the integrated structures of its ecosystems. An increase in the adverse events that affect life and growth all over the world has become a geographical phenomena. The effects of climate change have precipitated an increase in forest fires, the melting of glaciers in Antarctica and Greenland, the rise of the sea level, the inundation of coastal tsunamis, tornados, floods, and droughts, as well as mass migration due to excessive heat and changes in vegetation and animal life effecting biodiversity. These adverse effects influence Turkey and its tourism sector. It is certainly of the upmost importance to ensure the sustainability of the tourism sector. Sustainable tourism refers to the activities that both allow for the long-term protection of natural, cultural, and social resources, and contribute to positive economic development. The tourism sector, the world's largest service sector, is dependent upon the number of annual visitors. Tourism is often affected by adverse events generated by climate change. Conversely, mistakes made in the tourism sector can also affect climate change. After being ranked sixth in the annual number of tourists per country in 2014, Turkey should take some precautions against climate change in the tourism sector while adapting changes to ensure successful sustainability. The purpose of this study is to discuss the causes of climate change, the current status of Turkey, and the possible influence of tourism on climate change. In this context, several precautions were issued to Turkey concerning climate change. A number of hotels' sustainability reports worldwide were analyzed as a case study, and recommendations were also given based on the results. We hope that the measures referred to in the study and its suggestions for the tourism sector will be used as an example for other developing countries.

Method

In this study, qualitative research methods of document analysis were used. According to the document analysis, hotels' sustainability reports were investigated, starting from a case study and their recommendations, and suggestions have been developed for how these hotels should respond to climate change. The information in the documents has been examined, and the broad scope will be applied to both the Turkish case and Turkish proposals on tourism. It has also benefited from access to a number of foreign sources. Our research focused on the concept of climate change, climate change around the world, and the tourism sector in Turkey, and is based on the current and potential impacts of climate change on the tourism sector. We followed a number of climate change-related events in both Turkey and the rest of the world, as well as examined protocols and treaties on climate change.

Selected Findings

Recommendations were made based on the results obtained from the reports of the hotels viewed in the case study. The main objective of this research is to raise awareness of the impacts of climate change. The measures taken shed light on possible actions that the tourism sector could take.

As of July 2015, there are 4,090 hotels in Turkey licensed by the Ministry of Culture and Tourism. The recently introduced Green Star eco-label is awarded upon evaluation of 122 criteria. In 2013, 22 hotels received the eco-label. By the end of 2015, the figure grew to 244. Such hotels are fond of their activites, reusing, recycling, and reducing resources as well as training their staff on these matters. Among the hotels examined for this study, energy and waste

managment systems, as well as endemic flora and fauna friendly design, were commonly observed. Moreover, usage of state of the art technologies, such as cogeneration systems that utilize renewable energy sources, was also noticed.

Conclusion and Recommendations

We must all believe in the effects of climate change, and we must take action against it. Climate change is real. Being aware of this fact is important for the future of humanity. In this regard, the common denominator for all countries is climate change. Meeting and discussing this issue is crucial. As in every area of social consciousness, the state must awaken support for this issue. Educational institutions, TV, and social media channels should provide information on the effects of climate change. Turkey must be made to accept and implement international protocols. Climate change is not just a problem for either developed or undeveloped countries, but it is a problem for all of humanity. Curbing climate change may require a decades-long effort. This may require many of us to give up our lifestyle; however, this renunciation can be seen as an insurance policy purchased for the future.

Tangible energy savings by individuals may be able to make a difference. These changes will affect people and the tourism sector accordingly. The number of tourists worldwide has increased in recent years, and therefore, being a responsible tourist is a big responsibility. Small behavior changes of tourists will have great implications for sustainable tourism. Choosing environmentally friendly transportation, eating natural and local foods, nature conservation, and efficiently using energy resources are essential steps to developing responsible tourism that avoids creating unnecessary waste. In addition, waste treatment plant tourism and renewable energy use have become widespread. Further, emissions of greenhouse gases like to stay away from high-tech armor that we hope will help to keep this sector intact in the future. For example, energy efficient freezers and refrigerators not only help to keep food colder and thus reduce food waste but also help to reduce gas emissions. Additionally, hotels should recycle their water supply.

In the Turkish case, the Aegean and Mediterranean coasts are important for tourism. These regions are known for their high amount of sunny days, and therefore it is necessary to benefit from solar energy installations here. Both the government and tourism investors should be aware of the low cost of such precautions. Such a long-term investment is important for sustainable tourism. In order to reduce the effect of climate change, here are some recommendations given for citizens who hope to see a positive change in their home:

- Recycle.
- Plant trees.
- Diversify forms of transportation: Instead of cars, use rail and mass transit. Buy a hybrid car. Walk or ride a bicycle. Raise fuel economy standards to require lower emissions from automobiles.
- Insulate homes and buildings to benefit more from solar energy.
- Explain climate change more at schools.
- Buy energy efficient appliances and lightbulbs. It may cost a lot to change current lightbulbs, but in the long-term it will achieve a significant profit.
- Civil society organizations should increase awareness raising campaigns for climate change.
- Reduce energy for heating and cooling.
- Switch to renewable sources of energy.
- Tourism should gather hotel owners, managers, tourists, and governments to support and fight climate change. Green hotels are important. Pay attention to hotels' energy and water usage, waste reduction, etc.
- Vote for leaders who pledge to solve the climate change crisis.

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Istanbul Policy Center
Bankalar Caddesi No: 2 Minerva Han 34420
Karaköy, İstanbul TURKEY
+90 212 292 49 39
+90 212 292 49 57
@ ipc@sabanciuniv.edu
w ipc.sabanciuniv.edu