

Weather, Climate and Tourism
A Literature Review

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Becken, S. (2005). Harmonising climatic change adaptation and mitigation: the case of tourist resorts in Fiji. *Global Environmental Change Part A*, 15, 381-393.

This paper analyzes climate change adaptation by tourist resorts in Fiji as well as the resorts' potential to mitigate climate change through reductions in carbon dioxide emissions. The data used for the study are collected from three sources: stakeholder and expert interviews, tourist operator interviews, and an accommodation survey. Stakeholder and expert interviews are informal and notes are taken. The results and background information obtained accompanied the accommodation survey and industry interviews. Private-sector interviews are conducted at the resorts and included site visits. Interviews are semi-structured and designed to enhance or confirm knowledge gained in the accommodation survey. The interviews covered the operators' attitudes towards climate change, adaptation, and mitigation measures currently in place. The questionnaire seeks information on energy consumption, climate change mitigation, adaptation measures, and environmental management. The survey is undertaken with the support of the Department of Energy and the Ministry of Tourism. The questionnaire is posted to all tourism accommodation providers in Suva, the Coral Coast, the Mamanuca Islands, and Nadi.

Becker, S. (1998). Beach comfort index: a new approach to evaluate the thermal conditions of beach holiday resort using a South Africa example. *GeoJournal*, 44 (4), 297-307.

Becker describes a beach comfort index for various coastal resort locations in South Africa with an attempt to integrate human thermal perception into decision-making. In the calculation of the thermal perception of a sedentary beach user, Becker uses an extensively researched human energy balance system which considers metabolic heat, clothing isolation, latent energy flux, sensible heat flux, body surface, and skin albedo, among other variables. A resultant equation with Predicted Mean Vote (PMV) is calculated to determine the amount of thermal stress the body endures. Threshold PMV values are then assigned describing ranges from "severe cold stress" to "severe heat stress." Using the PMV, Becker applies its concept to available atmospheric components to assess comfort in a resort area. The climatic variables used are air temperature, humidity, wind speed, direct sun radiation, diffuse radiation, and long wave atmospheric counter radiation. The calculation uses the PMV to determine a binary "beach hour" and "beach day" count. A beach hour is defined as "when the average person or less than 10% of all people lying in a swimsuit on the beach will not feel uncomfortable chilly [or hot] under the present climatic conditions." Subsequently, a beach day occurs "when at least four successive beach hours are found within one day." The paper ends with graphical and map displays of the number of beach days for each location.

Bigano, A. F., Bosello, R., Roson, & Tol, R. S. J. (2008). Economy-wide impacts of climate change: a joint analysis for sea level rise and tourism. *Mitigation and Adaptation Strategies for Global Change*, 13, 765-791.

This study follows a joint analysis of climate change impacts on tourism and sea level. Combining the two impact studies into a single, integrated analysis provides two main advantages: i) the possibility of highlighting the complex interactions between the two adjustment processes; and ii) the potential for considering a direct effect of sea level rise on tourism destination choices. The study focuses on the economic assessment of two specific climate change impacts: sea-level rise and changes in tourism flows. The main source of information for this study came from the Global Vulnerability Analysis (Hoozemans et al. 1993),

complemented with the estimates of Bijlsma et al. (1996), and the model of coastal protection of Fankhauser (1994). Combined as described in Tol (2002), these data specify, per country, the amount of land lost due to a sea level rise of 1 m. This study uses a CGE model to evaluate the economic implications of two specific consequences of climate change: sea level rise and change in tourism flows. In addition to the economic evaluation, this exercise aims first to highlight the economic adjustments triggered by the initial shocks, key in driving the final result and second, to disentangle the role of possible interactions originated by the coexistence of different impacts. In addition, different land intensities in production systems, different degrees of ability in substituting the land lost with other production factors and capital outflows driven by reduced rate of returns, re-rank countries in terms of experienced losses. The authors show a penalization of warmer countries and an advantage for regions at the higher latitudes like Western Europe or Japan and Korea where tourism demand increases by 1.3 and 8%, respectively.

Brommer, M. B., & Burgh, L. M. B. (2009). Sustainable coastal zone management: a concept for forecasting long-term and large-scale coastal evolution. *Journal of Coastal Research*, 25, 181-188.

The paper illustrates the importance of integrating scientific information in forecasting long-term coastal physical processes for sustainable coastal zone management. The authors illustrate how geologic information from the (sub) surface, combined with the quantification of sediment budgets helps in assessing the long-term trend of the coastal system. In order to prepare a long-term vision that incorporates the natural dynamics of the sediment dispersal system, the study's propose is to attempt to i) better understand sources and sinks in the sediment dispersal system on different spatial and temporal scales; ii) quantify within the coastal zone the actual need for sediments to determine the sediment budget of the sediment dispersal system; iii) link the sediment budget to (decadal) shoreline behavior. The paper links human impacts to natural coastal dynamics in time and space and uses temporal and spatial scales for illustrating and identifying the sediment dynamics for coastal evolution. In this regard, the paper combines the use of numerical models and stratigraphic information for estimating sediment budget for forecasting coastal development for the sustainable coastal zone management. The paper emphasizes the social and natural components of sustainable integrated coastal zone management.

Chan, W. W., Mak, L. M., Chen, Y. M., Wang, Y. H., Xie, H. R., Hou, G. Q., & Li, D. (2008). Energy saving and tourism sustainability: solar control window film in hotel rooms. *Journal of Sustainable Tourism*, 26, 563-574.

The objectives of this study are to calculate the amount of energy saved, estimate reduction in emissions, and to appraise the investment in the application of solar control film application for hotels. The paper investigates solar energy in the fast growing hotel sector. The study is conducted in a subtropical summer climate, monsoonal humidity, with cooler winters and plentiful precipitation. It uses two guest rooms with the same area. The results indicate that applying solar control film to the guestroom windows would be beneficial both financially and environmentally. The authors reveal that given the rapid tourism and hotel development, these findings have wide implications for energy saving and sustainable development in the region. They find that about 155 kWh could be saved per room annually. These savings in energy can also indirectly reduce some 920 g of SO₂ and 131 kg of CO₂ emissions per year. The study

concludes that solar control window film helps limit tourism's impact on global warming and climate change.

Coombes, E. G., Jones, A. P., & Southerland, W. L. (2008). The biodiversity implications of changes in coastal tourism due to climate change. *Environmental Conservations*, 35, 319-330.

This paper highlights the biodiversity implications on tourism due to climate change. The climate change impacts on tourism will heighten due to deterioration of coastal vegetation and disturbance of nested birds. This study finds that overall levels of vegetation and diversity are likely to decline; although only by a small amount, if future visitor numbers increase due to warmer and drier weather conditions. The study is conducted in three stages in order to evaluate the biodiversity implications of changes in visitor use due to climate change. First, it assesses levels of visitor use across the different habitats at Holkham and Cley. Second, the authors review literature to determine the impacts that visitors have on biodiversity for different intensities of use. Finally, the study combines visitor impacts with information regarding the levels of use that habitats receive to assess visitors' current and future impacts on biodiversity. The paper anticipates that the lower levels of trampling observed in saltmarsh protect it from the reduction in biodiversity seen in dunes. It is revealed that greater visitor numbers are likely to increase levels of noise which further disturb shorebirds even if visitors do not directly pass through areas where plover are present.

Daniel, S., Dawson, J., & Jones, B. (2008). Climate change vulnerability of the US Northeast winter recreation – tourism sector. *Mitigation and Adaptation Strategies for Global Change*, 13, 577–596.

The objective of this study is to provide a broad perspective on the potential vulnerability of the Northeast winter recreation and tourism sector to climate change by examining whether a reliable snow-based recreation product remain viable under a range of climate change scenarios. It examines the vulnerability of the two largest winter recreation industries, snowmobiling and alpine skiing, with four climate change scenarios in the twenty-first century. The majority of the 15 locations examined in this study are projected to have marginal or non-existent snowmobile seasons in 2040–2069 under both lower and higher emission scenarios. Consequently, the loss of snowmobiling activity and related tourism would appear unavoidable in the following locations if the climate change scenarios projected for 2040–2069 were realized: western New York, north-central Pennsylvania, southeastern New York, south-central Pennsylvania, eastern Pennsylvania, western Massachusetts, southern New Hampshire, and northeastern New York. The findings of this study suggest that the adaptive capacity offered by advanced snowmaking substantially reduces the climate change risk of the Northeast ski industry. Through to 2040–2069, only seven of the study areas examined (Connecticut, western New York, southeastern New York, western Pennsylvania, southeastern Maine, eastern Pennsylvania, and eastern Massachusetts) were projected to have average ski seasons shorter than 100 days and have a lower than 75% probability of being open for the entire Christmas–New Year's holiday period, and thus be considered at risk economically. Even under the higher emission scenario for the 2070–2099, four study areas (southern Vermont, northeastern New Hampshire, northeastern New York, and western Maine) did not reach these two economic risk criteria, albeit with large increases in snowmaking requirements and the need to withstand occasional seasons as short as 75 days under new extreme conditions. The study focuses only on the supply-side impacts of

climate change and the implications for winter recreation. Demand remains an important area for future research if the economic implications of climate change for this important economic sector are to be fully understood.

De Freitas, C. R. (2003). Tourism climatology: evaluating environmental information for decision making and business planning in the recreation and tourism sector. *International Journal of Biometeorology*, 48, 45-54.

This paper reviews the current state of knowledge on tourism climatology and explores areas and priorities for future work. It proposes that a fundamental “driver” of tourism climatology is the identification and evaluation of environmental information for business planning and decision-making in the recreation and tourism industry. The paper integrates all facets of climate, uses standard data, and is objectively tested and verified in order to develop a better understanding of what climate-related information is required by both tourists and the tourism industry. This paper explores the distinction between the impact of climate on tourists and the tourism industry, setting a standard approach to tourism climate assessment. This paper also focuses on assessing the role of weather forecasts and long-term expectations of climate on choices made by tourists, the risks to tourism caused by extreme atmospheric events, what climate-related criteria people use to make decisions about tourism and recreational choices, how products giving information about weather and climate are currently used by the recreation and tourism industry and what are the existing and future requirements for this climate information. The paper uses two methods for assembling data on human response to climate and thus the demand for the climate resource: assessing conditional behavior by using questionnaires and images to determine how people react or think, and examining on-site behavioral changes.

De Freitas, C. R., Scott, D., & McBoyle, G. (2008). A second generation climate index for tourism: specification and verification. *International Journal of Biometeorology*, 52, 399-407.

De Freitas et al. conduct a survey assessment of climate tourism indices and suggest improvements. They state the utility of a climate index and how it applies to various industries and stakeholders; these include tourists, tourism businesses, event planners, and insurance companies. The idea behind a climate index is to better convey information to decision makers about how to structure vacation plans, business marketing designs, and insurance policies to combat short and long term monetary loss. The authors identify Mieczkowski’s TCI as “one of the most comprehensive schemes proposed so far” but are critical that it is an “expert based” index reliant on subjective opinions rather than field-tested tourist preferences. It is noted that other indices, which put a complete reliance on thermal factors, fail to accurately capture a complete tourism climatology and are not very useful. Proposed as a solution is the second generation climate index for tourism (CIT) which is i) Theoretically sound, ii) Integrates the effects of all facets of climate, iii) Simple to calculate, iv) Easy to understand, v) Recognizes effects of certain weather conditions, vi) Empirically tested. The CIT formula uses thermal (body-temperature energy balance), aesthetic (sky cover), and physical (a binary control factor for extreme events) elements while devising threshold values based upon user surveys. The results conclude that optimal conditions for “sun sea & sand” tourism were “slightly warm” with clear skies or scattered cloud.

Erdmann, G. (1997). The impact of tourism on coastal areas. *GeoJournal*, 42, 39-54.

This paper attempts to analyze the influences of tourism on coastal areas from three perspectives: i) the development of seaside tourism including the changes of socioeconomic and settlement patterns; ii) its cultural impact on the local population; iii) its environmental aspects. The paper discusses the influence of tourism on coastal society with the help of a model showing four peripheries in space and time: i) the North Sea and Baltic coasts since the 18th century; ii) Southern Europe during the 19th century; iii) the North African shores around 1950; iv) the tropical oceans after 1965. The paper concludes by stating that large scale tourism in coastal areas of developed and developing countries has positive and negative effects on the regional and national economies, local culture, physical infrastructure and environment. Whether the negative impacts of “western” societies are greater than those of the local ones remains to be analyzed as the study suggested. The paper recommends that it is essential for government not only to issue the relevant laws but also install the mechanisms for effective control and monitoring of the activities of investors, tour operators, and other private and official actors at all levels. If all the participants cooperate efficiently under the common understanding of an ecologically sustainable development then tourism may provide positive contributions to the future of coastal areas.

Gossling, S. (2003). Market integration and ecosystem degradation: Is sustainable tourism development in rural Communities a contradiction in terms? *Environment, Development and Sustainability*, 5, 383-400.

This paper applies a neoclassic economic theory to sustainable tourism development. The article describes tourism development in the village of Kiwengwa on the east coast of Unguja Island (Zanzibar), Tanzania. Kiwengwa is the study area, with 555 inhabitants living in 165 houses and huts. It is shown that changes caused by tourism are far more complex than economic theory suggests. The socio-economic situation of the village is investigated using a written questionnaire, which is provided systematically to local residents with the household as the unit of analysis. The in-depth study of the changes induced by tourism in Zanzibar reveals that turning to a market economy jeopardizes the overall integrity of the ecological and socio-economic system, which is complex beyond the simplistic understanding of economic theory. The main changes in Kiwengwa caused by tourism can be summarized as, i) tourism has given rise to individualism and focuses on personal economic benefit; ii) tourism has encouraged the abandonment of traditional resource-use systems; iii) tourism has contributed to turn local natural resources into commodities; iv) tourism has spread the idea that resources can be replaced by imports; v) tourism has both directly and indirectly imparted a negative effect on the local ecosystems; vi) tourism has turned the village into an emerging center of resource allocation on an industrial basis.

Gossling, S., Peeters, P., Ceron, J. P., Dubois, G., Patterson, T., & Richardson, R. B. (2005). The eco-efficiency of tourism. *Ecological Economics*, 54, 417-434.

This paper shows that tourism is not necessarily environmentally more beneficial than other economic activities. The paper uses case studies and indicates that eco-efficiency depends on the source and destination of the vacation, tourists’ culture, and the environments chosen for vacation. For the purpose of this article, environmental damage per unit of value generation has been chosen as the basis for calculations. It mentions that short travel distances are a precondition for sustainability and their analysis reveals that distance and mode of transport are the most important factors influencing eco-efficiency in tourism. Overall, the paper concludes that the eco-efficiency concept can be used to analyze the combined environmental and

economic performance of tourism. The concept can help to assess the relative importance of different tourism sectors in terms of environmental impacts and financial value generation. These results provide insights of how to improve its environmental performance in the economically most feasible way. The eco-efficiency concept has also proved to be applicable on very different levels, including day-visits, journeys, and destinations. It may be used to evaluate the eco-efficiency of destinations/markets, to identify problematic aspects of a journey (transport, accommodation, or activities), and to reveal differences between different forms of tourism (e.g., adventure-, nature-, eco-, cultural-, beach tourism) or tourist types (e.g. elderly rich, young adventurers, etc.).

Hamilton, J.M., & Tol, R. S. J. (2007). The impact of climate change on tourism in Germany, the UK and Ireland: a simulation study. *Regional Environmental Change*, 7, 161-172.

This study is a first step towards reconciling the local and global aspects of the impacts of climate change on tourism. The authors use an econometric simulation model of domestic tourism and of international tourist flows between 207 countries. For the analysis, they combined this model with the sub-national data-sets of domestic and international tourism and develop a downscaling method that is consistent with the assumptions in the country model. First, they apply this to Germany, the UK and Ireland; these are countries for which the authors have good data and with which they are familiar. The model shows that climate change in countries at higher latitudes and altitudes will become more attractive to tourists, both domestic tourists and those from abroad. Tourists from the northwest of Europe currently dominate international tourism—the Germans, the Irish and the British together account for 25% of the international tourist market—which implies that the world total of international tourist numbers would initially fall because of climate change. The model also shows that the effect of climate change is much smaller than the combined effects of population and economic growth, for most countries.

Jim, C. Y. (2000). Environmental changes associated with mass urban tourism and nature tourism development in Hong Kong. *The Environmentalist*, 20, 233-247.

This paper endeavors to evaluate the environmental impacts of tourism in Hong Kong. Conservation of the environment by spatial concentration, the mode of urbanization in Hong Kong, has inadvertently incorporated the tourism sector. The environmental problems of urbanization and industrialization have overshadowed the modest contributions of the relatively clean industry. The data of the study come from the Census and Statistics Department of Hong Kong. Recent trends in tourist activities show a small number taking up countryside excursions to supplement their urban experience. Heightened environmental awareness in the source countries may account for the increasing interest in the more nature- and ecologically-oriented tourism. The study suggests that the dedicated facilities to complement the use of the countryside for tourism could also be implemented, such as golf courses, theme parks, urban-fringe parks, and water-based recreation including more bathing beaches and marinas. With increasing overseas patronage, the existing conservation program could be given additional justifications, incentives and impetus, with the economic benefits ploughed back for countryside management.

Jones, B., & Scott, D. (2006). Climate change, seasonality and visitation to Canada's National Parks. *Journal of Park and Recreation Administration*, 24, 42-63.

This paper examines the relationship between climate and visitation in order to understand the potential impact of climate change on the volume of visits and seasonal pattern of tourism in Canada's national parks. The study uses visitation data obtained from Parks Canada, the federal agency responsible for managing the country's national parks. The data consists of the total number of visitors entering each of Canada's national parks per month between January 1996 and December 2003. Multivariate regression analysis using four climate variables and monthly visitation data for 1996 to 2003 is used to develop a monthly climate-visitation model for 15 high-visitation parks. Each park-specific model is run with two climate change scenarios to assess potential changes in park visitation under a range of climatic conditions projected for the 2020s, 2050s and 2080s. Results indicate that Canada's national parks could experience an increase in visitors under climate change due to a lengthened and improved warm-weather tourism season. In the 2020s, overall visitation levels were projected to increase 6% to 8%, with a number of parks projected to experience larger increases (+12% to 30%). The largest increase in visitation occurs during the spring and fall months. Visitation is projected to increase between 9% and 29% system-wide in the 2050s and between 10% and 41% in the 2080s.

Katz, R., & Brown, B. (1992). Extreme events in a changing climate: variability is more important than averages. *Climatic Change*, 21, 289-302.

Katz and Brown begin with a critique of several global climate models (GCMs) stating that they have simulated potential changes in average climate. They contend that it is the extremes and variability of weather and climate that a society most notices and is most impacted. Through a theoretical variable-based statistical analysis of climate change models they state that the results indicate that "(i) extreme events are relatively more sensitive to the variability of climate than to its average; and (ii) this sensitivity is relatively greater the more extreme the event." The paper goes on to cite environmental examples to emphasize the relative impact of climate variability and extreme events over average changes. The paper concludes that climate change scenarios that rely on assertions of only mean value changes and do not consider climate variability are "suspect."

Koetse, M., & Rietveld, P. (2009). The impact of climate change and weather on transport: An overview of empirical findings. *Transportation Research*, 14, 205-221.

This paper presents survey findings on the effects of climate change and weather conditions on the transport sector. It also reveals that global scale increase in temperature may influence patterns in tourism and skiing holidays with the associated changes in passenger transport. The paper also investigates that temperature increase affects touristic attractiveness. Climate change-related shifts in the weather patterns might also affect infrastructure disruptions. The paper reviews the traffic safety and congestion and it is revealed that precipitation increases accident frequency but decreases accident severity. Also precipitation reduces traffic speed and the effect is particularly large during peak hours and on congested roads. Furthermore, an increased frequency of low water levels may increase costs of inland waterway transport considerably. The study also finds that given the nature of transport as a derived demand, trade flow patterns will be affected by climate change in the long run when climate change affects location patterns of production and consumption.

Lin, T. P., & Matzarakis, A. (2008). Tourism climate and thermal comfort in Sun Moon Lake, Taiwan. *International Journal of Biometeorology*, 52, 281-290.

The purpose of this paper is to analyze tourism climate by using a modified thermal comfort range in Sun Moon Lake, one of Taiwan's most popular tourist destinations. The analysis of tourism climatology is based on climate indices. In order to calculate the thermal comfort range of tourists', results from a field study based on 1,644 interviews in the outdoor environment are used. In the survey, basic information on the person's activity level and clothing were obtained. Secondly, objective measurements of ambient air temperature, globe temperature (measured by standard globe), air humidity, air velocity and global radiation are carried out, which are then used together with the activity and clothing level, to calculate the physiologically equivalent temperature. Also, the interviewees are asked to subjectively evaluate thermal sensation, thermal preference, and thermal acceptability. The study compares two thermal scales and finds that the neutral temperature scale of Taiwan is higher than that of Western/Middle European. Furthermore, the physiologically equivalent temperature range of Taiwan is larger than that of Western/Middle European for each thermal sensation scale. The results of the study also suggest that tourists consider the impact of strong solar radiation on their thermal comfort.

Lise, W., & Tol, R. S. J. (2002). Impact of climate on tourist demand. *Climatic Change*, 55, 429-449.

This paper investigates the sensitivity of tourist demand for vacation destinations with respect to climate in order to draw conclusions for the possible impact of climate change in the long term. First, a general picture is obtained of the link between tourist demand and temperature. Next, this general picture is further clarified with a case study of Dutch tourists to study the link between the demand for tourist activities during holiday trips and temperature. Finally, adaptation of tourist suppliers is briefly discussed. The analysis of this paper is based on data sets of two levels. On the macro level, time-series on tourist numbers, destinations, and expenditures at the aggregate national level, are readily available from sources such as the Organization for Economic Cooperation and Development, World Development Indicators, and national statistical services. Climate data are obtained from various sources, including Cramer and Leemans', and Schlesinger and Williams' global climate data, as well as data from tourist guides. The analysis of this paper leads to the conclusion that climate is an important consideration for tourists' choice of destination. This paper finds that climate matters in a regular way that can be quantified. The authors find that an average temperature of about 21°C is ideal for the large bulk of international tourists. The factor and regression analysis showed that different dominant holiday activities imply different preferences for holiday climates. This study suggests that people's preferred vacation activities are largely independent of climate and people purchase a climate that suits their holiday plans. A gradual warming would thus induce tourists to seek different holiday destinations or travel at different times during the year. Climate change is therefore likely to lead to drastic changes in tourist behavior.

Maddison, D. (2001). In search of warmer climates? The impacts of climate change on flows of British tourist. *Climate Change*, 49, 193-208.

The main objective of this paper is to suggest an approach to measure the welfare-impact of changes in the climate of holiday destinations on tourists, and to predict changes in the number of trips to particular holiday destinations caused by climate change. A theoretical model is used

for this purpose. The model reveals how well-informed individuals allocate their time and money between visiting different holiday destinations and the consumption of other goods; in order to measure the welfare impact of changes in climate the author invokes the concept of “weak complementarity.” Weak complementarity describes a situation in which it is possible to hypothesize the price of a particular commodity being so high or so low that marginal changes in the level of a non-marketed environmental amenity cease to matter. This paper investigates the impact of climate change on the chosen destinations of British tourists. Destinations are characterized in terms of “attractors” including climate variables, travel, and accommodation costs. These variables are used to explain the current observed pattern of overseas travel in terms of a model based upon the idea of utility maximization. The dependent variable quarterly data on international travel (i.e., the number of return trips) by British residents is taken from the International Passenger Survey (IPS) for 1994. The data set also contains the average return fare (by air or by sea) paid per person to each destination, average spending on items other than fares, and the average duration of the stay.

Martin, M. B. G. (2005). Weather, climate and Tourism a geographical perspective. *Annals of Tourism Research*, 32, 571-591.

This article highlights the close relationship between climate, weather and tourism, and shows the need to understand the nature of these relationships in order to show how tourism planning might be more effective. Further, the article asserts that tourism planning should incorporate more than simple, general descriptions of the climate, which are often unconnected to the needs of tourism. The author suggests that various agents playing roles in tourism must be made aware of the need to incorporate aspects of climate and weather into the design and development of their various projects. The author explains nine factors on the implication of weather, climate and tourism for tourism planning. Specifically, the paper considers the influence that climate and weather exert on the geographical space, demand, supply, and market agents of the tourism system. The paper also emphasizes the need to improve the networks of meteorological observatories and better access to the information.

Matzarakis, A. (2006). Weather and climate related information for tourism. *Tourism and Hospitality Planning & Development*, 3, 99-115.

The aim of this paper is twofold, i) to describe in a useful and understandable way how weather and climate can affect the making of decisions about a vacation area and how to access existing information; ii) to show what kind of weather/climate information exists and which information is relevant for tourists and the tourism industry. The methodologies used for the paper are applied climatology and biometeorology to address the issues in climate and tourism. The sources of meteorological and climatological data include national weather services, private weather services, environmental agencies and governmental authorities running their own measurement networks. Also some of the data came from tourism guidebooks and the Internet. The paper suggests that climate information needs to be quantified and should be provided to the tourism planning and tourism industry using mean values, extremes, frequencies and probabilities. The paper also emphasizes that climate information is important from the human-biometeorology point of view especially the thermal component of climate index for tourism. The paper cautions that emission scenarios in tourism destinations will suffer from bioclimatic change conditions and this will have a significant impact on local economies in the near future.

Meze-Hausken, E. (2007). Seasons in the sun—weather and climate front-page news stories in Europe’s rainiest city—Bergen, Norway. *International Journal of Biometeorology*, 52, 17-31.

This paper explores aspects of weather and climate dealt with in print media over a period of 10 years. Two research issues are discussed in the paper. The first one investigates the diversity of contexts in which weather and climate information is taken up in a newspaper’s front-page story. This serves as a background for the second issue which tries to uncover the cliché of “good” and “bad” weather by comparing weather descriptions in the news with factual meteorological data. The paper hypothesizes that defining a day as “good” is a matter of supply and demand, suggesting that during seasons with generally much rainfall and darkness, even a day with relatively little sunshine, gives the impression of a “good” or beautiful day. The case study for this paper focuses on print media in Europe’s rainiest city, Bergen, Norway. Material for this paper is collected from 10 years of front-page articles of the daily newspaper Bergens Tidende, spanning 1994–2003. The findings suggest that many articles clearly had components from several categories, even if the primary weather message was the coding rule. An analysis of Bergens Tidende has shown that climate and weather issues tend to dominate front pages throughout much of the year, truncating the normal range of news topics, although some seasonality is present. Some stories on anomalous climate seasons or weather disasters lead to engaged debates over causes, impacts, and mitigation for the future, while others provide an event-description with some connotation of the weather during that event. Scientific knowledge on topics like climate change or El Niño is presented in a way which the audience comprehends without deeper knowledge of the subject, and is aimed to place local happenings in a wider time and geographical perspective. This study investigates how society represents weather events and climatic conditions through journalists and news in print media.

Mieczkowski, Z. (1985). The tourism climatic index: a method of evaluating world climates for tourism. *The Canadian Geographer*, 29, 220-233.

Mieczkowski outlines a method for determining a Tourism Climate Index. As stated, the goal is to “Propose a tourism climate index (TCI) as a composite measure of the climatic well-being of the tourists.” The emphasis is that a TCI can improve decision making, especially for international tourists who are unfamiliar with a region’s climate. The TCI method assumes a relatively low activity level and includes temperature, humidity, precipitation, sunshine, and wind as key variables influencing a region’s touristic climate. Temperature and humidity are specified into “thermal comfort,” a proxy for human thermal sensation defined from studies conducted by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). The TCI is calculated using ranges based upon a 0-5 point scale system for each climate variable; the variables are then weighted according to their relative importance. Mieczkowski emphasizes the variables in the following decreasing order: Daytime thermal comfort, solar insolation, precipitation, all-day thermal comfort, wind. A perfect score of 100 is attainable but TCI ranges of “good” are listed as above a score of 60. In closing, Mieczkowski offers a colored world map with TCI variables for all regions and emphasizes the malleability of the formula to different recreational applications.

Morgan, R., Gatell, E., Junyent, R., Micallef, A., Ozhan, E., & Williams, A. (2000). An improved user-based beach climate index. *Journal of Coastal Conservation*, 6, 41-50.

Morgan et al. seek to assess peak climatic conditions for resort areas and determine their relevance to peak tourist seasons. More than 1600 beach users in Malta, Wales, and Turkey were given a questionnaire which sought to determine the preferences for thermal sensation and bathing water temperature. The questionnaire also assesses the relative priority levels given to bathing water temperature, thermal sensation, sunshine, rain, and wind at each location. Based upon the survey results, a "Beach User Climate Index" is devised, relying heavily on Mieczkowski's TCI with a few changes and additions. Maximum thermal sensation thresholds are changed with the consideration of beach "sunbathing" as a more sedentary activity. An index for bathing water temperature is included in the index assessment. The relative priority levels for all climate aspects are determined to be in the following decreasing order and are weighted accordingly in the index: Water temperature (limited use), rain, sunshine, wind, temperature sensation. The paper concludes with a seasonal assessment of the regions studied along with 34 graphs describing the index score for "sea temperature score," "temperature sensation," and the additive "total climate score" for every location studied throughout a year. The paper argues the benefit of using surveys over "value judgments" when crafting a tourism index.

Nastos, P.T., & Matzarakis, A. (2006). Weather impacts on respiratory infections in Athens, Greece. *International Journal of Biometeorology*, 50, 58-369.

This paper focuses on the contribution of meteorological parameters to the total variability of respiratory infections. For this reason, data on the daily numbers of general practitioner consultations for respiratory infections during the year 2002 are used. These data came from the Local Health Service in Athens. The meteorological data are obtained by the Meteorological Station of the National Observatory of Athens and comprise daily values of mean, maximum, and minimum air temperature, air temperature range, relative humidity, absolute humidity, sunshine, surface atmospheric pressure, wind speed, as well as day-to-day changes of these parameters. In addition, biometeorological parameters and thermal indices such as mean radiant temperature, predicted mean vote, physiologically equivalent temperature, and standard effective temperature, as well as their day-to-day changes are used in the study. The relationship between every meteorological-biometeorological parameter and consultations for respiratory infections are examined by applying the Pearson Chi-Square Test. The study also applies generalized linear models. The results of the analysis show that the thermal index predicted mean vote is strongly associated with respiratory infections.

Page, S. J. (2009). Tourism: The evolution of travel medicine research: A new research agenda for tourism? *Tourism Management*, 30, 149-157.

The paper addresses the issues associated with tourist holiday-taking and its management by the tourism industry. The paper seeks to broadly outline the evolution of this area of study and some of the influential studies published to date along with some of the research agendas now emerging in this new area of study. The paper summarizes the social science intersection of tourism studies from individual concerns with travel. The paper discusses issues of tourist well-being, trends affecting tourist risk and injury, and the steps the tourism industry is taking to minimize the risk and incidence of injury. The paper emphasizes a limited and managed interaction with natural environment and local population which provide positive tourist

experiences of both place and wider holiday by minimizing risk situations. In the conclusion the author notes that government and public sectors have responsibilities to ensure that all tourism providers dutifully take care of their guests and visitors. In this regard, the author suggests “Best Practice” measures for government agencies.

Parrilla, J. C., Font, A. R., & Nadal, J. R. (2007). Accommodation determinants of seasonal patterns. *Annals of Tourism Research*, 34, 422-436.

This paper shows general agreement that certain characteristics such as weather, school holidays, and special events influence tourist demand. It explores an alternative vision, analyzing the supply determinants of seasonality related to accommodation services as a representative sector of tourism. The data come from the Economic Research Center and direct interviews from some establishment managers. The final results are derived from the behavioral model evaluation. From a demand perspective, the results show that the most popular tactics for reducing yearly peaks and troughs have been the organization of special events and festivals, the identification of new market segments, and promotional pricing. From a supply perspective, the tactics include expanding the current capacity to deal with peak-period demand and closing enterprises during the low periods. The authors suggest that for the private sector, results can help justify quality service investments related to expanding the high period and increasing efficiency through lower fluctuation. For public administration, results can justify restructuring industry policies to promote transforming lower-quality hotels into higher and converting them from the silver to the gold category.

Richins, H. (2009). Environmental, cultural, economic and socio-community sustainability: a framework for sustainable tourism in resort destinations. *Environment Development and Sustainability*, 11, 785-800.

This paper discusses an inclusive community-based sustainability framework with a focus on a resort destination in providing a potential model for more inclusive long-range destination planning and implementation. The model attempts to address the many difficult challenges of development through more inclusive and comprehensive long-range destination planning, implementation and management. In order to identify the socio-community assets, the study includes the important sub-areas of focus including, i) the visitor economy with a focus on achieving a viable tourism economy, ii) the brand or identity—that is Noosa as a destination and how a strong brand will enhance the regional tourism industry and its relevant stakeholders, iii) a major focus on achieving a viable tourism industry through new and existing product development, iv) gaining and maintaining quality employment, v) enhancing and achieving sustainable capital investment in the property and other financial assets, and vi) through the continued improvement of quality tourism products and its visitor economy, in turn related and peripheral businesses also are provided with support. Important aims are to achieve a viable tourism industry through providing diverse tourism products which meet sustainable tourism standards, providing excellence in facilities, and developing viable business practices based on strategic approaches for improved market share for Noosa. In addition important aims for product development and operation include achievement of best practice service, accessibility, presentation, range, and value for money in all sectors having contact with visitors.

Scott, D., & McBoyle, G. (2001). Using a 'tourism climate index' to examine the implications of climate change for climate as a tourism resource. Adaptation Impacts Research Group, University of Waterloo.

Scott and McBoyle use a modified Tourism Climate Index and apply it to global circulation models to determine the potential change in the tourism industry in cities across North America. The Mieczkowski TCI is the method of indexing with the following weights: daytime comfort index 40%, daily comfort index 10%, precipitation 10%, sunshine 20%, and wind 10%. The index is also modified with the replacement of effective temperature (from ASHRAE studies) for apparent temperature, or heat index as the utilized measure of thermal discomfort. This modified index is then applied to a total of 17 cities in Canada and the United States, and then reapplied under climate change scenarios using the Canadian Climate Impact Scenarios (CCIS) project. The models in use are CGCM2, and HadCM2. Six conceptual frameworks are discussed regarding tourism index outcomes. The outcomes are "optimal" describing high TCI at all times, "poor," "summer peak," "winter peak," "dry season peak," and "bimodal—shoulder peaks" describing a spring/autumn distribution. Cities observed generally followed these patterns based upon their climate data, giving the study a representation of each distribution. In addition, accommodation cost curves resemble the TCI curves for the cities studied leading to the conclusion that the economic supply side is cognizant of climate factors influencing demand. Finally, the paper overviews the impact of climate change and shows that western Canada is likely to improve its tourism climate while eastern Canada may experience a decline or changing seasonality.

Scott, D., McBoyle, G., & Schwartzentruber, M. (2004). Climate change and the distribution of climate resources for tourism in North America. Climate Research, 27, 105-117.

This study investigates current patterns and potential changes in the spatial and temporal distribution of the climate resource for tourism in North America using the TCI and two climate change scenarios. The paper discusses the implications of the changes in the length and quality of tourism offerings on tourism enterprises and competitive relationships between destinations. The paper uses a tourism climate index in order to assess the spatial and temporal distribution of climate resources for tourism in North America. In the methodology, the climate change scenario is used for analysis of tourism climate index variables. A total of 143 North American cities were selected for this analysis: 90 in the USA, 44 in Canada and 9 in Mexico. The cities were selected on the basis of 3 criteria: significance as tourist destinations, data availability, and regional spatial representation. The paper reveals that projected climate change substantively will redistribute climate resources for tourism. It is suggested that lengthened summer season will expand the domestic and international tourism markets and expenditures. The paper concludes that some cities are gaining climate suitable for winter sun vacations and there will be increased destination choice and competition for the short-term winter sun holiday.

Scott, D., McBoyle, G., & Minogue, A. (2006). Climate Change and the Sustainability of Ski-based Tourism in Eastern North America: A Reassessment. Journal of Sustainable Tourism, 14, 376-398.

This study examines how to reduce the vulnerability of ski areas to climate change by developing a model to assess the impact of climate change on season length, probability of

operations during critical tourism periods, snowmaking costs, and water requirements. It suggests that by 2020, even the warmest climate change scenario poses only a minor risk to four of the six ski areas. The climate data for Canadian locations are obtained from the Meteorological Service of Canada and the data for US locations are obtained from the National Climatic Data Center. The climate change scenarios used in this analysis are obtained from the Canadian Climate Impact Scenarios project and are constructed in accordance with the methodological recommendations of the United Nations Intergovernmental Panel on Climate Change (IPCC) Task Group on Scenarios for Climate Impact Assessment. A total of 25 possible scenarios representing a broad range of global climate models and future emission levels are considered for this analysis. Each scenario consists of single estimates of possible temperature and precipitation change for each month during three future periods: the 2020s, the 2050s and the 2080s. The snow model is evaluated by comparing the predicted and observed number of days with snow and days when snow depth met or exceeded the assumed operational requirement (30 cm) over the 1961–1990 baseline period. In order to complete the modeling of snow conditions at each ski area, a snowmaking module is integrated with the snow cover model. The estimated technical capacities are derived from communications with ski industry stakeholders and ski industry.

Yu, G., Schwartz, Z., & Walsh, J. E. (2009). A weather-resolving index for assessing the impact of climate change on tourism related climate resources. *Climatic Change*, 95, 551–573.

This study develops and tests a Modified Climate Index for Tourism (MCIT) utilizing more than 50 years of hourly temperature, wind and significant weather data from contrasting climatic regions: Florida and Alaska. This paper improves previous methods by incorporating variables that are more relevant to tourism activities by addressing the overriding nature of some conditions and by incorporating hourly observations rather than simple daily averages. The MCIT is tested using hourly weather observations from King Salmon, Alaska and Orlando, Florida. The results show that average temperature alone is not sufficient to represent tourism climate resources. The Weather observations come from two destinations, King Salmon, Alaska (1943–2005) and Orlando, Florida (1953–2005, except for 1971 and 1972). These observations are used to illustrate how the MCIT and sub-MCIT indices could be applied to measure climate as a resource for tourism. These hourly historical observation data are obtained from the National Climate Data Center of the National Oceanic and Atmospheric Administration. The proposed hourly-based index combines various weather elements in an attempt to better capture the dependence of outdoor tourism activities on climate and climate change. The empirical findings of this study support the use of a tourism-related climate index to assess the impact of climate change on tourism. The results presented here point to the feasibility of an assessment of the sensitivity of a tourism-related climate resource on a regional or national scale. The sample results for the two locations discussed in previous sections show that changes of climate tourism resources are already detectable and they vary with location.

Zaninovic, K., & Matzarakis, A. (2009). The bioclimatological leaflet as a means conveying climatological information to tourists and the tourism industry. *International Journal of Biometeorology*, 53, 369-374.

This paper presents a climate and bioclimate leaflet that can help the tourist industry, tourist operators, and tourists in their decision-making. The paper concentrates on temperature,

precipitation, and a climate-tourism-information-scheme that enables tourists to choose the most suitable time period for holidays. The climate tourism index and thermal and aesthetic facets of the tourism climate are used in the methodology. The paper states that climatological information can be used for the promotion of the natural potential for tourist destinations. In the conclusion the paper mentions that bioclimatological leaflets can improve tourist health, especially people who are sensitive to summer heat. The study provides a basis for the promotion of the natural potential of tourist destinations. Tourist managers can use climatological information for promotions offering a wider spectrum of possibilities for holiday activities. These activities range from summer tourism with sun and sea bathing, to health recreation or sport purposes, depending on climate and bioclimate conditions during the year. Also, physicians can use the information to warn their patients of periods that might be unhealthy for them, and suggest the best period for recreation.