

GLOBAL WARMING, CLIMATE CHANGE AND TOURISM: A REVIEW OF LITERATURE

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ABSTRACT:

Global warming, climate change and tourism of late, have taken the centre stage of academic research. A raging debate is on apart from the popular writings and research articles published on the theme. According to the Intergovernmental Panel on Climate Change “Warming of the climate system is unequivocal as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice since the mid 20th century”. This conceptual paper discussed the contributions of 30 selected papers published in tourism-related journals. The approaches of this manuscript are conceptual and are self-oriented to bring readers an all-encompassed state of the art. The purpose of this study is to identify and understand the extent of research carried out to assess the impact of global warming and climate change on tourism. A three pronged approach is adopted to collect data. First, a literature search is conducted on Google search engine, second, referred research journals in the areas of global warming, climate change and tourism are consulted and third, published reports of national and international scientific organizations and government organizations are examined. The fortunes of tourism industry, given the nature of activity, obviously depend on the magnitude and impact of global warming and climate change. Countries like USA, China, Russia, India and Australia are largely attributed for the growing pollution and the consequent changes in the global climate. Sector-wise, aviation accounts for 40%, automobiles 32%, accommodations 21% and others 7% are found to be the major contributors. Incidentally, all these sectors are related both directly and indirectly to the tourism industry.

KEY WORDS:

Global warming. Climate change. Tourism. Carbon emission. Temperature rise. Ice-melting & Sea-level-rise.

1. INTRODUCTION

Global warming, climate change and tourism of late, have taken the centre stage of academic research. A raging debate is on apart from the popular writings and research articles published on the theme. The Inter-governmental Panel on Climate Change (IPCC) declared that ‘warming of the climate system is unequivocal’ (IPCC 2007 a). The global mean temperature has increased by 0.76°C between 1850–1899 and 2001–2005 and the IPCC concluded that most of the observed increase in global average temperatures since the mid-20th century is ‘very likely’ (> 90% probability) the result of human activities that are increasing greenhouse gas (GHG) concentrations in the atmosphere. The IPCC (2007 b) predicts that the pace of climate change is ‘very likely’ (> 90% probability) to accelerate with continued GHG emissions at or above current rates, with globally averaged surface temperatures estimated to rise by 1.8°C to 4.0°C by the end of the 21st century. Changes in temperatures and other climatic features will vary globally (IPCC 2007b). It is very likely that hot extremes, heat waves and heavy precipitation events will continue to become more frequent. Tropical cyclones will likely become more intense, with larger peak wind speeds and more heavy precipitation associated with ongoing increases of tropical sea surface temperatures. Decreases in snow cover, already observed in some regions, are projected to continue. The regions affected by these extreme events, including many major tourism destinations, will expand. These predicted changes highlight the need for awareness and preparedness for natural hazards at the local level through systematic capacity building and strategies for disaster risk management (UNWTO 2007b). UNWTO has determined that tourism is a primary source of foreign exchange earnings in 46 out of 50 of the world’s Least Developed Countries (LDCs) (UNWTO 2007c , UNDP 2005; Hall 2007). Global discourse over Africa and UNWTO’s Sustainable Tourism for Eliminating Poverty (ST-EP) initiative re-energised the debate about pro-poor tourism or tourism for poverty alleviation (Hall & Coles 2008: 277; Simpson 2008; Schilcher 2007). Tourism has the potential to lift people out of poverty through the employment and entrepreneurial opportunities it provides, and the recognition of tourism’s role in poverty alleviation has made it a substantial component of the international development and trade agenda (Hall & Coles 2008). The tourism sector also embraces, and has the potential to make a substantial contribution to the achievement of, the United Nations’ Millennium Development Goals (UNWTO 2007c). This, however, demands that the sector adapts to climate change, and, as important, reduces its contribution to climate change through emissions of greenhouse gasses, and the overall environmental footprint of tourism. Both aspects require substantial changes in the tourism production system.

2. METHODS

A three pronged approach is adopted to collect data. First, a literature search is conducted on Google search engine, second, referred research journals in the areas of global warming, climate change and tourism are consulted and third, published reports of national and international scientific organizations and government organizations are examined. The literature review was conducted by end of 2011. Most of the publications in this category seem to be related to airlines emissions and the need to improve the technology linked to air travels. Some of these studies debated the idea that the society should reconsider the mobility and desire for travels emphasizing on how travelers contribute to sustainability of destinations. The quandary seems to be to what an extent the current transportation system still remains sustainable or must be changed.

2.1. Social Responsibility

This category represents responses to climate changes issues – either actual responses or the need to act toward positive change. Numerous articles focused on the need for society to work together towards sustainability, for individuals to act differently in their daily lives, and for governments to work on policy changes which may include subsidies to enable efficient private adaptations. Some articles highlighted hotels and what they have been doing to mitigate the climate change problem or how to make decisions for business planning. Adaptation and mitigation was the main theme that ran through this category.

2.2. Impact of Climate Change on Tourism

This category discussion of the impacts and consequences of climate change on tourism are provided. Articles presented in this category ranged from discussions of the effects of a carbon tax on international tourism to the environmental consequences of what tourism does and will continue to do if not addressed.

2.3. Policy

Policy is discussed in two basic approaches: 1) How current climate change policies impact tourism, and; 2) Policies, programs, and actions related to climate impact and tourism. Many of the articles provide a discussion of how the tourism industry could or should assist in the policy dialog so when policies that may impact their business are being formulated, they will not be caught off guard.

2.4. Books & Proceedings

Most of the books highlighted here were written around the theme of climate change and tourism providing a variety of topics within the chapters from describing climate change issues, to what tourism could do about climate change. A few of the books use the theme of sustainability and concentrate some chapters on the issue of climate change. One book uses the sustainability concept to discuss slow tourism – tourism that encourages people to stay and play in one area rather than traveling to many different sites throughout a vacation.

2.5. Measurement and Modeling

Reducing the carbon footprint, offsetting emissions, and becoming carbon neutral are some of the concepts discussed in these publications. Measuring the impacts and then mitigating those impacts are presented in this category. Most of the winter activity articles identified skiing as the one area that will be or already is affected by climate change. Ski areas will have reduced snow and some seasons with no snow at all. Therefore skiing will not exist unless adaptation strategies are undertaken such as snowmaking and moving ski areas to higher elevations.

2.6. Destination Preference and Choice

Winter seasons will likely vary greatly – some years the season will be longer and others much shorter. This will make business planning extremely difficult. In these articles, the concept behind destination choice and preference is analyzed with climate change as an intervening factor. Models showed there would be a shifting of tourists to other areas due to rain, temperatures, and snow. Beaches would erode and no longer be a destination; ski areas would not have snow and therefore fewer ski destinations would be available; wetlands would take over current dry lands and change the destination attributes. Travel behavior indicates that most destinations are chosen because of the type of climate (sun, warmth, snow, ecological diversity). When destinations change, so will the travelers' choice of destination according to these scenarios and models. These models and scenarios projected out to 2050, but some went as far as 2080 to determine change in travel destinations due to climate change.

2.7. Water Bodies

Implications of climate change effects on oceans and lakes were the main topics within this category. With the onslaught of melting ice at the earth's poles, oceans will rise causing many Island beach resorts to be covered in water according to modeling scenarios. Island destinations will be the hardest hit since building inland may not be an option. Changes in weather patterns suggest

more severe weather causing inland waterways to swell over their banks more frequently. This will negatively impact fisheries and wetland habitats and cause changes in recreation use on waterways. Many of the articles in this category discussed the ecological impact of climate change in mountains. Impacts discussed included flora and fauna migration, the increase in forest fires, a change in snowpack, and changes in recreation or tourism opportunities in mountain areas. Positive impacts could be a longer summer season for recreation.

2.8. Climate Change, Tourist behavior and Effect

These articles were more destinations specific and tended to use case studies to highlight how weather can change tourism in an area. France, Ontario's provincial parks, British tourism, and Bernese Oberland are some examples provided in this category. The main ideas in this category included assessment of travelers' attitudes toward climate change, business owner attitudes, and willingness to address climate change. Travelers seem to be well aware of climate change issues but most are not willing to change their travel. Behavioral change by business owners tends to occur when it affects their bottom line – either through the demands of their clients or through savings in energy and other resources. In order to be effective, educational campaigns on climate change require different approaches for different people. Other studies showed that when the desired attributes of a destination changed, travelers would prefer to go elsewhere. Articles about changes in season due to climate change refer to both the positive impacts, such as, a longer tourism season in Alaska and the negative changes, like longer and drier seasons in Tunisia. Climates have an impact on tourist demand which will affect destination choice and duration of travel. To some extent, publications that fell into this category generally touched on many topics of climate within the same article. A few articles called for more climate change and tourism research. One article discussed a historical review of climate change, and another gave examples of how climate is an economic engine. Of course, it is almost impossible to review all existent studies regarding global warming; therefore, a selected number of thirty papers are being discussed in the next lines.

3. SELECTED LITERATURE REVIEW ON GLOBAL WARMING, CLIMATE CHANGE AND TOURISM

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

The purpose of this paper is to analyze adaptation to climate change by tourist resorts in Fiji as well as their potential to reduce climate change through reductions in carbon dioxide emissions. The data used for the study were collected from three sources: stakeholder and expert interviews, tourist operator interviews, and an accommodation survey. The stakeholder and expert interviews were informal and notes were taken. The results and background information obtained accompanied the accommodation survey and industry interviews. The private-sector interviews were conducted at the resorts and included site visits. Interviews were 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 sought information on energy consumption, climate change mitigation, adaptation measures, and environmental management. The survey was undertaken with the support of the Department of Energy and the Ministry of Tourism. The questionnaire was posted to all tourism accommodation providers in Suva, the Coral Coast, the Mamanuca Islands, and Nadi.

3.2. Bigano, A. F. Bosello, R. Roson & R. S. J. Tol. 2008. Economy-wide impacts of climate change: a joint analysis for sea level rise and tourism. *Mitigation & Adaptation Strategy for Global Change*, Vol. 13, pp. 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 showed a penalisation 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.

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

This 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; and iii) link the sediment budget to (decadal) shoreline behavior. This work links human impacts to natural coastal dynamics in time and space. The study used temporal and spatial scales for illustrating and identifying the sediment dynamics for coastal evolution. In this regard the paper combined the use of numerical models and stratigraphic information for estimating sediment budget for forecasting coastal development for the sustainable coastal zone management. The paper emphasized the social and natural components of sustainable integrated coastal zone management.

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

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

emissions per year. The study concluded that by limiting solar control the window film helps limit tourism's impact on global warming and climate change.

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

Coombes et al 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 was conducted in three stages in order to evaluate the biodiversity implications of changes in visitor use due to climate change. First, it assessed levels of visitor use across the different habitats at Holkham and Cley. Second, the authors reviewed the literature to determine the impacts that visitors have on biodiversity for different intensities of use. Finally, the study combined visitor impacts with information regarding the levels of use that habitats receive to assess visitors' current and future impacts on biodiversity. The paper anticipated 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.

3.6. Daniel, S., J. Dawson and B. Jones. 2008. Climate change vulnerability of the US Northeast winter recreation– tourism sector. *Mitig Adapt Strat Glob Change*, Vol. 13, pp. 577–596.

The objective of this study was 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 remained viable under a range of climate change scenarios. It examined the vulnerability of the two largest winter recreation industries, snowmobiling and alpine skiing, to four climate change scenarios in the twenty-first century. The majority of the 15 locations examined in this study were 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 focused 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.

3.7. 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*, Vol. 48, pp. 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 the 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 which includes assessing the influence or role of weather or climate forecasts and examine on-site experience.

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

De Freitas, Scott and Mcboyle examined the details of tourists' climate preferences by ranking of climate conditions, range of climate parameters, and weather thresholds in order to validate a Climate Index for Tourism. It aims to address the deficiencies of past climate indices for tourism by devising a theoretically solid and practically useful climate index called the Climate Index for Tourism(CIT). The paper suggested that a climate index for tourism can be reliably used as an integrated index for beach-based tourism and recreation where the thermal, aesthetic, and physical facets of weather collectively determine climate impacts on tourism. The paper addresses the deficiencies of past indices by developing a theoretically sound and empirically tested method. The study uses CIT model and prototyped questionnaire surveys; controlled settings were used to measure the satisfaction for a range of atmospheric environmental conditions. Six essential characteristics for a new generation climate index were identified as: i) theoretically sound (research must include the results from different disciplines to get more understanding of tourism-climate relationships); ii) integrates the effects of all facets of climate (tourists respond to the integrated effect of various facets of climate such as air temperature, humidity, wind, sunshine clouds etc); iii) simple to calculate and uses readily available data (the index should be designed so that it can use either standard climate data or, for short-time forecasts, weather variables); iv) easy to use and understand; v) recognize overriding effect of certain weather facets (the combined effect of a given weather or climate condition is not necessarily the sum total of its various facets); and vi) empirically tested (the performance of the index and its thresholds should be validated against measures of tourist satisfaction with weather climate conditions). The paper combines three conceptual attributes of climate for tourism and recreation: the thermal, aesthetic and physical/mechanical.

3.9. Erdmann, G. 1997. The impact of tourism on coastal areas. *GeoJournal*, Vol. 42, pp. 39–54.

In this valuable work, Erdmann 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; and iii) its environmental aspects. The paper discussed 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; and 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 analysed as the study suggested. In the initial phase it is frequently the case while later on, domestic tourism and recreation often have detrimental consequences on the sensitive coastal landscapes. The paper recommended 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.

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

Following the previous argument, Gossling is convinced to apply the 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 was 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 was investigated using a written questionnaire, which was 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; and vi) tourism has turned the village into an emerging center of resource allocation on an industrial basis.

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

This paper has shown 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 has mentioned 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 concluded 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.).

3.12. Hamilton, J.M. and R. S. J. Tol. 2007. *The impact of climate change on tourism in Germany, the UK and Ireland: a simulation study. Reg Environ Change, Vol. 7, pp. 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 used an econometric simulation model of domestic tourism in countries and of international tourist flows between 207 countries. For the analysis they combined that model with the sub-national data-sets of domestic and international tourism and developed 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 showed 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 north west 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 initially falls because of climate change. The model also showed that the effect of climate change is much smaller than the combined effects of population and economic growth, at least for most countries.

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

The importance to evaluate the environmental impacts of tourism in Hong Kong is well examined by Jim who argues that conservation of the environment by spatial concentration, the mode of urbanization in Hong Kong, has inadvertently but by necessity 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 came from the Census and Statistics Department of Hong Kong. Recent trends in tourist activities showed 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 suggested 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.

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

This paper examined 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 used visitation data obtained from Parks Canada, the federal agency responsible for managing the country's national parks. The data consisted 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 was used to develop a monthly climate-visitation model for 15 high visitation parks. Each park-specific model was then 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 was projected to increase between 9% and 29% system-wide in the 2050s and between 10% and 41% in the 2080s.

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

This paper presents survey findings on the effects of climate change and weather conditions on the transport sector. It also revealed that global scale increase in temperature may influence patterns in tourism and skiing holidays with the associated changes in passenger transport. The paper also investigated that temperature increase affects the touristic attractiveness. Climate change related shifts in the weather patterns might also affect infrastructure disruptions. The paper reviewed 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 found 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.

3.16. Lise, W., and R. S. J. Tol. 2002. Impact of climate on tourist demand. *Climatic Change*, Vol. 55, pp. 429-449.

What is interesting to see in the studies dedicated to global warming is 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 found that an average temperature of about 21°C is the 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. Instead, 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.

3.17. Maddison, D. 2001. In search of warmer climates? The impacts of climate change on flows of British tourist. *Climate Change*, Vol. 49, pp. 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 also 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 characterised 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 maximisation. For 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.

3.18. Martin, M.B.G. 2005. Weather, climate and Tourism a geographical perspective. *Annals of Tourism Research*, Vol. 32, pp. 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 suggested 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 emphasized the need to improve the networks of meteorological observatories and better access to the information.

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

The aim of this paper is twofold. One is 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. The second aim is to show what kind of weather/climate information exists and which information is relevant for tourists and the tourism industry. The methodology used for the paper is applied climatology and the human 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 suggested 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 emphasized that climate information is important from the human-biometeorology point of view especially the thermal component of climate index for tourism. The paper also 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.

3.20. Meze-Hausken, E. 2007. Seasons in the sun - weather and climate front-page news stories in Europe's rainiest city, Bergen, Norway. *Int J Biometeorology*, Vol. 52, pp. 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 hypothesized 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 was collected from 10 years of frontpage 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 investigated how society represented through journalists and news in print media, value, think, and perceive weather events and climatic conditions.

3.21. Morgan, R., E. Gatell, R. Junyent, A. Micallef, E. Özhan, and A.T. Williams. 2000. An improved user-based beach climate index. *Journal of Coastal Conservation*. Vol. 6, pp. 41–50.

This study was based on responses of North European beach users at sites in the UK and various Mediterranean locations. Investigation of this issue together with associated publicity might help to spread the tourism load and hence reduce undesirable social and environmental effects of extreme seasonality in tourist demand. Questionnaire surveys were carried out in Wales, Malta and Turkey to establish the preferences of north European beach users for thermal sensation and bathing water temperature, plus priority levels for other climatic attributes. In total, more than 1600 beach

users were interviewed during the summers of 1994 and 1995. The questionnaire survey included an investigation into the preferences of beach users for the climatic aspects of thermal sensation and bathing water temperature. It also aimed to assess the relative priority levels given to these two aspects plus sunshine, absence of rain, and windiness at the beach location. Results showed that excessively hot thermal sensation occurs in many southern and eastern Mediterranean coastal destinations during July and August, the present peak of the beach tourism season. The climate index devised showed that many southern and eastern Mediterranean tourist destinations can become unpleasantly hot even for sedentary beach use during July and August. This is the peak of the summer season in terms of visitor numbers for many such destinations, when infrastructure components such as accommodation, transport (both local and international), sewage and water supply are often strained to their limit.

3.22. Nastos, P.T. and A. Matzarakis. 2006. Weather impacts on respiratory infections in Athens, Greece. *Int J Biometeorol*, Vol. 50, pp. 58–369.

The 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 were used. This came from the Local Health Service in the surroundings of Athens. The meteorological data obtained by the Meteorological Station of the National Observatory of Athens 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 was examined by applying the Pearson Chi-Square Test. The study also applied generalized linear models. The results of the analysis show that the thermal index predicted mean vote is strongly associated with respiratory infections.

3.23. Page, S. J. 2009. Current issue in tourism: The evolution of travel medicine research: A new research agenda for tourism? *Tourism Management*, Vol. 30, pp. 149-157.

In contrast to existent body of knowledge, Pages addresses the issues associated with tourist holiday-taking and its management by the tourism industry seeking 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. His research summarizes the social science intersection of tourism studies from individual concerns with travel. The paper discussed 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 emphasized 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 noted that government and public sectors have responsibilities to ensure that all tourism providers dutifully take care of their guests and visitors. In this regards the author suggested “Best Practice” measures for government agencies.

3.24. Parrilla, J.C., A.R. Font, and J. R. Nadal. 2007. Accommodation determinants of seasonal patterns. *Annals of Tourism Research*, Vol. 34, pp. 422–436.

According to earlier discussed works, this research showed 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 came from the Economic Research Center and direct interview from some establishment managers. The final results derived from the behavioral model evaluation. From a demand perspective the results showed 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. Authors suggested 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.

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

Based on the belief that community-based sustainability framework is more than important to mitigate the green-house effect, Richins focuses 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 were 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 included achievement of best practice service, accessibility, presentation, range and value for money, in all product categories and in all sectors having contact with visitors.

3.26. Scott, D., G. McBoyle, M. Schwartzentruber. 2004. Climate change and the distribution of climate resources for tourism in North America. *Climate Research*, Vol. 27, pp. 105-117.

The purpose of this study was to investigate current patterns and potential changes in the spatial and temporal distribution of the climate resource for tourism in North America using the TCI and 2 climate change scenarios. The paper discussed the implications of the changes in the length and quality of tourism offerings on tourism enterprises and competitive relationships between destinations. The paper used 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 revealed 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 concluded 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.

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

Readers should keep in mind the upshot of Scott et al who examined how it reduces the vulnerability of ski areas to climate change in six study areas 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 in the 2020s, even the warmest climate change scenario poses only a minor risk to four of the six ski areas. The climate data for Canadian locations were obtained from the Meteorological Service of Canada and the data for US locations were obtained from the National Climatic Data Center. The climate change scenarios used in this analysis were obtained from the Canadian Climate Impact Scenarios project and were 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 were 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 was 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 was integrated with the snow cover model. The estimated technical capacities were derived from communications with ski industry stakeholders and ski industry.

3.28. Tzu-Ping Lin, T. –P. and A. Matzarakis. 2008. Tourism climate and thermal comfort in Sun Moon lake, Taiwan. *Int J Biometeorol*, Vol. 52, pp. 281–290.

The goal of this investigation is oriented 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 was 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 were 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 were carried out, which were then used together with the activity and clothing level, to calculate the physiologically

equivalent temperature. Also, the interviewees were asked to subjectively evaluate thermal sensation, thermal preference, and thermal acceptability. The study compared two thermal scales and found 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 suggested that tourists consider the impact of strong solar radiation on their thermal comfort. On the other hand, the authorities or the tourism industry may offer sheltered outdoor areas to ensure the thermal comfort of tourists in periods with extreme high solar radiation.

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

Things not always are as they appear. Centered under this premise, Yu, Schwartz and Walsh develop 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 was 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 came from two destinations, King Salmon, Alaska (1943–2005) and Orlando, Florida (1953–2005, except for 1971 and 1972). These observations were 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 were 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.

3.30. Zaninovic, K., and A. Matzarakis. 2009. The bioclimatological leaflet as a means conveying climatological information to tourists and the tourism industry. *International Journal of Biometeorology*.

Last but not least, Zaninovic and Matzakaris present a model to understand how climate and bioclimate leaflet that can help the tourist industry, tourist operators and also the tourists themselves in their decision-making. The paper concentrated on temperature, climate-tourism-information-scheme, and precipitation that enable tourists to choose the most suitable time period for holidays. The climate tourism index, thermal and aesthetic facets of the tourism climate are used in the methodology. The paper stated that the climatological information can be used for the promotion of the natural potential for tourist destinations. In the conclusion the paper mentioned that the bioclimatological leaflets can improve the tourist health and 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 could use the information to warn their patients of periods that might be unhealthy for them, and suggest the best period for improving their health.

4. CONCLUSIONS AND APPLICATIONS

Research and discussions about tourism and climate change began in earnest in the past decade. The literature review shows a dramatic increase in published articles about tourism and climate change after 2005, of course demonstrating an awakening by tourism researchers to the phenomenon. Research also shows that certain areas will be affected more by climate change than other areas including mountains (lack of snow), islands and beaches (higher water levels and erosion), warm climates getting too hot, and cold climates warming up. This, in turn, changes the types of tourism such as snow skiing, beach recreation, and hiking, while possibly eliminating some recreation, such as snowmobiling. The applications of the information gained from this study are numerous. First, visitor numbers will likely increase in the northern part of the northern hemisphere and the southern part of the southern hemisphere. Additionally, destination seasonality will affect length of visitation. Ski areas will shrink in their season, but mountain tourism in the fall and spring will lengthen. Land managers will need to address capacity issues on public lands due to extended seasonal use. Second, ecological shifts caused by climate change can alter not only the type of

recreation, but the subsequent impact visitors could have on the land. For example, fishing opportunities will decrease as rivers and lakes show reduced water levels (lack of snow melt). This, in turn, causes warmer waters which is deadly to many fish. As river and lake water levels fall, conflicts for water use will increase (recreation, irrigation, drinking water). Destinations dependent on water recreation will need to diversify soon. Experts predict that droughts will happen more frequently with more severity. Designing alternative recreation opportunities now may keep some businesses open. Third, people in the USA have misconstrued the message and convinced others that climate change does not exist (Anderegg, 2010). This lack of faith in the experts is a fundamental issue in this country. As stated in Farrell and Ward's research, whether you are diagnosed with cancer you go to the experts (oncologists), you may get several opinions, but you still trust the experts since they are most qualified to identify and address the problem. In climate change there is a renewed need to trust the experts. We would argue that climate change mitigation by the tourism industry should become part of a 'normal' conversation worldwide. Relying solely on business knowledge, economics and potential capacity of adaptation of destinations (Farrell and Ward, 2004), and some social sciences is inadequate in a universe where managers must proactively protect. Nonetheless, this is a much broader issued that should be discussed in next approaches.

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