UNCERTAINTIES IN PREDICTING TOURIST FLOWS UNDER SCENARIOS OF CLIMATE CHANGE

Editorial Essay

STEFAN GÖSSLING[1] and C. MICHAEL HALL[2]

[1]*Dept. of Service Management, Lund University, Box 882, 251 08 Helsingborg, Sweden*
E-mail: stefan.gossling@msm.lu.se
[2]*Dept. of Tourism, University of Otago, New Zealand*
E-mail: cmhall@business.otago.ac.nz

Tourism is largely dependent on climatic and natural resources. For example, "warmer" climates generally constitute preferred environments for recreation and leisure, and natural resources such as fresh water, biodiversity, beaches or landscapes are essential preconditions for tourism. Global environmental change threatens these foundations of tourism through climate change, modifications of global biogeochemical cycles, land alteration, the loss of non-renewable resources, unsustainable use of renewable resources and loss of biodiversity (Gössling and Hall, 2005). This has raised concerns that tourist flows will change to the advantage or disadvantage of destinations, which is of major concern to local and national economies, as tourism is one of the largest economic sectors of the world, and of great importance for many destinations. In consequence, an increasing number of publications have sought to analyse travel flows in relation to climatic and socio-economic parameters (e.g. Lise and Tol, 2001; Maddison, 2001; Christ et al., 2003; Hamilton et al., 2003; Hamilton and Tol, 2004). The ultimate goal has been to develop scenarios for future travel flows, possibly including "most at risk destinations", both in economic and in environmental terms. Such scenarios are meant to help the tourist industry in planning future operations, and they are of importance in developing plans for adaptation.

1. Climatic and Other Parameters Influencing Travel Decisions

It is recognized that tourism is subject to weather and climate, with sun, sand and sea travel decisions to a large extent being based on perceptions of warm, sunny environments. Likewise, winter tourism is built on expectations of snow. Hence, tourism is dependent on a range of climate variables such as temperature, precipitation and humidity (e.g. Smith, 1993; de Freitas, 2001, 2005). Accordingly, it is expected that climate change will affect travel behaviour, both as a result of altering conditions

Climatic Change (2006) 79: 163–173
DOI: 10.1007/s10584-006-9081-y

for holidaymaking at the destination level and climate variables perceived as less or more comfortable by the tourists. One branch of publications has thus sought to assess the consequences of climate change for the tourist industries of nations (e.g. Agnew and Viner, 2001; Hamilton et al., 2004), destinations (e.g. Staple and Wall, 1996; König, 1999; Richardson and Loomis, 2005), specific attractions, such as national parks (e.g. Scott and Suffling, 2000), or particular tourism activities or sectors of tourism such as ski-tourism (e.g. Beniston, 2003; Breiling and Charamza, 1999; Bürki et al., 2003; Harrison et al., 2005; König, 1999; Scott, 2003, 2005). Most of these publications have warned that tourist destinations might loose part of their attractiveness, for example as a result of loss of snow in ski resorts, even though there might also be 'gains' in terms of less rain or extended summer seasons. A second branch of publications has focused on tourists and their response to changing climatic variables. In particular, the effects of increasing temperatures and related parameters (such as rain) on the choice of a destination and time of departure have been the focal point of research. For example, in an attempt to identify 'optimal' temperatures, Maddison (2001) analysed travel patterns of British tourists and found that the maximum daytime temperature was 30.7 °C, with even small increases above this level leading to decreasing numbers of visits. Maddison also found that greater rainfall would deter tourists. In another study, Lise and Tol (2002) analysed a cross-section of destinations of Organization of Economic Co-operation and Development (OECD) tourists. Using factor–and regression analysis, they found that OECD tourists preferred an average temperature of 21 °C at the hottest month of the year at their destinations. Both studies come to the conclusion that tourists may shift to other destinations or travel during other periods of the year under a scenario of climate change. Such a conclusion has also served as the basis for a number of studies of potential direct (e.g. changes in temperature) and indirect (e.g. changes in water supply) impacts of climate change on the spatial and temporal flows and activity behaviours of tourists in tourism dependent regions such as the Caribbean (e.g. Belle and Bramwell, 2005; Uyarra et al., 2005) and the Mediterranean (e.g. Perry, 2000, 2004; Kent et al., 2002).

2. Weaknesses of Current Models

Statistics-based models express the behaviour of tourists as a function of weather, climate and other factors (such as travel costs, length of coastline, etc.), and thus need to be seen as determinist approaches to understanding the interaction of travel choice and climate. The objective of this essay is to point out some of the weaknesses of such approaches (Table I). Concerns raised here mainly include the reliability and structure of statistical databases; the dominance of one weather parameter in current models, this is 'temperature'; the neglected role of other weather parameters, such as 'rain', 'storms', 'humidity', 'hours of sunshine' or 'air pollution'; the role of weather information in decision making; the importance of non-climatic parameters such as

TABLE I
Major weaknesses of current models in predicting travel flows

- Validity and structure of statistical databases
- Temperature assumed to be the most important weather parameter
- Importance of other weather parameters largely unknown (rain, storms, humidity, hours of sunshine, air pollution)
- Role of weather extremes unknown
- Role of information in decision-making unclear
- Role of non-climatic parameters unclear (e.g., social unrest, political instability, risk perceptions)
- Existence of fuzzy-variables problematic (terrorism, war, epidemics, natural disasters)
- Assumed linearity of change in behaviour unrealistic
- Future costs of transport uncertain
- Future levels of personal disposable income (economic budget) and availability of leisure time (time budget) that are allocated to travel uncertain

Source: Gössling and Hall, 2005, modified.

political instability or risk perceptions (e.g. risk of food poisoning, diseases, etc.); and the role of unpredictable events such as terrorism or natural disasters. There is also substantial evidence that perceptions play a major role in decision-making (e.g. Jenkins, 1999; Feighey, 2003). Even though their role is insufficiently understood, it is clear that perceptions are complex, and might even result in abrupt changes in travel behaviour and longer-term behaviour modification. For example, after 11 September 2001 flying was generally perceived as risky and travel behaviour changed globally with new travel behaviour patterns developing over time (Hall, 2002; Floyd et al., 2004). Overall, these aspects might be of such importance that modelled tourist flows might not at all develop according to expectations. Finally, there is uncertainty about the future cost of travel in relation to oil prices and taxation as well as the personal characteristics of the consumer.

2.1. DATABASES

Statistical databases used to predict travel flows are generally insufficient. For example, data provided by the World Tourism Organization does not distinguish between business, leisure and VFR (Visiting Friends and Relations) tourists. Instead, statistics refer to 'international arrivals of tourists by country of residence', 'arrivals by nationality', 'arrivals in all [accommodation] establishments' and 'arrivals of tourists in hotels'. None of these databases is consistent for all countries in the world, and for many important national destinations data is even missing. Predicting travel flows on such generalized databases is thus likely to have substantial influence on results, as missing data might constitute one substantial error, while

the non-distinction of leisure and business travellers constitutes another because the latter can be assumed to travel irrespective of reasons related to climate. Business travellers might also influence other correlations, such as the one between a country's poverty line/wealth and the number of tourist arrivals (cf. study by Hamilton, 2003), because it seems plausible that there are more business co-operations between wealthier countries, and hence more travel in between these. In addition, statistical information is usually gathered at an aggregate national scale which is insufficient to adequately generalise and detail tourist flows between and within regions that would be variably affected by climate change as well as other dimensions of global environmental change (Hall, 2005).

2.2. TEMPERATURE AND WEATHER INFORMATION

Temperature is often assumed to be the most important weather parameter in the analysis of tourism flows, and it has been pointed out that outside a certain temperature range, weather perceptions become unfavourable and problems of discomfort arise (McGregor et al., 2002). For example, Maddison (2001), in analysing travel patterns of British tourists, found that the maximum daytime temperature perceived as comfortable was 30.7 °C, with even small increases above this level leading to decreasing numbers of visits. Based on such analyses, statistical models have sought to predict how travel flows will change in the future with increasing temperatures. While this is not to question that temperature is an important weather parameter with major influence on travel decisions, it should nevertheless be considered that a substantial share of tourists does not gather information on weather conditions before booking a vacation (cf. Hamilton and Lau, 2005 for one case study among German tourists). This leads to the issue of perceptions, which is little explored in relation to climate and tourism (Hall and Higham, 2005). For example, the expectation of warm destinations might follow a general logic of 'warm is good – warmer is better'. Consequently, an advertisement campaign by the tour operator Resfeber in Sweden in January/February 2005 promotes well-known destinations in the tropics in association with temperatures. The list starts with: "Bangkok – 32 °C", indicating that temperatures beyond 30 °C might not at all be understood as 'too hot'. Perceptions of 'too hot' would also imply that tourists are (i) usually informed on the climatic conditions at their holiday destinations and (ii) that they are able to interpret this information. For example, it seems questionable whether a tourist is capable of interpreting a 1 °C temperature increase in terms of comfort – notably in the absence of information on other parameters such as humidity or wind-speed. Rather, climate in the sense of warm weather conditions at the destination level might often be implicitly considered in travel decisions; there might, for example, be the notion that the tropics are warm. This notion might also be 'broad', in the sense that tourists do not seem to distinguish between 'warm and dry' climates as for example in Tunisia or 'warm and humid' climates as for example in

the Indian Ocean islands. This is of importance, as it is generally expected that there is a linear relationship between increasing temperatures and changing travel flows (Hamilton, 2003; Lise and Tol, 2001; Maddison, 2001). Note as well that warming will be more pronounced in the northern latitudes and less pronounced in the tropics, where tourists might expect to find 'hot' climates anyway (cf. Gössling et al., 2005). In conclusion, one might expect *perceptions* to play the most central role in decision-making. For example, should the perception of 'warm' countries change towards one of being 'too warm', this might cause rather sudden changes in travel flows on broad regional scales.

2.3. WEATHER EXTREMES

It is also clear that temperature increase is only linear when measured over long periods, while there might be great differences from year to year. The fuzzy reaction of tourists to such changes could, for example, be felt in central Europe in summer 2003 (prolonged period of temperatures reaching 42 °C peaks) and 2004 (cold and rainy, temperatures generally not exceeding 25 °C), when travel decisions were rather random in Germany. Obviously, many people had expected a warm summer even in 2004, and made a decision to stay at home. When the weather remained cold and rainy, there was a rush on last-minute charter trips to virtually any 'warm' destination in late July 2004. Headlines in newspapers read, for example: "Hamburg escapes weather-frustration. Last minute record bookings. Stress on airports. Almost all trips booked out" (Hamburger Morgenpost, 14 July 2004). Likewise, repeated hurricane impacts in Florida in 2004 and 2005 (Blake et al., 2005) might influence travel decisions in this region in the longer term if the frequency and severity of the impacts is maintained. However, in the short-term such impacts have been only marginal on a state-wide basis with impacts being more marked at a local level because of tourist infrastructure damage rather than changes in tourist preferences. The long-term consequences of such weather extremes for tourism thus remain a fuzzy variable in the modelling of travel flows. Indeed, what little evidence that exists suggests that it is the perceived increased frequency of extreme events rather than their severity that may negatively influence tourists' images of destinations in the longer term (Hall, 2002; Hall et al., 2004). Note, in this context, the suggestion that 'due to the complexity of the Earth-system, it is possible that climate change will evolve differently from the gradually changing scenarios. [. . .] For example, storm intensities and tracks could change in unforeseen ways or temperatures could rise or fall abruptly due to unexpected disturbances of global weather systems' (ACIA, 2004: 125). With more incidences such as experienced during the summers of 2003, 2004 and 2005, tourists might become more aware of weather extremes – and either adapt to these or adjust their travel behaviour. Overall, little is known as yet about the complexity of these issues, and in conclusion it seems not justified to assume simple relationships building on, for example, linear increases in temperature.

2.4. TERRORISM, WAR, EPIDEMICS, NATURAL DISASTERS

There are substantial variations in the predictive success of those who forecast the future properties of physical systems versus those who forecast socio-economic systems (Hall, 2005). Tourism is highly susceptible to low-probability events, including terrorism, war, epidemics, and natural disasters. For example, following attack on tourists in Luxor, Egypt, in 1996, accommodation occupancy rates dropped to 18% nationwide and to 10% in Luxor itself (Poirier, 2000). In Kenya, blacklisting by tour operators as a result of political instability caused occupancy rates to fall to 24% in April 1998 as compared to 52% in the previous year (Sindiga, 2000). Immediately after 11 September 2001, 40–50% of tourist reservations were canceled, and after three months international tourism had dropped by about 30% on average (di Castri, 2002). Tourists also seem increasingly to become the target of terrorists as seen in Tunisia, Indonesia and Kenya in 2001 and 2002. SARS, as an example of an epidemic, had substantial influence on tourist flows in Asia in 2003, and the tsunami hitting South-Asia in December 2004 cost hundreds of thousands of human lives, and has devastating consequences for tourism in the region. Overall, these examples show that single events can have a large influence on tourism, and, as most of these are not foreseeable, they remain fuzzy variables in the prediction of travel flows.

2.5. COSTS OF TRANSPORT

Mobility is a precondition for tourism. For example, worldwide, some 42% of all international tourist arrivals are now by air (WTO, 2005). Air travel consumes large amounts of fuel, and is thus dependent on the availability of oil resources as well as on stable world market prices for fuel. Currently, oil prices are increasing, and there are plans to introduce a tax on kerosene. There are also plans to include air travel in the Kyoto-protocol, which would imply that national greenhouse gas inventories need to consider this means of transport. This is likely to have substantial consequences for the parties that ratified the protocol, as the emissions that need to be reduced will be greater. In addition, the cost of travel is also determined by demand factors related to the consumer's disposable income and availability of time to travel, when these are reduced, then travel behaviour also alters. For example, following the Asian financial crisis of 1997 outbound travel from Thailand fell over 10% on the previous year and Indonesia's by over 20% (Prideaux, 1999). All of these developments might have substantial consequences for mobility, which is not considered in any of the models used to predict future tourist flows.

3. Case Studies Eilat, Israel and Zanzibar, Tanzania

There are as yet few bottom-up in situ case studies to support the arguments forwarded above, but some insights can be derived from a case study in Eilat, Israel

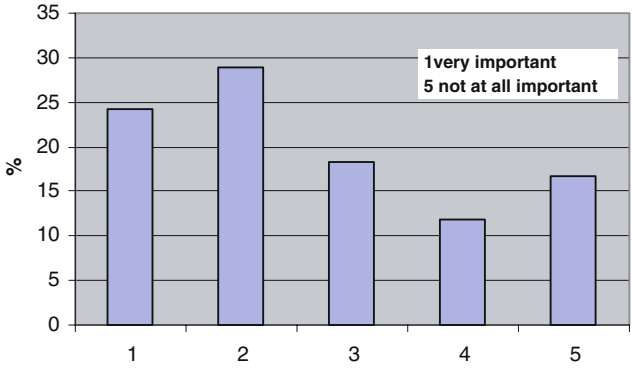

Figure 1. Importance of climate for travel decisions. *Source*: Gössling et al., 2005.

and another one in Zanzibar, Tanzania. Using a combined strategy of climate variable measurements and stated weather perceptions based on structured interviews, Mansfeld et al. (2003) assessed the biometeorological comfort of beach tourists in Eilat, Israel. The results show that differences in wind velocity and cloudiness had a significant influence on the tourists' comfort perception, which in this case study with rather moderate temperatures (20–24 °C) was negative. Temperature differences also had an influence on the tourists' comfort perception, but the importance of this variable was generally much smaller. Mansfeld et al. thus remark that perceptions might be very different under summer conditions, when both wind velocity and cloudiness might be perceived as rather positive. Furthermore, the study revealed that domestic tourists were more sensitive to weather conditions than tourists from overseas, hinting at the importance of other aspects, such as whether the tourists usually live in warm, temperate or cold climates. Mansfeld et al. (2003) conclude that weather conditions shape the tourists' comfort perception, even though the importance of single variables depends on the background conditions at the destination level, this is, relatively extreme (high or low) weather variables, and the conditions experienced before going on holiday.

The Zanzibar case study provides more evidence for the complexity of climate perceptions (Gössling et al., 2005). The in situ study was conducted in October 2003 and based on 252 face-to-face interviews with leisure tourists. Tourists were asked to rate the importance of 'climate' for their travel decision on a Likert scale from 1 (very important) to 5 (not at all important). More than half of the tourists rated climate 1 or 2, corresponding to 'very important'/'important' (Figure 1). However, almost 30% of the interviewed claimed that climate would be 'not very important or not important at all' for travel decisions.

Tourists were also asked whether changing weather patterns would have an influence on tourism in Zanzibar. The answers indicate a high degree of variation, reflecting heterogeneous understandings and perceptions of different weather parameters (Figure 2). 'Temperature' and 'storms' were mentioned to clarify the

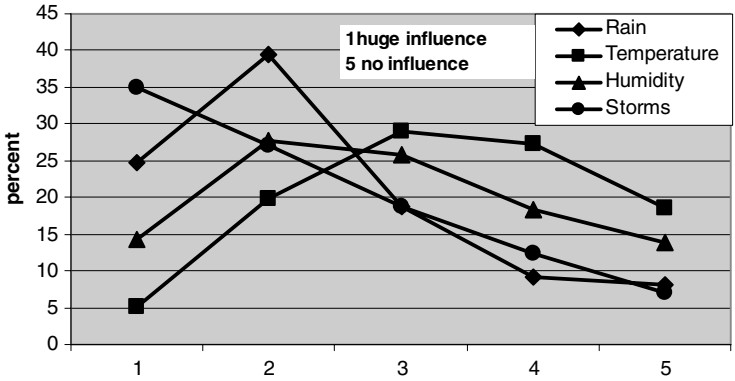

Figure 2. Importance of changes in selected weather parameters for travel decisions. *Source*: Gössling et al., 2005.

question and thus automatically served as an anchor for the respondents. Despite of this, most tourists referred immediately to rain, which seems the most important weather variable influencing tourist comfort at the destination. However, it should be noted that there were periods of intense showers during the study period, which is likely to have influenced the statements of the tourists. Nevertheless, one third of the tourists also claimed to regard 'more rain' as being of little importance for tourism. With respect to storms, tourist perceptions were not homogenous. While some tourists claimed that storms would not have consequences for tourist arrivals, a majority perceived these as problematic, and incidences of great storms (hurricanes and the like) were perceived by virtually all respondents as a threat to tourism. Overall, tourists viewed rain and storms as the most important parameters influencing travel decisions, with 75% (rain) and 62% (storms) of the tourists ranking these 1 or 2 ('huge influence'/'major influence', Figure 2).

'Temperature' was ranked 1 or 2 only by 25% of the tourists, and stated perceptions of this variable varied accordingly. One group of tourists claimed that higher temperatures would not have any effect on tourism, while other tourists suggested that higher temperatures would either attract or deter tourists. Overall, most tourists seem to believe that temperatures need to increase substantially before the effect on tourist arrivals can be felt. Increasing temperatures were often mentioned in the context of increasing humidity, the latter being perceived as negative. In contrast to storm and rain polygons, which show a clear downward-trend, temperature and humidity polygons are rather parabola-shaped. Overall, temperature was the least relevant factor for travel decisions, ranked as having no major influence (4 and 5 on the Likert scale) by almost half of the tourists (46%).

The study suggests that a considerable group of tourists makes travel decisions irrespective of the climate. For example, travel motives might include such as visiting relatives and friends or the visitation of a World Heritage Site. Climate change

may have little influence on such travel decisions, even though weather extremes such as tropical storms might become relevant for this group of tourists. The study also suggests that tourist perceptions of weather and climate vary widely. For example, tourists reported that higher temperatures will be negative, of no importance, or positive, indicating varying comfort factors within this limited sample entirely consisting of travellers to the tropics.

4. Conclusions

A wide range of publications have sought to assess the consequences of climate change for tourism. In particular, one branch of these has sought to express the behaviour of tourists as a function of weather, climate and other factors such as travel costs, length of coastline, economic wealth, etc. As pointed out above, these models do not capture a wide range of aspects that are likely to influence results. For instance, databases used for modelling do not differentiate between business and leisure tourists or those tourists travelling to visit friends and relations, with each of these groups having substantially different travel behaviours and elasticities of demand. There is also uncertainty about the role of other weather parameters such as rain, storms, air pollution or humidity, the effects of weather extremes, the information process in decision-making, perceptions of other non-climatic parameters (e.g. perceived travel risks), fuzzy variables, and the complexity of travel behaviour. Furthermore, the future costs of transport and their effects on travel are uncertain. Results derived from two behaviour-focused case studies in Israel and Tanzania confirm that the role of climate in destination choices is more complex than assumed in current models, and there is thus reason to caution about the use of top-down models using a few selected climate-related parameters to predict travel flows.

References

Agnew, M. D. and Viner, D.: 2001, 'Potential impacts of climate change on international tourism', *Tourism and Hospitality Research* **3**(1), 37–60.

Belle, N. and Bramwell, B.: 2005, 'Climate change and small island tourism: Policy maker and industry perspectives in Barbados', *Journal of Travel Research* **44**(1), 32–41.

Beniston, M.: 2003, 'Climate change in mountain regions: A review of possible impacts', *Climatic Change* **59**, 5–31.

Blake, E. S., Rappaport, E. N., Jarrell, J. D. and Landsea, C. W.: 2005, The deadliest, costliest, and most intense United States tropical cyclones from 1851 to 2004. National Weather Service – National Hurricane Center. http://www.nhc.noaa.gov/pdf/NWS-TPC-4.pdf [accessed 11-11-2005]

Breiling, M. and Charamza, P.: 1999, 'The impact of global warming on winter tourism and skiing: A regionalised model for Austrian snow conditions', *Regional Environmental Change* **1**(1), 4–14.

Bürki, R., Elsasser, H. and Abegg, B.: 2003, 'Climate change impacts on the tourism industry in mountain areas', paper presented at *First International Conference on Climate Change and Tourism*, Djerba, Tunisia, 9–11 April 2003.

Christ, C., Hilel, O., Matus, S. and Sweeting, J.: 2003, *Tourism and Biodiversity: Mapping Tourism's Global Footprint*, Washington D.C.: Conservation International.

de Freitas, C.: 2001, 'Theory, Concepts and Methods in Tourism Climate Research', *Proceedings of the First International Workshop on Climate, Tourism and Recreation, Porto Carras, Neos Marmaras*, Halkidiki, Greece, 5–10 October 2001, pp. 3–20.

di Castri, F.: 2002, Tourism revisited after 11 September 2001, in di Castri, F. and Balaji, V. (eds.), *Tourism, Biodiversity and Information*, Leiden, The Netherlands: Backhuys Publishers, pp. 483–488.

Feighy, W.: 2003, 'Negative image? Developing the visual in tourism research', *Current Issues in Tourism* **6**(1), 76–85.

Floyd, M. F., Gibson, H., Pennington-Gray and Thapa, B.: 2004, 'The effect of risk perceptions on intensions to travel in the aftermath of September 11, 2001', in Hall, C. M., Timothy, D. J. and D. Duval (eds.), *Safety and Security in Tourism: Relationships, Management and Marketing*, New York, Haworth Press, pp. 19–38.

Gössling, S. and Hall, C. M.: (eds.), 2005, *Tourism and Global Environmental Change: Environmental, Economic, Social and Political Interrelationships*, London, Routledge.

Gössling, S., Bredberg, M., Randow, A., Svensson, P. and Swedlin, E.: 2005, 'Tourist perceptions of climate change', *Current Issues in Tourism* in press.

Hall, C. M.: 2002, 'Travel safety, terrorism and the media: The significance of the issue-attention cycle', *Current Issues in Tourism* **5**(5), 458–466.

Hall, C. M.: 2005, *Tourism: Rethinking the Social Science of Mobility*, Harlow, Prentice-Hall.

Hall, C. M. and Higham, J.: (eds), 2005, *Tourism, Recreation and Climate Change*, Cleveldon, Chanellview Press.

Hall, C. M., Duval, D. and Timothy, D.: (eds.), 2004, *Safety and Security in Tourism: Relationships, Management and Marketing*, Haworth Press, New York.

Hamilton, J. M.: 2003, 'Climate and the Destination Choice of German Tourists', Research Unit Sustainability and Global Change, Working paper FNU-15 (revised).

Hamilton, J. M., Maddison, D. J. and Tol, R. S. J.: 2004, 'Climate Change and International Tourism: A Simulation Study', Research Unit Sustainability and Global Change, Centre for Marine and Climate Research, University of Hamburg, Germany, Working Paper FNU-31.

Jenkins, O. H.: 1999, 'Understanding and Measuring Tourist Destination Images', *International Journal of Tourism Research* **1**, 1–15.

Kent, M., Newnham, R. and Essex, S.: 2002, 'Tourism and sustainable water supply in Mallorca: A geographical analysis', *Applied Geography* **22**, 351–374.

König, U.: 1999, 'Climate Change and Snow Tourism in Australia', *Geographica Helvetica* **54**(3), 147–157.

Limb, M. and Spellman, G.: 2001, 'Evaluating domestic tourists attitudes to British weather', *A Qualitative Approach in Proceedings of the First International Workshop on Climate, Tourism and Recreation, Porto Carras, Neos Marmaras*, Halkidiki, Greece, 5–10 October 2001, pp. 21–34.

Lise, W. and Tol, R. S. J.: 2002, 'Impact of climate on tourism demand', *Climatic Change* **55**(4), 429–449.

Maddison, D.: 2001, 'In search of warmer climates? The impact of climate change on flows of British Tourists', *Climatic Change* **49**, 193–208.

Mansfeld, Y., Freundlich, A. and Kutiel, H.: 2003, 'The Relationship between Weather Conditions and Tourists' Perception of Comfort: The Case of the Winter Sun Resort of Eilat', Paper presented during the NATO Advanced Research on Climate Change and Tourism: Assessment and Coping Strategies, 6-8 November 2003, Warzawa, Poland.

Perry A. H.: 2000, *Impacts of Climate Change on Tourism in the Mediterranean: Adaptive Responses*. Nota di Lavoro 35.2000, Fonazione Eni Enrico Mattei, Milan, Italy.

Perry, A.: 2004, 'The Mediterranean: How can the World's most popular and successful tourist destination adapt to a changing climate?', in Hall, C. M. and Higham, J. (eds.), *Tourism, Recreation and Climate Change*, Clevedon: Channelview Press, pp. 86–96.

Poirier, R. A.: 2000, 'Tourism in the African economic milieu: A future of mixed blessings', in Dieke, P.U.C. (ed)', *The Political Economy of Tourism Development in Africa*, New York: Cognizant Communication Corporation, pp. 29–36.

Prideaux, B.: 1999, 'Tourism perspectives of the Asian financial risis: Lessons for the future', *Current Issues in Tourism*, **2**(4), 279–293.

Richardson, R. B. and Loomis, J. B.: 2003, 'The effects of climate change on mountain tourism: A contingent behavior methodology', *Paper Presented at the First International Conference on Climate Change and Tourism*, Djerba, Tunisia, 9–11 April 2003.

Scott, D.: 2003, 'Climate Change and Tourism and the mountain regions of North America', *First International Conference on Climate Change and Tourism*, Djerba, Tunisia, 9–11 April 2003.

Scott, D.: 2005, 'Global Environmental Change and Mountain Tourism', In Gössling, S. and Hall, C. M. (eds.), *Tourism and Global Environmental Change: Environmental, Economic, Social and Political Interrelationships*, London, Routledge, pp. 54–75.

Scott, D. and Suffling, R.: 2000, *Climate Change and Canada's National Parks*. Toronto: Environment Canada.

Sindiga, I.: 2000, 'Tourism development in Kenya', in Dieke, P.U.C. (ed.), *The Political Economy of Tourism Development in Africa*, New York: Cognizant Communication Corporation, pp. 129–53.

Smith, K.: 1993, 'The influence of weather and climate on recreation and tourism', *Weather* **48**(12), 398–403.

Staple, D. and Wall, G.: 1996, 'Climate change and recreation in Nahanni National Park Reserve', *The Canadian Geographer* **40**(2), 109–120.

Uyarra, M. C., Coté, I. M., Gill, J. A., Tinch, R. R. T., Viner, D. and Watkinson, A. R.: 2005, 'Island-specific preferences of tourists for environmental features: Implications of climate change for tourism-dependent states', *Environmental Conservation* **32**, 11–19.

World Tourism Organization (WTO): 2003, 'Climate Change and Tourism', *Proceedings of the 1st International Conference on Climate Change and Tourism*. Djerba, Tunisia 9–11 April 2003. Available at: http://www.world-tourism.org/sustainable/climate/final-report.pdf [accessed 11-01-2004].

(Received 29 March 2004; in revised form 5 January 2006)