THE IMPACT OF CLIMATE CHANGE ON TOURISM AND RECREATION

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Abstract

Tourism is one of the largest and fastest growing economic sectors. Tourism is obviously related to climate, as tourists prefer spending time outdoors and travel to enjoy the sun or landscape. It is therefore surprising that the tourism literature pays little attention to climate and climatic change and it is equally surprising that the climate change impact literature pays little attention to tourism. The number of studies on tourism and climate change is, however, starting to grow. This paper reviews this literature, discussing shortcomings and recent developments in global modeling of tourism flows are presented. The range of methods used and issues studied in the literature is large, and findings are correspondingly diverse. However, all studies agree that climate change matters to tourism and recreation. Future avenues of inquiry are also discussed.

Key words

Tourism, recreation, weather, climate, climate change

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1. Introduction

Tourism is one of the largest and fastest growing economic sectors. Tourism is obviously related to climate, as tourists prefer spending time outdoors and travel to enjoy the sun or landscape. It is therefore surprising that the tourism literature pays little attention to climate and climatic change (e.g., Witt and Witt, 1995), perhaps because climate is deemed constant and beyond control. It is equally surprising that the climate change impact literature pays little attention to tourism (Smith *et al.*, 2001), but this can perhaps be explained by the fact that most climate change impact studies are done by field rather than climate experts.

The situation is now slowly changing (e.g., Nicholls, 2004). Five branches of literature have started to grow. Firstly, there are a few studies (e.g., Maddison, 2001) that build statistical models of the behavior of certain groups of tourists as a function of weather and climate and there are similar studies on recreational behavior.[1] Secondly, there are a few studies (e.g., Abegg, 1996) that relate the fates of particular tourist destinations to climate change. Thirdly, there are studies (e.g., Matzarakis, 2002) that try to define indicators of the attractiveness of certain weather conditions to tourists. Fourthly, there are a few studies (e.g., Hamilton *et al.*, 2003) that use simulation models of the tourism sector. Finally, a handful of studies (e.g., Berritella *et al.*, 2004) analyze the economic implications.

This paper reviews these studies. Section 2 briefly reviews studies on tourism or recreation demand estimation. In section 3, the importance of climate for tourism and recreation demand is discussed. Section 4 provides an overview of climate change studies. Section 5 reviews global model studies. Section 6 concludes, focusing on future avenues of inquiry.

Note that there is no separate section on adaptation. Most of the “impacts” discussed below are in fact “adaptations”, that is, tourists deciding to travel elsewhere or tourist operators relying on artificial rather than natural snow.

[1] The difference between tourism and recreation is that the former includes at least one overnight stay away from home.

This paper does not review the environmental consequences of tourism and recreation, including the emission of greenhouse gases (e.g., Gössling, 2002) let alone the implications of climate policy for tourism and recreation (e.g., Piga, 2003).

2. Tourism and recreation demand estimation

2.1 Tourism demand

Tourism demand forecasting continues to be a popular theme in the tourism literature. Reviews of this literature by Witt and Witt (1995) and Lim (1995) show that demand forecasting, in the majority of studies, is focused on economic factors. Morley (1992) criticizes typical demand studies because they do not consider utility in the decision making process. Moreover, he suggests an alternative way to estimate demand based on the expected utility derived from the characteristics of the product – in this case the destination country is the product. Most importantly, he argues that climate and landscape attributes of countries should be included in the characteristics set. Seddighi and Theocharous (2002) have applied this theory using a Logit analysis. Political stability was the focus of their study and not environmental characteristics such as climate or landscape. Rather than just examining the demand for a single country, demand systems provide the opportunity to examine the pattern of flows of tourists to different destination countries. Recent studies, however, do not include natural resource characteristics (see Lyssiotou, 2000; Divisekera, 2003 and Lanza et al., 2003).

2.2 Recreation demand

In the majority of studies, recreational demand has been estimated using travel cost models. Hotelling[2], a Harvard economist, developed the travel cost (TC) method in the late 1940s, in

[2] Ward and Beal (2000) provide more detail on the origins and development of the travel cost method.

order to calculate the value of the United States' national parks in monetary terms. Hotelling's idea was that the costs that people incur traveling to a site reflect their willingness to pay for the recreational experience at that site. As travel costs increase and therefore the price of the visit, the number of trips will decrease. Collecting data on the costs of all the trips made to a particular site allows the construction of a demand curve, which can then used to calculate the value of the site. Travel cost models fall into two groups: single site and multiple site models. Apart from demand estimation, the use of single site models is limited to calculating the total value of a specific site. In contrast, the hedonic travel cost model and the pooled travel cost model, which are multiple site models, can be used to value the characteristics of sites. In the standard TC models, the relationship between the number of visits and travel cost is analyzed, whereas the hedonic travel cost model can be used to examine the relationship between travel cost and site characteristics. For example, the travel cost method has been applied to demand estimation for forest use (Starbuck et al., in press); water quality (Sutherland, 1982); hiking and biking (Hesseln et al., 2003); fishing (Morey et al., 2002); and snorkeling (Park et al, 2002). More recently, developments have applied the pooled travel cost model to international tourism destinations (see below).

3. Tourism, recreation, weather and climate

In the tourism literature, there are three different types of study where the importance of climate and weather have been examined: destination image studies, climate index studies and in daily use models of recreational sites. Of the 142 destination image papers that are reviewed by Pike (2002)[3], only one specifically dealt with weather. This was a study by Lohmann and Kaim (1999), who note that there is a lack of empirical evidence on the importance of weather/climate on destination choice decision-making. Using a representative

[3] These were published in the period 1973 to 2000.

survey of German citizens, the importance of certain destination characteristics were assessed. Landscape was found to be the most important aspect even before price considerations. Weather and bio-climate were ranked third and eighth respectively for all destinations. Moreover, they found that although weather is an important factor, destinations are also chosen in spite of the likely bad weather. Measuring the importance of destination characteristics is also the focus of a study by Hu and Ritchie (1993) where they review several studies from the 1970s and find that "natural beauty and climate" were of universal importance in defining destinations' attractiveness. A good climate and the possibility to sunbathe were included in Shoemaker's (1994) list of destination attributes.

De Freitas (2001) classifies climate according to its aesthetic, physical and thermal aspects. The thermal aspect is argued to be a composite of temperature, wind, humidity and radiation. There is growing evidence, however, that climate has significant neurological and psychological effects (Parker 2001), which may also have some influence on the choice of holiday destination. In order to capture the complexity of the thermal aspect of climate, numerical indices have been developed and these allow comparisons of suitability of different destinations for different tourism activities. De Freitas (1990) found that the relationship between HEBIDEX, a body-atmosphere energy budget index, and the subjective rating of the weather by beach users was highly correlated. Furthermore, he found that the optimal thermal conditions for beach users were not at the minimum heat stress level but at a point of mild heat stress. Matzarakis (2002) uses an index of thermal comfort to identify areas of Greece where there is high likelihood of heat stress occurring.

Dwyer (1988) has estimated a daily site use model, for urban forest recreation, using data on noon temperature, percentage sunshine, percentage rain and snow depth. Although not intended as a climate change study, he goes on to examine the effects of increases in the climate variables. These, however, are not related to any climate change scenario. A temperature increase, of ten degrees, increases the daily use levels from September to May but decreases them in July. Brandenburg and Arnberger (2001) attempt to predict daily use levels of the Danube Flood Plains National Park in Austria. They find that using standard climate data does not produce any satisfactory results. Instead they use the Physiological Equivalent Temperature (PET), the occurrence of precipitation and cloud cover to estimate the number of visitors per day in total and for four groups: cyclists, hikers, joggers and dog walkers. The PET value is very important in determining the use levels, particularly for cyclists and hikers. Thorson et al. (2004) finds a positive relationship between thermal comfort and park use in urban areas of Sweden.

4. Tourism, recreation and climate change

4.1 Qualitative impact studies

Qualitative impact studies of climate change have been carried out for the Mediterranean (Nicholls and Hoozemann, 1996 and Perry, 2003), the Caribbean (Gable, 1997), wetland areas in Canada (Wall, 1990) and the German coast (Krupp, 1997 and Lohmann, 2001). These studies vary in their focus and techniques. The latter used surveys, scenarios and consulted both tourist and tourist industry discussion groups in their analysis. Viner and Agnew (1999) examine the current climate and market situation for the most popular tourist destinations of the British. The consequences for demand for these destinations under a changed climate are discussed.

4.2 Quantitative impact studies

While the aforementioned studies provide information about vulnerabilities and the likely direction of change, they do not provide estimates of changes in demand. Four groups of quantitative climate change studies exist: predicting changes to the supply of tourism services, using tourism climate indices coupled with demand data, estimating the statistical relationship between demand and weather or climate and finally, studies that have their foundations in economic theory.

Firstly, predicting changes in the supply of tourism services has been applied to the winter sports industry. Abegg (1996) analyzed the impact of changes in temperature on snow depth and coverage and the consequences of these changes on ski season length and the usability of ski facilities. Similar studies were carried out for winter sports tourism in Scotland (Harrison *et al.*, 1999), Switzerland (Elsasser and Bürki, 2002; Elsasser and Messerli, 2001), Austria (Breiling and Charamza, 1999; Kromp-Kolb and Formayer, 2001), Finland (Kuoppamaeki, 1996) and Canada (Scott *et al.*, 2001). These studies rely on the assessment of physical conditions that make tourism possible in these areas for a certain activity, that is the supply of tourism services for a specific market segment. These studies find a general decline in natural skiing conditions.

Secondly, the index approach has been used. Scott and McBoyle (2001) apply the tourism index approach to the impact of climate change on city tourism in several North American cities. Cities are ranked according to their climatic appropriateness for tourism and the relationship between tourist accommodation expenditures is examined. Then this ranking is recalculated using data from a scenario of climate change. The authors predict an increase in revenue from tourist accommodation for Canadian cities.

Thirdly, some studies use the statistical relationship between demand and weather. For example, Agnew and Palutikof (2001) model domestic tourism and international inbound and outbound tourism using a time series of tourism and weather data. One would suspect that, day trips apart, tourism is affected by the expected weather rather than the actual weather.

Fourthly, we have the studies that are grounded in economic theory. The impact of climate change in the US on eight recreation activities are examined by Loomis and Crespi (1999). They estimate demand equations relating the number of activity days to temperature and precipitation. Under a scenario of a +2.5°C change in temperature and a 7% reduction in precipitation, they predict sharp reductions in the number of skiing days (-52%) and increases in the number of days spent playing golf (14%), at the beach (14%) and at reservoirs (9%). Mendelsohn and Markowski (1999) also estimate the impact of climate change on a range of recreation activities. The aggregate impact is estimated in terms of welfare and ranges from a reduction of 0.8 billion 1991$ to an increase of 26.5 billion 1991$. Using the contingent visitation approach, Richardson and Loomis (2004) find that temperature is a positive determinant of demand for visits. Moreover, depending on the climate scenario, they estimate an increase in recreational visits from 9.9% to 13.6% in 2020.Snow dependent activities are the focus of a study by Englin and Moeltner (2004). Using data on price, weekly conditions at ski resorts and the participant's income they find that although demand increases as snow amount increases, trip demand is more responsive to changes in price.

A development of the travel cost model, the Pooled Travel Cost Model (PTCM) has been applied for tourists from the UK, the Netherlands and Germany (Maddison, 2001; Lise and Tol, 2002; Hamilton, 2003). Nevertheless, they have estimated the relationship between demand and certain climate variables. The possibility of taking a vacation in the origin country was included in the study by Hamilton. Lise and Tol (2002) also study the holiday travel patterns of tourists from a range of OECD countries. The data and method are crude, but the results suggest that people from different climates have the same climate preferences for their holidays: The climate of Southern France and California is preferred by everyone, regardless of the home climate. Bigano *et al.* (in preparation) confirm this result, using less crude econometrics for a much wider range of countries including African and Asian ones. However, Bigano *et al.* also find that people from hotter places tend to have sharper preferences. That is, while Southern France is preferred by people from both hot and cold places, people from hot places would feel much worse about going elsewhere than would people from cold places. See Figure 1.

From this review of tourism demand forecasting and climate and tourism literature, the following gaps are evident: Firstly, the possibility of substitution between destinations has been neglected in all studies. Secondly, the studies have focused on particular areas or particular origin nationalities; the global picture has yet to be filled in. Thirdly, in the forecasting literature, environmental characteristics are assumed to be fixed and only economic variables are seen as varying over time. Climate as a "push" factor has also been largely overlooked. A global study of flows from origin countries to destination countries that includes the climate of countries as a factor in both the estimation of demand to travel as well as the demand for a particular destination would fill this gap, as well as allowing an examination of the substitution process.

5. Model studies

There are only two groups that model tourism to study the impacts of climate change: Amelung and Viner; and Hamilton, Tol and colleagues.

5.1. Hamilton, Tol and others

Hamilton *et al.* (2003) present version 1.0 of the Hamburg Tourism Model. This is a simulation model that traces the flows of international tourists from and to 207 countries. The model is calibrated for 1995, using data for total international departures and arrivals. Bilateral tourism flows are generated by the model, independent of data (e.g., WTO, 2003). The simulations are driven by four variables: distance, population, income, and temperature. Distance is assumed constant and has no effect on the results. It is relevant to construct the 1995 tourism pattern, however. The effect of population growth is (assumed to be) simple: More people implies more tourists. The effect of per capita income is twofold. Firstly, richer people travel more frequently. Secondly, tourists avoid poor countries. A world that grows ever richer – HTM runs on the SRES scenarios (Nakicenovic and Swart, 2001) – thus sees more tourists, and much more tourists from developing countries; in addition, developing countries become more attractive as tourist destinations.

The annual temperature is the index for climate. There are two quadratic relationships. Firstly, cool destinations become more attractive as they get warmer, and warm destination become less attractive. Secondly, cool countries generate less international tourists as they get warmer, and warm countries generate more. Put together, these two effects generate an interesting pattern. Climate change shifts international tourists towards the poles and up the mountains. However, climate change also reduces the total number of tourists, because international tourism is dominated by the Germans and the British, who would prefer to take their holidays in their home countries. See Figure 2. The reduction in international tourism because of climate change is, however, dwarfed by the growth due to population and economic growth.

Hamilton *et al.* (2004) slightly change the simulation model, initially allowing tourism to grow more rapidly with economic growth but then assuming saturation of demand. This does not drastically change the results, although tourists from hot and poor countries gain in importance; these tourists would increasingly seek to escape to cooler places during their holiday.

Recent model developments include the explicit modeling of domestic tourism, and an increased spatial resolution. Next steps are the inclusion of seasons and more climate variables.

5.2. Amelung and Viner

Amelung and Viner (submitted) also model international tourism, but by restricting themselves to the supply side, they model tourism potential rather than actual flows of tourists. That said, their approach is considerably more detailed than that of Hamilton *et al.*

(2003). Amelung and Viner (submitted) work with a spatial resolution of 0.5°x0.5°, using monthly data. The attractiveness of a location for tourists depends on temperature, precipitation, humidity and wind in a very non-linear way.

The results show that climate change would shift tourists towards higher latitudes and altitudes. Also, there would be a shift from summer to spring and autumn in some destinations, and from spring and autumn to winter in other destinations.

5.3. Economic implications

Few of the climate change and tourism studies reviewed above extend into economics. Those that do (e.g. Maddison, 2001 and Mendelsohn and Markowski, 1999), offer a straightforward welfare analysis limited to an estimate of the direct costs and benefits.

The sole exception is the study of Berritella *et al.* (2004). Using the Hamburg Tourism Model of Hamilton *et al.* (2003) as an input, Berritella *et al.* use the GTAP5 computable general equilibrium model to analyse the economy-wide implications. Climate change impacts on tourism are represented as two additive shocks. Firstly, there is a transfer of income from the countries that receive fewer tourists to those that receive more; this is because the GTAP data is based on the gross *domestic* product. This, of course, partially cancels out in the regional aggregation. Secondly, there is a shift in demand as consumers behave differently whilst on holidays.

The results show that the global impact is negligible. There is substantial redistribution, however. Countries in Western Europe, the subtropics and the tropics are negatively affected. North America, Eastern Europe and the former Soviet Union, and Australasia are positively affected. The negative impacts may amount to –0.3% of GDP by 2050, the positive impacts of 0.5% of GDP. These numbers are large compared to other monetized impacts of climate change (e.g., Smith *et al.*, 2001).

6. Discussion and conclusion

The review of the literature reveals a rather scattered field. There are a number of case studies on climate change impacts, and there are a number of related studies that could be re-interpreted as climate change impact studies, but each of these studies is unique. The studies use widely different methods and resolutions, looking at different periods, and different places. A comprehensive, quantitative message does not emerge from this diversity. One clear, qualitative message does arise, however: climate change could well have substantial effects on tourism and recreation. As a corollary, because tourism and recreation is an important and fast growing sector, the economic ramifications may well be substantial too.

The impact of climate change should be seen in its context, however. The tourism and recreation industry is growing very rapidly, and it is very adaptive. Climate change may accelerate or decelerate growth, but is unlikely to change growth into decline (or vice versa). Competition is high, new attractions, destinations, and niches continuously emerge, technological progress is rapid, and the system is used to coping with natural disasters, epidemics and political events. Gradual climate change does not pose a particular threat to such a versatile sector. Climate change may well threaten particular locales. In some places, tourists come for one thing only, and would stop coming if that one thing – be it snow or a beach – disappears.

Our literature review reveals a number of serious gaps. We already mentioned the diversity of the research to date. More coordinated research would be welcome. Although it is clear that climate is an important consideration in destination choice, it is not clear what aspects of climate tourist pay particular attention to. Is the Mediterranean popular because the weather is nice, or because the weather is predictable? England and Germany will get warmer, but weather variability is not likely to fall. Most reviewed studies assume that tourists would go elsewhere; however, tourists may also take their holidays at different times of the year. The relative importance of spatial and temporal substitution is unknown. Exceptions are ski and island resorts; the former may lose their snow, and the latter may disappear altogether. Here, the scarcity effect has yet to be studied. The final remaining ski resort with real snow, and the final remaining atoll would be able to extract a considerable monopoly rent. Scenarios for tourism and recreation have not been developed. Tastes, technologies, and relative prices all change, and would make the impact of climate change greater or smaller, but it is not known by how much. These and other questions are hopefully subject of future research. Results to data indicate that such research would be fruitful and worthwhile.

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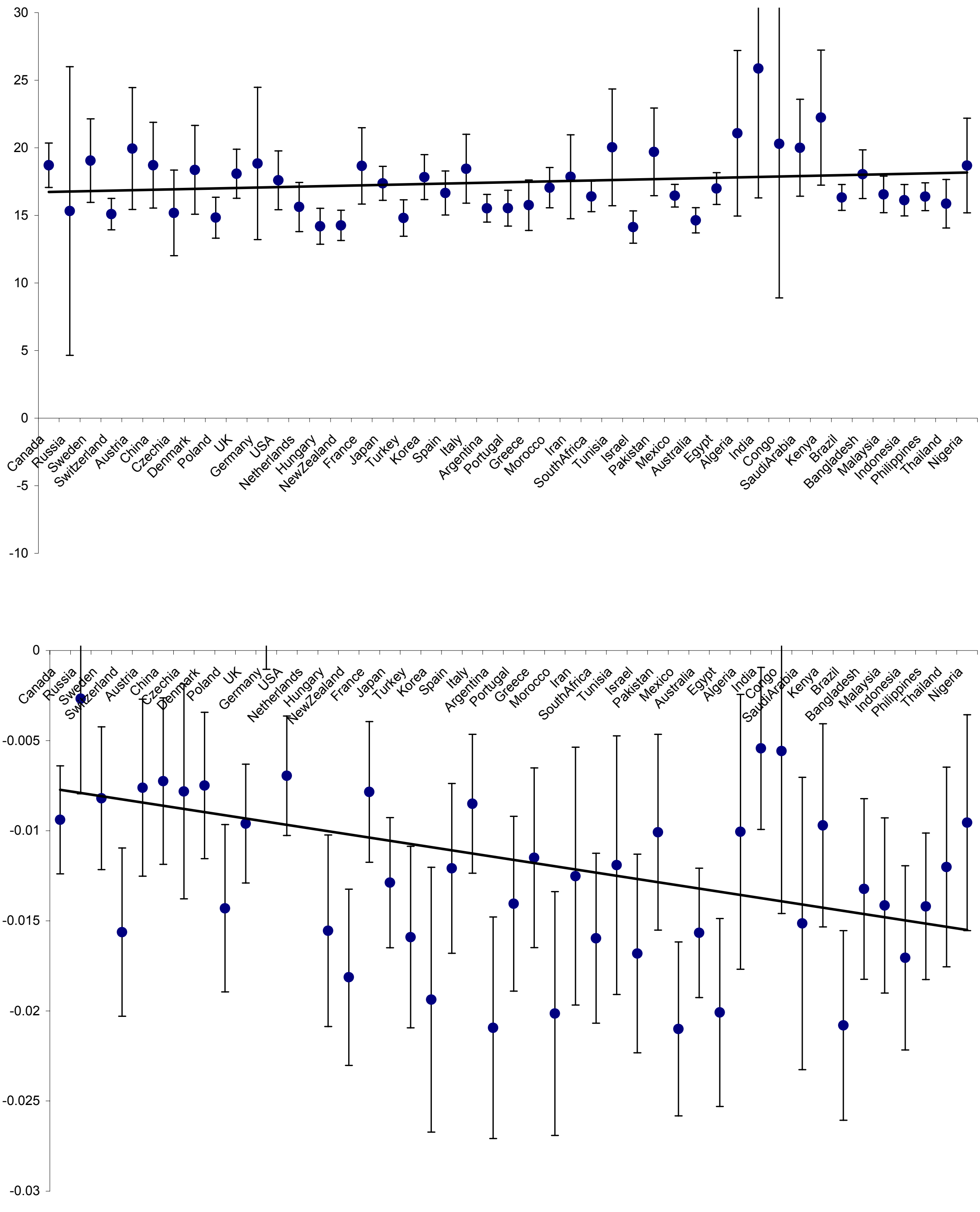

Figure 1. The optimal holiday temperature for 45 countries of origin (top panel) and the sharpness of this preference (bottom panel); the smaller the coefficient, the faster the attractiveness of non-optimal destinations declines. The countries of origin are ranked according to their temperature. Source: Bigano *et al.* (in preparation).

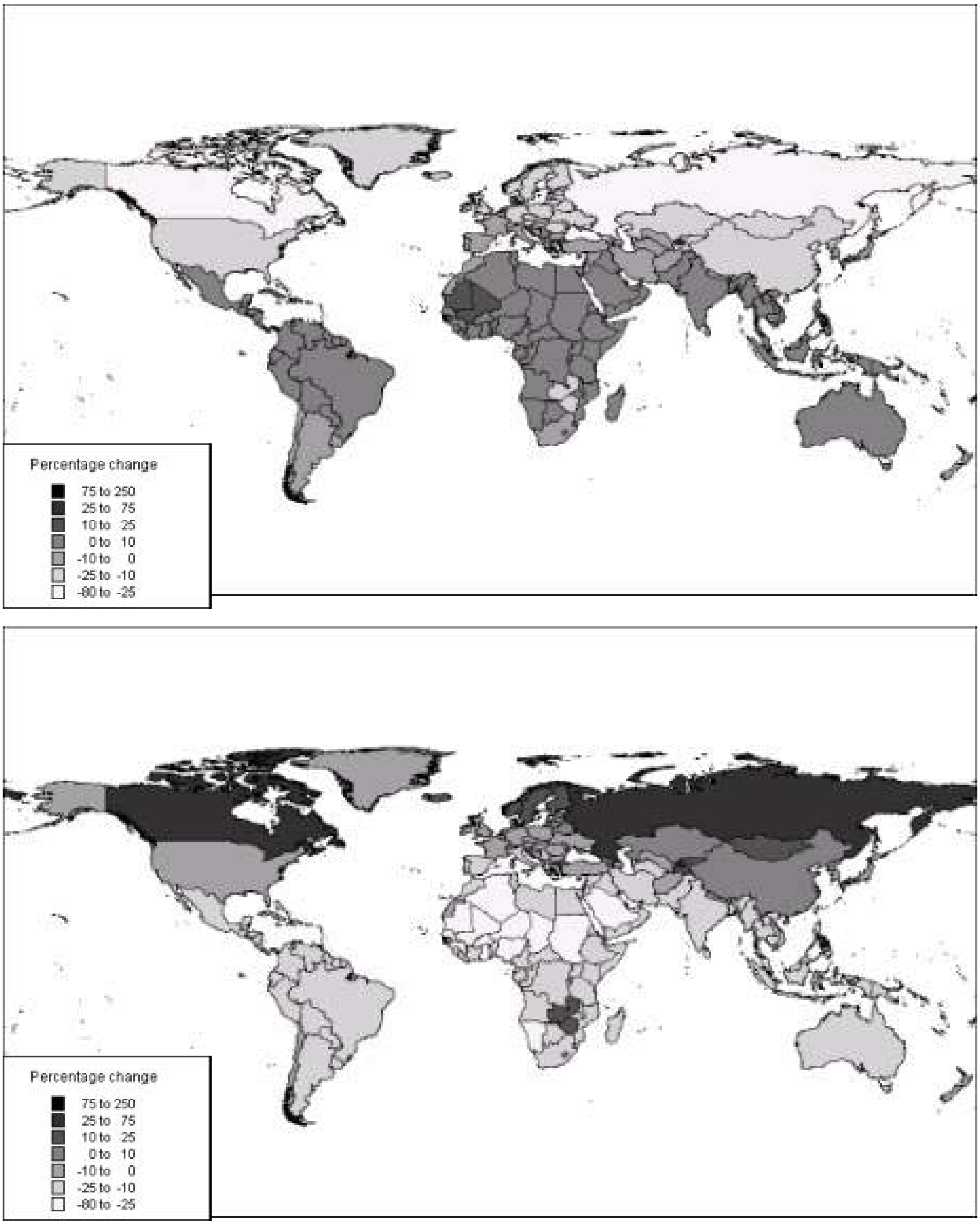

Figure 2. The change in departures (top) and arrivals (bottom) as a result of a 1°C global warming in 2025. Source: Hamilton *et al.* (2003).

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Research Unit Sustainability and Global Change

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