TOURISM, CLIMATE CHANGE AND THE COASTAL ZONE

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Dissertation

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Introduction

1.1 General introduction

Tourism has become one of the world's major cultural and economic activities. Tourists travel to a wide variety of environments, including high-density urban areas and uninhabited regions. The coastal zone, however, is the main destination of tourists. Furthermore, tourism takes place in a wide variety of climates, ranging from the cold of the arctic, to the warmth and humidity of tropical countries and to the dry heat of the desert. As climate varies over the year, tourists have the possibility to experience a destination under a variety of climatic conditions. Nevertheless, there is a distinct pattern of seasonality in tourism demand. In other words, tourists not only choose a spatial location for their holiday, they also choose a temporal location.

Climate scientists are very certain that the Earth's climate will change at an unprecedented rate over the 21st century (Houghton *et al*., 2001). Whether through the direct effects of climate change, such as increased temperature, or through ancillary effects such as sea-level rise or the impact on landscapes, it can be expected that the spatial and temporal pattern of tourism demand will adjust. Despite the apparent seasonality of tourism and its overwhelming dependence on climatic factors, relatively few studies have tackled the impact of climate change on tourism (Butler, 2001; Scott *et al*., 2005). This is reflected in the brief coverage of the impacts on tourism in the Intergovernmental Panel on Climate Change (IPCC) reports (Watson *et al*., 1997; McCarthy *et al.*, 2001).[1] Since these reports were completed, however, the number of studies has been increasing. Nevertheless, there is still a scarcity of *quantitative* studies on the effect that climate change will have on tourism. This thesis is a step towards reducing the scarcity, and so providing information for the tourism industry as well as policy-makers.

[1] The Intergovernmental Panel on Climate Change was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). Its task is to assess the scientific information on the risk of climate change, its impacts and possible response strategies (IPCC, 2004).

Section 1.2 presents the purpose, aims and scope of this study. The structure of this thesis is outlined in section 1.3.

1.2 Purpose, aims and scope

In 2003 in Djerba, Tunisia, the World Tourism Organisation (WTO) and other UN agencies organised the first international conference on tourism and climate change with the purpose of creating an awareness of the issue within the tourism industry and within governmental agencies involved in tourism policy and planning (Scott *et al.,* 2005). This conference resulted in the "Djerba Declaration on Climate Change and Tourism" (WTO, 2003a), which was signed by representatives of 45 nations. One of the points agreed to by the participants was that there is still a need for research on "the reciprocal implications between tourism and climate change" (WTO, 2003a). A further point is that such information is necessary for decision-making on adaptation and mitigation strategies (WTO, 2003a). The purpose of this thesis is to contribute to the information that can be used in the decision-making process.

This thesis will focus on one direction of the "the reciprocal implications." To be precise, the impact that climate change will have on tourism and in particular on the demand for destinations. The impact of tourism on climate change will not be covered here (see Gössling, 2002; Becken and Simmons, 2005) nor will the impact of climate change *policy* on tourism be examined (see Piga, 2003). Of course, the role that the factors climate and the coast play in the development of tourism supply at particular destinations, regions or even countries is an important issue when considering the adaptation of the tourism industry to climate change. This, however, would be a thesis in its own right and so will be deferred to future research. First, it is necessary to examine how demand will change in response to climate change. This will be done with particular reference to tourism in the coastal zone. The aims of the thesis are:

1. to review the historical evidence and contemporary scientific literature on the importance of climate and the coastal zone for tourism demand,

2. to provide quantitative evidence that climate and the coast are important destination characteristics that affect tourists decisions for a particular destination,

3. to establish the quantitative relationship between climate and tourism demand as well as between coastal characteristics and tourism demand,

4. to use these relationships to examine the effects of climate change on tourism, and.

5. to examine the impact of climate change at various destination and source market spatial scales.

The extensiveness and diversity of tourism has lead to this thesis being focussed on one source market. Germany is the second largest source market in the world, accounting for 10% of the global expenditure on international tourism (WTO, 2005b). Additionally, it has a very large domestic market. For these reasons, along with the relative ease of access to tourism data and the possibility to survey outbound tourists, Germany makes an ideal focus for this thesis. Chapters 7 and 8 are an exception to this: they examine the global picture.

1.3 Outline

Chapter 2 provides background information on tourism, climate, the coast and climate change. Along with a sketch of the historical development of tourism with particular reference to climate and the coast, chapter 2 reviews the contemporary literature on the relationships between tourism and climate and tourism and the coastal zone. The perspective is then shifted to the future. The causes and impacts of climate change are briefly discussed. This is followed by a review of the literature on the impacts of climate change on tourism. Furthermore, chapter 2 locates this thesis in the aforementioned literature.

The focus of chapter 3 is the role that information about the climate of destinations plays in the destination choice of tourists. This is examined using data from a survey of German tourists carried out in summer 2004. This study examines if tourists actively inform themselves about the climate of their planned destination. In addition, the sources of information they use are determined as well as establishing the phase in the holiday decision-making process where the information search occurs. Another aspect of the survey is the ranking of the most important characteristics of the destination that were crucial for the tourist’s decision to go to the chosen destination. The results are examined using descriptive statistics and hypothesis testing. The methods, data and spatial scale of the studies contained in chapters 3 to 8 are depicted in table 1-1.

Chapter	Method	Source of tourism data	Origin of the tourists	Type of tourism	Spatial Scale	Temporal Scale
3	Descriptive statistics and hypothesis testing	Survey data	Northern Germany	International	Places and countries	Daily
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Table 1-1: Comparison of the methods, data and scales used in chapters 3 to 8. (Chapter 1 is a brief introduction, Chapter 2 a literature review, and Chapter 9 concludes.)

Chapter 4 contains an application of the pooled travel cost model (Maddison 2001; Lise and Tol, 2002) using data on the destination choices of German tourists. The data is taken from a representative survey of German citizens carried out in 1998 about holidays taken in 1997 (FUR, 1998). In addition, data on climate, beach length and indicators of cultural, natural resource and economic attractiveness of the destination countries are used to estimate the demand function. Using the results of the statistical analysis, an index of climatic attractiveness is calculated. For a selection of European destinations, the climate index is recalculated using climate change scenarios. In chapter 4, the complete data set is used for the analysis. In chapter 5, however, the data set is segmented. This is carried out using three different means: first, using phase in the life cycle; second, using holiday motivation and holiday activities; and finally, using regional origin.

Chapter 6 moves away from international tourism and the national scale to the district level to examine the role that coastal and other landscape features have on the attractiveness of destinations for tourism. The focus area is Schleswig-Holstein, the most northerly state in Germany. For this study, the relationship between the average price of accommodation in the coastal districts of Schleswig-Holstein and the characteristics of these districts is examined using the hedonic price technique.

Returning to the international scale, chapters 7 and 8 extend the examination of the impacts of climate change to global tourism, modelling both the demand from countries and the demand for countries. In chapter 7, a simulation model of international tourism is introduced. The current pattern of international tourist flows is modelled using 1995 data on departures and arrivals for 207 countries. Using this basic model, the impact on arrivals and departures through changes in population, per capita income and climate change are analysed. In chapter 8, the model is extended to include domestic tourism and tourist expenditures. The results of the simulation model are discussed with special reference to Germany.

In the final chapter, the results of the previous chapters are summarized, and their relevance to the research field of tourism and climate change, to the tourism industry and to policy is discussed.

Chapter 1

Introduction

1.1 General introduction

Tourism has become one of the world's major cultural and economic activities. Tourists travel to a wide variety of environments, including high-density urban areas and uninhabited regions. The coastal zone, however, is the main destination of tourists. Furthermore, tourism takes place in a wide variety of climates, ranging from the cold of the arctic, to the warmth and humidity of tropical countries and to the dry heat of the desert. As climate varies over the year, tourists have the possibility to experience a destination under a variety of climatic conditions. Nevertheless, there is a distinct pattern of seasonality in tourism demand. In other words, tourists not only choose a spatial location for their holiday, they also choose a temporal location.

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Chapter 2

Context*

2.1 Tourism

2.1.1 An introduction to tourism

Although tourism is economically, socially and politically important, there is still debate over what tourism exactly is. This can be seen in the range of definitions of tourism that can be found in the literature. One commonly used definition of a tourist (and hence tourism) is that of the World Tourism Organisation (WTO):

> "Persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes" (WTO, 2002a, online).

This is a technical definition, which was created to harmonize the different national tourism statistics. Furthermore, it is a demand side definition. Attempts at a supply-side definition have been made but these are also disputed. For example, Smith has developed a definition:

> "Tourism is the aggregate of all business that directly provide goods or services to facilitate business, pleasure, and leisure activities away from the home environment" (Smith, 1988, 183)

For the purposes of this thesis, the term tourism industry will be used as an umbrella term to cover the businesses that Smith includes in his definition. For tourists, the WTO definition will be used. Domestic tourism "is the tourism of resident visitors within the economic territory of the country of reference" (WTO, 2000). International tourism, on the other hand, consists of all trips that tourists make to a country other than that in which they are residents (WTO, 2000).

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* Sections of this chapter are based on Hamilton and Tol (2004).

The demand and supply sides of tourism can also be mapped spatially. Leiper (1979) describes tourism as a system consisting of a generating region, a destination region and a transit zone. Tourists and the tourism industry can be found in all of the regions in the system. At the generating region a tourist's need or motivation to go on holiday develops, which leads the potential tourist to gather information about destinations and activities, and to book or purchase elements of the holiday. The tourism industry is also present in the generating region, for example travel agents, tour operators and transport providers. The tourism industry in the transit zone will mainly consist of transport operators but also of hospitality services. At the destination, the tourist uses the hospitality services, participates in activities and visits attractions. Attractions can range from the natural to the artificial. Artificial attractions may be historical, cultural or purpose built for tourism. Aspects of the natural environment that are attractions for tourism include climate, landscape, beaches, the sea and lakes and mountains (Mieczokowski, 1990). Smith (1988) states that his definition depicts tourism as a retail service industry. Nonetheless, the supply-side of tourism embodies more than just businesses; inherent features of destinations are also “supplied“ to tourists.

Tourism would not take place without the tourist's decision to go on holiday. The process of coming to a decision about whether to go on holiday and where to go on holiday is the subject of holiday decision-making models. The first phase in such models is typically the individual's motivation to go on holiday (Van Raaij, 1986; Gunn, 1989; Ahmed, 1991; Mansfeld, 1992). Motivation is often understood as being composed of two factors: first, push factors that influence the need to have a holiday and the need to leave the origin region; and second, pull factors that generate the need to undertake particular activities and attract tourists to a particular region (Ryan, 2003). The normal environment of the tourist may be a push factor. For example, a stressful urban environment or an extremely wet winter may be motivating factors to take a holiday. The strength of the pull factor will depend on the image that tourists have of the destination, which is a function of the attributes of the destination. Environmental preferences will have a role to play in this (Fridgen, 1984), and, of course, the natural attractions of the destination.

There will be an array of combinations of potential destination regions, potential times to take the holiday and other potential holiday options that may meet the tourist's needs, although these will be constrained by available income and leisure time. The tourist's choice of a particular destination, time and type of holiday represent the observable demand side of the tourism system. Forecasting tourism demand is a large branch of the tourism literature. Typically, these studies do not include environmental factors in the estimation of demand; they focus rather on economic or demographic factors. Morley (1992) criticizes tourism demand studies for this reason, and 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. Lancaster (1966) originally developed the concept that the characteristics of a good are more important to the consumer than the actual good itself. In the case of tourism, the good is the holiday at a certain destination and at a certain time and this product will have certain characteristics. How these characteristics are perceived, in other words the image, will determine the expected utility. Section 3.2.1 deals with the subject of destination image in more detail.

2.1.2 Historical development

The previous subsection introduced the main concepts of modern tourism. However, people have been travelling for business and pleasure since ancient times. This section briefly describes the development of European tourism from the Classical period to the start of modern tourism in the 1950s.

Travel in Ancient Greece was not only for trade and for warfare. People would travel shorter distances to religious and sporting events. Roman roads and a unified coin system made travel easier within the Roman Empire (Mieczokowski, 1990). For young, rich Romans Athens and other Greek cities were part of an educational tour (Towner, 1996). Richer Romans were able to afford second homes either in the countryside or at the coast (and occasionally both). By the first century BC there were many villas scattered in the hills surrounding Rome. This practice spread to other parts of the Empire (Sharpley, 1994). During the Middle Ages, travel was mainly for religious reasons. Long pilgrimages were undertaken and suffering was an expected part of the journey (Mieczokowski, 1990).

The Grand Tour, a long tour of Europe for educational purposes, is thought to have originated in the early 16th century. Those on the Grand Tour would visit Italy as well as the Netherlands, France and Germany. Towner (1985) finds that age, social class and education of those on the Grand Tour changed over the period 1547 and 1840. In addition, an analysis of primary sources of information shows that there were some changes in the spatial aspects of the tour (Towner, 1985). As the social class of the tourists changed and more middle class tourists were going on a tour, the tour gradually became shorter and developed into a summer tour of one or two months.

Spas were popular in ancient times and this popularity was revived in Europe during the Renaissance (Holloway, 1998). During the 16th and 17th centuries, the health-bringing effect of the waters was the main attractions of the spas. In the 18th century, however, the spas were one of the places where the high society met and a trip to take “the cure” was an important part of the social calendar, even if the trip was more for pleasure than health. The clientele at the spas changed over the course of the 18th century; the gentry gave way to merchants and those from the professional classes (Sharpley, 1994). According to Holloway (1998), the life cycle of the spas popularity in the rest of Europe was much longer than in England.

It was the recommendations of English doctors in the mid 18th century that were to popularise sea bathing and holidays at the coast, and so stimulate the popularity of seaside towns and villages, mainly in the south of England, as health and eventually as pleasure resorts (Towner, 1996). The costs of the journey to a resort, both in terms of time and money, restricted the seaside resorts to the wealthy until 1830 (Sharpley, 1994). Then steamer services from London to the coast opened up the seaside resort for the less wealthy. As the domestic resorts became popular with other social groups, the gentry and the aristocracy began to seek exclusiveness elsewhere (Towner, 1996). Advances in transport technology at the end of the 19th Century allowed those who could afford it to travel abroad to seek out the best waters and more exclusive resorts. In particular, the French and Italian Riviera were popular; the Cote d’Azur was the main destination of the European aristocracy (Sharpley, 1994). Across Europe development at the coast for touristic purposes continued up until the First World War (Walton, 1997). In France, development extended into Brittany. The Belgian coast also developed. In Spain, the main resorts were still on the northern coast and this was not to change until the advent of coach and charter flight package holidays. Estoril in Portugal began to compete for the Spanish tourists. Further east resorts could be found in what are now Croatia, Rumania and the Crimea (Walton, 1997).

New and faster modes of transport may have opened up resorts further a field but there were still considerable barriers for the middle classes: these barriers included language, currency, finding a suitable destination and of course suitable accommodation. In 1841, Thomas Cook first began with organised day trips to nearby cities, moving on to interregional tours, trips to Europe from 1855 on, to the United States from 1866 and in 1872, the first round the world tour (Mieczokowski, 1990). Cook's company organised all of the travel arrangements for their clients even providing a form of credit note that could be used at participating hotels or banks (Sharpley, 1994). Cook's tours made tourism available to the wider population. Thus, he is often credited as having brought democratisation to tourism and of developing the fore-runner of the modern package tour (Sharpley, 1994).

In the early 20th century transport innovations, in particular public transport, increased the number of places that were accessible for tourists. With the invention of the car followed by increasing car ownership, domestic motoring holidays became popular (Mieczokowski, 1990). It was not until the 1950s that travel by air became as cheap if not cheaper than travel by the other modes. The first charter flight, using second-hand planes from the airlines, was organised by Vladimir Raitz in 1950 (Holloway, 1998). The first trip to Corsica was a success; Raitz continued to offer package tours, and many other companies in the UK and Europe copied him. The package tour by plane to destinations on the Mediterranean coast became the main tourism product (Sharpley, 1994). The countries of the Mediterranean were less developed than those of northern Europe were. This was not the only reason that made tourism there so popular: the climatic advantage over the north or what Raitz coined "the rush to the sun" was also important (Holloway, 1998).

From this brief review, it can be seen that many forms of tourism that were popular in the past still exist today. Travel for education, sport, religious reasons, social reasons, health and bathing at the sea are still the main motivations of tourists.

2.1.3 Modern tourism

The WTO has documented the rapid increase in tourism since the birth of the package tour in the 1950s. The WTO is the main source of statistics on tourism. Hence, the information contained in the following paragraphs on the size of tourism and its main markets is taken from the latest overview report of the WTO (2005b). There were a total 25 million international arrivals globally in 1950. By 1975 arrivals had increased by over 800% to 222.3 million, and by 2002 global tourist arrivals had reached 702 million.[2] Europe and the Americas had market shares of 66.4% and 29.6% in 1950 respectively. In 2002 these had declined to 56.9% and 16% respectively, and the Asia and the Pacific region overtook the Americas to become the

[2] Preliminary figures for 2004 show tourist arrivals of 763 million (WTO, 2005b).

second largest market (18.6%). For the period 1950 to 2002, the WTO reports that the annual average growth rate was 6.6%. The Asia and Pacific region had a higher than average growth rate of 13%. France, the most popular destination, had 77 million arrivals in 2002, which corresponds to 11% of global market. In second place was Spain (7.4%) closely followed by the US, Italy and China (5.2%).

Also of interest is the distribution of departures. As well as having the most arrivals, Europe generates slightly more than half of all departures (404.9 million). Moreover, 352.1 million of these are within Europe. The other regions also have intraregional shares higher than 70% but these are considerably smaller in absolute terms. Of the interregional flows, the largest are 23 million from the Americas to Europe, 18 million from Europe to the Americas and 16 million from Europe to Asia and the Pacific region.

Tourism receipts have also expanded enormously. In 1950, the global total was US$ 2.1 billion, which had increased to 40.7 billion in 1975 and in 2002, receipts had reached 474.2 billion. Again, Europe dominates with 50.7% of all receipts. The Americas have the second highest market share of 24.1%. In terms of individual countries the US earned 66.5 billion US$ in 2002, which amounts to a market share of 14%. China, Italy, France and Spain all earned more than US$ 20 billion. These countries and the US have a combined market share of 38%. Within Europe the bulk of the receipts are in the countries of Southern Europe[3] and Western Europe[4] with market shares of 34.2% and 36.2% respectively.

The countries of the top ten tourism spenders account for slightly more than half of the global total expenditure. The US, Germany, the UK and Japan had international tourism expenditures of over US$ 20 billion in 2002: the US and Germany with US$ 58 and US$ 53 respectively, corresponding to market shares of 12.2% and 11.2%.

One of the main services provided by the tourism industry is accommodation. For hotels and similar establishments, the WTO recorded 17.4 million rooms globally in 2001. Around one four of these are in the US, roughly one in ten in Japan and one in twenty in Italy, Germany and China. These values reflect the high levels of domestic tourism and country specific patterns of accommodation types.

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[3] Albania, Andorra, Bosnia Herzgovina, Croatia, Former Yugoslav Republic of Macedonia, Greece, Italy, Malta, Portugal, San Marino, Serbia and Montenegro, Slovenia and Spain.

[4] Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands and Switzerland.

As well as collecting statistics on the development of tourism over the years, the WTO provides a long term forecast for the global and regional development of tourism in 2010 and 2020. Tourism arrivals are expected to continue to grow at 4.1%, although there will be regional differences. The WTO (2005a) predicts that the Americas and Europe will experience lower than average growth rates. By 2010, the number of arrivals is expected to reach the 1 billion mark and by 2020, almost 1.6 billion arrivals are expected (WTO, 2005a). Europe Central and Eastern Europe will increase in importance, overtaking Western Europe to have the highest market share. The WTO predicts that by 2020 346 million tourists will visit destinations at the Mediterranean accounting for more than a fifth of all arrivals (WTO, 2001b). France remains the largest destination market within Europe in 2020 but with a decreasing market share. In addition, Germany continues to be the major source market of tourists within Europe. The Indian Ocean region is expected to have an average growth rate of 6.3% and will reach a market share of 11% (WTO, 2001a). China will overtake France to have the most visitors: the WTO (2001a) predict 130 million arrivals.

2.2 Climate, the coast and tourism

2.2.1 Climate, weather and the coast

Climate describes the weather conditions that can be expected at a certain time and place, and is calculated from the average of thirty years of weather data. Weather is the current state of the atmosphere that is actually experienced. The weather is typically described in terms of temperature, humidity, levels and frequency of precipitation, wind, cloud cover and other weather features (Perry and Thompson, 1997).

For humans, weather has a direct effect on physiological functioning. Core body temperature must be maintained to avoid discomfort and in extreme cases life threatening illness. High air temperatures lead to increased body temperatures, if the relative humidity is so high that sweat cannot evaporate. Depending on humidity, heat stress can occur from 26°C. Activity also raises body temperature. Thus, strenuous activities will increase the likelihood of heat stress than passive activities carried out in the same weather conditions. Wind increases the rate that the body losses heat. At higher temperatures this may be wished for; at colder temperatures, however, wind-chill causes the body to lose heat rapidly resulting in increased discomfort and the need for extra clothing. These are the thermal aspects of weather.

In addition, the weather also has neuro-biochemical effects on well-being (Parker, 2001). Sunlight stimulates the production of serotonin (Lambert *et al*., 2002), a neuro-transmitter responsible for mood. Low levels of serotonin are associated with depression, whereas normal to high levels of serotonin are associated with feelings of happiness and relaxation.

According to de Freitas (2001), there are two further aspects of climate that are relevant for tourism: first, there is the physical aspect. Here, the climate facilitates or hinders certain tourist activities whether through rain, wind or snow. For example, wind and rain will make a day of sunbathing at the beach impossible. Second, there is the aesthetic aspect of climate. This may be through the quality of light that affects the appearance of the tourists' surroundings or it may come from the appearance of the sky and of the sea and other water bodies. In the long run, climate has an effect on other elements that fall under the aesthetic category of de Freitas. The appearance of the built environment is influenced by, among other things, climate. Landscape is also influenced by climate. Climate determines the types of crop that are possible to grow and through this the appearance of the cultivated landscape. Moreover, the influence of climate on the types of flora and fauna that exist in a particular area affects the appearance of cultivated environments as well as ones that are more natural.

The coast is the interface of the sea and the land, which Mieczokowski (1990) calls "a junction of seascape and landscape." Coastal tourism can be found mostly on sandy coasts; rocky or marsh coasts are less popular (Wong, 1994). Mieczokowski (1990) divides the coastal zone into four areas that are relevant to tourism: the marine zone, the beach, the shoreland and the hinterland. The beach is the most important of these, as it is where the main tourist activities take place. Defert (1966) differentiates between four kinds of coastal type. First, there is the oceanic type with a large tidal range. The oceanic type may be continuous with long stretches of beach or discontinuous, where cliffs or marshland interrupt the beach. Second, there is the Mediterranean type. Again, this can be continuous or discontinuous. The coast has a special climate. Cooler air from the sea that flows landwards creates a breeze at the seashore. Without this breeze the thermal conditions at the beach would not be as pleasant (Mieczokowski, 1990).

Although attempts have been made to describe the "best" climate or coastal type, it is difficult to determine a generally applicable set of conditions: people have different tastes. Moreover, preferences for certain kinds of climate, landscape or seascape have changed over time. A brief review of historical changes in the relevance of climate and the coast to tourism is given in the following section.

2.2.2 Historical importance of climate and the coast for tourism

In Ancient Rome, countryside or coastal villas were mainly used in summer to escape the heat in the cities (Ryan, 2003). Access to the coastal areas during the summer months was made easier by the road network. The first of Rome's resorts was Baia, near Naples, which was originally a winter spa resort but developed into a summer resort (Sharpley, 1994). According to Sharpley (1994), the Romans introduced the idea of the summer holiday, a form of tourism that died (temporarily) with the Empire.

Seasonality was also an aspect of the Grand Tour. This was partly due to the social season in England but also festivals and conditions at the destination or on transit routes. Towner (1985) states that climate "kept tourists away from southern regions especially in June, July and August." These southern regions had a winter season as opposed to a summer one. Research has shown that tourists moved to the Alban hills from Rome rather than travelling north during the summer heat. Tours of Switzerland were undertaken in summer (Sharpley, 1994).

As stated above, the popularity of coast as a tourist destination began in the 18th century. Historically, the coast was not always as attractive as it is to the modern visitor. Up until the 17th century, the sea and the coast were wholly unattractive and were even seen as disgusting (Corbin, 1999). Corbin (1999) explains the change towards an appreciation and celebration of the coast by the public, and its subsequent popularity for tourism, through the developments in science and the Romantic and Picturesque movements. With the increased popularity came the need for guidebooks. These contained assessments of the physical environment and the climate of resorts. The authors considered factors such as "wind direction and strength, air quality, temperature variations…" (Towner, 1996:201). Moreover, Towner (1996) finds that the southern coasts of Britain were considered superior. Quality of the air was an important factor from the 18th century through to the 20th century. That is, whether it was bracing or soothing. The constitution of the prospective tourist would determine which air quality was suitable (Adler, 1989; Towner, 1996). Towner (1996) mentions a guidebook of 1914, which published comparative assessments of the climate of the English coastal resorts and destinations in Switzerland.

At first, tourism at the French Riviera was during the winter – the tourists were there to escape from the northern winter. The winter season lasted from October until the end of April (Boyer, 2001). The British also visited resorts such as Biarritz in the winter. During the same period, resorts not far away in Spain were popular as summer destinations (Boyer, 2001). In the mid-nineteenth century, Spain had become popular as a destination for international tourists (Walton, 1997). Different resorts and different seasons were popular with domestic and international tourists. For example, Malaga had some popularity with the English as a winter climatic resort. However, the northern Atlantic coast of Spain was popular with domestic tourists (Walton, 1997). According to Walton (1997) the summer season at San Sebastian and other developing resorts was partly to do with the need to escape from the heat of the cities and because of the trend at that time for doctors to prescribe cold and bracing seas.

The fashion of pale skin was replaced by the popularity of the suntan in the 1920s. Previously, white skin that had been darkened with the sun was associated with a lower social status. Now the suntan was associated with wealth. This change in fashion had a large impact on the preferred seasons. The French Riviera became a summer resort as well as a winter one (Boyer, 2001). The popularity of the suntan is still one of the main motives for going on holiday.

From this brief review of the historical importance of climate and the coast for tourism, the following points are evident. First, climate has exerted both a push and a pull effect on the motivation to go on holiday. Second, through the centuries different kinds of climate were considered the healthiest or were fashionable. Third, the popularity of the coast has also seen great changes since the Classical period. The next section looks at contemporary studies on the importance of climate and the coast for tourism.

2.2.3 Review of studies on climate, the coast and tourism

Whether in the process of deciding on the destination and the right time for a holiday or in the daily choices made about recreation activities whilst on holiday, climate and weather play an important role. One would suspect that, "last minute" holidays and short breaks apart, tourist destination choice is affected by the expected weather (climate) rather than the actual weather. For daily recreation choices, actual weather is the decisive factor in decision-making. In the literature, there are two broad types of study where the importance of climate and weather for tourism and recreation has been examined: attitudinal studies and behavioural studies.

Two kinds of attitudinal studies exist, those that examine the subjective rating of climate compared to the ratings from indices of weather data and those that examine the significance of climate in the image and the attractiveness of particular destinations. Thermal comfort indices have been developed in order to capture the complexity of the thermal aspect of climate, which is argued to be a composite of temperature, wind, humidity and radiation. Special modifications of such indices have been used to assess the suitability of certain climates for tourism (e.g. Amelung *et al.*, forthcoming). The basis of these indices, however, is subjective and arbitrary according to de Freitas (2003). In a case study, carried out at a beach in Queensland, Australia on 24 days spread over a single year, de Freitas (1990) finds that the relationship between HEBIDEX, a body-atmosphere energy budget index, and the subjective rating of the weather by beach users is highly correlated. Furthermore, he finds that the optimal thermal conditions for beach users are not at the minimum heat stress level but at a point of mild heat stress. Using the thermal comfort index, predicted mean vote, Thorson *et al.* (2004) find a positive relationship between thermal comfort and urban park use for recreational activities in Göteborg, Sweden. They also find, however, that there is a discrepancy in the subjective rating of the weather and the rating of the weather according to the index. The majority of those surveyed said that the weather was “acceptable” when it was “warm” or “hot” according to the calculated index. These levels are associated with heat stress.

In spite of the popularity of studies of destination image in the tourism literature, only one of the 142 destination image papers that are reviewed by Pike (2002) specifically deals 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 survey of German citizens, the importance of certain destination characteristics was 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). They review several studies from the 1970s and find that “natural beauty and climate” are of universal importance in defining destinations’ attractiveness. In their own study, they examine the image of Hawaii, Australia, Greece, France and China using a survey of Canadian citizens. They find that climate is the second most important characteristic for the group of tourists on a “recreational” holiday. For the group of tourists taking an “educational” holiday climate ranks 12th. When the images of the countries are compared, Hawaii is found to have the most attractive climate. Attitudinal studies looking specifically at tourists' preferences for coastal types were not found.

Some behavioural studies examine daily recreational use patterns of particular sites in terms of weather data. For example, Dwyer (1988) has estimated a daily site use model, for an urban forest in Chicago, USA, using data on noon temperature, percentage sunshine, percentage rain and snow depth. In this study, data on wind-chill is not useful for estimating the use levels. Demand is highest on the sunniest days and on days that are exceptionally warm especially when these conditions occur in late spring or in early summer. High temperatures in July decrease demand. Brandenburg and Arnberger (2001) 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.

Other studies examine the statistical relationship between tourism demand and weather. For example, Agnew and Palutikof (2001) model domestic tourism and international inbound and outbound tourism using a time series of UK tourism and weather data. The results show that temperature is the strongest indicator of domestic demand. In contrast, wetter weather increases the demand for trips abroad in the current period and in the year following. Snow dependent activities are the focus of a survey of US college students carried out in 1997 and 1998 by Englin and Moeltner (2004). Using data on price, weekly conditions at ski resorts in California and Nevada and the participant's income they find that although demand increases as snow amount increases, trip demand is more responsive to changes in price. As said before tourism (as opposed to recreation) is likely to be affected by the expected weather (climate) rather than the actual weather.

Another set of studies uses climate data to capture the role of expected weather in destination choice and consequently demand. Lise and Tol (2002) 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. (Of course, this does not imply that all tourists travel to these places; climate is not the only factor in tourist destination choice.) Bigano *et al.* (forthcoming) confirm this result, using less crude econometrics for a much wider range of countries including African and Asian ones. However, Bigano *et al.* (forthcoming) 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 Southern France than would people from cold places.

Also using climate data, the Pooled Travel Cost Model (PTCM) has been applied to the demand of tourists from the UK and the Netherlands for a range of countries (Maddison, 2001; Lise and Tol, 2002). The studies include temperature and temperature squared in their estimation of demand. The estimated coefficients on these studies allow the optimal temperature to be calculated. That is, where demand for a country is highest. Demand for a country by tourists from the UK is maximized when the quarterly maximum daytime temperature is 31°C. In the Dutch study, the coefficients on the temperature variables were not significant.

There have been some economic studies that examine the demand of tourists for visits to the beach (Bell and Leeworthy, 1990; Chen *et al.*, 2004) and others that seek to examine the economic value of the shoreline (Brown and Pollakowski, 1979). These studies, however, do not use the characteristics of the sites in their estimation process.

2.3 Climate change and tourism

2.3.1 Climate change

Climate scientists have observed that over the 20th century that the climate has been changing. The earth's climate has changed at other points in history. Nevertheless, there is a consensus among climate scientists that the change occurring now is unlike previous changes in that it is partly influenced by human activity. The IPCC compiles the latest scientific evidence of climate change and the predictions of climate change for the coming decades from the various general circulation models. The information in this and following paragraphs is drawn from the publications of the IPCC (Houghton *et al.*, 2001; McCarthy *et al., 2001*). From the 11th to the 20th century, the 1990s was the warmest decade. In addition, 1998 was the warmest year since recorded history. Other evidence for climate change can be seen in the shrinkage of the glaciers, thawing of permafrost, the extension of growing seasons and in the shift in the range of animal and plant species. For the 21st century a temperature rise of 1.4°C to 5.8°C is predicted. This increase will occur at a rate higher than that seen in the 20th century. In addition, precipitation patterns are predicted to change. In mid to high latitudes of the northern hemisphere precipitation is predicted to increase in winter whereas at low latitudes of both hemispheres there will be increases and decreases depending on the region. Model predictions estimate that snow cover and sea ice will decrease in the northern hemisphere. Moreover, glaciers and ice caps will continue to shrink. It is likely that there will be changes in the frequency of extreme climate events. A further effect of climate change is sea level rise, which will be dealt with below.

Changes in human activities since the industrial revolution are the main anthropogenic causes of climate change. The most significant of these is the use of fossil fuels as an energy source. The combustion of fossil fuels results in the production of the gases carbon dioxide, methane and nitrous oxide. These gases belong to the group of gases found in the atmosphere called greenhouse gases, which, because they reflect infrared radiation in all directions, create an effect known as the greenhouse effect - more energy enters the earth's atmosphere than leaves the atmosphere. As the concentration of these gases increases in the atmosphere, the greenhouse effect is enhanced and consequently the atmosphere warms. Fossil fuel combustion also results in the emission of aerosols. In addition, the emission of CFCs and other compounds deplete the ozone layer adding to the radiative forcing. Emissions are not the only anthropogenic source of disturbance to the climate system: changes in land use also influence the greenhouse effect. Urbanisation and agriculture change the physical and biological properties of the earth's surface.

Warming not only affects the climate it also affects the global sea level. As the atmosphere warms the volume of the seas and oceans increases through thermal expansion. Glacier loss and ice cap shrinkage also contribute to the increase in sea level. In the 20th century, it was observed that the sea level increased by 10 to 20 cm. For the 21st century, however, an increase in sea level of 9cm, for the low emissions scenario to 88cm, for the highest emissions scenario is predicted. Tectonic movements will affect the regional net sea level rise. According to Nicholls and Hoozemans (1996), the main impacts of sea-level rise are erosion, inundation, an increased risk of flooding and impeded drainage, salinity intrusion and higher water tables.

Climate change will affect ecosystems. In particular, the following systems are at risk: glaciers, coral reefs, atolls, mangroves, tropical forests, polar and alpine ecosystems and prairie wetlands. It is expected that many species will be lost leading to a decrease in biodiversity.

There will also be major impacts for human systems. These can be summarised in the following categories: changes in the availability of water resources, changes in agricultural crop yields, impacts on the coastal zone, the effects of flooding on settlements, changes in energy requirements and impacts on human health.

What impact will climate change have on tourism? This can be through two means: directly through the changed climate and indirectly through the environmental changes brought about by climate change. In both cases, these impacts will occur at the origin country or region and at the destination country. These impacts will be discussed in the following section.

2.3.2 The impact of climate change on tourism and recreation

Climate change impact studies can be categorized as qualitative and quantitative. Qualitative impact studies provide information about vulnerabilities and the likely direction of change; nevertheless, they do not provide estimates of changes in demand. Quantitative impact studies can be categorized further into three groups: first, studies that predict changes to the supply of tourism services; second, studies that use tourism climate indices to predict the change in climatic attractiveness and finally, studies that use the statistical relationship between demand and weather or climate to estimate the change in demand.

Qualitative studies rely on experts' opinions on the likely impact of climate change. For example, Perry (2000) discusses the impact that climate change will have on tourism at the Mediterranean. The main impact caused by an increase in temperature will be a "doughnut" shaped pattern of demand: in the shoulder season there will be more visits than in the summer season. In addition, he expects that there will be an increase in the demand for long winter holidays particularly from the older generations. The indirect effect of enhanced beach erosion caused by sea level rise will reduce demand and increase the need for planning restrictions in the coastal zone. According to Gable (1997), Caribbean coastal areas will also experience a drop in demand through beach loss. Viner and Agnew (1999) describe the current climate and market situation for the most popular tourist destinations of the British. In addition, the consequences for demand for these destinations under a changed climate in the 2020s and 2050s are discussed. Currently warm resorts such as those in the Eastern Mediterranean are expected to become less attractive as temperature and humidity increase. As summer weather becomes more favourable and reliable in temperate countries, tourism is expected to increase. All of these studies rely on a synthesis of existing work on the physical impacts of climate change or on the expert opinion of the authors; a direct link with demand (or supply) of tourism is not made. Nevertheless, these studies highlight the range of impacts that climate change will have. One qualitative study, however, has involved the tourism industry. This a study by Krupp (1997), where tourism experts from the local tourist industry discussed the impact of climate change on tourism in the West coast of Schleswig-Holstein in Germany. Krupp finds that an increase in summer precipitation will reduce the willingness of the tourism industry to make new investments in tourism infrastructure and facilities.

Predicting changes in the supply of tourism services has been applied to the winter sports industry. Breiling and Charamza (1999) analyse, for all districts in Austria, the impact of a 2°C change in temperature on seasonal snow-cover depth. They estimate that these changes will reduce ski season length and the usability of ski facilities. Warming will have strong impact on low altitude resorts, which the authors expect will disappear first and the remaining resorts will become more expensive. Similar studies have been carried out for winter sports tourism in Scotland (Harrison *et al.*, 1999), Switzerland (Abegg, 1996; Elsasser and Messerli, 2001), Finland (Kuoppamaeki, 1996) and Canada (Scott *et al.*, 2001). These studies find a general decline in natural skiing conditions, although this will be less of a problem at high altitude sites. Moreover, the use of snow making machines is also temperature dependent, which restricts the adaptation options available.

The index approach, discussed in section 2, has been used to examine the impact of climate change on the climatic attractiveness of tourist destinations. Scott *et al.* (2004) 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 scenarios of (the lower and middle bounds of) climate change for the 2050s and the 2080s. The attractiveness of the cities improves in both time slices. Improvements in spring are the largest of all the seasons. The authors predict an increase in revenue from tourist accommodation for Canadian cities. Amelung *et al.* (forthcoming) also use a tourism index to analyse tourism potential for Europe. The attractiveness of a location for tourists depends on temperature, precipitation, humidity and wind in a very non-linear way. They calculate the index values for a spatial resolution of 0.5˚ x 0.5˚ using monthly data for the 2020s, 2050s and the 2080s. The results show that climate change would shift tourists towards higher latitudes and altitudes. In addition, there would be a shift from summer to spring and autumn in some destinations and from spring and autumn to winter in other destinations.

There are studies that examine the impact of climate change on recreation demand. For example, the impact of climate change in the US on eight recreation activities is 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 in 2060, 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) estimate the impact of climate change on a range of recreation activities using the same climate change scenario and timeframe as Loomis and Crespi (1999). 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 to the Rocky Mountain National Park in Colorado. Moreover, depending on the climate scenario, they estimate an increase in recreational visits from 9.9% to 13.6% in 2020. These three studies examine domestic demand within the United States either at site level or for each state, and although they refer to recreation tourist trips (involving an overnight stay) have been included in their data.

Agnew and Palutikof (2001) examine national demand for domestic and international tourism. They find that a 1°C increase in the summer temperature leads to a 1%-5% increase in UK domestic demand. Another UK study finds that the number of visits and the consumer surplus per year increase as the temperature increases although only until the optimal maximum daily temperature (Maddison, 2001). More specifically, Maddison (2001) finds that for a climate change scenario for the 2030s, a temperature increase of 2°C and a reduction in precipitation of 15% in summer, leads to a 1.3% reduction in trips from the UK to Greece and a 2.2% increase in trips to Spain. For the other seasons, there are increases in the number of trips and in the consumer surplus.

2.4 Conclusion

Tourism has developed from its beginnings in the Classical period to an industry that generates over 700 million international arrivals. Estimates for the 21st century expect arrivals to reach 1.6 billion by 2020. Climate has been shown to be both a push and a pull factor since the Classical period. Despite the unpopularity of the coast up until the 17th century, it has developed into one of the main tourist destinations. For these reasons, climate change, in terms of the direct effects such as temperature or precipitation changes as well as ancillary effects such as sea-level rise, is likely to have considerable impact on tourism. A review of the literature on the impacts of climate change on tourism highlights the following gaps: first, the coverage of countries and activities has been piecemeal. Second, substitution between countries has not properly been considered. Third, existing studies focus on particular origin countries or on particular destinations: the global picture is neglected. Fourth, there have not been any studies that look directly at the impact of sea-level rise on coastal tourism. The following chapters deal with these gaps.

Chapter 3

The role of climate information in tourist destination choice decision-making*

3.1 Introduction

Chapter 2 shows that the impact of climate change on tourism has been examined quantitatively in several different ways. There are economic theory based studies that involve estimating the demand for destinations using various climate variables (see Maddison, 2001; Lise and Tol, 2002; chapters 4 and 5 of this publication). Related to these studies are global models of tourism flows that include temperature as a determinant of the flows of tourists between countries (Berrittella *et al.*, in press; chapters 7 and 8 of this publication). There are also studies that use tourism climate indices to predict the effect of a changed climate on tourism demand (Scott *et al*, 2004; Amelung *et al*, forthcoming). The third group of studies combine climate variables in a more complex way to reflect the thermal, physical, and aesthetic properties of climate. The first two groups take a more simplistic approach: they include temperature and up to two other climate variables. Some researchers argue that this reduces the applicability of such studies. Moreover, de Freitas (2003) argues that climate data expressed as an average, as used in the economic studies mentioned above, has no psychological meaning. Nevertheless, the economic theory based studies and the global models base their analysis on the actual behaviour of tourists, in other words actual destination choices. A tourist's choice of destination will be based on what they expect from the chosen destination. Furthermore, what tourists expect will be driven by the image that they have of the destination. Of course, weather is not experienced as a set of separable and independent attributes but as a complex impression. In terms of climate, this leads to the question: do tourists have an image of the climate of their intended holiday destination and if so, how was this image formed? Moreover, it is unclear whether tourists form a complex picture of climate or if information on a few key attributes tells them enough about climate to construct an image. Lohmann and Kaim (1999) note that there is a lack of empirical evidence on the importance of climate on destination choice decision-making. In contrast to the German travel surveys reported on by Loh-

* This chapter is based on Hamilton and Lau (2005).

mann and Kaim, this study is focussed on climate image and climate information. This is the first study of its kind, and there is a considerable gap to be filled.

After considering the aforementioned issues, the following research questions have been formulated:

A: How decisive is climate as a factor in decision-making?

B: At what point in the holiday decision-making process do tourists gather information about climate and weather?

C: What sources of climate information are most frequently used?

D: What are the most frequently used types of climate information?

In order to gather data to answer these questions, a survey of tourists departing from Hamburg and its vicinity was carried out during July and August 2004. The survey produced 394 useable completed questionnaires. The questionnaire provided details on the current holiday, on destination image, on information sources, on the type and presentation of information and on demographic details of the respondents.

This chapter continues in the second section with a review of the literature related to climate and tourism demand, tourist decision making and destination image and develops the hypotheses. The third section presents the research design. The results of the study are presented in section four. The fifth section discusses the implications and the limitations of this study and concludes.

3.2 Literature review and hypothesis formulation

Morley (1992) criticizes tourism demand studies, which typically focus purely on economic factors, because they do not consider utility in the decision making process.[5] 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. Lancaster (1966) originally developed the concept that the characteristics of a good are more important to the consumer than the actual good itself. How these characteristics are perceived will determine the expected utility. In the case of tourism, the product is the holiday at a certain des-

[5] For an extensive review of tourism demand studies see Witt and Witt (1995) and Lim (1995).

tination and at a certain time, and this product will have certain characteristics. Knowledge of destination characteristics will be limited for a first time tourist. As climate can be temporally as well as spatially defined, even repeat visitors will not necessarily have experienced all seasons at the destination. Limits to knowledge lead Um and Crompton (1990) to argue that “the image and attitude dimensions of a place as a travel destination are likely to be critical elements in the destination choice process, irrespective of whether or not they are true representations of what the place has to offer” (Um and Crompton, 1990, p. 433).

The final choice of destination is the result of a decision-making process that involves the use of information, whether from personal experience or through an active search, to generate an image of the destination. This section develops the hypotheses related to destination image, to decision-making and information search as well as to climate information for tourists.

3.2.1 Destination image

There are many different definitions of what destination image actually is (Gallarza *et al*., 2002). There is, however, a consensus that destination image plays an important role in destination choice. What role does climate play in destination image? Not all studies of destination image include climate as an image defining attribute, as can be seen in the extensive review of destination image studies by Gallarza *et al*. (2002). Of the 25 destination image studies reviewed, climate was included as an attribute in 12 studies. Nevertheless, from the list of 20 attributes used in all of the studies reviewed, climate is the seventh most frequently used attribute. Studies of destination image, that include climate/weather as an attribute, find that it is one of the most important attributes. There are, however, differences in the preferences shown by different types of tourists and for tourists from different places (Hu and Ritchie, 1993; Shoemaker, 1994; Kozak, 2002; Beerli and Martin, 2004).

Only one of the 142 destination image papers reviewed by Pike (2002) specifically deals with weather. This was a study by Lohmann and Kaim (1999), who assess, using a representative survey of German citizens, the importance of certain destination characteristics. Landscape was found to be the most important aspect even before price considerations. Weather and bioclimate 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. In a study by Gössling *et al*. (2006) of tourists surveyed in Zanzibar, tourists were asked to rate climate’s importance for their decision to travel to Zanzibar. More than half rated climate important but a small share of the respondents (17%) stated that climate was not important at all. Based on the existing literature, it seems that climate is an important factor for tourists when choosing their holiday destination. Thus, the following hypothesis has been formulated:

Hypothesis A1:
Destination climate is an important consideration for the choice of destination.

3.2.2 Decision-making and information search

Fridgen (1984) expands on the five-phase model of recreation behaviour of Clawson and Knetsch (1966). The five phases are anticipation, travel to the site, on site behaviour, return travel and recollection of the trip. The anticipation phase includes decision-making and preparation for the holiday. According to Fridgen (1984), tourism decision-making involves environmental preferences and the cognitive image of what tourists expect from the destination. Other models of decision-making in the tourism literature contain a number of stages. Among these stages may be the motivation to go on holiday, information gathering and evaluation of the holiday, which may include feedback loops into the next holiday decision (see, for example Van Raaij, 1986; Gunn, 1989; Ahmed, 1991; and Mansfeld, 1992). The temporal aspect of the holiday decision, in other words when to go on holiday, is absent from these models of decision-making. Sirakaya and Woodside (2005) distinguish between behavioural and choice set approaches to decision-making. According to them, behavioural approaches seek to identify the different stages in the decision-making process and the factors that influence the process. Choice set approaches involve identifying the various destinations that are in the awareness set and following an active information search, an evoked set develops (see, for example, Um and Crompton, 1990). From the latter set, the final destination is chosen. In both of these models, the tourist assesses the destination options available using information acquired from their search and gradually eliminates the options that do not meet their needs. In both cases and in the studies discussed above, information is gathered in order to make the decision.

Hence, the hypothesis is formulated as:

Hypothesis B1:
Tourists gather climate information before they make their concrete holiday decision.

Information on the current weather at the destination or predictions for the weather in the coming week can only be used to make decisions about destination choice at the very last minute. Therefore, it is assumed that tourists gather weather information in order to prepare for their holiday and make any necessary adjustments to the clothing or equipment that they will take with them. They may also do so to adjust their image of the destination according to the current situation and so modify their expectations. This leads to the following hypothesis:

Hypothesis B2:
Tourists gather weather information in preparation for their holiday**.**

Closely related to the time of information gathering is the question of which information sources are used. The destination image studies that take climate and weather into account do not consider this factor, whereas another group of studies focus on information search strategies but do not specifically look at climate information. Three distinct information search strategies are classified by Fodness and Murray (1998 and 1999). First, there is a spatial element. The information search can occur internally, that is information from the individual's own memory, or it can occur externally, through the acquisition of information from sources such as travel agents or friends and family. Second, there is a temporal element to the information search. Tourists may continually be gathering information for their holiday or they may do so only when they are planning to go on holiday. The third aspect of the search is operational, which reflects the type and number of sources used. In a survey of American tourists who travelled to Florida, 68% of the tourists used more than one source in their information search (Fodness and Murray, 1998 and 1999). The sources most likely to be used on their own were: personal experience, travel agencies, and friends and relatives. For a repeat visit, which involves less complex problem solving than a first time visit, Fodness and Murray (1999) argue that personal experience will be favoured. In their results, however, an external source of information - friends and relatives - was the main source. For those tourists with a longer decision period, possibly reflecting a first time visit, friends and relatives is also the main source followed by auto club and travel agent. This study uses the length of planning period but the actual type of decision, that is whether it was a first time visit or a repeat visit, is not made explicit. Van Raaij (1986) argues that novel destination possibilities and expensive holidays will necessitate an extensive information search. As the following analysis concerns itself with international tourism trips, the holidays under consideration are likely to be one of the major purchases by a household. Not only this, a holiday abroad is a significant event. Therefore, it can be assumed that the majority of the tourists will use several different information sources. Four information source categories were examined by Baloglu and McCleary (1999). These were professional advice, word of mouth, advertisements and books/movies/news. Word of mouth was ranked highest in terms of its importance for forming an image of the destination. The least important category was advertisements. In addition, they find that the mean number of sources used in their sample to be 3.75. In a study on the destination image of India, tourists used several different information sources. Friends and relations was the main source for more than half of the tourists (Chaudhary, 2000). From the above, the following hypotheses have been formulated:

Hypothesis C1:
Tourists rely on more than one information source.

Hypothesis C2:
'Friends and family' is the dominant information source category for first time visitors.

Hypothesis C3:
'Own experience' is the dominant category for repeat visitors.

3.2.3 Climate information

Types of climate information can be examined in terms of content as well as presentation. De Freitas (2003) 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. Since climate is complex, it is assumed that tourists are motivated to inform themselves about different aspects of it. Therefore, we formulate the hypothesis as:

Hypothesis D1:
Tourists gather climate information on several different attribute types.

The studies that analyse the demand for destinations in terms of characteristics include variables for temperature and in some cases precipitation and the number of wet days in the demand function (see Loomis and Crespi, 1999; Mendelsohn and Markowski, 1999; Maddison, 2001; Lise and Tol, 2002; Berritellla *et al.*, 2006; this publication chapters 4, 5 and 7). Moreover, in the studies that use tourism indices, such as Scott *et al.* (2004) or Amelung *et al.* (forthcoming), temperature plays a greater role than any other climate variable. The tourism climate index, developed with regard to the biometeorological literature on human comfort, consists of five sub-indices. The sub-indices contain seven climate variables, three of which are temperature ones (mean, maximum and minimum temperature). The two sub-indices that contain the various temperature variables account for 50% of the weighting in the tourism climate index (Amelung *et al.*, forthcoming). As temperature is an important factor in both behavioural and biometerological studies of tourism and climate, the following hypothesis has been formulated:

Hypothesis D2:
Temperature is the dominant attribute for climate information.

There is little guideance in the literature on the optimal way that climate information should be portrayed. De Freitas (2003) argues that a climate index would be the most appropriate way to present climate information to tourists. Nevertheless, no studies were found, where the preferences of tourists for different formats are tested. From a survey of the Internet and print sources of climate information, it can be concluded that there are many different ways of presenting such information. There was, however, no clear tendency towards a particular presentation form. For this reason one of the possibilities for the hypothesis has been chosen, which has been formulated as:

Hypothesis D3:

Tourists prefer a textual format for the presentation of climate information.

The nine hypotheses and the related research questions are shown in figure 3-1. This figure depicts the phases of potential image change indicated by the various grey shades. The tourist has an image before planning that may change during the actual planning process and even after the decision for a specific destination has been made. Although not examined in this paper, the tourist's image could also change after the experience of the holiday.

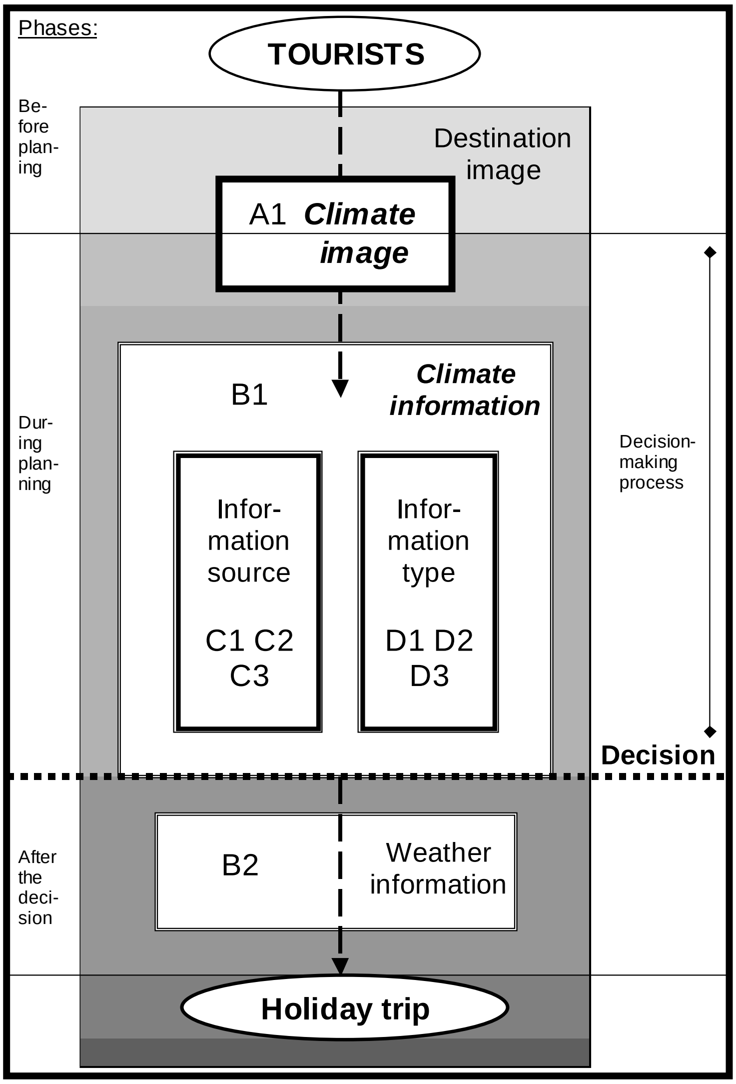

Figure 3-1: Conceptual model with hypotheses of the role of climate information in the tourist decision-making process

3.3 Research Design

The fact that this study includes not only the questions of which information sources and which information types but also emphasizes the time of information gathering lead to the choice of a specific point in time to survey tourists – shortly before departure. This allowed the travelpreparation phase to be included. The study population are those residents of Germany going on an outbound holiday and departing from Hamburg and its vicinity. Our sampling frame consists of those tourists departing from Hamburg and its vicinity at specific points of departure: the airport, the train station,[6] the international bus terminal and the harbours of Travemünde and Kiel (for ferries to Scandinavia).[7] The convenience sample consists of those tourists travelling on the selected days and on the selected departures. All participants were aged 16 or over and resident in Germany. Additionally, only one person out of a travel party was asked to take part in the survey. Business travellers have been purposefully excluded from the sample.

The following quotas were paid attention to:

1) Destination countries according to the market shares from the Reiseanalyse (FUR, 1998 and 2004)

2) Transportation mode market shares also from the Reiseanalyse (FUR, 1998 and 2004)

The survey was carried out on 20 days spread over the months of July and August 2004. The days and times of the survey were chosen to correspond with departures to the countries with a high quota. The study period covered the main parts of the local school holidays.[8] The schedule and budget of this study did not allow for an inclusion of car travellers according to the market share of about one third of all travellers. Therefore, this group was left for future research. The quotas, therefore, corresponded to the relative market shares of the other transport modes.

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[6] Car-train departures to southern Europe from the station Hamburg-Altona were chosen. This gave us direct access to tourists travelling abroad by train, whereas with the normal international trains it would have taken a lot of time to locate the international travellers as domestic travellers also use the international trains.

[7] There are no international ferries departing directly from Hamburg.

[8] The six-week long school holidays of the states of Hamburg, Schleswig-Holstein and Mecklenburg-Pomerania were partly covered by the study period. For the states of Bremen and Lower Saxony, the school holidays coincided with the study period.

While creating the questionnaire a group of specialists was consulted, who then commented on the preliminary versions of the questionnaire. These were tourism experts from academia as well as professionals from the tourism industry and others from the fields of marketing and quantitative research. A two-step pilot study was carried out at the end of June with two different groups: tourists leaving from Hamburg Airport and a group of randomly chosen students. The comments of the experts and the results of the pilot phase were used to reformulate individual questions and improve the structure of the questionnaire, and so improve the overall intelligibility.

The following provides an overview of the relevant questions from the questionnaire that were used in this analysis. The first section of the questionnaire includes general questions on the holiday: the destination country, the length of stay and the organizational form of the trip. This section is largely oriented on the Reiseanalyse (FUR, 1998 and 2004) in order to guarantee comparability to other studies. As far as possible, these questions are in multiple-choice format. Another section contains two questions that identify the main image attributes and the main information sources. See table 3-1 for details of the sources used to formulate these questions. The next section begins with a filter question about whether the respondent had been to the destination country before. If answered positively, the respondents are then asked to complete five additional questions. After this, there is another filter question on whether the respondent had informed themselves about the climate of their destination. If answered positively, another block of five questions follows. The questionnaire closes with a section containing demographic questions that provide details on the respondent's place of residence, gender, age, and education level.

3.3.1 Hypothesis A1

This hypothesis is tested by examining if climate is at least the third most important attribute for the choice of destination. In order to assess this the respondents were asked to rank the three most important attributes out of ten attributes. The ten attributes were chosen according to an analysis of the attributes that were found to be the most important[9] for tourists in studies on destination image (see table 3-1 for the sources used). This ranking question was deliberately put on the first page of the questionnaire. Respondents were not told in advance the spe-

[9] The five highest valued attributes from each study were taken and the frequency that each attribute appeared over all the studies was calculated. The ten most frequent were then taken from this list.

cific focus of the questionnaire. This way the individual's perception of the importance of climate could be assessed before the respondent became aware that climate was the main theme of the questionnaire.

Tested attributes	Source of attributes
Destination image	Baloglu and Mangaloglu (2001), Baloglu and McCleary (1999), Kozak (2002), Lohmann and Kaim (1999), Gallarza *et al*. (2002), Hu and Ritchie (1993) and Yuan and McDonald (1990)
Information sources	Baloglu and McCleary (1999), Chaudhary (2000), Fodness and Murray (1999) and Phelps (1986)
Type and presentation of information	own research of online weather information providers, online travel guides, information provided online by travel agents, tour operators, foreign offices and tourist boards, and print travel guides
General information on the trip and demographic information	FUR (1998 and 2004)

Table 3-1: Sources of attributes for the questionnaire

The assumption that climate information is indeed important within the decision-making process purposefully does not mean a particular climate, e.g. as Baloglu and Mangaloglu (2001) do when using the attribute 'good climate'. This is unclear, as it could mean either a good climate according to the individual's preferences or a good climate for certain activities that the tourist prefers to undertake while on holiday. It is assumed that some tourists will search for warmer places to go, others may prefer a cooler climate than they experience in their home region at the same time of the year and some may be completely indifferent. Moreover, the individual's perception of the climate at the destination as being 'good' may be influenced by the home weather at the time of booking. In the region of Hamburg, where the survey was undertaken, the summer of 2004 was comparatively cold and wet. In this study only climate is referred to and not a valuation of it.

3.3.2 Hypotheses B1 and B2

Motivated by the decision phases formulated in the studies by Fridgen (1984), Ahmed (1991) and Mansfeld (1992) three distinct phases of information gathering have been derived. The first phase is limited to the time before the tourist decides to go on holiday. It is not an active information gathering phase, since an image of the climate of the destination may be there already either through previous experience in the country (or comparable climatic regions) or through knowledge gained from a general interest in the area. The second phase covers the period after the tourist is motivated to go on holiday but has not made the actual decision of where and when. In this phase, information is actively gathered in order to make these decisions. The third phase includes information gathering in preparation for the holiday. This is carried out after the decision has been made but before the actual trip.

The hypotheses B1 and B2 are tested using the results of two questions. The first question asks the tourists to state when they informed themselves about climate. There were seven options, which belonged to the following three groups: *before planning, during planning* and *after the decision,* which correspond to the phases 1 to 3 respectively. The tourists were given the opportunity to choose more than one option. The second question concerns the actual weather at the destination before the trip: the tourists were asked whether they had been following the weather during the week before their holiday.

Pinpointing the time at which information is gathered also contributes to the analysis of climate as an important factor in decision-making (see hypothesis A1). Information gathering *during planning* indicates a decisive character, while *after the decision* indicates, for example, an adaptation of clothing to the climate and does not play an important role in the decision to go to the destination.

3.3.3 Hypotheses C1, C2 and C3

A question on the sources of information about the destination in general was included in the questionnaire. Information sources for general information on a destination may be different from the sources used for climate information. From the review of the studies shown in table 3-1, 12 possible sources of information were compiled, including *friends and family* and *own experience* as well as weather information providers. The latter was included not only because of the purpose of this study but also because such sites contain information about destinations and links to online travel agents, tour operators and airlines.

In order to test the hypotheses, the exact same sources were included in a question specifically focusing on climate. The tourists were asked to rate, on a five point Likert scale, the actual information sources used according to the importance for the decision. A filter question on previous visits is used to establish the two groups of first time and repeat visitors.

3.3.4 Hypotheses D1, D2 and D3

In these hypotheses, the presentation of information is examined separately from the content of the information. An examination of typical sources of destination information and destination climate information resulted in the inclusion of the following presentation categories: text format, maps, diagrams and numerical data (see table 3-1 for the sources). The various information sources provide different types of climate information, these range from several temperature types to precipitation related information and less frequently mentioned attributes such as humidity or UV-radiation.

3.4 Analysis

3.4.1 General results

Not all of the tourists asked to participate in the survey agreed to take part. The response rate differed in two ways: first, between July and August and second, according to the departure point where the survey was carried out. Generally, July showed a better response rate (of 2:1 and even better) than August. The response rate at the airport was generally not as high as at the bus terminal, train station or ferry terminal. At the airport, the choice of terminal had an effect. The survey was easier to carry out in the charter flight terminal, where the response rate was 3:1 during August, whereas at the terminal for scheduled flights there was a response rate of 10:1 on some survey days. In total, 413 questionnaires were returned. Questionnaires where core questions were unanswered had to be removed from the sample, and so 394 questionnaires could be coded.

Table 3-2 shows the demographic profile of the tourists surveyed. Compared to the age structure from the Reiseanalyse data from 1998 (FUR, 1998), this survey has a more distinctive bimodal pattern, which can be seen by the larger shares of tourists in the 20-29 and 40-49 age groups and a much smaller share in the 30-39 age group. The male/female split corresponds to that of the current population of Germany. Compared to the Reiseanalyse from 1998, this survey has a much larger share of those with a degree or who have a university entrance diploma.

National statistics cover the age group 25-64 and are based on completed years of education,[10] which makes a comparison with the results of this study difficult.

	Mean	Frequency
Age (n=377)	40.3	
16-19		9.0%
20-29		28.9%
30-39		18.3%
40-49		21.5%
50-59		10.1%
60-69		11.4%
70-79		0.8%
Gender (n= 387)		
Male		48.8%
Female		51.2%
Place of residence (n=362)		
Hamburg		34.5%
Northern Germany		51.7%
Other within Germany		13.8%
Education (n=378)		
Completion of compulsory education		40.2%
University entrance diploma		27.5%
Higher education		31.7%
No qualifications		0.5%

Table 3-2: Descriptive profile of respondents (n=394)

In addition, questions were asked about the respondent's current holiday, the results of which are presented in table 3-3. The average length of the holiday is 14.3 days, which corresponds to the average length of holiday (13.7 days) reported for the Reiseanalyse 2004 (FUR, 2004). Surprisingly, a large share of the holidays were organised independently.[11] The shares for package tours and booking through a travel agent are similar to those categories for international trips in the Reiseanalyse 2004. As mentioned above, quotas have been used to get a representative spread of holidays to the most popular countries for German tourists. Nevertheless, an important group of tourists, those travelling to their destination by car, could not be included. Countries that are very popular but are typically travelled to by car, Austria, Swit-

[10] This includes time spent gaining technical qualifications, which were not included in the options for level of education.

[11] The Reiseanalyse (FUR; 2004) examines direct booking with the providers of accommodation, whereas in this study the "individual" category includes both transport and accommodation.

zerland, Poland, Denmark and the Netherlands, are underrepresented in the survey. In addition, the share of long-haul trips is smaller than that of the Reiseanalyse 2004. It must be taken into consideration, however, that the Reiseanalyse covers a whole year. This study concentrates on the summer and it is logical that there would be less of a tendency to travel far, when Europe is at its most attractive climatically. Finally, the majority of respondents had visited their destination previously.

		Mean	Frequency
Duration of stay (n=388)	in days	14.3	
Less than one week			14.4%
One week			17.5%
One to two weeks			19.1%
Two weeks			27.1%
Two to three weeks			9.8%
Three weeks			4.9%
Three to four weeks			1.0%
Four weeks and more			6.2%
Holiday organisation (n=393)			
Independent			42.5%
Travel agents (but not a package tour)			20.6%
Package tour			32.3%
Other			4.6%
Destination (n=394)			
Spain			25.4%
Greece			8.9%
France			7.1%
Italy			6.3%
Croatia			5.3%
Hungary			5.3%
Turkey			5.3%
Bulgaria			3.8%
Sweden			3.8%
Tunisia			3.8%
Other European			20.1%
Other non-European			4.8%
Previous visit to the destination (n=391)			
No			36.8%
Yes			58.6%
No response but answered the follow up questions			4.6%

Table 3-3: Descriptive profile of holidays (n=394)

3.4.2 Research question A: climate as a factor in decision-making

The tourists were asked to pick the three attributes from a list of ten that were most important in their decision to go to the destination, and rank them. 94% of the respondents provided a useable ranking of the attributes. From table 3-4, it can be seen that only two attributes are chosen more often than they are not chosen: namely climate and access to the sea/lakes. Not only was climate the most frequently chosen attribute, it also achieves the highest ranking of all attributes. The t-test for related samples was used to test if the mean rank value of climate is significantly different from that of sea/lakes, culture/history and nature/landscape, the three attributes closest in popularity to climate. Table 3-5 presents the results of this test and shows that the mean of climate is significantly different from the other three attributes. For that reason, the hypothesis that climate is at least the third most popular attribute can be accepted. Indeed, it is the most popular attribute for the tourists in our survey.

	1st position value = 3	2nd position value = 2	3rd position value = 1	Not chosen value = 0	Total Chosen	Mean
Access to the sea/lakes	53	79	56	182	188	1.01
Accomodation	14	33	22	301	69	0.35
Climate	**91**	**65**	**40**	**174**	**196**	**1.20**
Cuisine	2	12	10	346	24	0.11
Cultural/historical attractions	60	50	33	227	143	0.85
Ease of access	3	22	23	322	48	0.21
Hospitality	17	38	35	280	90	0.44
Nature/Landscape	62	58	36	214	156	0.91
Price	17	61	48	244	126	0.60
Sport and leisure activities	8	22	19	321	49	0.24

Table 3-4: Results of the ranking of destination attributes (n= 370)

	Mean	T-value	2-Tail sig.
Climate and Nature/Landscape	0.28	2.701	0.007
Climate and Access to the sea/lakes	0.19	2.228	0.027
Climate and Cultural/historical attractions	0.35	3.242	0.001

Table 3-5: Mean differences between destination attribute rank values (n= 370)

Almost two thirds of the respondents said that they had informed themselves about climate before their holiday. A further 10% answered the questions on climate information, even though they said that they did not inform themselves about climate or they did not give answer to the question at all.

3.4.3 Research question B: decision-making process and information search

To examine this research question seven multiple-choice options, which were converted into three stages: *before planning the holiday*, *during the planning* and *after the decision* (has been made to go to the destination). The most common phase for gathering information about climate is during the planning stage (42%). Nevertheless, “shortly before the holiday” was the most frequently chosen single category (34%). Moreover, for those that only chose one category, the split between the three phases, *before planning*, *during planning* and *after the decision* is 25%, 35% and 39% respectively. The majority stated only one phase where they gathered climate information. Of the tourists that combined two or more options, 61% combined the phases *during planning* and *after the decision*. The hypothesis B1 that tourists gather climate information before they make their decision is accepted but with the caveat that the group of tourists informing themselves after the decision is also considerable.

In addition to the results presented above, the analysis is extended to whether the respondents had been following the weather at their destination during the week before their departure. The majority of respondents (59%) had been following the weather of the week before their departure. Table 3-6 shows the cross-tabulations of this variable and the groups *before planning, during planning* and *after decision.* The correlations are not significant. It seems that there is no relationship between when the tourists inform themselves about climate and whether they follow the weather. Nevertheless, the relationship between getting climate information and following the weather in the week previous to travel is significant. If tourists inform themselves about climate, they also inform themselves about the weather shortly before they travel. As the majority of tourists gather weather information before they travel, hypothesis B2 can be accepted. Nevertheless, this hypothesis is accepted with the caveat that a large group of tourists (41%) showed no interest in the actual weather. An examination of different tourists groups and destinations could provide more information on what conditions make weather and climate information important for the tourist.

			Yes	No
Respondent was aware of the weather at their destination during the week before their holiday			*Climate information gathered*	
	Yes		68%	33%
	No		33%	67%
		N	286	91
			Climate information before planning	
	Yes		71%	68%
	No		29%	33%
		N	68	206
			Climate information during planning	
	Yes		70%	67%
	No		30%	33%
		N	133	141
			Climate information after the decision	
	Yes		68%	68%
	No		32%	32%
		N	132	142

Table 3-6: Cross-tabulations of climate information and the weather in the week before the holiday

3.4.4 Research question C: sources of climate information

The responses to the question on information sources are problematic. The tourists were asked to rate 12 different information sources and a thirteenth option of “other” on a scale of one to five *but* only for those sources that they used. The question was answered in two different ways: first, that only the actual sources used were given a rank and second, that all sources were given a rank. For the following analysis, these two groups are examined separately. The first group, those that ranked only the sources that were used, is called group A. The second group, B, are those that ranked more than ten sources. Table 3-7 shows the number of climate information sources used. The first column contains the number of sources used by group A. The second column contains the number of sources used, for group B, excluding those that are ranked lowest. In both cases, the hypothesis C1 that more than one source is used can be accepted, given that 21% (A) or 7% (B) of the respondents state only one source. For comparison, the number of sources used as information about the destination is shown. Here there is a greater reliance on only one source (45%).

	Climate-Group A	Climate-Group B	Destination
1	21%	7%	45%
2	24%	6%	28%
3	24%	20%	17%
4	17%	19%	8%
5	4%	10%	2%
6	4%	17%	<1%
7	<2%	9%	<1%
8	<2%	14%	
9	<2%	7%	
10	2%	8%	
11		4%	
12		6%	
13		2%	
N	141	138	392

Table 3-7: Number of information sources used

For the first time visitors of group A, friends and family and travel guides are the most frequently chosen sources with 51% each (more than one response was possible). The second most important sources are travel agent and tour operator. For the group of repeat visitors of group A, own experience was chosen by 69% of the respondents followed by friends and family (53%) and travel guides (40%). An examination like this is difficult for group B as they rank (almost) all of the sources. From this preliminary analysis, it seems that the hypothesis C2 and C3 can be accepted. Nonetheless, a more detailed analysis is needed. Table 3-8, shows the cross-tabulations of previous visit (yes/no) with the sources family and friends (yes/no) and with own experience (yes/no). This is shown for the sources of information on the destination in general (for all tourists) and on climate for the groups A and B. For destination information and for climate information (group A), there is no statistically significant effect of being a first time visitor on the likelihood of getting information from family and friends. For group B, the effect is significant but counter-intuitive. Having visited the destination before has the effect that you are more likely to ask family and friends about climate. The results are much clearer for own experience. The positive relationship between previous visit and own experience is significant for all groups.

Not only is it possible to examine the most frequently chosen sources, the mean rank values can also be analysed. There are no statistically significant differences in the means of own experience and family and friends for groups A and B. There are, however, differences in the means, if the groups of repeat and first time visitors are examined separately. For group A,

		Previous visit	
		Yes	No
Sources of information about the destination			
Family and friends	Yes	38,5%	41%
	No	61,5%	59%
	N	247	145
Own experience	Yes	53%	2%
	No	47%	98%
	N	247	145
Sources of climate information (group A)			
Family and friends	Yes	49%	57%
	No	51%	43%
	N	92	47
Own experience	Yes	65%	6%
	No	35%	94%
	N	91	47
Sources of climate information (group B)			
Family and friends	Yes	71%	51%
	No	29%	49%
	N	83	53
Own experience	Yes	85%	36%
	No	15%	64%
	N	85	50

Table 3-8: Cross-tabulations of information sources and the weather and having visited the destination previously

there are few first time visitors, who used both sources. This makes a comparison of the means difficult, so only the repeat visitors will be discussed here. For that group, there is a mean difference of -0.4828 between friends and family and own experience, which is significant at the 5% level. Not only is own experience relied on by more tourists it is also more important. For the first time visitors of group B, friends and family has a higher mean value than own experience and is statistically significant at the 10% level. Again, for the repeat visitors, there is a significant difference in the means and own experience is ranked the more important of the two sources. Other sources that were given a high rank were newspapers and television, travel guides and weather information providers.

3.4.5 Research question D: Types of climate information

An overwhelming majority of the respondents (91%) chose more than one climate attribute. The mean number of attributes chosen is 3.23. Thus, the hypothesis D1, that tourists choose more than one attribute, can be accepted.

	Mean	Frequency
Number of attributes chosen	3.23	
Climate attributes chosen		
Maximum temperature		67%
Water temperature		52%
Duration of sunshine		51%
Number of rainy days		50%
Average temperature		32%
Minimum temperature		16%
Amount of precipitation		16%
Humidity		14%
Cloudiness		10%
Wind conditions		7%
UV Radiation		6%
None of these		3%
Air temperature options chosen		
Maximum temperature		27%
Average temperature		19%
Minimum temperature		1%
Maximum and minimum		8%
Maximum and average		25%
Average and minimum		<1%
Maximum, minimum and average		6%
Did not choose any temperature option		12%
N	283	

Table 3-9: Preferences for information about climate attributes

In table 3-9, temperature is quite clearly the most frequently chosen attribute. Maximum temperature was chosen by two thirds of the respondents. 32% and 16% of the respondents chose average and minimum air temperature respectively. Other attributes that were chosen by more than half of the respondents were the number of rainy days, duration of sunshine and water temperature. As respondents were able to choose more than one attribute, the frequencies with which the air temperature attributes were chosen both individually and in combination are presented. The lower half of table 3-9 shows that only 12% of the respondents did not choose one of the air temperature attributes. This gives very clear support for hypothesis D2, that temperature is the dominant attribute.

From the five presentation options offered, textual format was the second least preferred option, and if the option “other” is discounted then it is the least preferred. In this case, the hypothesis D3, that tourists prefer a textual format, can be rejected. Table 3-10 shows the results for all options in two forms: for all respondents and for those only giving one response. In both cases, numerical data is the most popular option.

	Frequency	
	more than one response	only one response
Maps and satellite images	33%	23%
Text	27%	15%
Diagrams	36%	17%
Numerical data	57%	42%
Other	2%	3%
N	283	149

Table 3-10: Preferences for the presentation of information about climate attributes

3.5 Discussion and conclusion

This study adds to the evidence that climate is an important factor in destination choice. In addition, it provides clarity over the role of climate and weather information gathering in the various phases of the decision-making process.

The results highlight the importance of information gathering before making a decision. Furthermore, this study shows that information gathering also occurs after the decision. The number of sources used by the tourists is comparable with other studies (Van Raaij, 1986; Fodness and Murray, 1998 and 1999; Baloglu and McCleary, 1999 and Chaudhary, 2000). Moreover, this study gives support for Fodness and Murray’s theory (1999) that personal experience will be the main source of information for repeat visitors. The importance of friends and family as an information source for all of the tourists in our sample reflects the results of Chaudhary (2000). The majority of tourists informed themselves about climate from a variety of sources. Therefore, the results of this study could also be useful for the providers of tourism information: they can then tailor the information they present to meet the preferences of tourists.

There has been some debate on the effectiveness of using tourism climate indices and demand studies to assess the impact of climate change on tourism. Studies of destination demand have been criticised of simplistically representing climate using single variables, such as temperature and precipitation and not a weighted group of variables. The results presented in this study support the use of temperature as the main determining variable in destination demand studies. Nevertheless, it cannot be claimed from these results that temperature alone is enough to represent the considerations of tourists about destination climate. This study does not find support for de Freitas' argument (2003) that data presented as averages have no psychological meaning. Travel guides typically present climate data as monthly averages and these were, along with family and friends, the most frequently used source for first time visitors.

The limitations of this study need to be addressed. A major issue is that of the sample used. Time and budget considerations limited the study to easily accessible departure points. As tourists travelling by car have no common departure point, this group had to be omitted from our sample. This had the consequence that certain destinations, such as Italy, Denmark, the Netherlands and Austria, were underrepresented. Nevertheless, climatically comparable destinations were well represented. It is unclear if different information search strategies are related to particular travel mode choices. In addition, a non-random sampling method was used, which limits the ability to generalize from these results. The survey period encompassed the school holidays of the states of Northern Germany. This peak holiday period can easily be avoided by other groups of tourists who are not tied to institutional holidays. Therefore, the study may be biased towards tourists travelling with children. From other survey sources, it can be seen that older travellers favour the off-peak months (for example, Oppermann, 1995). Despite two pilot studies, certain questions were not formulated clearly enough, which hindered the analysis (see the results for research question C). An interview methodology may be better to examine such complex issues but this would be expensive and time consuming on this scale. Instead of using a self-administered questionnaire, verbally administering the questionnaire could bring more success.

Although they have quite different definitions, the terms weather and climate are used interchangeably by the public. This can also be seen in some of the image studies that refer to weather, even though what is actually meant is climate. Even though great care was taken to be clear and to distinguish between weather and climate in our survey, in some questions it is possible that the respondents misunderstood and gave responses in terms of weather information. This is particularly the case with climate information sources, where some of the sources listed can give information on past weather, the climate, current weather and predicted weather. For example, online weather information providers[12] or even family and friends could provide such information. Again, a verbally administered questionnaire could be more effective.

Global climate change is already having an effect on mean temperature and its further course is very likely to have an impact on the tourism industry as well. As the results of this study show, climate is a defining factor for the destination choice of tourists. When the climate changes, destinations' attractiveness will change and with it – probably with a considerable time lag – tourists' images of the destinations. An ancillary effect of global warming is that of sea-level rise. Access to the sea will change considerably as the quality of beaches will mostly deteriorate, with intensified erosion and change of slope occurring. As this study shows that the access to the sea and to lakes is the second most important attribute to tourists when choosing a destination, sea-level rise will have a large effect on the tourism industry, as tourists will not necessarily adopt to the new situation by changing their preferences, they would rather change destinations.

Having carried out this survey, the first of its kind to focus on climate as a specific attribute of destination image and on its role in the decision-making process, a valuable database that can be used for further research has been produced. For instance, the issue of whether the tourists' images of climate are accurate when compared to the climate of their destination can be assessed (Um and Crompton, 1990). Some destination image studies found that there were differences in image for different groups of tourists (Shoemaker, 1994 and Kozak, 2002). It would be an interesting extension of this study to examine, whether different information preferences exist for different demographic or holiday groups of this survey.

[12] For example www.wetter.com, the website of the German Meteorological Service, where it is possible to access a climate data bank, plot weather data from the recent past, check current weather and get a ten day forecast for many towns and cities in the world.

Chapter 4

Climate and the destination choice of German tourists*

4.1 Introduction

Typically, when estimating tourism demand the attributes of destinations are not included. However, these attributes, according to Morley (1991), will determine the utility of a visit to a certain destination with a certain set of characteristics. This study looks further than just to the different spatial attributes of destinations but also to the *temporal* ones; different months have different climatic conditions. Moreover, climate change implies that these attributes will change over the long term and so utility and the resulting patterns of demand will change.

With this in mind, the purpose of this chapter is to examine demand in terms of destination characteristics. This is done by way of a case study of German tourists. German tourists make up the second largest market in terms of expenditure (after the USA) and they account for 10% of world spending on tourism (WTO, 2005b). Their market importance means that an examination of the possible impacts of climate change on the patterns of demand is of particular interest. The estimated relationships between the climate variables can then be used to examine the impact of climate change on demand. The pooled travel cost method, which is used in this study, had been developed in other case studies for the UK and the Netherlands. However, in this study, the set of destination attributes used in the regression analysis is extended and the temporal aspect is examined at the monthly scale as opposed to the quarterly scale. Whereas previous PTCM studies have used quarterly data and focussed on outbound tourism, this study uses monthly data and the origin country Germany is included as a destination option.

This chapter is structured as follows. In the second section, the pooled travel cost method is discussed. The data used in this study is presented in the third section. The fourth section presents the results of the regression analysis. The implications of these are discussed in the fifth section. In the sixth section, the impact of climate change on climatic attractiveness is exam-

* This chapter is based on Hamilton (2003).

ined. Some limitations of the methodology are discussed in section 7. The eighth section concludes.

Only two studies examine quantitatively the sensitivity of tourism demand to climate and climate change. Maddison (2001) examines climate as a determinant of the destination choices of British tourists and estimates a demand function that included climate variables and beach length for each country. The estimated function is then used to examine changes in the number of tourists as well as changes in welfare using projected changes in temperature and precipitation under a “business as usual” greenhouse gas emissions scenario. Lise and Tol (2002) adapt Maddison's model and apply it to data on the destination choices of Dutch tourists.

4.2. Methodology: the pooled travel cost method

The pooled travel cost method, which is based on microeconomic theory, includes characteristics of destinations which Morley (1992) and Papatheodorou (2001) argue to be necessary. This technique is a variant of the travel cost models, which have been widely used for estimating the demand for recreation sites. Two different types of these models exist: those that focus on single sites and those that examine multiple sites. In the former case, the purpose is to calculate the total economic value of the site and, in the latter case, the object is to obtain a measure of the change in value when site characteristics change. It is this second set of models that is useful for examining the impact of climate change.

The basic premise of both types of model, however, lies in the fact that in order to use services provided by a certain site you have to travel there. This will involve a cost in terms of travel expenditure and the opportunity cost of time. If recreation is a normal good then sites with a higher travel cost will be visited less than those with the same characteristics but a lower travel cost. In the case of single sites, individuals who incur a lower travel cost for a certain site will visit that site more frequently than those individuals with a higher travel cost will. Using data on the number of visits and the cost of these visits, a demand function can be estimated. The total value of the site can be measured by the area under the demand curve. In the case of multiple sites, the characteristics of sites are included in the demand function.

As travel is necessary for the consumption of the environmental amenities at a particular site, it is said to be a complement to them. That is, changes in the price of travel will affect the number of trips and through this, the quantity consumed of the amenities. Further, travel cost exhibits the quality of weak complementarity for the environmental amenities. Weak complementarity exists when there is a price where demand for the market good will be zero and changes in the public good, the environmental quality, will have no effect on welfare. In terms of travel to a site, this means that if the price of travel to a particular place is so high that no one wants to go there then changes in the qualities of that site do not bring any benefits to consumers. This enables the use of the demand curve for the market good to estimate the value of the non-market good, which in this case is the environmental quality of a site. When certain characteristics of a site improve, the demand curve for the market good, in this case travel cost, will shift outwards and to the right and so more of the favoured amenities are available at the same travel cost. To value this change, the difference in the area under the demand curves but above the market price for the original level of amenities and for the improved level is calculated.

Freemann (1993) describes the methods used to estimate the demand for multiple sites, with the qualification that these models have limitations through their simplification. One technique involves pooling the number of visits to recreation sites and estimating a single demand equation. The set of explanatory variables will include quality variables, which must be sufficiently varied across the sites, in order to use regression techniques to estimate the demand function. The coefficients on the parameters are the same across all sites. Freeman states that such models can be used to examine changes in the characteristics at one site, but argues that as they do not contain substitute site qualities or prices in the specification, it is not possible to examine the case where quality changes occur at more than one site.

Maddison (2001) adapted the recreation demand models described by Freemann (1993) and applied it to a case study of international tourism. Using data on British tourists' destination choices, he pools the choices of individuals for different destinations and estimates the demand function for British tourists as a group. He assumes that tourists have perfect information about the climate of countries. In addition, the demand function is used to analyse the impact of changes in environmental quality, in this case changes in climate. The model described by Maddison will be used in this study to examine the sensitivity of the demand of German tourists to climate and other destination factors.

4.3 Data and model specification

The dependent variable data were taken from a representative survey of 7780 German citizens who were asked about their holidays of more than 5 days that they took in 1997 (FUR, 1998). The respondents provided information on the region, country or group of countries where they took their holiday. They also specified in which month it took place. From the individual responses, visitation rates for each country (or group of countries) and month combination were calculated. The countries included in the analysis are presented in tables 4-1 and 4-2. Information was also provided on total holiday expenditure but not on travel cost. It was considered too time consuming to estimate the travel cost as many different modes of transport were used to reach the chosen destinations. For this reason, distance between the destination and origin capital city was taken as a proxy for travel cost.[13]

Albania	Finland	Lebanon	Slovenia
Algeria	France	Libya	South Korea
Austria	Germany	Malta	Spain
Bulgaria	Greece	Morocco	Sweden
Canada	Hungary	Netherlands	Switzerland
China	Iceland	Norway	Syria
Croatia	Ireland	Poland	Tunisia
Cyprus	Israel	Portugal	Turkey
Czech Republic	Italy	Romania	United Kingdom
Denmark	Japan	Slovakia	USA
Egypt			

Table 4-1: Countries included in the analysis

Country specific variables were included in the analysis. There are many groups of countries in the data set and so for each of the variables a group value was calculated using market shares for 1995 (WTO, 2002b). Table 4-2 contains the country groups. GDP per capita, population and population density are taken from the World Resources Institute (WRI, 2000). Richer countries are more likely to have the basic facilities necessary for tourism, such as quality transport infrastructure and banking services. Richer countries will also have a devel-

[13] This was calculated using spherical trigonometry formulas for calculating the great circles distance between two points.

oped network for domestic tourism and recreation and so the necessary tourist specific infrastructure will be in place. Such countries are more likely to be favoured as international tourist destinations. For population density, it is unclear what effect on tourism demand they have. Densely populated countries may be attractive as they will contain many towns and cities but on the other hand, if this implies a lack of natural areas, they may then be unattractive for tourism. The stability index compiled by Kaufmann *et al.* (1999) is a proxy for the perception of citizens of the likelihood that their government will be overthrown by non-constitutional means. This has been included in the specification of the model to capture the influence of tourists' concerns about safety on the demand for a destination. Of course, the internal perception may be different from that of the tourists.

Belgium and Luxembourg
Estonia, Latvia, Lithuania, Russian Federation and Ukraine
Bosnia-Herzegovinia, Macedonia and Yugoslavia
Costa Rica, El Salvador, Guatemala, Mexico, Nicaragua and Panama
Bolivia, Colombia, Ecuador, Guyana, Peru and Venezuela
Brazil and Paraguay
Argentina, Chile and Uruguay
Antigua, Bahamas, Barbados, Bermuda, Cuba, Dominican Republic, Guadeloupe, Jamaica, Martinique, Puerto Rica, St. Lucia and Trinidad and Tobago
Benin, Burkina Faso, Cameroon, Gabon, Ghana, Kenya, Madagascar, Mauritius, Nigeria, Senegal, the Seychelles, Togo, Uganda, Zambia and Zimbabwe
Botswana, Lesotho, Namibia, South Africa, Swaziland and Tanzania,
Bahrain, Jordan, Oman and Saudi Arabia
India, Maldives, Pakistan and Sri Lanka
Cambodia, Brunei, Laos, Malaysia, Myanmar, Singapore, Thailand and Vietnam
Fiji, Palau, Samoa and Vanuatu
Australia and New Zealand

Table 4-2: Country groupings included in the analysis

At a national scale, it is difficult to find comparable data on resource characteristics that are relevant to tourism. One of the key tourist markets is the "sun, sand and sea" holiday. For this particular type of holiday, the availability of beaches is important. To capture the effect of this on demand, the length of beach for each country, taken from Delft Hydraulics (1990), was included in the country dataset. Existing studies used population density and population as proxies for the existence of untouched natural areas and the number of cultural attractions respectively. Both population and population density are included in this analysis, as they may have an independent effect; however other variables are used as a proxy for natural and cultural attractions. In this study, the total area of all protected areas in a country is taken as a proxy for the availability of undeveloped land. The attractiveness of the landscape and the scope for outdoor recreation will depend on this. The total areas protected in each country were obtained from World Conservation Monitoring Centre (WCMC, 2002) for 1996. Only those protected areas of more than 1000 ha in any of the six International Union for Conservation of Nature and Natural Resources (IUCN) categories are included in the WCMC data set. The categories cover nature reserves, wilderness areas, management areas, national parks and monuments, and protected landscapes. Of course, larger countries are more likely to have larger protected areas, as will richer countries that will be able to afford to protect more of their territory. The number of sites on the World Heritage List (UNESCO, 2001) was used as a proxy for the historical and cultural attractiveness of a country. Sites on the world heritage list are those that are considered cultural or natural properties of outstanding natural value. Examples of such sites are Angkor in Cambodia and the Red Square in Moscow.

Climate data were taken from a data set on the recent climate in countries (Mitchell *et al.*, 2002). For each country monthly averages for the period 1961-1991 are available for the following: daily temperature (mean, minimum and maximum), precipitation, number of wet days, cloud cover, vapour pressure, and the number of ground frost days. Some of the climate variables show a strong correlation with each other. Vapour pressure and temperature, ground frost days and temperature and wet days and cloud cover are highly correlated (0.87, -0.9 and 0.87 respectively). On the one hand, this is because of the natural relationship between them and on the other hand because data on vapour pressure and the number of ground frost days was estimated using temperature[14]. For this reason two possible specifications of only three climate variables each were analysed. Both contain mean monthly temperature and average monthly precipitation, as in the two previous studies for the UK and the Netherlands.

The first specification contains the number of wet days per month and in the second wet day frequency is replaced by cloud cover. A wet day is defined as any day with rainfall greater than 0.1mm and the use of this variable in conjunction with precipitation provides more information on the spread of rainfall over the month. As an alternative to the inclusion of wet day frequency, the average cloud cover as a percentage was used in the second specification. The effects of sunlight on the psychological balance have been documented by Parker (2001)

[14] See New et al (1999) for more details on the calculation of the different variables

and the variable cloud cover has been included to capture the effect of sunlight at the destination country.

To examine the possibility of optimal levels of the climate variables the square of each of these variables was included. In the study by Maddison (2001), the cubic and quartic terms of the temperature variable are included in the regression analysis, to examine the possibility that more than one temperature optimal exists because of winter sports tourism. This is examined in the third specification and the fourth specification is a refinement of the third.

There are certain disadvantages to using country aggregated climate data, particularly for large countries. Tourist destinations within a country may have a particular climate that is quite different from that of the national average and areas with extreme conditions, such as deserts or mountain ranges, which may be of little interest for tourists, will have an effect on the country average. Country data was preferred to capital city climate data, which is also inaccurate. As far as the author knows, a data set containing the climate of only tourist destinations in each country does not exist.

As Germany was included as a destination, a dummy was used to control for it being chosen more frequently. It is usual that domestic tourism makes up a large part of total tourism, as familiarity of culture and language or visits to friends and relatives will make the origin country a popular destination. Besides climate, other factors may influence temporal choice, such as public holidays or school holidays. To control for this, monthly dummies are included in the analysis. The variables and their definitions are contained in Table 4-3. The summary statistics of the variables used in the regression analysis are shown in Table 4-4.

The log of the number of visits was used, as this was found to fit the data better than the linear form. It also conveniently prevents the model predicting negative numbers of visits. The majority of recreation studies use this functional form, as did the aforementioned tourism and climate studies. As the error components from same country observations are likely to be correlated, panel corrected least squares regression analysis was used instead of ordinary least squares. It is expected that the following variables have a positive relationship with the dependent variable: Stability, GDP per capita, temperature, beach length and the HOME dummy variable. Whereas the coefficients of distance, precipitation and cloud cover are expected to be negatively signed. For the other variables, it is unclear what sign to expect.

Variable	Definition
VISITS	Number of visits from Germany in 1997
GDPPC	GDP per capita, market prices (1995 US$)
POP	Population (thousands)
PDEN	Population density (number per square km)
STAB	Stability index value (range -2.5 to 2.5)
BLEN	Beach length (km)
PROTECT	Area of protected areas (ha)
HER	Number of heritage sites
DIST	The distance between the origin and destination capital (km)
TEMP	Average monthly mean temperature (°C)
PRE	Average monthly precipitation (mm)
WETD	Average number of wet days per month
CLOUD	Average monthly cloud cover in percent
HOME	Will take the value unity when Germany is the destination, otherwise 0
M1	Will take the value unity for January, otherwise 0
M2	Will take the value unity for February, otherwise 0
M3	Will take the value unity for March, otherwise 0
M4	Will take the value unity for April, otherwise 0
M5	Will take the value unity for May, otherwise 0
M6	Will take the value unity for June, otherwise 0
M7	Will take the value unity for July, otherwise 0
M8	Will take the value unity for August, otherwise 0
M9	Will take the value unity for September, otherwise 0
M10	Will take the value unity for October, otherwise 0
M11	Will take the value unity for November, otherwise 0

Sources: see text

Table 4-3: Definition of the variables used in the analysis

Variable	Mean	Std. Dev.	Minimum	Maximum
GDPPC	13171.11	11771.36	520	40998
POP	100484.90	230597.80	271	1232456
PDEN	180.37	291.84	3	1620
STAB	0.55	0.77	-2.42	1.69
BLEN	263.85	480.73	0	2970
PROTECT	1.47E+07	2.68E+07	0	1.04E+08
HER	9.33	7.98	0	33
DIST	3548.71	3916.27	174	16933
TEMP	13.92	9.14	-21.2	30.7
PRE	74.93	50.27	0	251.4
WETD	11.14	4.97	0	22.3
CLOUD	57.25	14.93	8.1	86.8
HOME	0.02	0.15	0	1
M1	0.07	0.25	0	1
M2	0.07	0.25	0	1
M3	0.08	0.27	0	1
M4	0.09	0.28	0	1
M5	0.09	0.28	0	1
M6	0.09	0.29	0	1
M7	0.09	0.29	0	1
M8	0.09	0.28	0	1
M9	0.10	0.30	0	1
M10	0.09	0.29	0	1
M11	0.08	0.27	0	1

Table 4-4: Characteristics of the data used

4.4 Results

The results of the regression analysis are presented in Table 4-5. For specification 1, the regression explains 58.4% of the variation in the log of the number of visits. The number of heritage sites, length of beach and the level of GDP per capita are all highly significant and signed as expected. The stability variable STAB has a positive relationship to the dependent variable but it is not significant. The coefficient for PROTECT is negatively signed but is significant only at the 10% level. Although protected areas may be an attraction for tourists many of these protected areas may not in fact be accessible for tourists or tourist development has been restricted because the land has been protected. The coefficient on DIST is as expected, highly significant and negatively signed. The popularity of domestic tourism is reflected in the positive and highly significant coefficient for the variable HOME. The coefficients on population and population density are not significant. From the monthly dummies, the months February and November are found to be negative and significant. This result is plausible considering that these two months lie either side of the Christmas and New Year holiday period, when many people take holidays and also a large portion of the household budget will be used during the festive period.

Temperature is highly significant. However, the square of temperature is not significant. Therefore, the optimal temperature cannot be calculated. Here we have a positive relationship between demand and temperature; as temperature increases so will demand. Purely from the human physiological point of view, this is rather unlikely, as at high temperatures, particularly in combination with high levels of humidity, a state of discomfort will occur. For precipitation, a minimum turning point is found at 137mm per month, which is much higher than the observed values for any month in Germany or in Northern Europe. Before this point, any increase in precipitation will have a negative effect on demand. There is an optimal number of wet days at 11.5 days per month. The Northern European countries have more wet days per month all year round and such a value is typical of a Mediterranean winter. The calculated optimal values for each specification are shown in Table 4-6.

Observations: 493								
Dependent variable: LN(VISITS)								
Specification	1		2		1a		1b	
R-squared	0.57		0.55		0.59		0.59	
Variable	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
M1	-2.08E-01	-1.44	-1.40E-01	-0.98	-2.23E-01	-1.58	-2.34E-01	-1.63
M2	-4.09E-01	-2.45	-1.79E-01	-1.15	-3.73E-01	-2.25	-3.68E-01	-2.21
M3	-2.67E-02	-0.19	1.50E-01	1.01	1.79E-03	0.01	1.93E-02	0.15
M4	-3.35E-01	-1.96	-1.04E-01	-0.48	-2.94E-01	-1.70	-2.58E-01	-1.76
M5	1.59E-02	0.08	2.55E-01	1.02	3.47E-02	0.17	8.03E-02	0.52
M6	-1.58E-01	-0.79	9.48E-02	0.41	-1.73E-01	-0.85	-1.28E-01	-0.73
M7	1.14E-01	0.45	3.78E-01	1.41	6.10E-02	0.25	1.02E-01	0.44
M8	3.06E-01	1.27	5.31E-01	1.93	2.55E-01	1.06	2.94E-01	1.37
M9	-1.08E-03	-0.01	2.26E-01	1.06	-1.70E-02	-0.09	2.26E-02	0.14
M10	-1.53E-01	-0.84	-7.54E-03	-0.04	-1.39E-01	-0.81	-1.06E-01	-0.64
M11	-6.02E-01	-4.44	-5.39E-01	-3.96	-6.10E-01	-4.71	-5.95E-01	-4.57
HOME	1.98E+00	6.02	2.43E+00	8.03	2.01E+00	6.02	2.03E+00	6.09
GDPPC	3.12E-05	2.48	1.86E-05	1.49	3.25E-05	2.52	3.21E-05	2.47
POP	-4.48E-07	-1.25	-7.95E-07	-1.84	-3.96E-07	-1.11	-4.19E-07	-1.15
PD	-2.59E-04	-0.75	-7.88E-05	-0.19	-2.35E-04	-0.65	-2.22E-04	-0.60
STAB	2.48E-01	0.84	2.63E-01	0.94	2.21E-01	0.74	2.17E-01	0.74
BLEN	5.54E-04	2.73	5.98E-04	2.63	5.84E-04	2.67	5.93E-04	2.69
PROTECT	-8.60E-09	-1.58	-5.10E-09	-0.93	-9.02E-09	-1.57	-9.41E-09	-1.68
HER	5.13E-02	2.64	5.74E-02	2.73	5.06E-02	2.53	5.06E-02	2.51
DIST	-9.93E-05	-2.48	-1.23E-04	-3.13	-1.06E-04	-2.54	-1.06E-04	-2.52
TEMP	4.82E-02	3.04	2.27E-02	1.29	1.45E-02	0.46		
TEMPSQ	1.36E-04	0.23	-3.18E-04	-0.50	3.21E-03	3.19	3.58E-03	3.62
TEMP3					7.97E-05	1.04	1.11E-04	3.88
TEMP4					-5.77E-06	-2.33	-6.90E-06	-5.15
WET	3.50E-01	3.85			3.24E-01	3.55	3.14E-01	3.49
WETSQ	-1.54E-02	-5.20			-1.41E-02	-4.84	-1.39E-02	-4.62
PRE	-2.06E-02	-2.25	-1.82E-03	-0.30	-2.05E-02	-2.16	-1.92E-02	-2.19
PRESQ	7.61E-05	2.77	1.93E-05	0.90	7.76E-05	2.75	7.36E-05	2.72
CLOUD			4.01E-02	1.14				
CLOUDSQ			-5.51E-04	-1.80				
CONSTANT	-3.99E-01	-0.80	3.10E-01	0.29	-3.80E-01	-0.72	-3.24E-01	-0.66

Table 4-5: Results of the regression analysis

optimal	minimum/ maximum	Specification			
		1	2	1a	1b
temperature (°C)	maximum	not significant	not significant	23 and -11 *	23 and -10 *
wet day frequency (days)	maximum	11.37	not significant	11.48	11.33
precipitation (mm)	minimum	135	not significant	132	131

* The first optimal is for temperatures above zero the latter for below zero

Table 4-6: Comparison of the estimated climate optima for the different model specifications

For the second specification containing the variable cloud cover, the greatest changes are seen in the climate variables. Temperature and precipitation are no longer significant and therefore no turning points can be estimated. The square of cloud cover is negative and significant. For the majority of the other variables there are no changes in sign and significance. However, the monthly dummy for August is positive and significant; this is plausible as it is the time of school holidays and the traditional holiday month.

A third specification including the quartic terms of temperature was analysed. There are no changes in the significance or signs of the other variables. The turning points do not change significantly either. The turning points are 134 mm for precipitation and for 11.6 days for wet day frequency. However, from the four temperature terms the square and the quartic of temperature are significant. A fourth regression is carried out dropping the least significant term, the linear temperature term. The results with this specification are very similar to those of the first and third specification. Again, the turning points for precipitation and wet day frequency are 133 mm and 11.6 respectively. Optimal mean temperatures of 24°C for the values above zero and for those below zero an optimal mean of –11°C.

4.5 Comparison with other studies

A comparison with the UK and Netherlands studies shows broadly similar results. In contrast to the case study presented here, the two previous studies were carried out using quarterly visitation rates and climate data. The significant variables from all three studies are shown in Table 4-7. In all studies, distance is negatively signed but only significant when a travel cost variable is not included as well as a variable for distance. In both the German and the Dutch study, the square of temperature is not significant. Whereas, the optimal temperature in the UK study (maximum daytime temperature was used) was found to be 29°C. Precipitation was not significant in the Dutch and British studies. Maddison (2001) also finds beach length to be an important factor in determining demand. However, in the study by Lise and Tol (2002) coast length was not found to be significant. For the variable population, the result from this study is very different from the other two. In this case study, the coefficient on population is negative but not significant. In the Dutch and British studies, population was used as a proxy for cultural resources and the coefficient was positive, as was the coefficient on the number of heritage sites in this case study. Whether this difference is caused by the additional variables or that German tourists have different preferences to the Dutch and British tourists is not clear. Not included in the German study, but in the others, was a variable to measure the price level in each country. Variables to examine the influence of age and income were also used in the Dutch study, which improved the R^2.

	Maddison (2001)	Lise and Tol (2002)	This study Specification 1
Origin Country	United Kingdom	The Netherlands	Germany
Year	1994	1988/1992	1997
Observations	305	187	493
R^2	0.5	0.43	0.57
Variable	Significant variables and their signs		
GDPPC	+	+	+
BLEN	+	ne	+
PDEN	-	ns	ns
POP	+	+	ns
DIST	ns	-	-
TEMP	+	+	+
$TEMP^2$	-	ns	ns
PRE	ns	ns	-

[1] "ne" denotes the variables that were not included in the particular analysis and "ns" indicates that the variables were included but were not found to be significant.

Table 4-7: Comparison of the case study results with those of the UK and Dutch studies

4.6 The climate attractiveness index and a scenario of climate change

According to the Third Assessment Report of the IPCC, it is projected that global surface temperature and the sea level are expected to increase during this century. Based upon the results of a set of different climate models and greenhouse gas emissions scenarios, an increase in the global mean temperature of between 0.8°C and 2.6°C is projected for the period 1990 to 2050 (Houghton *et al.*, 2001). Globally the average annual precipitation is also expected to increase, however at the regional scale there may also be considerable decreases in the level of precipitation. It is possible to examine the impact of these changes on the attractiveness of a destination using the results of this case study. This has been done through the construction of a climate index. Taking only the climate data for each country and the coefficients for each of the climate variables resulting from the regression analysis, the contribution of climate to demand can be calculated and the countries then ranked according to their climatic attractiveness. Then using an arbitrary scenario, for the European summer months, of a 2°C temperature increase, a 15% decrease in precipitation and a 10% decrease in the number of wet days per month, new climate index values were calculated. Figure 4-1 shows the index values for August for certain European countries for the observed data and for the arbitrary scenario both for specification 1b. The climate scenario leads to an increase in the index value for almost every country; the increase is particularly large for the northern European countries. However, for Spain, Greece and Portugal there is actually a decrease in the index values under a scenario of climate change. This is because the monthly mean temperature is now higher than the calculated optimal temperature. Spain has the highest index value for August. Figure 4-2 shows the index values of the other countries as a fraction of Spain's value. Under a scenario of climate change, the northern European countries come much closer to Spain's attractiveness and make considerable gains on the other southern European countries. In particular, domestic tourism becomes even more attractive relative to the biggest outbound market. The popular neighbouring countries, the Netherlands, Poland, Denmark and the Czech Republic, would experience an increase in popularity.

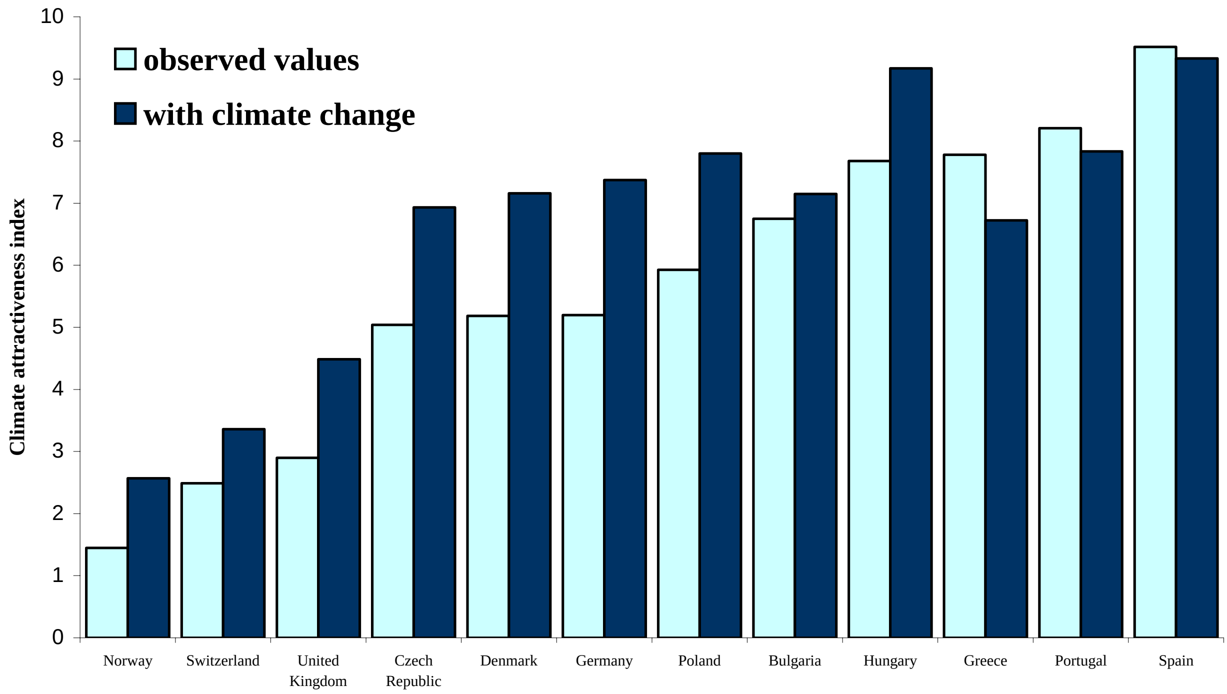

Figure 4-1: Climate attractiveness index for the month of August for selected European countries

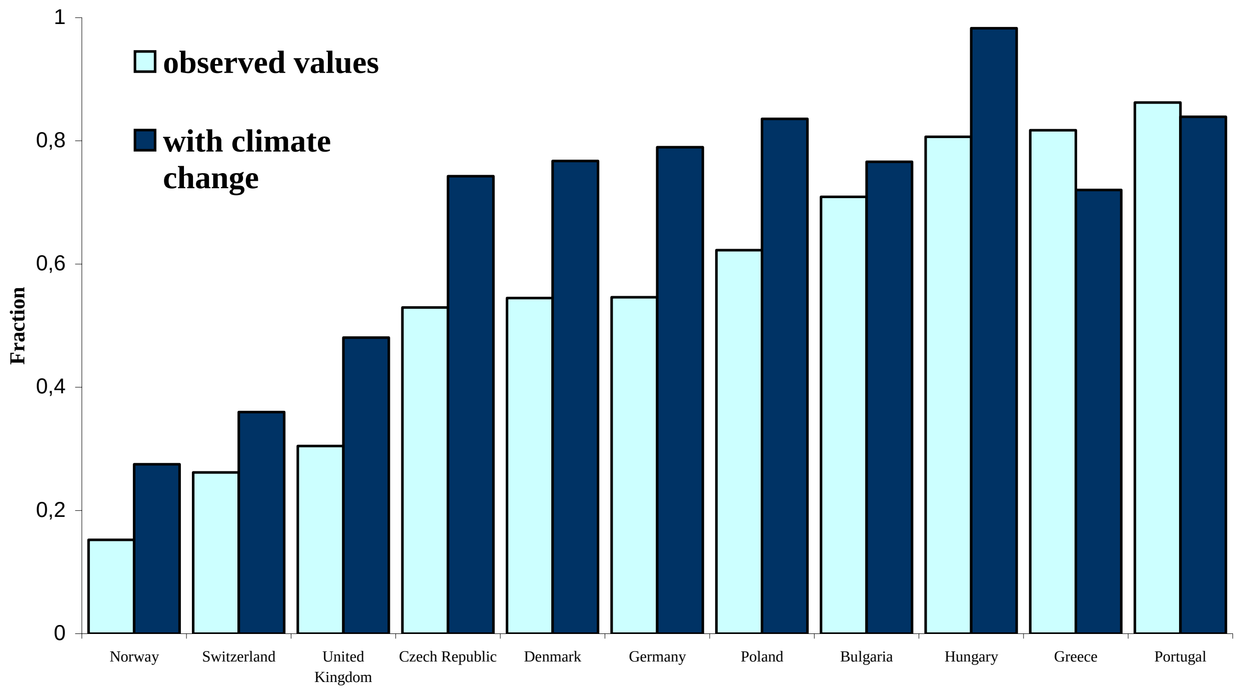

Figure 4-2: Climate attractiveness index values for August for selected European countries expressed as a fraction of Spain's index value

4.7 Limitations of the method

This study has further investigated the relationship between climate and demand for particular destinations. There are, however, some limitations of this study with regard to the method. The usefulness of the pooled travel cost method is limited because of the omission of substitution effects. As the substitute site qualities and prices are not included in the demand function in the model presented here, the effect of these on the demand for a destination is not known. If for example the model predicts an increase in the number of visits to a certain destination, after a change in one or more characteristics, it is not possible to say which destinations are now avoided because they have become relatively less attractive. Moreover, the failure to account for substitution effects in the model poses a further problem when changes occur at all sites. This would be the case with climate change, which will occur globally. The decision to go on holiday or not is not included in this model, therefore increases in the total number of tourists cannot be predicted. This method is also less useful for a single country or a region to examine the importance of climate or other factors in the attractiveness for tourism. Suitable variation in the parameters used will be needed in order to carry out the statistical analysis, although with a large monthly variation in the data it would still be possible.

The implications of climate change were examined only for the summer months in Europe using an arbitrary scenario. This is of limited use, as the relative attractiveness of the climate of the different months and of other continents is also of interest. Modelled scenario changes are available for all countries of the world (Mitchell *et al.*, 2003). In table 4-8, the climate values for the arbitrary scenario and the average of four scenario results of the Hadley centre climate model (HadCM3) are presented for Bulgaria, Germany, Spain and Sweden. For temperature, there is very little difference in the arbitrary and the Hadley model. However, for precipitation the arbitrary results are much lower for Sweden under the arbitrary scenario. Although the use of the arbitrary scenario is useful to illustrate the effect of climate change on a range of countries for a particular month, the work of this paper could be refined by using the detailed country climate change data. This task will be left for a subsequent paper.

Country	August temperature - 1961-1990 mean	August temperature - from arbitrary scenario	August temperature - from average of 4 scenarios from HadCM3 (2000-2025)
Bulgaria	20.6	22.6	22.5
Germany	16.9	18.9	17.8
Spain	21.9	23.9	23.4
Sweden	12.5	14.5	13.7

Country	August precipitation - 1961-1990 mean	August precipitation - from arbitrary scenario	August precipitation - from average of 4 scenarios from HadCM3 (2000-2025)
Bulgaria	43.6	37.1	38.5
Germany	71.5	60.8	64.5
Spain	25	21.3	22.4
Sweden	72.2	61.4	72.5

Table 4-8: Comparison of the results of the arbitrary scenario and the scenario results of a climate model

4.8 Conclusions

A limited amount of research has been undertaken on the relationship between tourism demand and the natural resource, climate. The pooled travel cost method, employed here, exploits the necessity of travel to a destination and the associated costs of this travel to analyse the effect destination characteristics, such as climate, have on demand. Expanding on the work of previous studies, a tourism demand function, which included economic, climatic and other country characteristics as explanatory variables, was estimated using data from a survey on the destination choices of German tourists. Moreover, this study examined destination choice at the monthly level, extended the set of country characteristics used and examined domestic and outbound tourism. Proxy variables to measure safety and cultural attractiveness were included and two specifications with different climate variables were examined. The specification including wet day frequency was found to perform better than the specification with the variable cloud cover. The former specification was extended to include cubic and quartic terms. In addition to the optimal wet day frequency and precipitation levels, two optimal temperature values were estimated. For temperatures above zero, the optimal was found to be at 24°C. All of the specifications improve on the results of the earlier studies for the Netherlands and the United Kingdom. An index of climate attractiveness for each country and month was calculated and used to examine the changes in attractiveness under an arbitrary climate change scenario. The northern European countries increase in attractiveness with climate change; the southern European countries becoming relatively less attractive. Using a more detailed climate change scenario, for each country and month, as opposed to an arbitrary one for a particular month and a restricted set of countries, would be an improvement on the current study. Although the travel cost methodology provides us with an insight in to the relationship between tourism demand and destination characteristics, it inadequately describes the substitution process. For this reason, further research is needed to find suitable ways to model this process.

Chapter 5

Climate preferences and destination choice: a segmentation approach*

5.1 Introduction

In the previous chapter the impact of climate change on tourism is examined in terms of the behaviour of the average tourist. This chapter moves on to investigate the climate-related behaviour of German tourists, not on average, but of several classes of tourists.

Recent studies assessing the impact of climate change on tourism demand patterns use current behavioural patterns to estimate what demand will be under scenarios of climate change (Lise and Tol, 2002; Maddison, 2001; this publication chapters 4, 7 and 8). As well as environmental changes such as climate change, countries can be expected to experience changes in population, in income, in values and in policy emphasis. In order to gain an insight into the possible range of impacts in an unknown future, scenarios are used. The SRES scenarios of population change and economic development are based on storylines describing different futures according to a positioning on a globalization-regionalization scale and on an economic-environmental emphasis scale (IMAGE Team, 2001). These different storylines have different energy use and emissions patterns and therefore different estimates of climate change. Chapters 7 and 8 of this thesis examine future changes in global tourism flows with respect to, not only a climate change scenario, but also to the economic and population scenarios of SRES. But it is not only will the amount of tourists that will change. In addition, the socio-economic and demographic characteristics of those who travel will change. Moreover, on a long-term scale, it is plausible that tourism trends and tourist preferences will change. On the supply side, new destinations may emerge, while some existing destinations may no longer be available for tourism.

To extend existing studies, tourism scenarios that describe possible tourism trends or that include demographic changes could be used along side the socio-economic and climate scenarios. Such scenarios would extend the storylines of the SRES scenarios to include tourism aspects. The core of these scenarios would be the relationship between demand and destination

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* This chapter is based on Hamilton *et al.* (2005c).

climate, and for each scenario there would be a different tourism demand and climate relationship.

Market segmentation involves defining tourist groups according to certain demographic, behavioural or psychographic traits. In the numerous segmentation studies in the literature, the segments are compared according to socio-economic characteristics, holiday characteristics or preferences for certain destination characteristics. One of the frequently used means of segmentation is nationality. Although not segmentation studies, the studies by Maddison (2001), Lise and Tol, (2002) and chapter 4 in this publication have examined the tourism demand of the UK, the Netherlands and Germany respectively. These studies use the pooled travel cost method to examine the relationship between destination characteristics and demand. Moreover, climate variables, namely temperature, precipitation and in the case of the German study, wet day frequency, were included in the demand equation. Using the climate coefficients obtained from the regression analyses, the optimal values of the climate variables are estimated. The results of these studies apply to the demand of a nation as a whole. For tourism scenarios that, for example, seek to examine a new trend or a demographic change, the interest is in the climatic preferences of certain demographic or behavioural groups and not in national groups.

The objective of this study is to combine the segmentation approach and the pooled travel cost method to examine the climate preferences of different segments and so provide quantitative information for tourism scenarios. A survey of the holiday travel behaviour of German citizens during 1997 is segmented using three different means: phase in the life cycle, holiday motivation and holiday activities, and region of residence. The next section begins with a review of the literature on segmentation. Following this, the methods used to segment the survey data and to analyse the climate-demand relationships of the segments are presented. The results of the statistical analyses and, as a means of comparison, the climate index values for certain destinations are discussed in section four. The fifth section concludes.

5.2 Literature review

Segmentation can be carried out using various criteria; the most common, however, is the use of the life cycle. Lawson (1991) examines the expenditure and activities of eight family life cycle groups. These groups were heterogeneous in terms of spending and in the activities chosen. Unfortunately, this study does not examine the behaviour of different national groups even though five countries are represented. Oppermann (1995) argues that travel patterns are dynamic over the life cycle. What is more, childhood holiday experience, according to Oppermann, has an influence on destination choice later in the life cycle. These ideas are confirmed in a longitudinal study of German tourist behaviour: younger tourists leave Central Europe more frequently than older tourists, and for the age group 34-48 there is a decline in demand compared to the other age groups. In addition, different generations show different travel patterns at the same point in the life cycle. The bi-modal demand pattern over the life cycle, with the trough occurring in the thirties to late forties, is observed by Collins and Tisdell (2002). Psychological needs also change over the life cycle and as a consequence the type of tourist behaviour chosen. Gibson and Yiannakis (2002) note that, for a survey of citizens of the USA, getting older affects the pattern of behavioural roles taken. In their study, the tourist role "sun lover" is observed most frequently. Nevertheless, this role becomes less important over the lifetime of the individuals surveyed. Segmentation according to age has been carried out extensively for the senior market. Even within the senior market there are heterogeneous groups (Shoemaker, 1989). Reviewing the literature on the senior market, Fleischer and Pizam (2002) find that income and health are the determinants of heterogeneity between the groups in terms of number of vacation days. Moreover, the number of vacation days decreases with age.

The use of nationality as a segmentation approach has generated some debate (Dann, 1993; Mykletun *et al*. 2001). Mykletun *et al.* (2001) find that nationality is the most important factor in defining groups according to levels of expenditure or of satisfaction. Other studies confirm that there are differences in the behaviour of nationalities in terms of destination choice motivation, spatial distribution patterns and the likelihood of independent travel (Oppermann, 1992; Oppermann, 1994; Kozak, 2002). Yuan and MacDonald (1990), however, find that the motivation for travelling is the same across national groups.

In order to gain a profile of high spending groups, segmentation studies have been carried out according to levels of expenditure at a destination. Mok and Iverson (2000) note that very little work has been done on segmentation according to expenditure. Nevertheless, studies on visitors to the Canary Islands and the Balearic Islands show that different nationalities and different demographic clusters have heterogeneous expenditure patterns (Bethencourt *et al*., 2002; Perez and Sampol, 2000).

The activities undertaken by tourists are also used to segment the tourist market. This can be done generally by defining different types of tourists (Gibson and Yiannakis, 2002; Wickens, 2002) or more specifically using activity choices to build homogeneous clusters (Lise and Tol, 2002; Shoemaker, 1994).

Some of the segmentation studies analyse different preferences for destination characteristics. Hu and Ritchie (1993) find that for a survey of Americans, climate is ranked higher by recreational tourists than by educational ones. Moreover, climate is ranked second from 16 possible attributes by the former segment and ranked 12th by the latter. Shoemaker (1994) uses factor analysis to build three segments of tourists: adventurous/educational travellers get away/family travellers and gamblers/fun travellers. The gamblers/fun travellers rank “good climate/weather” higher than the other two groups. In addition, this group ranks “opportunity to sunbathe“ and “good beaches“ higher than the other groups. Based on segmentation according to nationality, Kozak (2002) examines the push and pull motivations of German and British tourists visiting Mallorca and Turkey. He found that there are some differences in the importance attached to destination characteristics between the resorts visited and by the origin country of the tourists. For both origin countries “enjoying good weather” is the most important motivational factor. From the destination-based factors, “weather” is the second most attractive factor for the British visitors to Mallorca and the most important for those visiting Turkey. The German tourists rank “weather” as the most important characteristic for both destinations.

These studies demonstrate that climate is a significant factor in determining a country’s attractiveness. Nevertheless, the rank position does not tell us how climate influences the demand for different countries. Using factor analysis and data on the destination choices of Dutch tourists, Lise and Tol (2002) construct nine activity clusters. For each of the activity clusters a demand function is estimated using climate other country characteristics. They find that the optimal temperature for fishing and playing tennis is 18°C. For visiting amusement parks and other attractions they find an optimal of 15°C, and for travelling with public transport, which they interpret as budget holiday makers, they find an optimal of 20°C. Surprisingly, for their beach holiday segment they do not find an optimal temperature.

5.3 The model and its application

The model specification and the data set of country characteristics that are used in this chapter are taken from chapter 4, where detail on the data sources and the pooled travel cost methodology can be found.

5.3.1 Data

The original survey contained the responses of 7780 German citizens in 1998 to questions about the holidays that they took in 1997 (FUR, 1998). Those not taking a holiday were dropped from the data set. The data set has been constructed so that for every destination and month, the total number of trips taken by the survey group was calculated. In addition, for each country the data shown in tables 4-3 and 4-4 were collected. For each month and country, climate data on the average monthly temperature, wet day frequency, and the average monthly precipitation are included in the data set.

As well as the destination and departure month, the travel survey contains information about the type of accommodation, the transport mode and total expenditure for each holiday. Moreover, a series of questions deals with holiday motivation and the activities undertaken on holiday. For a scenario that assumes a change in holiday trends, it is useful to know if certain holiday activities or certain motivations have different climate-demand relationships. Three segments were made from the responses about motivation and three were made from responses about activities. In addition, the travel survey contains information about the socio-economic characteristics of the respondents: for example, gender, age, education, profession, origin state and phase in the life cycle. Using age and family status to segment the data allows an examination of the climate preferences of different age groups and of the differences in behaviour of households with and without dependent children. Four segments were constructed using phase in the life cycle. As geographic regions have diverse environmental conditions, it is interesting to study if these conditions affect environmental preferences for holiday destinations. Moreover, these regions may exhibit cultural dissimilarities. Segmentation was carried out according to four broad geographic groups. In addition to the segments of interest, the inverse of each segment was generated. For example, for the segment of all tourists under 40 without dependent children, the inverse segment was created containing all of the destination choices of the survey respondents who were over 40 or had dependent children.

In chapter 4, the best fit was achieved with the following specification (equation 5-1), which was estimated using panel corrected least squares regression for the complete data set:

Equation 5-1:

$$\ln(VISITS) = a + \beta_1 M1 + \beta_2 M2 + \beta_3 M3 + \beta_4 M4 + \beta_5 M5 + \beta_6 M6 + \beta_7 M7 + \beta_8 M8 + \beta_9 M9 + \beta_{10} M10 + \beta_{11} M11 + \beta_{12} HOME + \beta_{13} GDPPC + \beta_{14} POP + \beta_{15} PDEN + \beta_{16} STAB + \beta_{17} BLEN + \beta_{18} PROTECT + \beta_{19} HERITAGE + \beta_{20} DIST + \beta_{21} TEMP + \beta_{22} TEMP^2 + \beta_{23} PRE + \beta_{24} PRE^2 + \beta_{25} WETD + \beta_{26} WETD^2 + \varepsilon$$

This specification was used to estimate the demand function for each segment and its inverse. In order to test whether there are differences between the estimated demand equation for the segment (containing a subset of the destination choices) and the pooled model (containing all of the observed destination choices), a Chow test is used. This tests the null hypothesis that the two models are equivalent. In this case, the test is if the complete model (containing the destination choices of all of the surveyed tourists) is significantly different from the segmented models, that is, the segment of interest and its inverse. The test statistic is given by:

Equation 5-2: $$SSR_c \cdot (n - 2p - 2) / SSR_s / (n - p - 1)$$

and is distributed as F(n-p-1, n-2p-2), where SSR_c and SSR_s are the sum of squared residuals for the complete model and the segmented models respectively. The number of observations is denoted by n, and p is the number of parameters. The subscripts c and s denote the complete model and the segmented model respectively.

For each segment, it is possible to compare the estimated coefficients. Moreover, the estimated coefficients can be used to estimate the optimal value of the climate variables. In chapter 4 climate index values for the complete data set, calculated using the estimated coefficients of the climate variables, are presented for the climate of certain European countries in August. In this chapter, the index values of each segment are calculated and compared.

5.3.2 Segmentation specification and data

Firstly, segmentation according to the stage in the life cycle of the respondents was carried out. There were eight possible responses covering three age groups and whether there were dependent children in the household or not. These were combined to form four clusters. In addition, the inverse segment of *Children* was examined more closely. The segment definitions are presented in table 5-1.

Information was available on the federal state of residence of the respondent. There are 16 federal states in Germany and these were used to form four segments, which are defined in table 5-1. These segments capture broad regions of topographic and climatic similarity. As well as the influence of environmental factors, differences in culture may give rise to different travel patterns, which has been observed in aforementioned studies of different nations.

There were eight survey questions on motivation and nine on holiday activities. Based on the literature review, three segments were produced for both motivation and activities. These are defined in table 5-1. The segments *Sport* and *Outdoor* may in fact be very similar, as one would expect that those whose motivation is to take part in sporting activities will go on to carry out those activities while on holiday.

Segment name	Definition
Life cycle segments	
Young	Respondent between 14 and 39 years old
Children	Respondent from a household with children under 14
Middle	Respondent between 40 and 59 years old
Senior	Respondent older than 60 years
Regional segments	
East	Respondent resident of Berlin, Brandenburg, Saxony, Saxony-Anhalt or Thuringia
North	Respondent resident of Bremen, Hamburg, Mecklenburg-Western Pomerania, Lower Saxony or Schleswig-Holstein
South	Respondent resident of Baden-Württemberg or Bavaria
West	Respondent resident of Hessen, North Rhine-Westphalia, Rhineland-Palatinate or Saarland
Motivation and activity segments	
Sport	Motivation is to take part in sport
Health	Motivation is to do something for one's health and appearance
Family	Motivation is to spend time with partner, friends and family
Outdoor	Holiday activities include walking, hiking, cycling or other outdoor activities
Sights	Holiday activities include sightseeing and taking part in cultural events
Swimsun	Holiday activities include sunbathing and swimming

Table 5-1: Definition of the segments

5.4 Model estimation and empirical results

5.4.1 Life cycle segments

Eight different demand equations were estimated corresponding to the life cycle segments defined in table 5-1 and the inverse of those segments. The regression results for the main segments and the inverse segment *Invchildren* are presented in table 5-2. The different segments show different R^2; the segment *Children* has the best fit. For all segments, the variable HOME has a positive relationship with demand and is statistically significant. The results for the oldest segment, *Senior*, show the largest value for the coefficient of the HOME dummy variable. This denotes that older people prefer domestic holidays. The youngest segment, *Young*, have the lowest value for this variable. These results confirm the findings of Oppermann (1995). For the oldest segment, GDPPC is not significant; for the other groups it is. Moreover, there are no significant differences in the estimated coefficients. The results for the oldest segment, however, show a significant and negative relationship between population (POP) and demand. The other three groups show negative but non-significant relationships. As in the combined model, the coefficients of the variable stability (STAB) are not significant. PROTECT is significant and negative for the youngest and the middle aged segment. There are no significant differences in the two coefficients. For BEACH the pattern of significance is the same. The relationship with demand, however, is positive. This variable is more important for the youngest group. Moreover, for *Young* the variable HERITAGE is significant at the 1% level, for the segment *Middle* at the 5% and for the segments *Children* and *Senior* at the 10% level. DISTANCE has a negative coefficient for all of the subsets but it is not significant.

Table 5-3 reports the results of the Chow test for the four segments. In each case, the hypothesis that each segment and its inverse have the same demand function as the complete data set can be rejected.

	Young		Children		Middle		Senior		Invchildren	
Observations	355		240		349		252		430	
R-squared	0.57		0.61		0.58		0.56		0.59	
Variable	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
M1	-2.72E-01	-1.59	-2.81E-01	-1.13	-1.56E-01	-0.90	-6.78E-02	-0.25	-2.47E-01	-1.63
M2	-3.90E-01	-2.24	-4.48E-01	-1.78	-2.93E-01	-1.80	-8.00E-02	-0.36	-3.33E-01	-2.19
M3	-2.28E-01	-1.97	-2.86E-01	-1.33	-1.18E-01	-0.86	3.08E-02	0.18	-1.97E-03	-0.02
M4	-3.06E-01	-2.20	-3.92E-01	-1.32	-2.26E-01	-1.42	7.17E-02	0.37	-2.04E-01	-1.48
M5	-2.63E-01	-1.43	-3.25E-01	-1.19	1.46E-01	0.70	5.32E-01	2.19	1.44E-01	0.89
M6	-2.85E-01	-1.60	-4.32E-01	-1.50	2.08E-02	0.11	3.95E-01	1.36	-4.79E-02	-0.28
M7	-1.39E-01	-0.64	1.04E-01	0.31	1.98E-01	0.76	6.20E-02	0.18	7.16E-02	0.31
M8	-1.02E-01	-0.52	2.79E-01	0.83	3.07E-01	1.35	3.21E-01	1.10	1.42E-01	0.68
M9	-9.77E-02	-0.70	-3.56E-01	-1.14	-1.56E-02	-0.07	3.38E-01	1.24	7.06E-02	0.44
M10	-3.25E-01	-2.10	-1.11E-01	-0.47	-1.25E-02	-0.07	-6.06E-03	-0.02	-1.26E-01	-0.81
M11	-6.49E-01	-4.33	-5.09E-01	-1.75	-2.63E-01	-1.42	-2.21E-01	-0.96	-4.85E-01	-3.36
HOME	1.14E+00	4.31	1.58E+00	4.76	1.71E+00	5.46	2.46E+00	7.35	2.03E+00	6.35
GDPPC	3.56E-05	4.01	3.73E-05	4.02	3.19E-05	3.29	1.11E-05	0.96	2.84E-05	2.38
POP	-3.14E-07	-0.87	-2.48E-07	-0.47	-3.20E-07	-0.86	-8.92E-07	-1.99	-4.38E-07	-1.18
PD	-9.30E-05	-0.34	-9.45E-05	-0.20	-9.26E-05	-0.26	-4.10E-05	-0.15	-9.72E-05	-0.25
STAB	-4.02E-02	-0.20	-1.64E-01	-0.70	-1.75E-02	-0.07	1.16E-01	0.55	2.07E-01	0.73
BLEN	5.71E-04	4.07	1.94E-04	1.14	2.96E-04	1.95	9.01E-05	0.49	5.79E-04	2.80
PROTECT	-1.32E-08	-3.14	-8.33E-09	-1.48	-1.02E-08	-2.25	-5.89E-09	-0.97	-9.02E-09	-1.64
HER	4.17E-02	2.52	3.52E-02	1.73	4.15E-02	2.14	4.22E-02	1.72	4.88E-02	2.38
DIST	-2.63E-05	-0.86	-9.12E-05	-1.76	-4.12E-05	-1.23	-5.98E-05	-1.12	-9.65E-05	-2.36
TEMPSQ	3.31E-03	4.46	4.33E-03	3.58	-1.11E-03	-0.36	1.37E-03	1.14	3.04E-03	3.08
TEMP3	8.21E-05	3.60	7.51E-05	1.98	4.34E-04	1.94	5.42E-05	0.94	1.05E-04	4.08
TEMP4	-5.73E-06	-6.02	-6.03E-06	-3.25	-1.34E-05	-2.80	-4.89E-06	-2.22	-6.22E-06	-4.79
WET	2.69E-01	4.00	4.05E-01	4.35	3.27E-01	4.03	1.08E-01	1.05	2.74E-01	3.28
WETSQ	-1.04E-02	-3.97	-1.69E-02	-4.76	-1.35E-02	-4.86	-7.11E-03	-1.77	-1.24E-02	-4.38
PRE	-2.79E-02	-4.18	-2.60E-02	-2.74	-2.00E-02	-2.48	-7.36E-05	-0.01	-1.51E-02	-1.84
PRESQ	1.02E-04	4.31	9.04E-05	2.67	7.08E-05	2.64	2.39E-05	0.71	6.13E-05	2.40
CONSTANT	-3.82E-01	-1.23	-1.05E+00	-2.09	-8.45E-01	-1.85	-1.32E-01	-0.27	-3.18E-01	-0.72

Table 5-2: Results for the life cycle segments

Segment name	F-statistic
Life cycle segments	
Young	1.286 ***
Children	1.196 *
Middle	1.327 ***
Senior	1.171 *
Regional segments	
East	1.245 **
North	1.268 **
South	1.294 ***
West	1.268 **
Motivation and activity segments	
Sport	1.229 *
Health	1.335 ***
Family	1.306 ***
Outdoor	1.330 ***
Sights	1.267 **
Swimsun	1.276 ***

*** Significant at the 0.5% level
** Significant at the 1% level
* Significant at the 5% level

Table 5-3: Chow test F-Statistics for differences between the segments, the inverse of the segments and the full model

The segment *Senior* has only one significant climate variable: TEMP4. TEMPSQ is not significant for the segment *Middle*. For the other segments, however, all of the climate variables are significant. The observed optimal climate values of the segments are shown in table 5-4. The optimal temperatures for the two oldest age segments are not significant. The segment *Children* has the highest optimal temperature of 24°C and the relationship between temperature and demand is much more peaked for this segment. Those with children prefer destinations that are near this optimal temperature. A change in the temperature would lead to larger changes in demand than it would for the *Young* segment, which has a similar optimal temperature but a less peaked temperature-demand relationship. For wet day frequency, the highest optimal frequency of 13 days is found for the *Young* segment (the *Invyoung* has an optimal at 11.4). Again, the segment *Children* has a more peaked wet days-demand relationship than the other segments. The precipitation minima range from 133mm (*Invchildren*) to 144mm (*Children*).

	temperature (°C)		wet day frequency (days)	precipitation (mm)
	maximum		maximum	minimum
Life cycle segments				
Young	23	-12	13.0	137
Children	24	-15	12.0	144
Middle	ns	ns	12.1	141
Senior	ns	ns	ns	ns
Regional segments				
East	ns	ns	11.5	128
North	21	-18	12.5	146
South	23	-10	11.3	127
West	23	-9	11.9	138
Motivation and activity segments				
Sport	23	-12	10.8	125
Health	23	-12	11.4	117
Family	23	-10	11.8	139
Outdoor	23	-10	10.9	120
Sights	22	-13	11.5	123
Swimsun	23	-17	11.1	134

ns - not significant

Table 5-4: Optimal values of the climate variables for each segment. Only those significant at the 5% level are listed

Climate index values were calculated for the month of August for certain European countries. The different values for each of the segments and the index values for the pooled model are shown in Figure 5-1. The highest index values are for the segment *Children*, which has even higher values than the combined data set. The lowest values are estimated for the segment *Senior*. In general, the *Middle* segment has higher climate values than the *Young* segment. There are some differences in the ranking of the different countries.

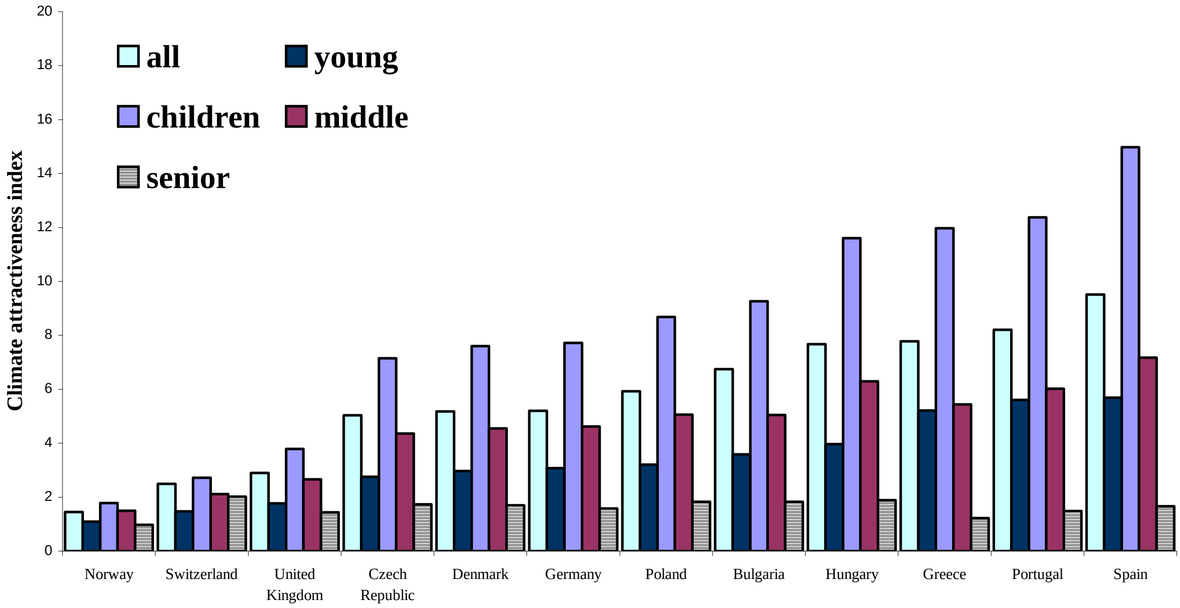

Figure 5-1: Climate index values for the life cycle segments

5.4.2 Regional segments

The demand equations of the four regional segments as defined in table 5-1 and four inverse segments were estimated. The results of the main segments are shown in table 5-5. Again, there are different R^2 values for each of the segments; *South* has the worst fit of all. The segment *East* has the largest coefficient for the variable HOME of all of the segments. GDPPC is significant for all segments apart from *East*. The segment *West* has the largest coefficient for GDPPC. The coefficient on population is negative and significant at the 10% level for the segment *East*. This was also seen for the oldest group in the life cycle segmentation. The coefficient for BEACH is positive for each segment but significant for the segments *North* and *West*; the latter has a larger coefficient. The segment *North* has a negative and significant coefficient for PROTECT. The segments *South* and *West* have positive and significant coefficients for HERITAGE. The coefficient on DISTANCE has the correct sign for all segments but is only significant at the 10 % level for *East* and *South*.

	East		North		South		West	
Observations	274		283		329		328	
R-squared	0.56		0.62		0.53		0.59	
Variable	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
M1	-2.81E-01	-1.28	-8.43E-02	-0.57	-2.98E-02	-0.15	-3.19E-01	-1.50
M2	-3.29E-01	-1.53	4.88E-03	0.03	-4.18E-01	-1.86	-1.12E-01	-0.62
M3	-1.09E-01	-0.55	6.78E-02	0.45	-2.81E-01	-2.14	-7.37E-02	-0.56
M4	-3.20E-01	-1.55	-2.89E-02	-0.18	-3.54E-01	-2.42	-1.57E-01	-1.05
M5	-6.53E-02	-0.27	4.39E-01	2.28	1.09E-02	0.07	-1.24E-01	-0.69
M6	-1.68E-01	-0.59	1.43E-01	0.75	-1.91E-01	-1.04	-2.16E-01	-0.96
M7	3.07E-01	0.99	3.05E-01	1.56	-4.79E-01	-2.39	2.42E-01	0.94
M8	6.33E-02	0.20	2.69E-01	1.47	1.14E-01	0.57	4.54E-02	0.17
M9	-1.30E-01	-0.47	1.22E-01	0.74	8.78E-02	0.52	-1.67E-02	-0.07
M10	-1.74E-01	-0.69	7.05E-02	0.40	-2.33E-01	-1.36	-1.70E-01	-0.94
M11	-3.89E-01	-2.13	-3.39E-01	-2.06	-5.17E-01	-3.14	-5.25E-01	-2.10
HOME	2.09E+00	6.82	1.95E+00	5.14	1.28E+00	4.35	1.72E+00	4.77
GDPPC	2.04E-05	1.64	2.94E-05	3.04	2.85E-05	2.21	3.84E-05	3.49
POP	-6.55E-07	-1.84	-5.23E-07	-1.09	-5.01E-07	-1.11	-5.71E-07	-1.10
PDEN	-2.68E-04	-0.97	-6.05E-05	-0.32	1.97E-05	0.05	2.05E-04	0.53
STAB	-6.98E-02	-0.25	-1.10E-01	-0.68	1.17E-02	0.05	-1.09E-01	-0.43
BLEN	1.70E-04	0.94	3.52E-04	2.75	2.79E-04	1.42	4.16E-04	2.36
PROTECT	-7.66E-09	-1.46	-9.69E-09	-2.38	-7.67E-09	-1.52	-9.13E-09	-1.71
HER	2.75E-02	1.46	3.27E-02	1.32	4.08E-02	2.19	4.52E-02	2.10
DIST	-7.67E-05	-1.90	-1.89E-05	-0.56	-7.44E-05	-1.89	-7.99E-05	-1.53
TEMPSQ	1.96E-03	0.39	3.30E-03	4.36	3.12E-03	3.09	2.48E-03	2.16
TEMP3	1.47E-04	0.38	1.70E-05	0.74	1.18E-04	2.37	1.04E-04	2.99
TEMP4	-7.26E-06	-0.87	-4.31E-06	-3.56	-6.82E-06	-4.45	-5.68E-06	-3.87
WET	1.86E-01	2.38	2.26E-01	2.75	2.71E-01	3.17	3.27E-01	3.35
WETSQ	-8.11E-03	-3.15	-9.04E-03	-3.09	-1.20E-02	-3.64	-1.38E-02	-4.27
PRE	-1.42E-02	-1.65	-1.41E-02	-1.52	-1.78E-02	-2.30	-1.88E-02	-1.89
PRESQ	5.51E-05	2.00	4.83E-05	1.49	6.99E-05	2.78	6.81E-05	2.27
CONSTANT	5.26E-02	0.11	-8.01E-01	-2.09	-5.78E-01	-1.45	-8.45E-01	-1.70

Table 5-5: Results for the regional segments

From the results of the Chow test shown in table 5-3, it can be seen that the demand equations for the respective segments and their inverses are not equivalents.

Segments *South* and *West* have significant coefficients for all of the climate variables. The calculated climate optima can be seen in table 5-4. The segments *South* and *West* both have an optimal temperature of 23°C. The estimated temperature-demand relationship, however, is much steeper for the segment *South*. For precipitation, the minimum optima range from 127mm to 146mm. It is interesting that *South* and *West* have significant climate optima, as the south west of Germany is the warmest and sunniest region of Germany. It would seem that tourists with a warmer home climate are more particular about their holiday destination climate.

Figure 5-2 shows the index values for the regional segments. The complete model has higher index values than any of the segments. Generally, the highest index values are for the segment *West* followed by the segment *South*, although there are some differences in ranking.

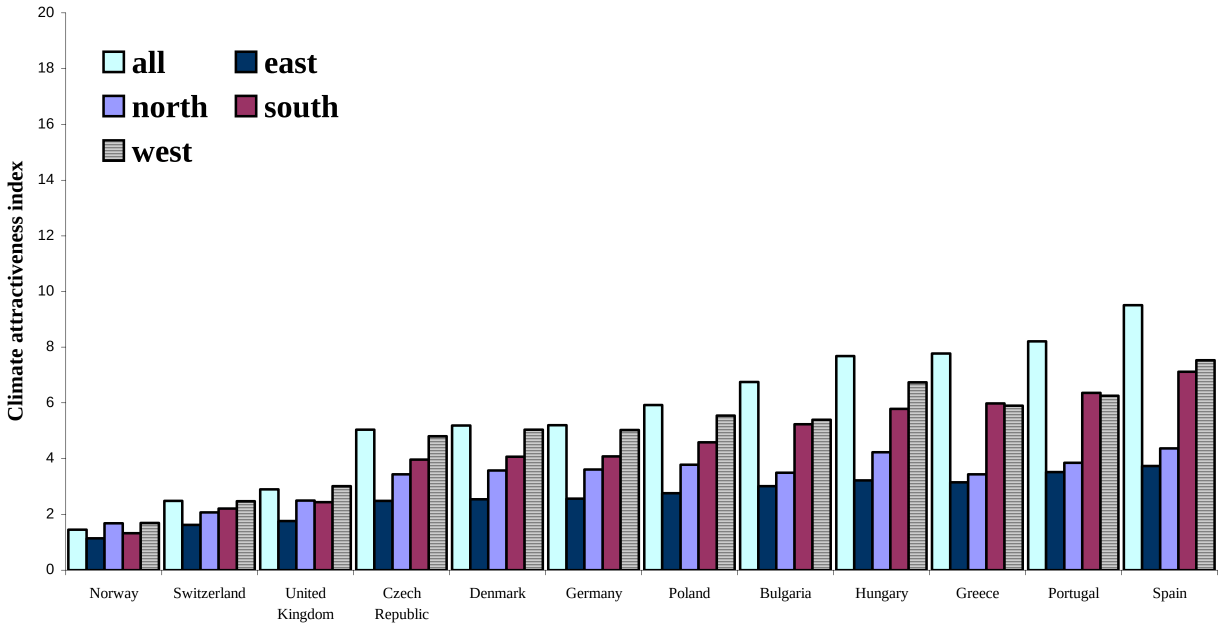

Figure 5-2: Climate index values for the regional segments

5.4.3 Activity and motivation Segments

The statistical analysis was carried out for the six activity and motivation segments, as defined in table 5-1, and their inverse segments. The results of the regression analyses are presented in tables 5-6 and 5-7.

For all the motivation segments, the coefficients for HOME are positive and significant (see table 5-6). The motivation segment *Health*, however, has the largest coefficient for this variable and it is more than twice as large as the coefficient for the *Sport* segment. This may be caused by an aversion to longer distances when tourists are looking for a holiday that will be beneficial for their health. Avoiding stress, which may be in terms of the physical distance but also in terms of cultural or linguistic distance, could be a restriction on health holidays. Moreover, Germany has a very strong tradition of Kur[15] holidays at domestic destinations where the air is considered particularly beneficial. The importance of trips to family and friends

[15] Kur translates as a treatment at a health resort.

within Germany is reflected in the size of coefficient of the HOME variable for the *Family* segment. Like the majority of the other segments discussed above GDPPC is positive and significant for all of the motivation segments. The variables POP, PDEN and STAB are not significant for any of the segments. As visiting the beach is often seen as a family activity, it is not surprising that BEACH is significant and positive for the *Family* segment. The *Sport* and *Health* segments have positive and significant coefficients for the variable HERITAGE.

For segmentation according to motivation, the hypothesis that each segment and its inverse have the same demand function as the complete data set can be rejected (see table 5-3).

	Sport		**Health**		**Family**	
Observations	263		404		330	
R-squared	0.54		0.59		0.60	
Variable	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
M1	5.94E-02	0.27	-1.60E-01	-0.81	-3.54E-01	-1.59
M2	-1.79E-01	-1.24	-1.39E-01	-0.67	-5.37E-01	-2.80
M3	-2.42E-01	-1.63	-4.76E-02	-0.29	-1.50E-01	-0.88
M4	-2.09E-01	-0.96	-2.40E-01	-1.36	-4.26E-01	-2.25
M5	-6.50E-01	-2.30	6.04E-02	0.32	-2.97E-01	-1.49
M6	-4.80E-01	-1.59	-9.93E-02	-0.53	-4.35E-01	-1.74
M7	-3.66E-01	-1.17	1.72E-01	0.79	-1.51E-01	-0.57
M8	-1.25E-01	-0.38	3.74E-01	1.80	1.14E-01	0.40
M9	-2.83E-01	-0.84	7.95E-02	0.38	-3.25E-01	-1.64
M10	-5.14E-01	-2.18	-7.38E-02	-0.40	-2.83E-01	-1.51
M11	-4.30E-01	-1.43	-6.04E-01	-3.40	-4.60E-01	-2.08
HOME	1.00E+00	3.41	2.02E+00	5.50	1.90E+00	5.15
GDPPC	4.52E-05	3.63	3.47E-05	2.97	4.13E-05	3.54
POP	-3.95E-07	-1.00	-6.17E-07	-1.28	-2.92E-07	-0.62
PDEN	3.52E-05	0.12	-3.14E-04	-0.93	-1.22E-04	-0.30
STAB	1.61E-02	0.05	1.93E-01	0.68	-1.01E-02	-0.03
BLEN	9.97E-05	0.53	2.94E-04	1.66	3.74E-04	2.11
PROTECT	-9.34E-09	-1.54	-1.03E-08	-1.96	-9.60E-09	-1.81
HER	4.18E-02	2.24	4.93E-02	2.11	3.45E-02	1.52
DIST	-7.91E-05	-1.48	-8.40E-05	-2.01	-1.11E-04	-2.48
TEMPSQ	3.53E-03	3.01	3.98E-03	4.09	3.88E-03	3.15
TEMP3	9.64E-05	2.52	1.02E-04	4.35	1.58E-04	2.66
TEMP4	-6.37E-06	-4.38	-7.12E-06	-5.46	-8.66E-06	-3.88
WET	3.09E-01	3.45	2.94E-01	3.50	3.75E-01	4.53
WETSQ	-1.43E-02	-3.71	-1.29E-02	-4.56	-1.59E-02	-5.37
PRE	-2.25E-02	-2.78	-2.00E-02	-2.25	-2.32E-02	-2.66
PRESQ	9.03E-05	3.24	8.51E-05	3.06	8.34E-05	2.78
CONSTANT	-6.37E-01	-1.42	-6.82E-01	-1.50	-7.57E-01	-1.59

Table 5-6: Results for the motivation segments

The climate variables are significant for all of the motivation segments. There is little difference in the optima for temperature or for wet days across the motivation segments (see table 5-4). Nevertheless, differences in the steepness of the climate-demand relationships can be seen. The segment *Family* has the steepest and highest demand relationship for temperature and wet day frequency. Precipitation minima range from 117mm (*Health*) to 139mm (*Family*). The climate index values for the motivation segments are shown in figure 5-3. The values for the segments *Sport* and *Health* are lower than the index values from the pooled model, whereas the values for the segment *Family* are higher. There are slight differences in the ranking of the countries.

	Outdoor		**Sights**		**Swimsun**	
Observations	414		460		375	
R-squared	0.59		0.58		0.55	
Variable	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
M1	-3.47E-01	-2.01	-2.54E-01	-1.80	-2.36E-01	-1.09
M2	-3.97E-01	-2.11	-4.12E-01	-2.53	-4.20E-01	-1.81
M3	-2.87E-01	-2.05	1.01E-03	0.01	-1.92E-01	-0.94
M4	-3.93E-01	-2.42	-1.36E-01	-0.91	-2.30E-01	-1.13
M5	-5.45E-02	-0.30	2.64E-01	1.78	1.85E-01	0.83
M6	-2.97E-01	-1.65	1.04E-01	0.58	-1.14E-01	-0.49
M7	-6.75E-02	-0.29	2.89E-01	1.37	2.74E-01	1.02
M8	1.07E-01	0.45	4.16E-01	2.02	3.83E-01	1.40
M9	-8.74E-02	-0.45	2.05E-01	1.22	-5.99E-02	-0.27
M10	-3.77E-01	-2.09	2.57E-02	0.16	-1.23E-01	-0.56
M11	-5.36E-01	-2.65	-4.46E-01	-3.26	-4.74E-01	-2.86
HOME	2.13E+00	6.20	1.97E+00	6.46	1.33E+00	3.30
GDPPC	3.66E-05	2.90	2.12E-05	2.07	2.68E-05	2.61
POP	-6.94E-07	-1.41	-6.26E-07	-1.60	-6.33E-07	-1.25
PDEN	-2.61E-04	-0.71	-1.40E-04	-0.38	1.94E-05	0.05
STAB	1.78E-01	0.58	2.06E-01	0.70	5.73E-02	0.18
BLEN	2.69E-04	1.39	6.65E-04	3.61	6.51E-04	3.61
PROTECT	-1.04E-08	-1.77	-8.32E-09	-1.62	-1.48E-08	-2.22
HER	4.94E-02	2.22	4.80E-02	2.50	4.49E-02	1.74
DIST	-8.97E-05	-1.92	-8.93E-05	-2.35	-6.20E-05	-1.24
TEMPSQ	3.39E-03	3.34	3.74E-03	3.91	5.85E-03	5.19
TEMP3	1.17E-04	3.78	7.62E-05	3.10	5.71E-05	1.90
TEMP4	-7.16E-06	-5.01	-6.48E-06	-5.00	-7.35E-06	-4.97
WET	2.86E-01	3.64	2.39E-01	2.73	4.20E-01	3.31
WETSQ	-1.31E-02	-4.85	-1.04E-02	-3.60	-1.89E-02	-3.96
PRE	-1.65E-02	-1.98	-1.83E-02	-2.18	-2.54E-02	-2.43
PRESQ	6.87E-05	2.55	7.45E-05	2.95	9.44E-05	2.79
CONSTANT	-3.35E-01	-0.68	-1.67E-01	-0.36	-1.06E+00	-1.98

Table 5-7: Results for the activity segments

The results for the activity segments are shown in table 5-7. For the variable HOME, the activity segment *Swimsun* has a much lower coefficient than the other two activity groups *Outdoors* and *Sights*. The coefficient is significant for all of the activity segments. Population, population density and stability are not significant. As expected from the definition of the segment *Swimsun*, BEACH is positive and significant. Curiously, there is no statistically significant difference between the BEACH coefficients for the segments *Sights* and *Swimsun*. Taking into consideration the fact that 65% of the tourists stated that sightseeing was one of their holiday activities and 64% stated that swimming or sunbathing was part of their holiday it is clear that there is some overlap in these two segments. In addition, the standard package holiday there will normally be some combination of these two activities. For the variable PROTECT there is a negative and significant relationship evident for the segment *Swimsun*. This could be explained by the fact that countries that have more protected area within their territory may have less beach available for recreational and tourism purposes. The coefficient on HERITAGE is significant for the *Outdoors* and *Sights* segment at the 1% level and for the *Swimsun* segment at the 10% level. In addition, for the *Swimsun* segment, the coefficient for DISTANCE although negative, is not significant. The distance of the countries from Germany was less of a restriction for the people who were swimming or sunbathing on their holiday. Table 5-6 shows the results of the Chow test. As before, the Chow test confirms that the demand equations are different.

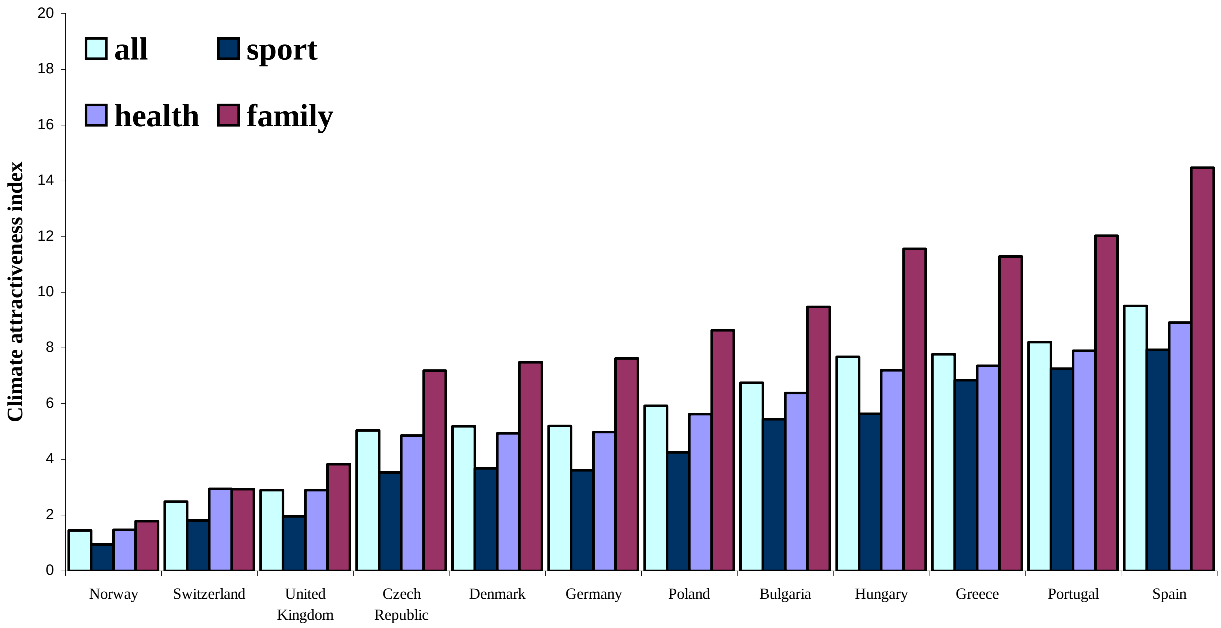

Figure 5-3: Climate index values for the motivation segments

It is possible to calculate climate optima for all of the activity segments. These can be seen in table 5-4. As with the previously discussed segments, the greatest differences in the optima can be seen in the precipitation minimum, which range from 120mm (*Outdoors*) to 134mm (*Swimsun*). *Sights* has the lowest temperature optimum at 22°C, whereas *Swimsun* and *Outdoors* have optima of 23°C. As before there are differences in the steepness of the temperature-demand relationships. *Swimsun* has the steepest relationship; demand falls rapidly when the temperature goes above 23°C.

The *Sights* segment has the lowest climate index values, whereas the *Swimsun* has the highest values. For example, the climate values for Spain for the *Swimsun* segment are almost double that of the values for the *Sights* segment. This is as expected: swimming and sunbathing are weather dependent recreation activities. In addition, the segment *Outdoors* has very similar values to that of the complete model. Again, there are slight differences in the ranking of the countries according to the index values. Figure 5-4 shows the calculated index values for the activity segments for a set of European countries for the month of July.

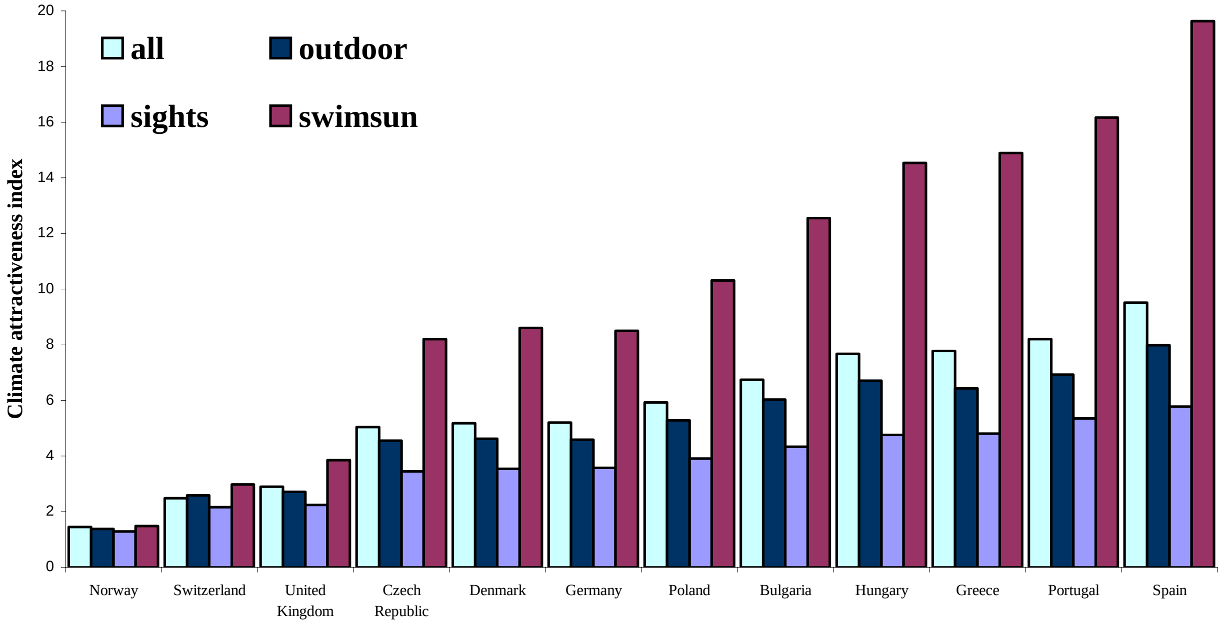

Figure 5-4: Climate index values for the activity segments

5.5 Discussion and conclusion

The aim of this chapter is to examine the climate-demand relationships of various segments, in order to provide a quantitative basis for tourism scenarios, which can then be used in climate impact research. Expanding the work of the previous chapter, this chapter presents three separate methods to segment the original data set and goes on to estimate the demand function for these segments in terms of destination characteristics such as climate, natural and cultural resources as well as socio-economic characteristics. Using a Chow test, the demand functions of all of the 28 segments were found to be significantly different from that of the complete model.

Certain variables were found to have a consistent relationship across all the segments. Domestic tourism was a positive factor in all of the estimated equations. There were, however, differences in size. For older tourists, those looking to do something for their health, those from the East or those wanting to take part in outdoor activities domestic tourism is particularly popular. For younger people, those motivated to participate in sport on their holiday or for those who were sunbathing or swimming domestic tourism is less important. Beach length was also an important factor for younger tourists. After younger tourists, the segments of tourists from the North and the West of Germany had the highest coefficient for beach length. It is not clear from this analysis if this is caused by the region of residence having beaches or being close to countries with beaches. The number of heritage sites also has a positive effect on demand, especially for those tourists who went sightseeing.

The temperature optima ranged from 21°C to 24°C. There were, however, differences in the steepness of the temperature-demand relationship. This was markedly so for the segments of tourists with dependent children and for those whose activities included sunbathing and swimming. Moving away from the optimal temperature leads to a sharp drop in demand, particularly for temperatures above the optimal. The optimal wet day frequency ranges from 11 to 13 wet days per month. Again, there were differences in the steepness of the relationship with demand. Almost one third of month with a rain day may seem high for an optimal holiday climate. It must be borne in mind that a wet day is one where there is more than 1mm of rain and a frequency of 11 days per month is normal for a central European summer or early and late summer in southern Europe. Moreover, climate is not just a thermal or physical factor it is also an aesthetic one, in that it affects, for example, the appearance and type of flora and fauna, the appearance of the built environment and visibility. Occasional rain is not necessarily detrimental for tourism demand. There are also some more practical effects of regular rain, such as the water availability, which may be considered by the tourist.

The ranking of tourist destinations, using the climate index developed in chapter 4, did not differ significantly across the segments. Nevertheless, the size of the climate index, on average and for the individual destinations, did differ. For the majority of the segments, the destination with the highest index value was Spain.

The results of this study confirm many of the results of previous segmentation studies. This can be seen in the differences in preferences across the life cycle or across activities. Like Mykletun *et al*. (2001), this study examines several kinds of segmentation and uses regression analysis to provide detail on the different preferences of the different groups. Previous studies that examined destination image preferences did so using a ranking of attributes. In this study, demand for a destination has been estimated with respect to the environmental characteristics, such as climate or beaches. This not only provides information on what is important for each segment but also how this quantitatively affects demand.

For climate change impact studies, a segmentation approach can provide useful information. Scenarios of population and economic change are only two aspects that will shape the development of tourism in the future. New trends or structural changes in the population will also affect demand. This study provides quantitative relationships, for different segments, such as seniors, health tourists or from different geographic regions. It was shown that regions with a warmer climate generate tourists that are more particular about their holiday destination climate. If this is applied to countries, it can be expected that warmer countries would also produce tourists that are less tolerant of temperatures away from the optimal. A similar result was obtained by Bigano *et al*. (2006) in a study of global demand. This has implications for climate change impact studies. Climate change may result in many origin countries having a climate closer to their optimal temperature, which combined with a preference, ceteris paribus, for domestic tourism, would result in a reduction in international tourism. Moreover, as a warmer climate becomes the norm, the tourists may also become more particular about their holiday destination climates.

This study examines the destination choices of German tourists in a single year. To obtain a more complete picture it would be useful to repeat the study for different years but also for different countries or look at smaller regions. The results of this study, however, provide a starting point for the development of quantitative tourism-climate scenarios.

Chapter 6

Coastal landscape and the hedonic price of accommodation*

6.1 Introduction

Studies on the impact of climate change on tourism focus on the relationship between climate and demand. Ancillary effects, however, like sea-level rise, will also have an impact on demand. Sea-level rise will result in the loss of low-lying islands, the loss of low-lying land at the coast and the erosion of beaches and cliffs. Nevertheless, there is a range of adaptation measures that can minimize these problems. In some cases, these measures will also change the appearance of the coast. To calculate the cost of the impact of climate change on tourism information is needed on the relationship between coastal morphology and tourism demand. The importance of the coast for tourism demand can be seen in chapters 3, 4 and 5. But in these chapters, different types of coastal landscape or morphology are not distinguished. This chapter is the first study to link accommodation price with coastal and other landscape attributes.

The state of Schleswig-Holstein in Northern Germany has been chosen as the study area. Schleswig-Holstein has two quite different coastlines: first, to the west there is the North Sea coast and second, to the east there is the Baltic Sea coast. In addition, there is the coastline of the river Elbe, which is heavily influenced by the North Sea. Tourism promotion in Schleswig-Holstein is organised at the level of the *Gemeinde* or district. These are small administration units at the level of LAU2.[16] The coastal districts included in this study have an average area of 21 km^2, and the maximum area is 67 km^2. The smallness of the districts allows a high-resolution study of tourism in the region.

To examine the effect that landscape and in particular seascape have on tourism demand the hedonic price method is used. The hedonic hypothesis is that goods are valued for their utility bringing characteristics, and that this is reflected in the willingness to pay for these characteristics and hence in the price. In tourism research, this method is not frequently used. Fleischer

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* This chapter is based on Hamilton (in press).

[16] LAU2 is the lowest of the administrative classes of the NUTS classification system of the EU.

and Tchetchik (2005), however, apply this method to the price of rural tourist accommodation in Israel. They focus on whether tourists value that their accommodation is located on a working farm. In this study the focus is on whether tourists value their accommodation being located in a district with certain coastal characteristics and if so by how much.

This chapter is structured as follows. In the second section, the study area is described. The hedonic method is introduced in the third section. The data used in this study and the model specifications are described in the fourth section. The fifth section presents the results of the regression analysis. The implications of these are discussed in the sixth section, and the seventh section concludes.

6.2 Study area

Schleswig-Holstein is the most northerly state in Germany, bordering Denmark in the North, and its southern border is defined by the river Elbe and the City State of Hamburg. The eastern border is shared with the state of Mecklenburg-Western Pomerania.

The coastal zone of Schleswig-Holstein consists of three coastlines: at the North Sea, at the Baltic Sea and along the River Elbe. The North Sea and Baltic Sea coast are quite different from their coastal morphology. The North Sea coast was formed by post-glacial floods. This resulted in low lying marshland, which may even be below sea level. The sandy moorland, *Geest*, is higher than the coastal marshland. Overall, the North Sea coast is flat, although the barrier islands of Sylt, Amrum and Föhr have moranic hills, cliffs and dunes (Kelletat, 1993). These barrier islands as well as the marsh islands that were formerly part of the mainland lie in the Schleswig-Holstein section of the Wadden Sea. The Wadden Sea is a large area of tidal flats, tidal gullies, salt marshes and sandy barriers stretching from Denmark along the North Sea coast of Germany to the Netherlands (Hofstede, 2003). The North Sea is salty with a salinity of 25%-30% (Reese, 2003). The Baltic Sea coast was formed by glaciers resulting in semi-enclosed inlets and fjords. There are also some stretches of coastline with cliffs. The land surrounding the coast is slightly hilly. Compared to the North Sea the Baltic Sea is much less salty. It has a salinity of 10% to 15% (Reese, 2003).

The main problem at the coast is the effect of storm floods. Around 24% of Schleswig-Holstein lies in the flood prone area, which is below 5m in the west and 3m in the east (Hofstede and Hammann, 2000). At the North Sea coast, these areas contain the main areas of high population and of high economic value, which has resulted in the coastline being protected with dikes. Hard structures such as dikes are not the only protection measures used: beach nourishment is also carried out on the barrier islands of Föhr and Sylt. This not only stabilises the coastline of the islands but also provides protection for the mainland as well as sandy beaches for recreation. The Baltic Sea coast has fewer stretches of dikes because of its natural protection system of beach walls and spits.

Climate change will result in sea-level rise and increased storminess. This will mean that existing dikes will have to be strengthened and raised. Currently Schleswig-Holstein spends 24 million Euros per year on keeping present safety levels. Under a scenario of 25cm sea-level rise by 2050, it is expected that the cost will rise by 5% to 15%. For the worst-case scenario of 50cm sea-level rise by 2050, the costs are estimated at 42 million Euros per year (CPSL, 2001). Furthermore, sea-level rise will increase the volume of sand required for beach nourishment.

3.1 million tourists spent their holiday at the coast and on the islands of Schleswig-Holstein in 2003. 10% of these tourists were from abroad. As a destination for German tourists, Schleswig-Holstein has a market share equivalent to that of France or Greece (NIT, 2001). In terms of its market share of tourism within Germany, Schleswig Holstein has a market share of approximately 4%. Tourism is important economically for the state: 7% of all jobs are in the tourism sector and 4.6% of the state income comes from tourism.

6.3 The hedonic price method

The hedonic price method, developed theoretically by Rosen (1974), is based on the idea that any differentiated product can be seen as a bundle of characteristics. The value that consumers attach to the characteristics will be reflected in the price of the differentiated product. The price of an individual characteristic is called the implicit or shadow price.

Hedonic price analysis is widely used for different goods such as cars (Irandoust, 1998), computer equipment (Doms and Forman, 2005) and agricultural products (Langyintuo *et al.*, 2004). The method has been extensively used for housing and in particular the valuation of environmental amenities. Moreover, it has been used to examine the impact of climate change on the price of housing in Italy (Maddison and Bigano, 2003), the UK (Rehdanz, 2006) and Germany (Rehdanz and Maddison, 2004). In tourism research, it has been applied to package tours (Clewer *et al.,* 1992; Sinclair *et al.,* 1990). Fleischer and Tchetchik (2005) have applied the technique to estimate the value to tourists of rural accommodation being located on a working farm. They find that an outstanding view from the tourist accommodation is positively related to price. Tourists are indifferent to the accommodation being located on a working farm.

Following Fleischer and Tchetchik's (2005) hedonic price framework for rural accommodation, P_i represents the minimum price per person per night for a particular district and accommodation type. X_i is the matrix of attributes of the districts and the accommodation types. The hedonic price equation is:

Equation 6-1: $P_i = f(X_i)$

The effect of an incremental increase in the *k*th attribute on price, that is the implicit price, is the partial derivative of Equation 6.1:

Equation 6-2: $\partial P_i / \partial X_{ik} = \partial f(X_i) / \partial X_{ik}$

6.4 Data and model specification

6.4.1 Data

The accommodation price data used in the analysis is taken from the tourist brochures of the coastal districts. These brochures, as well as containing the marketing and promotional information about the district, list all of the businesses providing accommodation with details on the number of beds, price per room or per unit and the facilities of each accommodation unit. From the 146 coastal districts, it was possible to calculate price data for 92 districts, which is more than is available from the official statistics.[17] The tourism marketing strategy of Schleswig-Holstein divides the state in to four regions: the North Sea coast, the Baltic Sea coast, inland and cities and large towns. As cities and large towns are marketed separately, such districts were not included in the analysis.[18] Furthermore, city or urban tourism is quite different from the rural coastal tourism under examination here.

[17] Official statistics only include business with more than nine beds, which leads to the exclusion of certain districts from the statistics. Data on accommodation prices is collected but not published.

[18] This applied to the cities and towns of Kiel, Lübeck and Flensburg and to the districts Harrislee and Wedel, which are so close to cities that they have a suburb function.

The accommodation listings provide information on up to seven different types of accommodation: hotel, hotel garni, guesthouse, bed and breakfast, rooms in private accommodation, holiday homes and flats. Holiday homes and flats, which make up half of all the available accommodation, show a great range in price dependent on the size of the unit and the quality of the features. For this reason, the price data set was constructed only for the categories hotel (including hotel garni), B&B (including guesthouse) and private rooms.

For each establishment the minimum price per person per night and the number of rooms was recorded. It was not possible to calculate separate prices for the different seasons as many establishments and individual districts have their own “seasons“ that deviate from the typical high and low seasons. From the listed establishment price and capacity data the district average minimum price per person per night was calculated for the three groups of accommodation. The accommodation listings are from the years 2001 to 2005. The year 2002 was taken as the base year. The prices for the other years were adjusted to 2002 prices using the German consumer price index for accommodation and hospitality services (Statistiches Bundesamt, 2005). If there was no average price for 2002 then the price for 2003 was used and so on until 2005. If there was not a price available for 2005 then the data for 2001 was used. In this case, the prices were converted from DM into Euro. The resulting dataset covers 92 coastal districts and has 189 observations. Note that as there are three types of accommodation each district may be represented by more than one observation. The 48 districts that are not covered in the data set may have specialised in self-catering accommodation or tourism might not have developed there at all.[19]

In addition to the price data, data on landscape features of each district were collected. First, for each district the area in hectares of sandy beach that extend beyond the main coastline was measured using the 1:50000 topographical map from the TOP50 CD-Rom (Landesvermessungsamt Schleswig-Holstein, 2005). Second, using maps showing coastal protection structures and coastal morphology from the Ministry of Coastal Protection (Ministerium für ländliche Räume, Landesplanung, Landwirtschaft und Tourismus des Landes Schleswig-Holstein, 2001) the length of dikes, cliffs and open coast in each district were measured using MAPINFO. The area in hectares of water surface, heathland, moorland and agricultural land

[19] In comparison, the official statistics report tourism data (but not price data) for 86 coastal districts, which means that for 54 districts data are not available.

were taken from the land use dataset of the state statistical office (Statistisches Landesamt Schleswig-Holstein, 1999).

In chapters 4 and 5, population and population density were included in the model specifications. For this dataset, it is not possible to include population and population density as they are highly correlated. Instead of using both, only population will be included as a variable (POP). This is used as a proxy for the number of man-made attractions or for the amount of infrastructure in each district. The source of the population data is the state statistical office (Statistisches Landesamt Schleswig-Holstein, 2001).

Climate variables have been omitted, as the climate is largely homogenous over the small area of Schleswig-Holstein.

Three regions are included in the dataset: the districts at the North Sea coast, the districts at the Baltic coast and those at the Elbe.[20] The North Sea districts border on the Wadden Sea National Park. The flora and fauna of this unique area, as well as the national park's facilities for education are an attraction for tourists that can only be found at the North Sea. In addition, the water at the North Sea is generally cooler than at the Baltic, and the waves tend to be higher. To control for these effects a dummy variable, NORTH, has been created for the districts at the North Sea coast. It is also possible, however, that this variable also picks up a preference for the North Sea coast that has nothing to do with the coastal landscape, such as the popularity of the distinctive Frisian culture.

Table 6-1 presents the variables used in this analysis, and table 6-2 presents the summary statistics of these variables.

[20] The districts at the river Elbe belong to the marketing category "Inland". In this analysis, however, they have been included as part of the coast, as the Elbe is strongly influenced by the tidal regime of the North Sea and the districts are part of the coastal defence programme.

Variable	Definition
MINP	The average minimum price for an accomodation category
HOTEL	Is unity if the price is for the hotel category, otherwise 0
BANDB	Is unity if the price is for the B&B category, otherwise 0
NORTH	Is unity if the district lies at the North Sea coast, otherwise 0
BEACH	Area of beach in hectares
OPENTOT	Length of open coast in kilometres
CLIFFTOT	Length of cliffs in kilometres
DIKETOT	Length of open coast in kilometres
OPENSH	Percentage of total coastline that is classified as open
CLIFFSH	Percentage of total coastline that is classified as cliffs
DIKESH	Percentage of total coastline that is classified as dikes
WATER	Area of water bodies in hectares in 1997
HEATH	Area of heathland in hectares in 1997
MOOR	Area of moorland in hectares in 1997
AGRIC	Area of agricultural land in hectares in 1997
POP	Number of people resident in each district in 2000

Table 6-1: Definition of the variables

Variable	Mean	Std. Dev.	Minimum	Maximum
MINP	25.41	11.57	10.36	80.68
HOTEL	0.30	0.46	0	1.00
BANDB	0.33	0.47	0	1.00
NORTH	0.50	0.50	0	1.00
BEACH	64.76	152.56	0	900.40
OPENTOT	4.17	5.47	0	25.94
CLIFFTOT	0.79	2.14	0	13.00
DIKETOT	4.88	6.42	0	29.81
OPENSH	38.09	37.71	0	100.00
CLIFFSH	9.33	19.94	0	89.74
DIKESH	52.58	100.42	0	100.00
WATER	204.78	380.33	0	2156.00
HEATH	6.80	23.54	0	132.00
MOOR	0.61	2.78	0	23.00
AGRIC	1394.39	1357.47	16	5317.00
POP	3546.49	4666.70	26	23304.00

Table 6-2: Summary statistics of the variables

6.4.2 Specifications

Three different ways of representing coastal features and two different ways of representing the landscape are examined in six specifications. In the first two coastal specifications, the coastal features, length of open coast, length of cliffs and length of dikes in each district are expressed as a percentage of the total coastal length of the district. Specification C1 contains the variables OPENSH and CLIFFSH, which represent the natural features of the coast. Specification C2 contains the variable DIKESH representing the man-made structures at the coast. The third specification C3 contains all of the coastal variables expressed as absolute values (OPENTOT, CLIFFTOT and DIKETOT).

The landscape of the districts can be described in different ways. There are many possible variables, but because of multicolinearity only some could be included in the final specifications. The first landscape specification L1 uses land use data on the area of water surfaces (WATER), the area of heathland (HEATH) and moorland (MOOR) in each district. In the second landscape specification L2, these three variables are replaced with the area in each district used for agriculture (AGRIC).

Combining the coastal and the landscape specifications gives six different specifications. Each of these contains the dummy variables HOTEL, BANDB and NORTH and the continuous variables BEACH and POP. (See Table 6-1 for the definitions of the variables and table 6-2 for the summary statistics.)

6.4.3 Functional form and implicit prices

There is no theoretical guidance on the best functional form. Using the specifications described above the linear, log linear and inverse functional forms were tested. The log-linear functional form performs the best, and so only the results of this functional form will be presented here. The price equation is now written as:

Equation 6-3: $$\ln P_i = \beta X_i + \varepsilon_i$$

Equation 6-4: $$P_i = e^{\left(\beta X_i + \varepsilon_i\right)}$$

Hence, the effect of an incremental increase is:

Equation 6-5: $$\partial P_i / \partial X_{ik} = e^{\left(\beta X_i + \varepsilon_i\right)} \cdot \beta_k$$

Substituting equation 6-4 into equation 6-5 means that the implicit price is the real price multiplied by the coefficient of the variable that has increased.

6.5 Results

6.5.1 Results of the regression analysis

The model specifications were estimated using panel corrected least squares (Williams, 2000). Each of the specifications has 189 observations allocated to 92 clusters. Table 6-3 shows the results for the combinations of C1 to C3 with the landscape specification L1. R^2 ranges from 0.68 to 0.70; coastal specification C3 has the highest R^2. Table 6-4 shows the results for the coastal combinations C1 and C2 with the landscape specification L2.[21] The landscape specification L2 has R^2 values of 0.66 and 0.65 for the specifications C1 and C2 respectively; these are slightly lower than for the combination with the landscape specification L1. Each of the specifications passes the Ramsay RESET test for correct functional form (the p-values range from 0.09 to 0.38).

The results for the variables describing the type of accommodation are highly significant and positively related to price. As can be expected the coefficient on the dummy HOTEL is much higher than that of BANDB; hotels are a much greater leap in quality than bed and breakfast establishments are from rooms in private accommodation. Hence, a greater price difference can be expected. The coefficient on HOTEL is significant at the 0.5% level for all specifications. The coefficient on the variable BANDB for the specification combinations L1 is significant at the 0.5% level, and for the combinations with L2 it is significant at the 1% level.

For the variable NORTH there is a positive relationship with price. This is significant at the 5% level in the specifications L1 and at the 1% level in the specifications L2. The various coastal specifications do not affect the significance. Here there is evidence that there is something attractive about the North Sea coast districts over and above the seascape and landscape elements included in the statistical models. The reasons for this advantage of the North Sea coast cannot be examined here and will be left for further research; it may be the waves, the salt, the Frisians, or accessibility.

The coefficient on the variable BEACH is not significant in any of the specifications. This is also the case for the variable POP. The population of each district had been included as a proxy for service infrastructure and man-made attractions. In this study, population has no influence on price.

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[21] The combination C3–L2 has not been estimated because of the high correlation between AGRIC and TOTDIKE.

Dependent varaible LN(MINP)						
	C1-L1		C2-L1		C3-L1	
HOTEL	7.21E-01	***	7.20E-01	***	7.34E-01	***
	4.24E-02		4.23E-02		4.30E-02	
BANDB	3.30E-01	***	3.27E-01	***	3.39E-01	***
	3.50E-02		3.50E-02		3.52E-02	
NORTH	9.32E-02	*	1.08E-01	*	1.03E-01	*
	4.56E-02		4.72E-02		4.11E-02	
BEACH	1.26E-04		1.34E-04		1.57E-04	
	1.00E-04		1.07E-04		8.37E-05	
OPENSH	1.33E-01	*				
	6.04E-02					
CLIFFSH	7.52E-03					
	1.05E-01					
DIKESH			-1.08E-01			
			5.48E-02			
OPENTOT					8.50E-03	*
					3.70E-03	
CLIFFTOT					-6.72E-03	
					5.98E-03	
DIKETOT					-7.69E-03	**
					2.54E-03	
WATER	1.05E-04	*	9.78E-05	**	1.27E-04	**
	4.30E-05		3.87E-05		4.05E-05	
HEATH	2.63E-03	*	2.80E-03	**	2.60E-03	**
	9.97E-04		9.69E-04		9.02E-04	
MOOR	-1.39E-02		-1.42E-02		-1.23E-02	
	7.06E-03		7.73E-03		7.26E-03	
POP	3.61E-06		5.03E-06		2.87E-06	
	3.59E-06		3.25E-06		3.44E-06	
Constant	2.68E+00	***	2.77E+00	***	2.72E+00	***
	4.53E-02		4.30E-02		3.91E-02	
N	189		189		189	
R^2	0.6849		0.6825		0.6967	

* Significant at the 5% level
** Significant at the 1% level
*** Significant at the 0.5% level

Table 6-3: Results for the first landscape specification

Moving on to the coastal variables, the coefficient on OPENSH, in the first coastal specification C1, is positive and significant at the 5% level and at the 1% level in combination with L1 and L2 respectively. Therefore, districts with a greater share of their coastline of the type open or flat coast will have higher prices for their accommodation. The coefficient on the variable CLIFFSH is not significant in either of the landscape specifications; therefore, the share of the coastline with cliffs plays no role in the determination of price.

Dependent variable LN(MINP)				
	C1-L2		C2-L2	
HOTEL	7.30E-01	***	7.29E-01	***
	4.35E-02		4.37E-02	
BANDB	3.38E-01	***	3.37E-01	***
	3.54E-02		3.56E-02	
NORTH	1.16E-01	**	1.31E-01	**
	4.37E-02		4.48E-02	
BEACH	1.55E-04		1.65E-04	
	9.50E-05		9.97E-05	
OPENSH	1.51E-03	**		
	5.39E-04			
CLIFFSH	3.42E-02			
	1.15E-03			
DIKESH			-1.31E-03	*
			5.16E-04	
AGRIC	-3.12E-05	*	-3.42E-05	**
	1.21E-05		1.17E-05	
POP	4.75E-06		5.81E-06	
	3.65E-06		3.49E-06	
Constant	2.72E+00	***	2.84E+00	***
	4.99E-02		4.15E-02	
N	189		189	
R^2	0.66		0.65	

* Significant at the 5% level
** Significant at the 1% level
*** Significant at the 0.5% level

Table 6-4: Results for the second landscape specification

In the second coastal specification, C2, the variable DIKESH, the share of the coastline with dikes, is the only variable. In both landscape combinations, the coefficient is negative. In the L1 combination, it is only significant at the 10% level. For the L2 combination, however, it is significant at the 5% level. In contrast to the existence of open coast, the existence of dikes has a negative effect on price.

The third coastal specification includes all of the coastal types as absolute values. The coefficient on OPENTOT is positive and significant at the 5% level. As was the case for the relative representations of the coastal variables, CLIFFTOT is not significant. DIKETOT is negative and significant at the 1% level. So not only does the length of the coastal type relative to the total coastal length have an effect on price, but so does the absolute length of the coastal type. The results for this specification emphasis the positive effect that coastlines that are free from hard coastal protection measures such as dikes have on price.

For the first landscape specification, there are very similar results across the coastal specifications. The coefficient of the variable WATER is positive and significant. For specification C1-L1 it is significant at the 5% level. For the other two specifications, C2-L1 and C3-L1 water is significant at the 1% level. Therefore, the more water features such as lakes and rivers in a district the higher the price of accommodation will be. In addition, heathland in a district has a positive effect on price: the coefficient on HEATH is positive and significant at the 5%, 1% and 1% level for C1-L1, C2-L1 and C3-L1 respectively. MOOR is not significant in any of the specifications.

The second landscape specification has only one landscape variable AGRIC, which is negative in all of the specifications and significant at least at the 5% level. The size of the coefficients and their standard errors are similar for the specifications C1 and C2.

6.5.2 Hedonic prices of coastal and other landscape features

To recap on section 6.4.3, the hedonic price of a characteristic is calculated by multiplying the coefficient by the price of the accommodation type in each district. The hedonic prices for the significant variables for the landscape specifications L1 are shown in table 6-5. The hedonic prices are calculated using the average, the minimum and the maximum price of all the districts for one night in private accommodation. Table 6-6 shows the results for the specifications L2. As mentioned above it can be expected that hotel accommodation is valued higher than B&B accommodation. Here, the hedonic price for hotel accommodation is double that of B&B for all of the specifications. Dike share and absolute dike length have negative hedonic prices; that is, they are a disamenity. On the other hand, the share of open coast and the absolute length of open coast are amenities. Agricultural land use has a small but negative hedonic price.

Variable	C1-L1			C2-L1			C3-L1		
	minimum	average	maximum	minimum	average	maximum	minimum	average	maximum
HOTEL	7.47 €	12.34 €	17.75 €	7.46 €	12.32 €	17.72 €	7.60 €	12.56 €	18.05 €
BANDB	3.41 €	5.64 €	8.11 €	3.39 €	5.60 €	8.06 €	3.51 €	5.80 €	8.33 €
NORTH	-	1.59 €	2.29 €	-	1.85 €	2.66 €	-	1.77 €	2.54 €
OPENSH	0.01 €	0.02 €	0.03 €	-	-	-	-	-	-
DIKESH	-	-	-	-0.01 €	-0.02 €	-0.03 €	-	-	-
OPENTOT	-	-	-	-	-	-	0.09 €	0.15 €	0.21 €
DIKETOT	-	-	-	-	-	-	-0.08 €	-0.13 €	-0.19 €
WATER	0.001 €	0.002 €	0.003 €	0.001 €	0.002 €	0.002 €	0.001 €	0.002 €	0.003 €
HEATH	0.03 €	0.05 €	0.06 €	0.03 €	0.05 €	0.06 €	0.03 €	0.05 €	0.06 €

Table 6-5: Hedonic prices (€) of the accommodation and district characteristics for the first landscape specification

Variable	C1-L2			C2-L2		
	minimum	average	maximum	minimum	average	maximum
HOTEL	7.56 €	12.48 €	17.95 €	7.56 €	12.48 €	17.94 €
BANDB	3.51 €	5.79 €	8.32 €	3.49 €	5.77 €	8.29 €
NORTH	-	1.98 €	2.85 €	-	2.25 €	3.23 €
OPENSH	0.02 €	0.03 €	0.04 €	-	-	-
DIKESH	-	-	-	-0.01 €	-0.02 €	-0.03 €
AGRIC	0.000 €	-0.001 €	-0.001 €	0.000 €	-0.001 €	-0.001 €

Table 6-6: Hedonic prices (€) of the accommodation and district characteristics for the second landscape specification

6.6 Discussion

The results described above show that the type of coastal landscape has an effect on the price of accommodation. Sea-level rise will have an impact on the coastal landscape, whether through erosion or land loss. Flooding of low-lying areas is a particular problem in Schleswig-Holstein, which will be exacerbated with sea-level rise and an increase in storminess. Sterr (2000) reckons that with a 1m increase in sea level there will be an increase in the probability of flooding by up to 1/10 at both the North Sea and the Baltic Sea coast. Adaptation measures to cope with the increased probability of flooding include increasing the height of existing dikes or in some cases the construction of new dikes.

The district of Westerland, which is situated on the island of Sylt at the North Sea and the district of Timmendorfer Strand at the Baltic Sea are important tourism districts. Furthermore, they are located in low-lying areas of the coast of Schleswig-Holstein. Table 6-7 shows the hedonic prices of the four coastal variables for each of the accommodation types. The coefficients are taken from the results of the model specifications L1. The minimum average price for each accommodation category is taken from the price database.

District	Accommodation type	Price	1km increase in:		1 percentage point increase in:	
			OPENTOT	DIKETOT	OPENSH	DIKESH
Westerland	Hotel	67.26 €	0.57 €	-0.52 €	0.09 €	-0.07 €
(North Sea coast)	B&B	27.59 €	0.23 €	-0.21 €	0.04 €	-0.03 €
	Private accomm.	22.36 €	0.19 €	-0.17 €	0.03 €	-0.02 €
Timmendorfer Strand	Hotel	50.50 €	0.43 €	-0.39 €	0.07 €	-0.05 €
(Baltic Sea coast)	B&B	22.34 €	0.19 €	-0.17 €	0.03 €	-0.02 €
	Private accomm.	18.41 €	0.16 €	-0.14 €	0.02 €	-0.02 €

Table 6-7: Hedonic prices (€) of the characteristics for the coastal characteristics for the three accomodation types in the districts of Westerland and Timmendorfer Strand

The hedonic prices can be used to calculate the potential loss of revenue from accommodation, if a dike were to be built on 1 km of open coast. Data on the number of nights[22] spent by tourists in 2004 in each accommodation type is multiplied by the hedonic price for each variable. For the specification C3-L1 the loss from the conversion of 1km of open coast to 1km dike is calculated by adding the cost of a 1km reduction in open coast to the cost of a 1 km increase in dike length. The results are shown in table 6-8. For Westerland this change in the coastal landscape results in a loss of revenue of € 825,979 per year. A loss of € 410,252 is estimated for Timmendorfer Strand. Table 6-9 shows the loss estimates using the hedonic prices estimated for the specifications C1-L1 and C2-L2. To calculate the loss from a 1km change, the loss for a 1 percentage point change was multiplied by 15 in the case of Westerland or by 17 in the case of Timmendorfer Strand. These values are calculated from the total coastal length of the respective districts. For Westerland the estimated loss ranges from € 826,489 to € 1,017,806. The former estimate is very close to that of the hedonic prices of specification C3-L1. For Timmendorfer Strand the estimated loss ranges from € 465,239 to € 572,933.

These loss estimates must be taken as a lower bound because the district prices used are the average minimum price for one person per night, which can be seen as low season prices and for the minimum accommodation standard. Moreover, only three categories of accommoda-

[22] Nights spent in hotels and bed and breakfast were estimated using the market shares for each accommodation type from the official tourism statistics for 2004 (Statistiches Amt für Hamburg und Schleswig-Holstein, 2005). Private accommodation is not included in the official statistics. In a market report on tourism in Schleswig-Holstein (NIT, 2001), however, it is estimated that an extra 67% of the total nights listed in the official statistics are spent in private accommodation. This figure was used to calculate the number of nights spent in private accommodation for both Westerland and Timmendorf.

tion are included in the cost calculation. In Schleswig-Holstein, nearly 6 million nights were spent in self-catering accommodation in 2004, which are not included in the cost calculation.

District	Accommodation type	Nights	1km increase in: OPENTOT	1km increase in: DIKETOT	Conversion of 1km open coast to dike
Westerland (North Sea coast)	Hotel	415,709	237,665 €	-215,017 €	-452,682 €
	B&B	57,339	13,447 €	-12,165 €	-25,612 €
	Private accomm.	960,432	182,540 €	-165,145 €	-347,684 €
		Total Westerland	433,652 €	-392,327 €	-825,979 €
Timmendorfer Strand (Baltic Sea coast)	Hotel	263,641	113,168 €	-102,384 €	-215,552 €
	B&B	36,364	6,905 €	-6,247 €	-13,152 €
	Private accomm.	609,102	95,315 €	-86,232 €	-181,548 €
		Total Timmendorfer Strand	215,388 €	-194,863 €	-410,252 €

Table 6-8: Losses (€) from the conversion of 1 km of open coast to 1km of dikes in the districts of Westerland and Timmendorfer Strand (Specification C3-L1)

District	Accommodation type	Nights	1 percentage point increase in:		Conversion of 1km of open coast to dike	
			OPENSH	DIKESH	OPENSH	DIKESH
Westerland (North Sea coast)	Hotel	415,709	37,188 €	-30,197 €	-557,814 €	-452,962 €
	B&B	57,339	2,104 €	-1,709 €	-31,561 €	-25,628 €
	Private accomm.	960,432	28,562 €	-23,193 €	-428,431 €	-347,899 €
	Total Westerland	1,433,480	67,854 €	-55,099 €	-1,017,806 €	-826,489 €
Timmendorfer Strand (Baltic Sea coast)	Hotel	263,641	17,707 €	-14,379 €	-301,027 €	-244,443 €
	B&B	36,364	1,080 €	-877 €	-18,368 €	-14,915 €
	Private accomm.	609,102	14,914 €	-12,111 €	-253,539 €	-205,881 €
Total Timmendorfer Strand		909,107	33,702 €	-27,367 €	-572,933 €	-465,239 €

Table 6-9: Losses (€) from the conversion of 1 km of open coast to 1km of dikes in the districts of Westerland and Timmendorfer Strand (Specification C1-L1 and C2-L1)

Through beach nourishment it is possible to protect the coastline as well as maintaining the touristically important beach. In the past, beach nourishment has been carried out in the district of Westerland every six years costing approximately € 3.6 million on each occasion. The total costs of beach nourishment for the island of Sylt are estimated at € 5 million per annum (Amt für Land- und Wasserwirtschaft Husum, 1997). Dikes would be a costly alternative: costs would arise through construction and maintenance and through the loss of revenue from tourism. For example, if the total coastline of the district of Westerland were protected with dikes the loss of revenue in the accommodation sector would be approximately € 5.5 million per year.

6.7 Conclusion

This chapter has provided a way of examining the value that tourists attach to different coastal attributes. Districts with open coast accrue higher accommodation prices than districts with other coastal types. The hedonic prices of the different coastal types produced from this study can be used along with other tourism data in a cost-benefit analysis when considering the best adaptation measures to sea-level rise. Nevertheless, this study categorises coastal type in a very simple manner. Dikes are not the only hard engineering structures than can be used to protect the coast. In addition, tetrapods, groynes and revetments can be used; all of which change the appearance of the landscape. In this study, stretches of the coastline that have such structures in place still fall under the category of open coast.

Although this study examines tourism at a very high resolution, it would be an interesting extension to increase the resolution even further. Instead of the district average price, the prices of individual accommodation units can be used. At a higher resolution and with a smaller focus area, it would be possible to include measurements such as distance to the nearest beach and the area of coastline that has tetrapods or other such structures. Such an extension, however, would depend on the availability of appropriate GIS data.

Here the focus has been on only one of the coastal states of Germany. The other coastal states, Mecklenburg-Western Pomerania and Lower Saxony, have large tourism industries. Although the broad coastal types that can be found in these states can also be found in Schleswig-Holstein, a comprehensive study of coastal accommodation prices in Germany would be useful both for integrated coastal zone management as well as for tourism planning and marketing. This method and the results presented in this study are a good starting point for future research.

Chapter 7

Climate change and international tourism: a simulation study*

7.1 Introduction

Chapter 2 drew attention to the lack of a larger, global assessment of push and pull factors of international tourism. The study presented in this chapter is an attempt to fill that gap.

If one wants to estimate the implications of climate change for a particular tourist destination, then one would not only want to know how the attractiveness of that place is changing – as is done in some of literature discussed in chapter 2. Rather, one would need to know how climate change affects the attractiveness of that place *relative to its competitors*. If, for instance, Switzerland loses half of its snow, but other European skiing destinations lose all – then Switzerland's position may well be strengthened as the only place in Europe with natural snow. Similarly, one would need the change in behaviour of all tourists, and not just of those from Germany, the Netherlands and the UK. Like the studies on climate attractiveness, this chapter uses attractiveness indicators, albeit ones that are based on observed behaviour. In combining country demand studies and attractiveness studies, it was necessary to simplify. The novelty of this study lies in the interactions of push and pull factors at a global scale, not in the details.

Section 7.2 presents the model, its calibration and the base results. Section 7.3 discusses the sensitivity of the model. Section 7.4 concludes.

From the review of climate and tourism literature in chapter 2, the following gaps are evident. Firstly, the possibility of substitution between destinations has been neglected in all studies. Secondly, the studies have focussed 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

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* This chapter is based on Hamilton *et al*. (2005a).

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.

7.2 The model and basic results

7.2.1 Model structure

A model of international tourist flows from 207 countries to 207 countries was constructed. The purpose of the model is not to understand the current pattern of international tourism; for that, more detailed information than is currently available would be needed. Rather, the purpose of the model is to analyse how the current pattern may change under not-implausible scenarios of future population growth, economic growth and, particularly, climate change. The inputs to the patterns and their changes are the empirical regularities reported in section 7.2.2. The exact details are given below.

The basis of the model is the matrix of bilateral tourism flows. This matrix is perturbed with scenarios of population growth, economic growth and climate change. The perturbations on the supply side are perturbations on the *relative attractiveness* of holiday destinations. The perturbations on the demand side are perturbations on the *number of tourists* from origin countries. For these perturbations, the same relationships are used that were used to construct the bilateral tourism flow matrix.

Note that data on international tourism is available only at the national level. This implies a distortion of reality, particularly for large and diverse countries for which a representative climate and a representative income have to be assumed. This is obviously problematic for the USA, but also for France, the most popular destination, where tourism is concentrated in Paris and the south. Similarly, data are reported per year. Seasonal tourism flows are not accounted for.

7.2.2 Baseline

The model is calibrated against the international arrivals and departures data of 1995 contained in the World Resources Databases (WRI, 2000).[23] There are three major problems with

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[23] The reported departures from the Czech Republic were divided by 10; comparison to earlier and later years shows that the 1995 data have a typographical error.

this dataset. Firstly, for some countries, the reported data is for arrivals and departures for tourism only. For other countries, the data is for arrivals and departures for all purposes. Unfortunately, it is impossible to correct for this.[24] Secondly, the data is on total arrivals and total departures; there is no data on the origin of the arrivals or the destination of the departures. Consequently, a database on bilateral tourism flows for all pairs of countries was constructed. Thirdly, there are missing observations, particularly with regard to departures.

For arrivals, 181 countries have data but 26 do not. The missing observations were filled with a statistical model, viz:

Equation 7-1:

$$\ln A_d = \underset{0.97}{5.97} + \underset{0.96}{2.05} \cdot 10^{-7} G_d + \underset{0.07}{0.22} T_d - \underset{2.21}{7.91} \cdot 10^{-3} T_d^2 + \underset{3.03}{7.15} \cdot 10^{-5} C_d + \underset{0.09}{0.80} \ln Y_d$$

$$N = 139; R_{adj}^2 = 0.54$$

where A denotes total arrivals, G is land area (in square kilometres); T is annual average temperature for 1961-1990 (in degrees Celsius) averaged over the country, C is length of coastline (in kilometres), and Y is per capita income; d indexes destination country. This model is the best fit[25] to the observations for the countries for which there is data.[26] The total number of tourists increases from 55.2 million (observed) to 56.5 million (observed + modelled). The 26 missing observations constitute only 2% of the international tourism market.

For departures, the data problem is more serious: 107 countries report but 99 do not[27]; 46.5 million departures are reported, against 56.5 million arrivals, so that 18% of all international tourists have an unknown origin. Again, the missing observations were filled with a statistical model, viz:

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[24] However, the Polish departure data was corrected. According to Statistic Poland, only 12% of the reported international departures are tourists (Central Statistical Office Poland, 2002)

[25] The estimation procedure started with a large number of explanatory variables, including precipitation, number of world heritage sites, political stability and a range of other indicators. Explanatory variables that are individually and jointly insignificant were eliminated. Different representations of temperature (e.g., temperature of the hottest month) were experimented with; the annual average temperature describes the data best.

[26] The data on per capita income were taken from WRI (2000), supplemented with data from CIA (2002); the data on area and the length of international borders are from CIA (2002); the data on temperature from New *et al.* (1999). All data can be found at http://www.uni-hamburg.de/Wiss/FB/15/Sustainability.

[27] These are mostly African countries and small dependencies; however, data from Pakistan and Taiwan are also missing. Luxemburg is the only OECD country without departures data.

Equation 7-2:

$$\ln \frac{D_o}{P_o} = \underset{17.05}{1.51} - \underset{0.17}{0.18} T_o + \underset{16.82}{4.83} \cdot 10^{-3} T_o^2 - \underset{4.22}{5.56} \cdot 10^{-2} B_o + \underset{0.09}{0.86} \ln Y_o - \underset{0.13}{0.23} \ln G_o$$
$$N = 99; R_{adj}^2 = 0.66$$

where *D* denotes departures (in number), *P* denotes population (in thousands) and *B* is the number of countries with shared land borders; *o* indexes the country of origin. Again, this model is the best fit[28] to the observations for the countries for which there is data,[29] but although the fit is better than for arrivals, the uncertainty about the parameters is larger. This leads to a total number of departures of 48.2 million, so *all* departures[30] were scaled up by 17% so that the total number of observed and modelled departures equals the total number of observed and modelled arrivals.

Note that most results below are given relative to 1995 or relative to the base scenario, which itself is relative to 1995. The fact that the data had to be adjusted should not distort the qualitative results.

Bilateral tourism flows were derived as follows. In keeping with the model described below, a *general attractiveness index* for each country was constructed.[31] The tourists of each country are allocated to other countries according to a *country-of-origin-specific attractiveness index* that is equal to the *general attractiveness index* times *the distance* between the two capital cities raised to the power $-1.7 \cdot 10^{-4}$.[32] That is, tourists are allocated to destinations based on the general attractiveness of the destinations and the distance to these destinations. In this manner, the model reproduces the 1995 pattern of total departures and arrivals (see Figures 7-1

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[28] The estimation procedure started with a large number of explanatory variables. Explanatory variables that are individually and jointly insignificant were eliminated.

[29] The data on population were taken from WRI (2000), the data on the number of land borders were taken from CIA (2002).

[30] Scaling up only the interpolated departures leads to distortions, as many small countries do not report departures data. Besides, countries have less of an interest in counting departures than in counting arrivals, so departures are probably underreported even if there are data available. Note that by equating total arrivals and total departures numbers, it is assumed that tourists visit one country per trip only.

[31] The general attractiveness index was adjusted in an iterative calibration. In the first iteration, the attractiveness index equals the market share of each country in world tourism. The ratio between predicted and observed tourist arrivals was used to adjust the attractiveness index. Changes in the attractiveness index follow Equation 7-1.

[32] Lise and Tol (2002) analyse tourism flows from selected OECD countries to selected OECD countries. This allows them to estimate a distance elasticity. The number reported here is the average of their estimates.

and 7-2). As a comparison of the two maps shows, the model is well calibrated. However, the fact that the total pattern is simulated well does not imply that all bilateral flows are simulated well. Figure 7-3 shows the observed and modelled destination preferences of German tourists. Although the overall pattern is similar, details may be quite different.

Qualitatively, the model works as follows. The number of tourists going on an international holiday is determined by the income and the climate in the country of origin. Richer people travel more. People from very hot or very cold places travel more. Other reasons to travel are assumed to be constant (area, land borders) or omitted. After deciding to take a holiday abroad, the destination is chosen. Poor countries, hot countries, and cold countries are not attractive. Other features that attract tourists are assumed to be constant (area, coastline) or omitted. With different climates, incomes, and populations, different travel patterns arise. The model is admittedly simple, but captures the essentials (cf. Figure 7-1 and 7-2) while richer representations of arrivals and departures do not describe the data better.

7.2.3 Population and economic growth

Scenarios of population and economic growth are taken from the 17-region IMAGE 2.2 implementation (IMAGE Team, 2001) of the SRES scenarios (Nakicenovic and Swart, 2001). Note that the SRES *scenarios* on populations, economies and emissions are associated to SRES *storylines* with qualitative descriptions of wider social and political change. Only the quantified scenarios are used here.

There is only weak empirical support that tourists are attracted to places with low or high population densities. Population growth is therefore assumed to affect international tourism as a proportional increase in departures. As population growth is not uniform over the globe and tourism is partly determined by distance, this simple assumption already creates a shift in the pattern of international tourism (see Tables 7-1 to 7-3).

Economic growth is assumed to affect tourism according to Equations 7-1 and 7-2. That is, a country becomes more attractive as it grows richer, with an elasticity of 0.80. A country generates more tourists as it become richer, with an elasticity of 0.86. The population and eco nomic scenarios together produce a marked shift of international tourism towards Asia (see Tables 7-1 to 7-3).

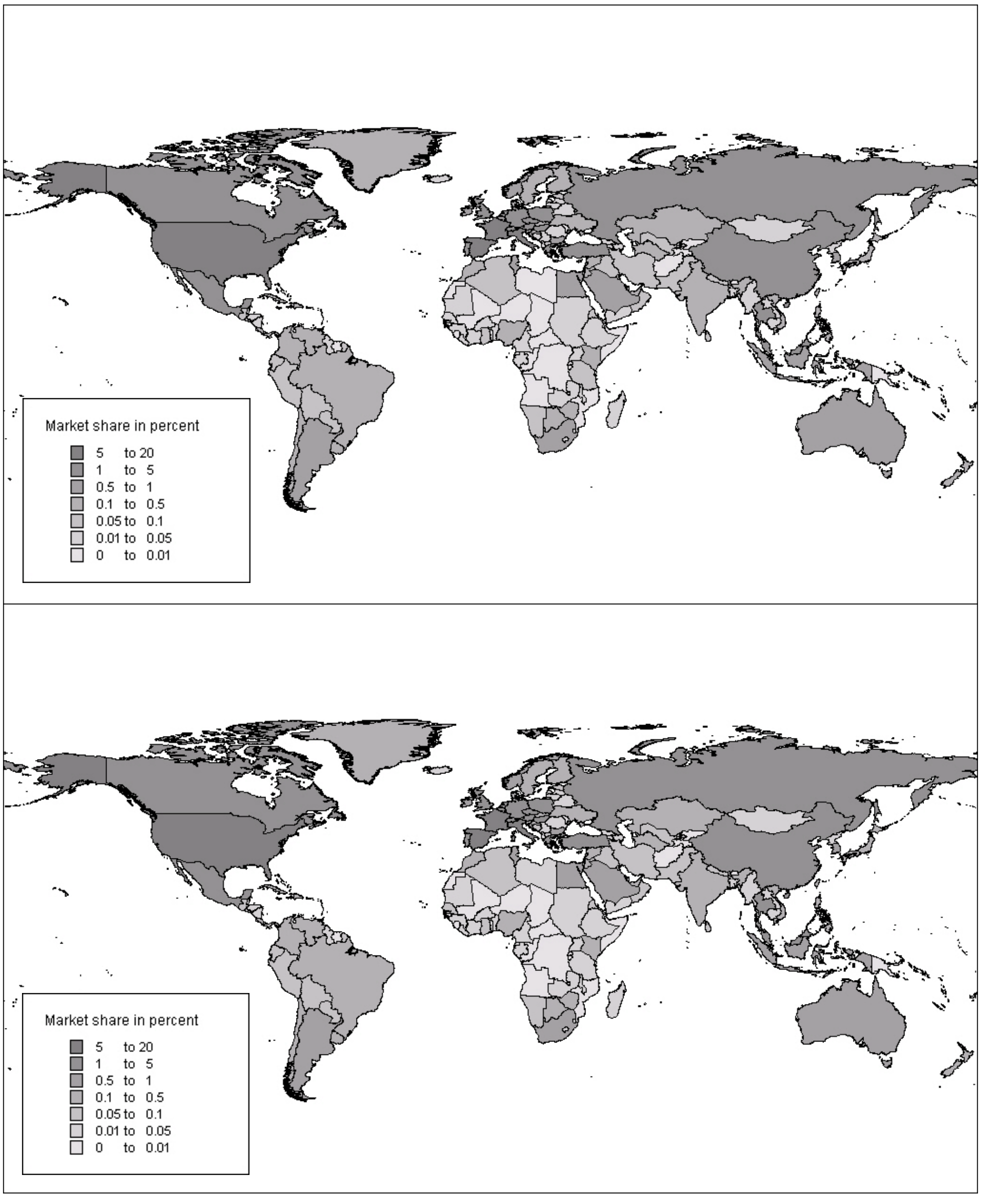

Figure 7-1: The share of worldwide arrivals per country as observed (top) and modelled (bottom) in 1995.

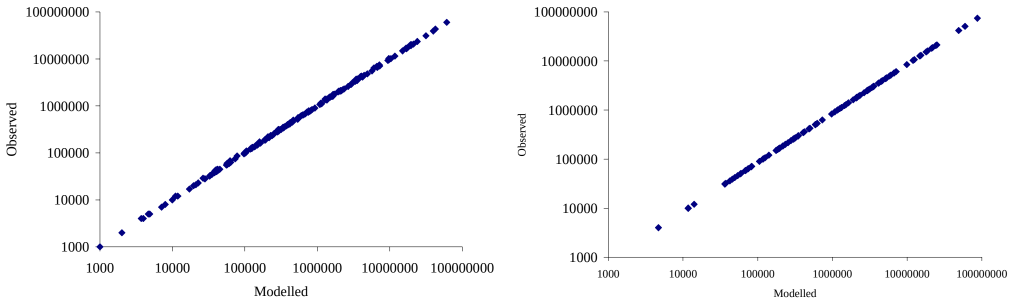

Figure 7-2: Modelled versus observed arrivals (left panel) and departures (right panel) in 1995

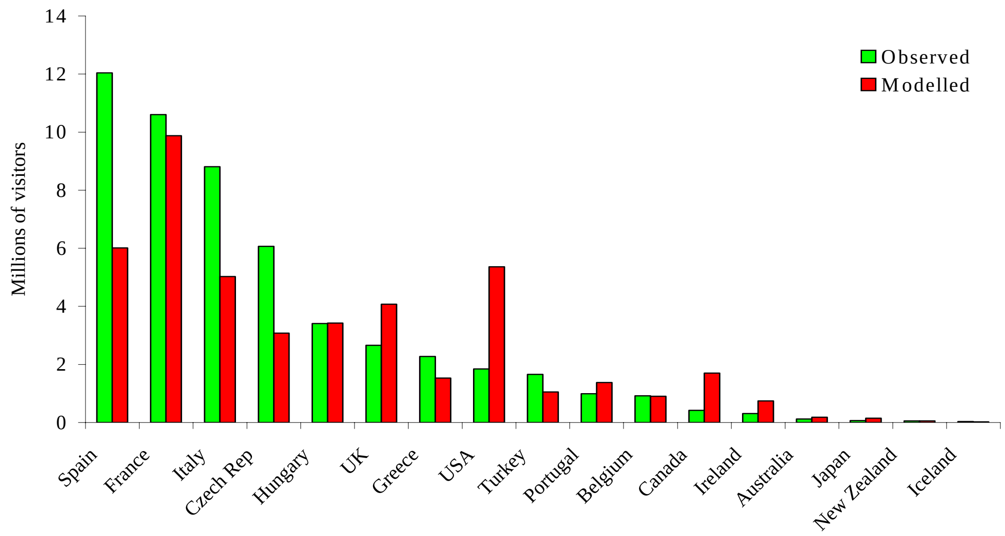

Figure 7-3: The most popular destinations of German tourists as observed and as modelled

	1995	2025[a]		
		P	P+E	P+E+C
France	10.79	10.62	7.73	7.67
United States	7.53	7.60	5.63	5.88
Spain	7.07	7.00	5.09	4.84
Italy	5.58	5.52	4.10	3.89
United Kingdom	4.23	4.18	3.07	3.17
Hungary	3.76	3.71	5.63	5.70
Mexico	3.50	3.59	3.71	3.16
Poland	3.46	3.40	5.25	5.52
China	3.41	3.44	7.25	8.17
Austria	3.09	3.04	2.25	2.43
Czech Rep	3.01	2.95	4.51	4.75
Canada	2.96	3.01	1.96	2.90
Germany	2.65	2.63	2.01	2.09
Switzerland	2.08	2.04	1.49	1.62
Greece	1.83	1.82	1.37	1.26
Hong Kong	1.71	1.75	2.60	2.22
Portugal	1.71	1.70	1.22	1.13
Russian Federation	1.66	1.65	2.20	3.11
Turkey	1.28	1.27	1.29	1.28
Malaysia	1.27	1.29	1.76	1.55
Netherlands	1.19	1.17	0.85	0.86
Thailand	1.17	1.21	1.69	1.49
Singapore	1.07	1.11	1.17	1.05
Belgium	1.01	0.98	0.71	0.72
Ireland	0.87	0.85	0.61	0.62

[a] Three scenarios are distinguished for 2025: population growth (P); population and per capita income growth (P+E); population and per capita income growth and climate change (P+E+C). Population and per capita income growth is according to the SRES A1B scenario (Nakicenovic and Swart, 2001; IMAGE Team, 2001) in 2025. Climate change is a 1˚C global warming; the spatial pattern is the average over 14 GCMs (Schlesinger and Williams, 1998).

Table 7-1: Market share of arrivals

As stated, international tourism demand has an income elasticity of 0.86, which is smaller than unity, that is, international tourism demand is a necessary good, not a luxury good. This is counterintuitive, but the best fit to the international cross-section of data. The data, unfortunately, do not allow us to estimate an income elasticity that falls with income, or with the number of international trips. Although one would expect tourism demand to saturate, if only because of time limitations, this is not observed in the data. Bermudans travel most, on average 1.57 trips in 1995, which is far below a sensible point of saturation. Some sensitivity analyses are reported below.

	Development[a]		Climate Change[b]
Maldives	5.99	Canada	1.37
Sri Lanka	5.98	Russian Federation	1.31
Bhutan	5.90	Mongolia	1.23
Nepal	5.90	Kyrgyzstan	1.16
Bangladesh	5.89	Iceland	1.15
Mongolia	5.82	Tajikistan	1.15
South Korea	5.76	Finland	1.14
Pakistan	5.75	Zimbabwe	1.14
Afghanistan	5.75	Norway	1.13
India	5.70	Zambia	1.12
China	5.63	Sweden	1.12
Seychelles	4.75	South Korea	1.07
Macedonia	4.12	Kazakhstan	1.05
Albania	4.11	China	1.04
Bulgaria	4.11	Georgia	1.04
Portugal	1.89	Guinea-Bissau	0.74
Andorra	1.89	Benin	0.74
Tuvalu	1.89	Sudan	0.74
Netherlands	1.89	Namibia	0.73
Kiribati	1.88	Chad	0.73
Marshall Islands	1.88	Gambia	0.72
Samoa	1.88	United Arab Emirates	0.72
French Polynesia	1.88	Niger	0.72
Luxembourg	1.88	Burkina Faso	0.72
Belgium	1.88	Kuwait	0.71
Iceland	1.87	Senegal	0.71
Ireland	1.87	Qatar	0.71
Virgin Islands	1.80	Bahrain	0.70
Japan	1.78	Mali	0.69
Canada	1.76	Mauritania	0.69

[a] Arrivals in 2025 without climate change (P+E) relative to 1995.
[b] Arrivals in 2025 with climate change (P+E+C) relative to without climate change.

Table 7-2: Ranking of countries with the highest and lowest fractional change in tourist arrivals through development (left) and climate change (right).

	1995	2025a		
		P	P+E	P+E+C
Germany	15.47	14.20	10.94	10.59
United States	10.53	11.19	8.63	8.32
United Kingdom	8.68	7.97	6.14	5.96
Russian Federation	4.42	3.92	5.75	4.61
Malaysia	4.28	4.75	6.58	7.43
France	3.87	3.56	2.74	2.73
Canada	3.77	4.01	2.86	2.21
Italy	3.32	3.04	2.34	2.41
Japan	3.17	2.88	1.74	1.75
Hungary	2.71	2.31	3.97	3.90
Austria	2.63	2.41	1.86	1.76
Spain	2.62	2.41	1.85	1.90
Switzerland	2.21	2.03	1.56	1.47
Netherlands	2.13	1.95	1.50	1.47
Mexico	1.75	2.10	2.54	2.81
Sweden	1.26	1.16	0.89	0.78
Romania	1.19	1.01	1.74	1.69
Belgium	1.18	1.08	0.83	0.82
Finland	1.07	0.98	0.75	0.65
Denmark	1.03	0.94	0.73	0.69
China	0.94	0.91	2.10	1.99
Czech Republic	0.93	0.79	1.36	1.30
Poland	0.91	0.77	1.32	1.27
Taiwan	0.87	0.84	1.27	1.42
Turkey	0.83	1.25	1.32	1.31

[a] Three scenarios are distinguished for 2025: population growth (P); population and per capita income growth (P+E); population and per capita income and climate change (P+E+C). Population and per capita income growth is according to the SRES A1B scenario (Nakicenovic and Swart, 2001; IMAGE Team, 2001) in 2025. Climate change is a 1˚C global warming; the spatial pattern is the average over 14 GCMs (Schlesinger and Williams, 1998).

Table 7-3: Market share of departures

7.2.4 Climate change

Climate change scenarios for the SRES emissions scenarios are derived with the *FUND* model (Tol, 1999). The spatial patterns are taken from the country-specific output of the COSMIC model (Schlesinger and Williams, 1998). The average of the 14 GCMs is used as the middle scenario; the standard deviation is used to derive the minimum and maximum scenarios.

The effect of temperature change follows from Equations 7-1 and 7-2, both of which have a quadratic specification. That is, if a cool country gets warmer, it first *attracts more tourists,* until it gets too warm and then starts attracting fewer tourists. The turning point lies at 14°C (annual 24-hour average). Similarly, if a cool country gets warmer, it first *generates fewer* *tourists* until it gets too warm and then starts generating more tourists. The turning point lies at 18°C (annual 24-hour average).

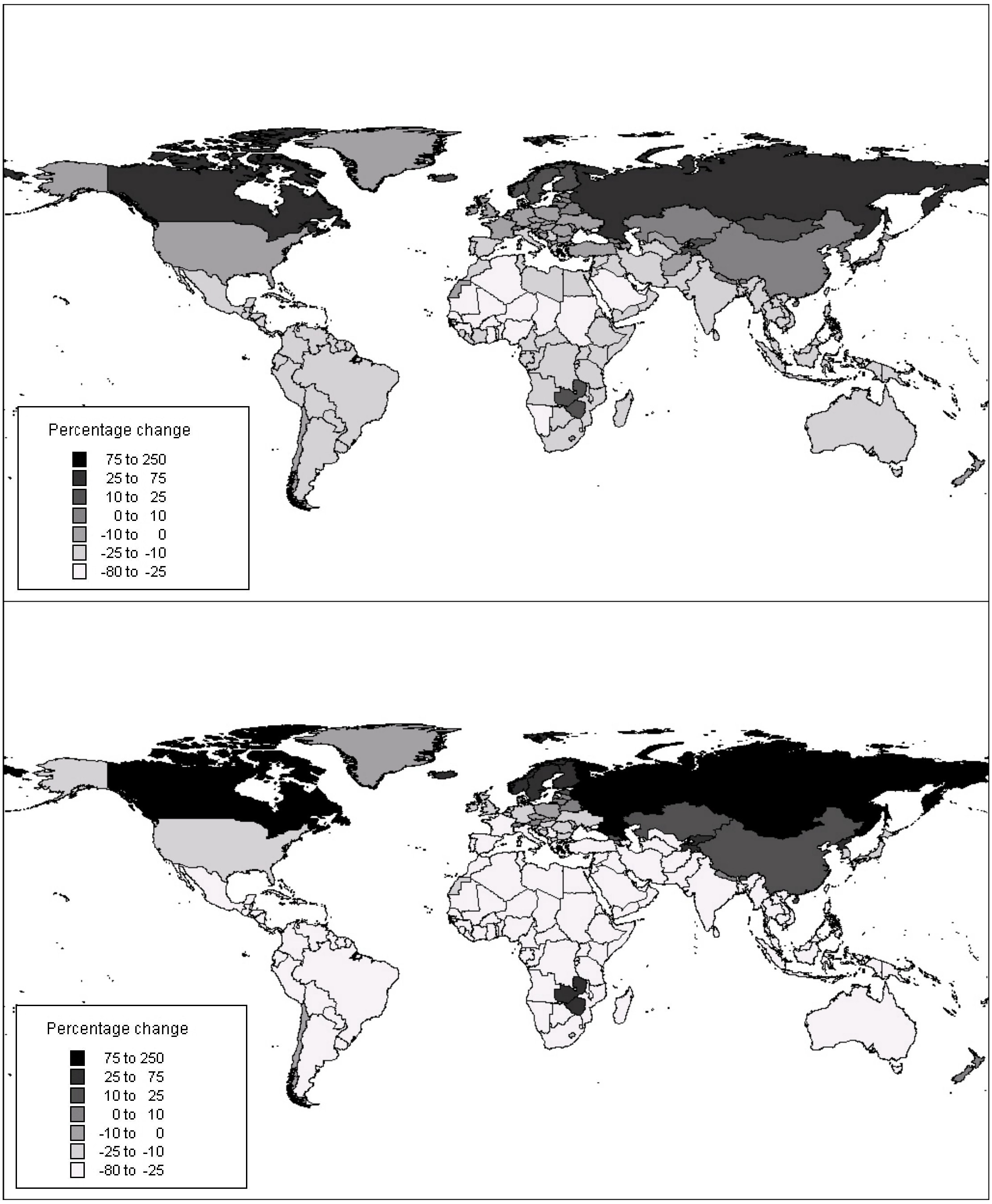

Figure 7-4: The percentage change in arrivals as a result of a 1°C (top) and a 4°C (bottom) global warming in 2025

Figure 7-4 shows the percentage change in arrivals in 2025, compared to the arrivals under the scenario of economic and population growth, for two arbitrary climate change scenarios,

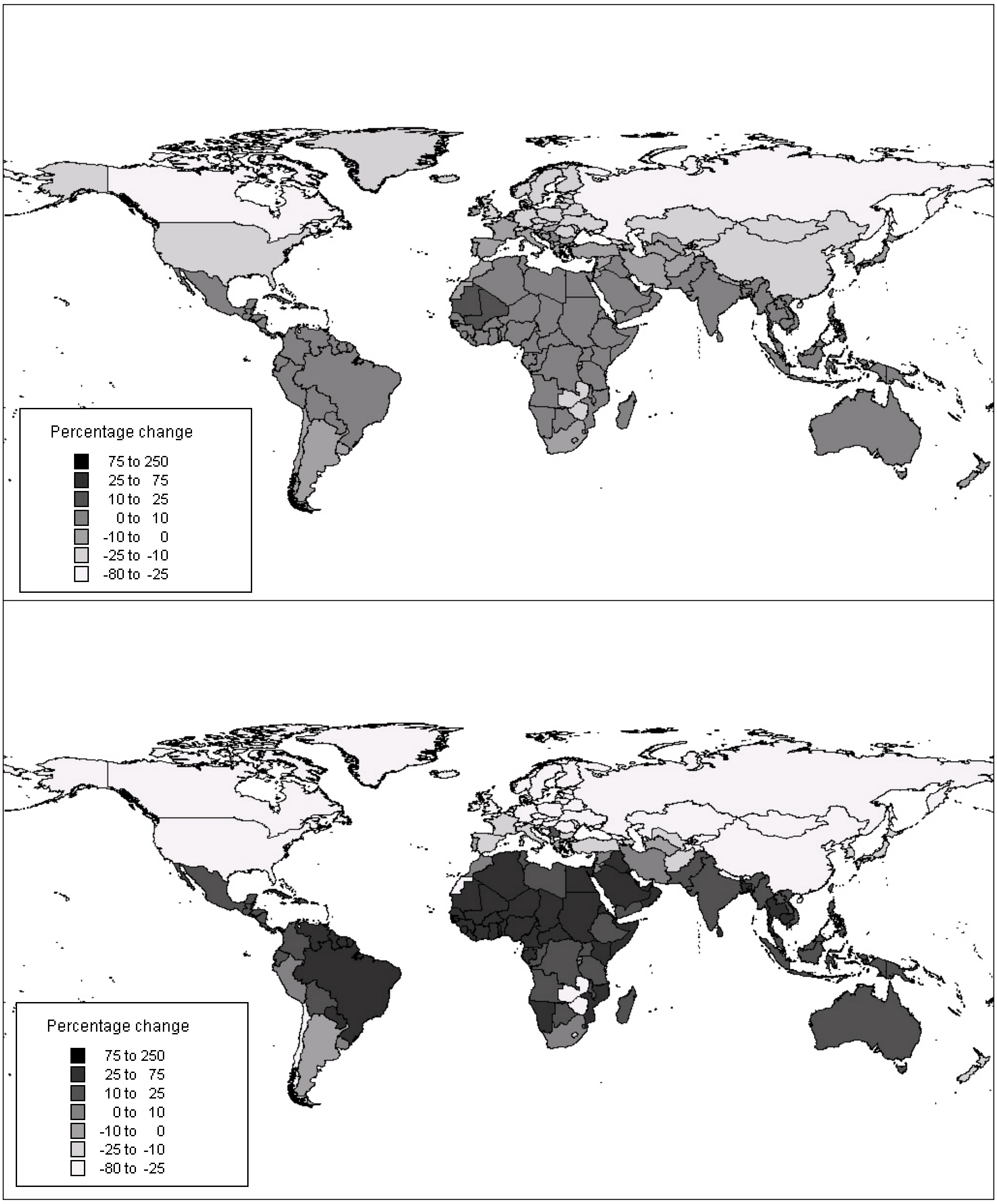

Figure 7-5: The percentage change in departures as a result of a 1°C (top) and a 4°C (bottom) global warming in 2025

that is, a 1°C and a 4°C global warming. The first scenario is realistic; the second is for illustration only. As expected, climate change would lead to a polewards shift of tourism. Moreover, figure 7-4 shows that there will be a shift from lowland to highland tourism; the tourism sectors in Zambia and Zimbabwe, for instance, would benefit greatly from climate change.

But that is not the only thing that will change: figure 7-5 shows that not only countries closer to the poles will become more attractive for tourists, but also that those countries will generate less international tourists – as these countries become more attractive to their own citizens as well.

7.2.5 Distance travelled

The previous sections have focussed on the travel pattern. The total distance travelled is also a parameter of interest, for instance because it is closely correlated with energy use and carbon dioxide emissions. The distances between the capital cities of the countries of origin and destination are used in the estimation of bilateral tourism flows. Figure 7-6 reports the travelled distances with and without climate change, for the A1B scenario. Without climate change, the distance travelled increases rapidly, in fact even more rapidly than the tourism numbers. With climate change, the upward trend is slightly slower – again largely because the heavy travellers from Northwest Europe stay closer to home. In addition, figure 7-6 shows the maximum and minimum change in distance travelled, +14% (Singapore) and –36% (Canada) in 2075, respectively. The travel pattern is more sensitive to climate change than the total distance travelled; this is no surprise, as things cancel out in the total distance travelled.

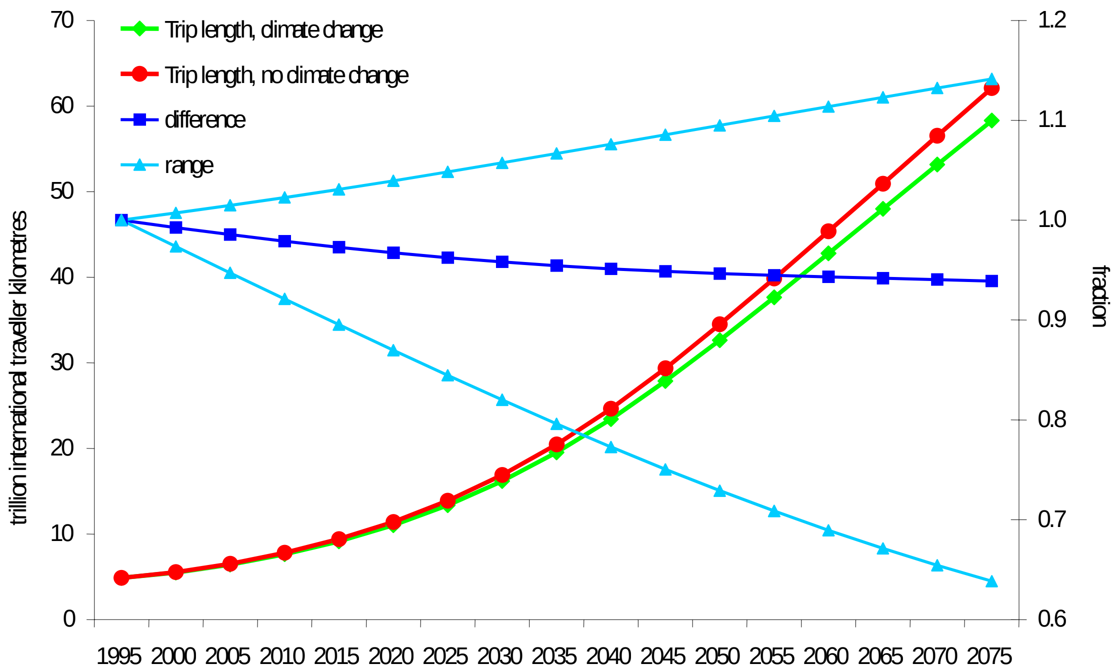

Figure 7-6: The total distance travelled with and without climate change (left axis) and the difference between them for the world as a whole, and minimum and maximum difference per country (right axis); results are for the A1B scenario.

Figure 7-7 shows the change in total distance travelled for the six SRES scenarios. The difference ranges from –4% to –7% in 2075, which is small compared to the projected increase in travel. Here as well, the pattern of travel changes more than total travel.

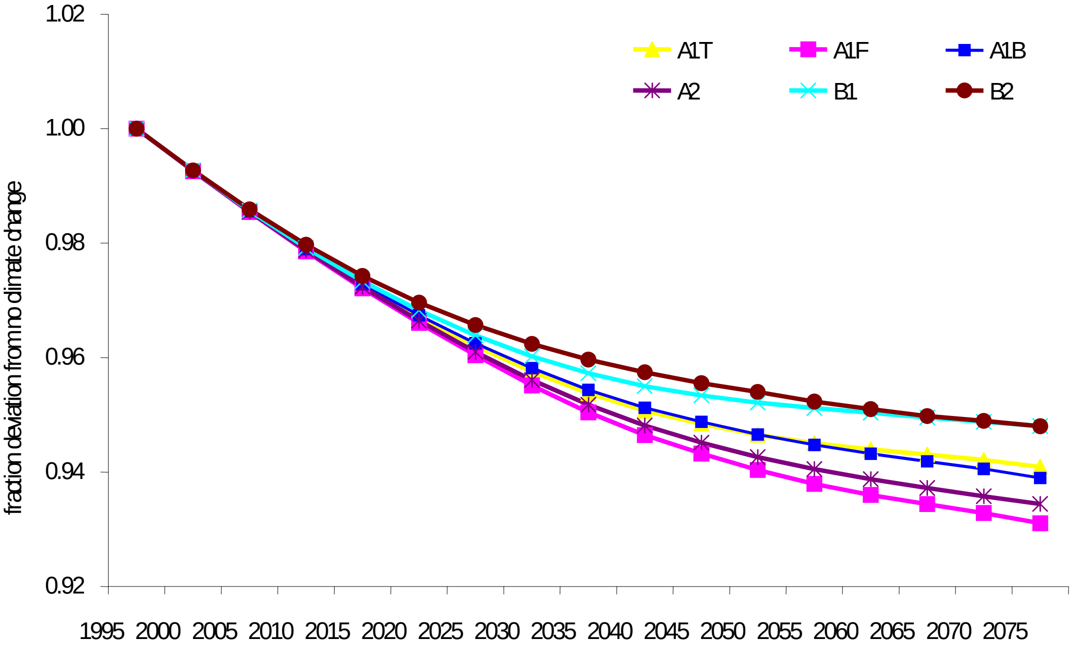

Figure 7-7: Climate change induced difference in total distance travelled for the six SRES scenarios, as fraction of the total distance travelled in the corresponding scenario without climate change

7.3. Sensitivity analyses

The model and the results presented above depend on a number of parameters, each of which is uncertain. The sensitivity to differences in the scenarios of population growth, economic growth and greenhouse gas emissions has been discussed above. In this section, further sensitivity analyses are reported.

The country-specific attractiveness indices are based on distance to the power $-1.7 \cdot 10^{-4}$, a number that has been kept constant. However, one may argue that travel speed will continue to increase, and travel costs continue to fall relative to other costs. Both factors would make distance less of a deterrent. Therefore, the distance parameter to $-0.8 \cdot 10^{-4}$ in 2080 has been reduced, arbitrarily, with a linear decline. This can be interpreted as decreasing relative travel costs. Figure 7-8 shows the change in tourist arrivals, which, in total numbers, is relatively small. As one would expect, remote locations – which are, because of their remoteness, currently not so popular – would see a large relative increase in arrivals. This is true for the Pacific island nations, which would see their tourist numbers increase by more than 50% in 2075 relative to the case of constant travel costs. New Zealand would gain most, over 60%. This happens at the expense of countries in Europe and the Middle East, which would see a decline of up to 12%.[33] Figure 7-8 also shows the change induced by climate change for the scenarios with constant and declining travel costs. The impact of climate change in 2075 on arrivals changes between –4% and +3% because of declining travel costs. With declining travel costs, the number of visitors to cool and temperate countries increases with climate change, as distant, warm countries become more accessible; visitors numbers to warm and tropical countries decrease, as tourists pass them by to fly further polewards. Note that, in the case of the alternative scenarios, the effect on climate change is small compared to the effect on the baseline.

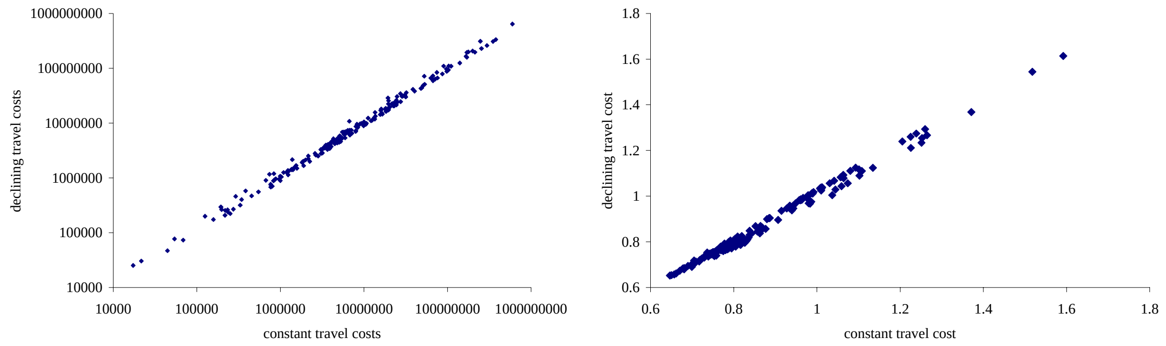

Figure 7-8: Tourist arrivals per country in 2075 (A1B), constant travel costs versus declining travel costs; the left panel displays absolute numbers of travellers without climate change; the right panel displays the effect induced by climate change, expressed as a fraction of the case without climate change.

In the analyses above, an income elasticity of tourism demand of 0.86 is used, which is the best estimate for the cross-section of 1997. This implies that tourism is a necessary good and not a luxury good, which one would expect. Cross-section may not be the best way of estimating income elasticities. Crouch (1995) reports the results of a meta-analysis of tourism demand. He finds an income elasticity of 1.86, with a standard deviation of 1.78 (encompassing the estimate used here). The elasticity found by Crouch is used as an alternative estimate. Figure 7-9 displays the results for the A1B scenario with and without climate change. Obviously, tourism grows much faster with the higher income elasticity than with the lower one.

[33] The pattern of change would be qualitatively the same but reversed in sign if travel costs would increase, say because of an international tax on kerosene.

For the estimate used here, the average growth rate of the number of international travellers between 1995 and 2075 is 3.2% per annum; with Crouch's estimate, the growth rate is 7.5% per year.[34] For both income elasticities, the effect of temperature change on the total distance travelled is small, never exceeding 7%. However, the pattern is qualitatively different. In the A1B scenario, poorer countries grow faster than richer countries. This implies that the share of currently poor countries in the international tourism market expands much more rapidly with a high income elasticity than with a low one. As the currently poor countries are in hot places, the share of tourists heading for cool places (relative to home) increases more rapidly with a high income elasticity than with a low one. Climate change accelerates this. In figure 7-9, it can be seen that climate change first suppresses international tourism (for both income elasticities) but then stimulates it (for the high income elasticity).

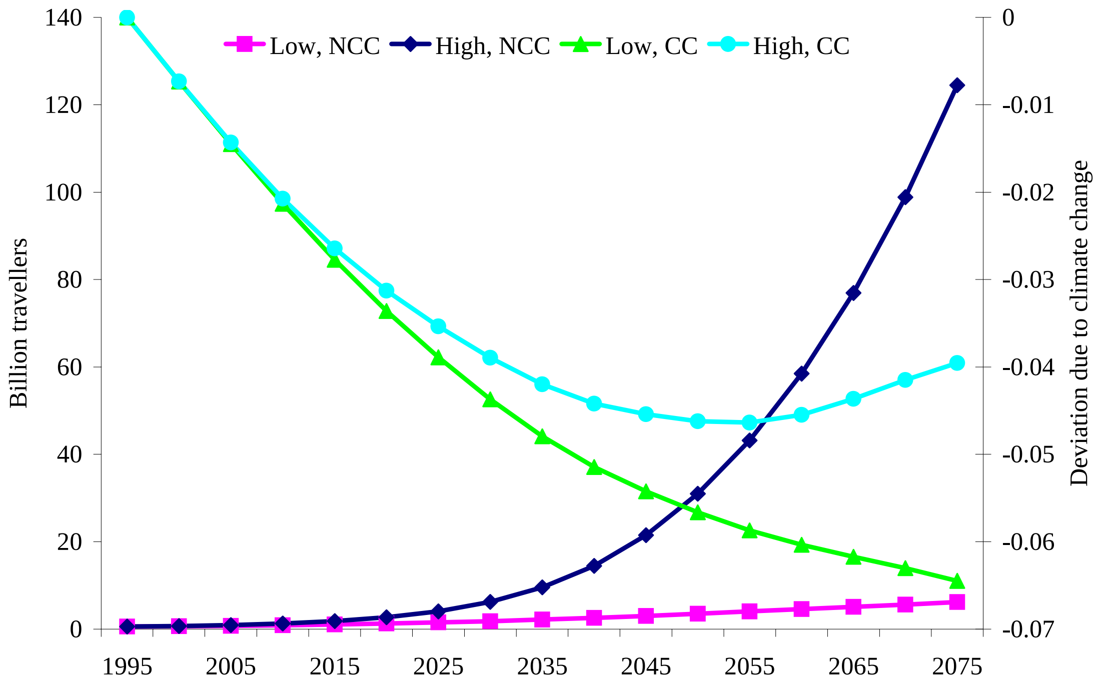

Figure 7-9: The total number of international tourists in the A1B scenario with climate change (CC – right axis, fraction deviation) and without (NCC – left axis, total numbers) for the base estimate of the income elasticity of tourism demand (low) and an alternative estimate (high).

[34] In 2075, the number of international trips reaches 120 billion, or about one international holiday per month per person *on average*. This is hard to imagine, as there would need to be a substantial number of people travelling much more than that. Then again, in 1930 it was probably unimaginable that Germans would take on average more than one foreign holiday a year.

Equation 7-1 gives the sensitivity of international tourist arrivals to temperature. The parameters are uncertain. Rather than a sensitivity analysis on the parameters that were estimated in Equation 7-1, parameters are taken from comparable studies, which have used different data and different specifications. Lise and Tol (2002) report parameters for the world as well as for selected OECD countries.[35] Italian tourists prefer the highest temperatures (optimal temperature around 24˚C), while the globally averaged tourists prefer the lowest temperatures (optimal temperature around 20˚C); Equation 7-1 suggests that the optimal temperature is around 14˚C. Figure 7-10 compares the climate-change-induced-change in tourist arrivals in 2075 under the SRES A1B scenario with the three alternative specifications. Comparing the world tourists of Lise and Tol (2002) to the tourists in this study, the overall impact of climate change is found to be fairly similar; the scatter plot shows a line of almost 45 degrees. However, the cooler countries benefit a bit more with the parameters of Lise and Tol (2002), and the warmer countries lose a bit more.

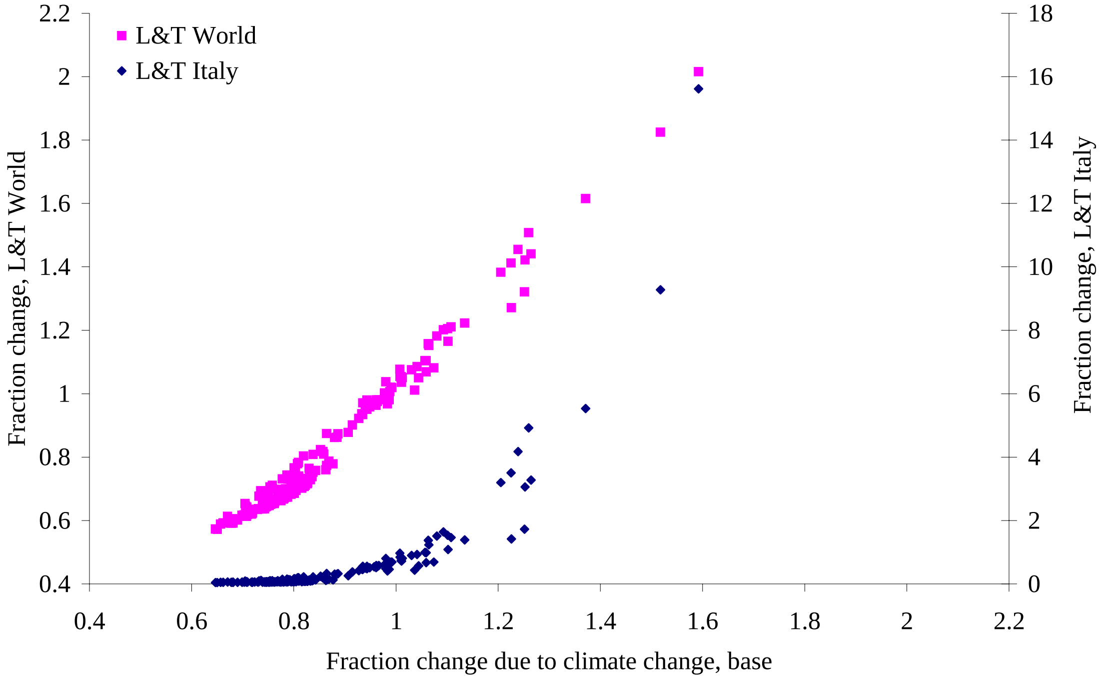

Figure 7-10: Climate change induced change to tourist arrivals per country in 2075 (A1B), tourist behaviour according to Equation 7-1 versus according to Lise and Tol (2002); of the latter, world average tourist behaviour and Italian tourist behaviour is shown.

[35] Maddison (2000) and chapter 4 of this publication use other climate parameters than are used here. Here the average of the day and night temperature over the entire year is taken.

Also, the minimum and maximum changes are larger; this is because the world tourists of Lise and Tol (2002) do not only prefer higher temperatures, their preferences are also sharper, that is, the attractiveness of a destination outside the optimal climate falls more rapidly than in case of the parameters reported in Equation 7-1. This effect is even more pronounced in the case of the Italian tourists of Lise and Tol (2002); their preferences are so sharp that, in fact, climate change dominates the socio-economic scenario. Climate change may decimate tourist numbers to almost nought, or increase arrivals by a factor 18. However, the Italian results are a sensitivity analysis only, as Italians are not representative.

Figure 7-11 shows the effects of varying the climate sensitivity. In the base case, the equilibrium rise of the global mean temperature for a doubling of the atmospheric concentration of carbon dioxide is 2.5˚C; this is changed to 1.5˚C and 4.5˚C. The results are as expected. Slower climate change leads to lower impacts of climate change, and faster climate change to higher impacts.

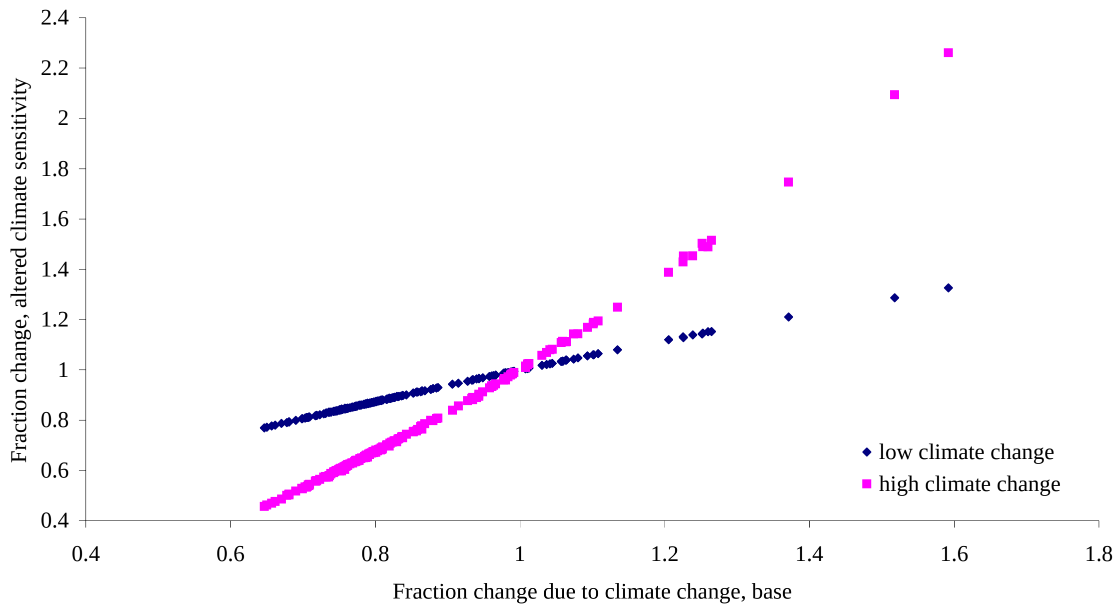

Figure 7-11: Climate change induced change to tourist arrivals per country in 2075 (A1B) for medium climate change versus high and low climate change.

7.4 Discussion and conclusion

In this chapter, a simulation model of international tourism has been presented, and scenarios of changes in international arrivals and departures have been developed corresponding to changes in population numbers, per capita income, and climate change. A model like this is for testing sensitivities rather than making predictions. Results are qualitative, not quantitative.

The model shows that the past growth of international tourism may well continue unabated in the medium to long term. The main driver is economic growth, and the growth of international tourism will therefore be concentrated in those regions with the highest economic growth; had a higher income elasticity been used, this conclusion would have been even stronger. Although intercontinental tourism will also grow, mass tourism is likely to continue to prefer destinations closer to home. Uncertainties about future population and economic growth, and uncertainties about elasticities and future travel costs make the projections of international tourist numbers very uncertain.

Climate change would lead to a gradual shift of tourist destinations towards higher latitudes and altitudes. Climate change would also imply that the currently dominant group of international tourists – sun and beach lovers from Western Europe – would stay closer to home, implying a relatively small fall of total international tourist numbers and total distance travelled. The changes in the patterns are greater than the changes in the aggregate numbers. The changes induced by climate change are generally much smaller than those resulting from population and economic growth are.

Chapter 8

The impact of climate change on domestic and international tourism: a simulation study*

8.1 Introduction

In Chapter 7 the first version of HTM, a model for international tourism is presented. However, domestic tourism is not explicitly modelled there. In fact, there it is assumed that the change in the absolute numbers of domestic tourists equals the change in the absolute numbers of international departures, without considering the actual number of domestic tourists. Recently collected data on domestic tourism (Bigano *et al.*, 2005b) allows us to consider this aspect and explicitly model the trade-off between holidays in the home country and abroad. Domestic tourists comprise 86% of the total tourist numbers (Bigano *et al.*, 2005b).

Compared to international tourism, there are relatively few studies on domestic tourism. There are some studies, however, that examine the trends in domestic tourism for particular countries: for example, Australia (Faulkner, 1988), China (Wen, 1997) and Germany (Coles, 2003). In some developing countries, domestic tourism has been increasing rapidly (Wen, 1997; Ghimire, 2001), whereas in developed countries such as Australia and Germany domestic tourism is relatively stable. The geographical spread of domestic tourists is different from international tourists and domestic tourists and from domestic holidaymakers and those visiting friends and relatives (see, for example, Seaton and Palmer, 1997 and Seckelmann, 2002). Some studies argue that tourists behave differently on a domestic holiday compared to an international holiday (see Carr, 2002). Few attempts have been made to estimate demand functions for domestic tourism. In a study carried out for the North East of England, the demand function is restricted to the price of tourism in the region, the price of substitutes and the income of tourists (Seddighi and Shearing, 1997).

Another major shortcoming of earlier versions of HTM was that it stopped at tourist numbers. In this chapter, the model is extended to include tourist expenditures. This allows us to

* This chapter is based on Bigano et al. (2005a).

estimate the economic implications of climate-change-induced changes in tourism. Berrittella *et al.* (2006) do this for HTM, version 1.0, but only for six world regions, using a computable general equilibrium model. Our economic approach is far simpler, but it does include all countries individually.

This chapter proceeds as follows. Section 8.2 discusses the data. Section 8.3 presents the model, its calibration and validation. Section 8.4 shows the base results and sensitivity analyses. Section 8.5 concludes.

8.2 The data

In this section, the domestic tourism data and the procedures to fill missing observations are described and discussed. The data used for international arrivals and departures is the same as that presented in chapter 7, section 7.2.2.

8.2.1 Domestic tourism

For most countries, the volume of domestic tourist flows is derived using 1997 data contained in the Euromonitor (2002) database. For some other countries, alternative sources, such as national statistical offices, other governmental institutions or trade associations, are relied upon. Data are mostly in the form of number of trips to destinations beyond a non-negligible distance from the place of residence, and involve at least one overnight stay. For some countries, data in this format were not available, and so either the number of registered guests in hotels, campsites, hostels etc., or the ratio between the number of overnight stays and the average length of stay was used. The latter formats underestimate domestic tourism by excluding trips to friends and relatives; nevertheless, such data for completeness have been included for completeness, relying on the fact that dropping them did not lead to any dramatic change.

In general, the number of domestic tourists is less than the regional population. ´However in 22 countries, residents were domestic tourists more than once per year. An examination of the characteristics of such countries shows that these are in general rich countries, endowed with plenty of opportunities for domestic tourism and large (or at least medium-sized). This definition fits in particular Scandinavian countries (e.g., 4.8 domestic trips per resident in

Sweden) but also Canada, Australia, and the USA.[36] In the USA, the combination of a large national area, a large number of tourist sites and high income per capita contribute to explain why, on average, an average American took a domestic holiday 3.7 times in 1997. Distance from the rest of the world is also important, and this is most probably the explanation for the many domestic holidays in Australia and New Zealand.

The missing observations were filled using two regressions. Total tourist numbers, $D+H$, where H is the number of domestic tourists, were interpolated using

Equation 8-1:
$$\ln\frac{D_o + H_o}{P_o} = -\underset{0.83}{1.67} + \underset{0.10}{0.93}\ln Y_o$$
$$N = 63; R^2_{adj} = 0.60$$

Note that equation 8-1 is not limited from above. The number of tourists may exceed the number of people, which implies that people take a holiday more than once a year. Note that population numbers are measured in thousands. The parameters imply that people with an income of $10,000 per person per year take one holiday per year.

The ratio of domestic to total holidays was interpolated using

Equation 8-2:
$$\ln\frac{H_o}{D_o + H_o} = -\underset{1.19}{3.75} + \underset{0.42}{0.83}\cdot 10^{-1}\ln G_o + \underset{0.30}{0.93}\cdot 10^{-1}\ln C_o + \underset{0.32}{0.16}\cdot 10^{-1} T_o - \underset{1.11}{0.29}\cdot 10^{-3} T_o^2$$
$$+\left(\underset{0.12}{0.16} - \underset{1.24}{4.43}\cdot 10^{-7} Y_o\right)\ln Y_o$$
$$N = 63; R^2_{adj} = 0.36$$

The individual temperature parameters are not statistically significant from zero at the 5% level, but they are jointly significant. “Observations” for 1995 were derived from 1997 observations by dividing the latter by the population and per capita income growth between 1995 and 1997, correcting the latter for the income elasticity of equations 8-1 and 8-2. The income elasticity of domestic holidays is positive for countries with low incomes but falls as income grows and eventually goes negative. See Figure 8-1. Qualitatively, this pattern is not surprising. In very poor countries, only the upper income class have holidays and they prefer to travel abroad, also because domestic holidays may be expensive too (cf. Equation 8-4). As a country gets richer, the middle-income class have holidays too, and they first prefer cheap,

[36] Poland, ranking 8th, is particularly active notwithstanding substantially lower per capita income than the rest of the top 10 countries.

domestic holidays. The share of domestic in total holidays only starts to fall if the lower income class are rich enough to afford a holiday abroad; with the estimates of Equation 8-2, this happens if average income exceeds $360,000, a high number. Sensitivity analyses on this specification are performed below.

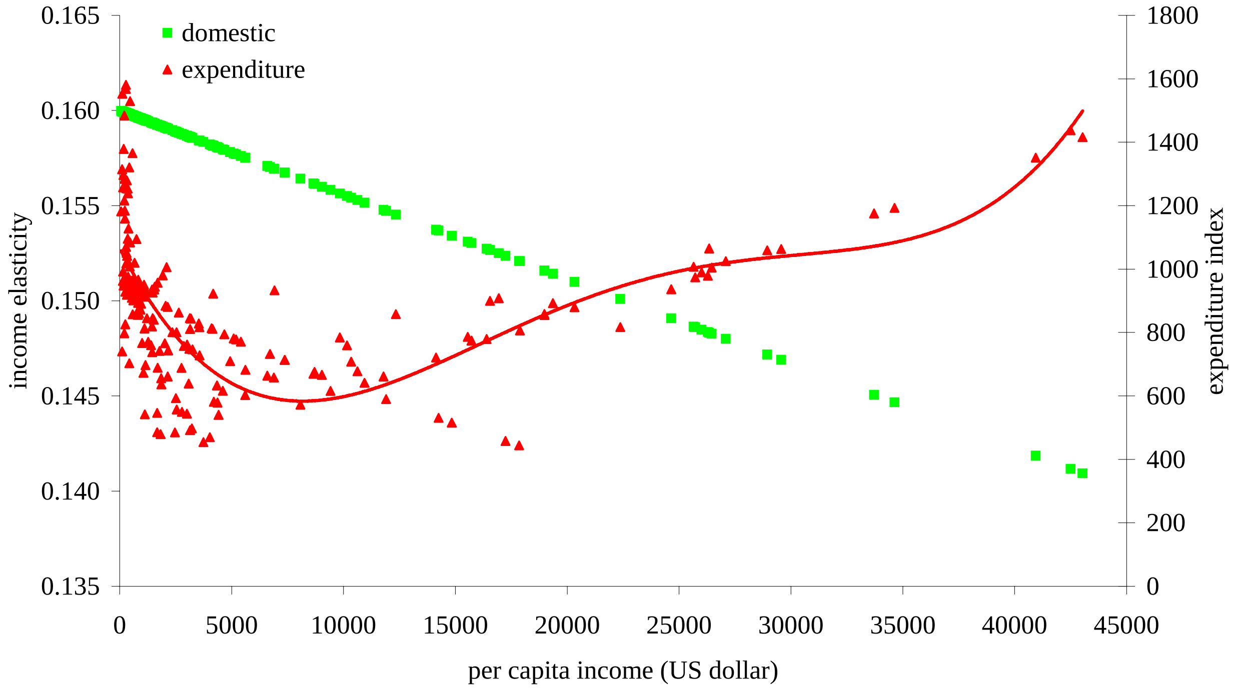

Figure 8-1: The income elasticity of the ratio of domestic to total tourists, and expenditures per tourist per day as a function of per capita income

For the total (domestic and foreign) number of tourists, the world total is 12.0% higher if the interpolated tourist numbers are included, that is, 4.0 billion versus 3.6 billion tourists. The observed world total includes those countries for which observed data on both domestic tourists and international arrivals is available. For domestic tourists only, the observations add up to 3.1 billion tourists, and 3.5 billion tourists with interpolation, a 12.1% increase.

Note that equations 8-1 and 8-2 can be used to derive international departures, just like equation 7-2. The correlation coefficient between these two alternatives is 99.8%. Equation 7-2 is preferred for its simplicity.

WTO (2002b) contains data on the number of nights foreign tourists stay in selected countries. Dividing by the number of foreign tourists, this leads to the average length of stay, *S*. This can be modelled as

Equation 8-3:
$$S_d = \underset{0.61}{2.13} - \underset{0.62}{2.58} L_d - \underset{0.79}{1.91} \cdot 10^{-6} G_d + \underset{0.40}{2.06} \cdot 10^{-1} T_d + \underset{0.78}{1.72} \cdot 10^{-4} C_d$$
$$N = 55; R_{adj}^2 = 0.40$$

where L is a dummy for measurement in hotels only (as opposed to all establishments). All parameters are significantly different from zero. The income per capita in the destination country does not affect the length of stay. Equation 8-3 says that tourists stay longer in hotter countries, in smaller countries and in countries with longer coasts and that tourists spend less time in the destination country if they are accommodated in a hotel.

WRI (2002) has data on the total expenditures of international tourists. Dividing by the number of arrivals and their length of stay, this yields expenditure per tourist per day, E, which can be modelled as

Equation 8-4:
$$E_d = -\underset{200}{611} + \underset{0.007}{0.029} Y_d + \underset{71}{295} X_d$$
$$N = 47; R_{adj}^2 = 0.31$$

where X is the ratio of the purchasing power parity exchange rate to the market exchange rate. Expenditures increase linearly with the average per capita income in the holiday country. This is as expected. Surprisingly, there is no significant relationship between the average income of the tourists and their expenditures. There is also no significant relationship between expenditures and income distributions, a measured by the Gini coefficient, in either the destination or the origin country. Per capita income is measured in market exchange dollars. The second explanatory variable in equation 8-4 is the ratio of purchasing power and market exchange rates. This ratio is high (up to 5) for the least developed countries and around 1 for developed economies. If the two effects are combined, plotting expenditures against countries ranked by per capita income – see Figure 8-1 – Equation 8-4 says that expenditures per tourist per day first *fall* with per capita income, then *increase* linearly with per capita income if the latter is above $10,000 per person per year. The increase is as expected, as per capita income is a rough proxy for price levels. Holidays are more expensive in poorer countries, probably because international tourists tend to be restricted to luxury resorts.

8.3 The model

The goal of this model is to describe, at a high level of geographic disaggregation, the reactions of tourist behaviour to climate change, both in terms of changes in domestic and international flows of tourists and in terms of changes in tourists' expenditure decisions. This has been performed through the following steps. First, a matrix of tourism flows from one country to the next is constructed. Second, scenarios of population, income and climate change are used to perturb this matrix. Third, the resulting changes in the average length of stay and expenditures are computed.

The data concerns the number of domestic tourists, international departures and international arrivals per country. For international tourism, the matrix of bilateral flows of tourists from one country to the next is needed. The procedure to do this is presented in chapter 7. This delivers the results for the base year 1995.

For other years, a similar approach is used. The total number of tourists per country follows from equation 8-1. This is divided into domestic and international tourists using equation 8-2, holding everything constant except for temperature and per capita income. Note that the ratio of equation 8-2 is not necessarily smaller than unity. The ratio of domestic to total tourists is restricted to lie between 0.01 and 0.99. Note also that the temperature parameters of equation 8-2 are highly uncertain. The domestic to total tourist ratio is at a maximum at a temperature of 30°C. This would imply that, except for in the very hottest countries, global warming would result in increasingly more domestic holidays. Thus, the temperature parameters of 8-2 are replaced with those of Equation 7-2, which imply that the domestic to international ratio is at a maximum at 18°C. A sensitivity analysis of this specification is discussed below.

Equation 7-1 multiplied by distance is used to allocate international departures, keeping everything constant except for per capita income and temperature. In addition, area is held constant. Tol (2004) argues that full coastal protection against sea level rise would be economically viable, even for small island countries. Nonetheless, to examine the case in which sea level rise erodes beaches a sensitivity analysis is performed.

The change in the length of stay follows readily from Equation 8-3. The change in expenditure per tourist per day follows from Equation 8-4. Following Tol (2004), the ratio of purchasing power to market exchange rate is allowed to fall with per capita income, using an income elasticity of 0.28. A lower bound is set on equation 8-4 equal to the observed lower bound in 1995.

Scenarios for population and per capita income growth are taken from the *IMAGE* 2.2 implementation of the IPCC SRES scenarios (IMAGE Team, 2002; Nakicenovic and Swart, 2001). The original scenarios are specified for 17 world regions. The growth rates of countries in each region are assumed equal to the regional growth rate. Scenarios for the global mean temperature are derived from the *FUND* model (Tol, 2002), using the same population and economic scenarios and the corresponding scenarios for energy efficiency improvements and decarbonisation. The global mean temperature change is downscaled to national means using the *COSMIC* model (Schlesinger and Williams, 1995).

The 1995 model values for the total number of tourists, the number of domestic tourists, the length of stay, and the expenditures are as observed. Data is not available for other years to validate this part of the model. It is possible, however, to validate international arrivals and departures. Figure 8-2 compares the model results for international arrivals to the observations for 1980, 1985, 1990 and 1995. The correlation between observed and modelled international arrivals in 1995 is almost perfect, largely because of calibration. For the other years, the correspondence between observations and modelled values is never below 92%.

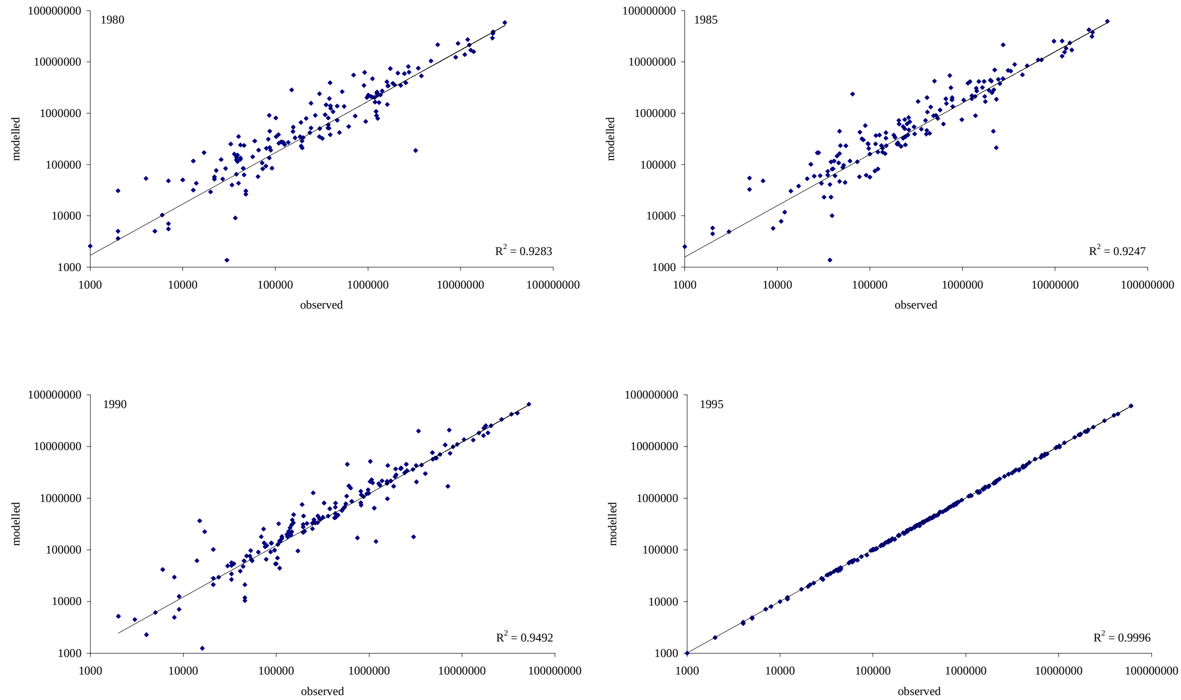

Figure 8-2: Observed versus modelled international arrivals in 1980, 1985, 1990 and 1995.

Figure 8-3 compares model results and data for international departures. Between 1985 and 1995, the correspondence between observations and model results is between 91% and 94%. For 1980, this drops to 79%, which is still a reasonable performance given the fact that data are patchy, not just for international tourism, but also for per capita income.

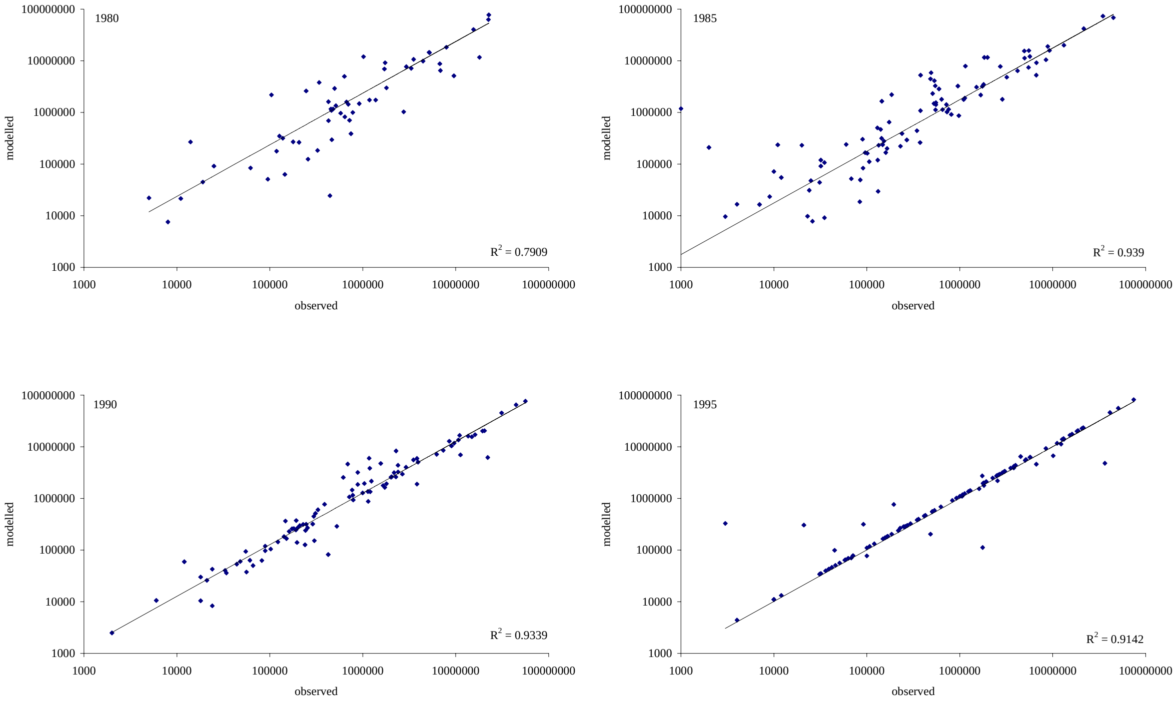

Figure 8-3: Observed versus modelled international departures in 1980, 1985, 1990 and 1995.

8.4 Results

8.4.1 Base results

Figure 8-4 shows some characteristics of the A1B scenario without climate change for 16 major world regions. Currently, the OECD (the regions at the bottom of the graph) dominates tourism, with over half of world tourists but only a fraction of the world population. Nevertheless, the OECD share has been declining over the last 20 years, and will continue to do so. For most of the 21st century, tourism will be predominantly Asian. Within Asia, East Asia leads at first, but South Asia will take over after a few decades. The dominance of the rich countries in international departures is stronger than it is in domestic holidays, and this dominance will decline more gradually. Asia (Africa) has a bigger (smaller) share of international tourism than of domestic tourism, because it has several large (many small) countries. The difference between Europe and North America can be explained in the same way. The pattern of international arrivals is similar to, but smoother than, the pattern of international departures; international tourists cross borders, but prefer to travel shorter distances. The pattern of receipts from domestic and international tourists is different. Here, the OECD first expands its market share as expenditures per tourist per day fall as the poorer countries grow richer – see Equation 8-6. After 2030, however, the other regions, particularly Asia, capture a larger share of the market.

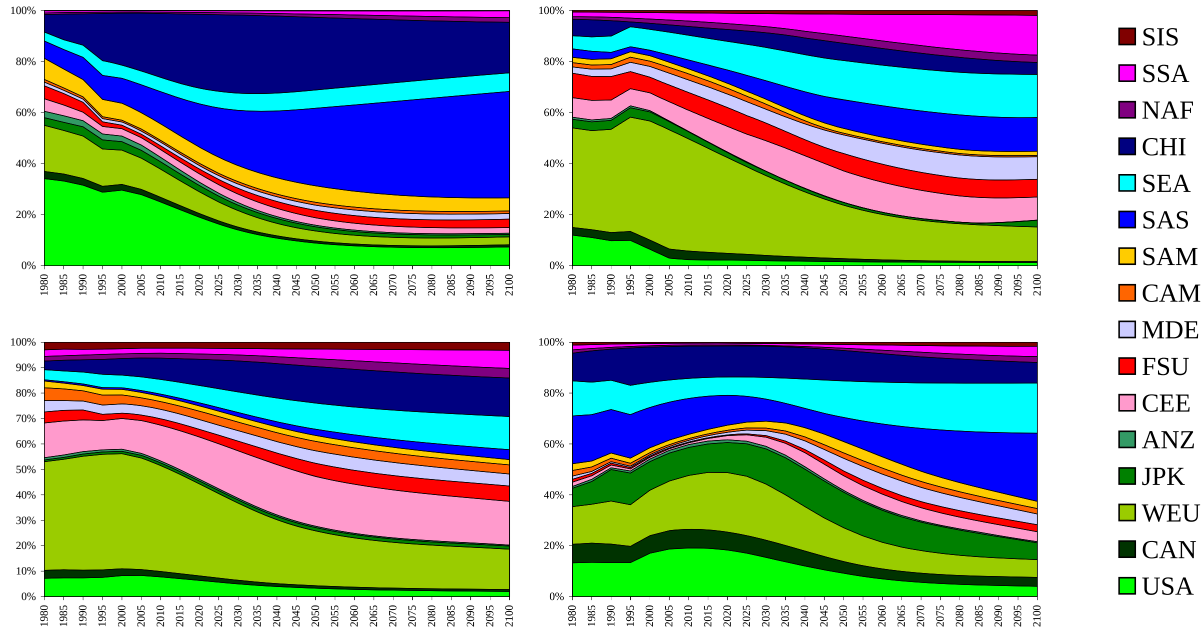

Figure 8-4: The regional distribution of domestic tourists (top, left), international departures (top, right), international arrivals (bottom, left) and tourism receipts (bottom, right) for the A1B scenarios without climate change. The regions are, from top to bottom: Small Island States; Sub-Saharan Africa; North Africa; China, North Korea and Mongolia; South East Asia; South Asia; South America; Central America; Middle East; Former Soviet Union; Central and Eastern Europe; Australia and New Zealand; Japan and South Korea; Western Europe; Canada, and the USA.

Figure 8-5 shows the impact of climate change on domestic tourism numbers, both over time and over space. While the world aggregate number of domestic tourists hardly changes due to climate change, individual countries may face dramatic impacts that grow rapidly over time. By 2100, domestic tourism numbers may be up by 100% or down by 30%. Roughly speaking, currently colder countries see an increase in domestic tourism. Colder countries see an increase in domestic tourism, warmer countries a reduction. Exceptions to this are countries at high altitudes; while colder than their neighbouring countries, they are projected to face roughly the same, absolute warming and therefore break the smooth pattern of Figure 8-5. Because tourists prefer to stay close to home, high altitude countries have an advantage over low altitude countries with a similar initial climate, because the neighbouring countries of the former are hotter than the neighbouring countries of the latter. Countries at the minimum (0.01) or maximum (0.99) share of domestic tourism in total tourism are not affected by climate change.

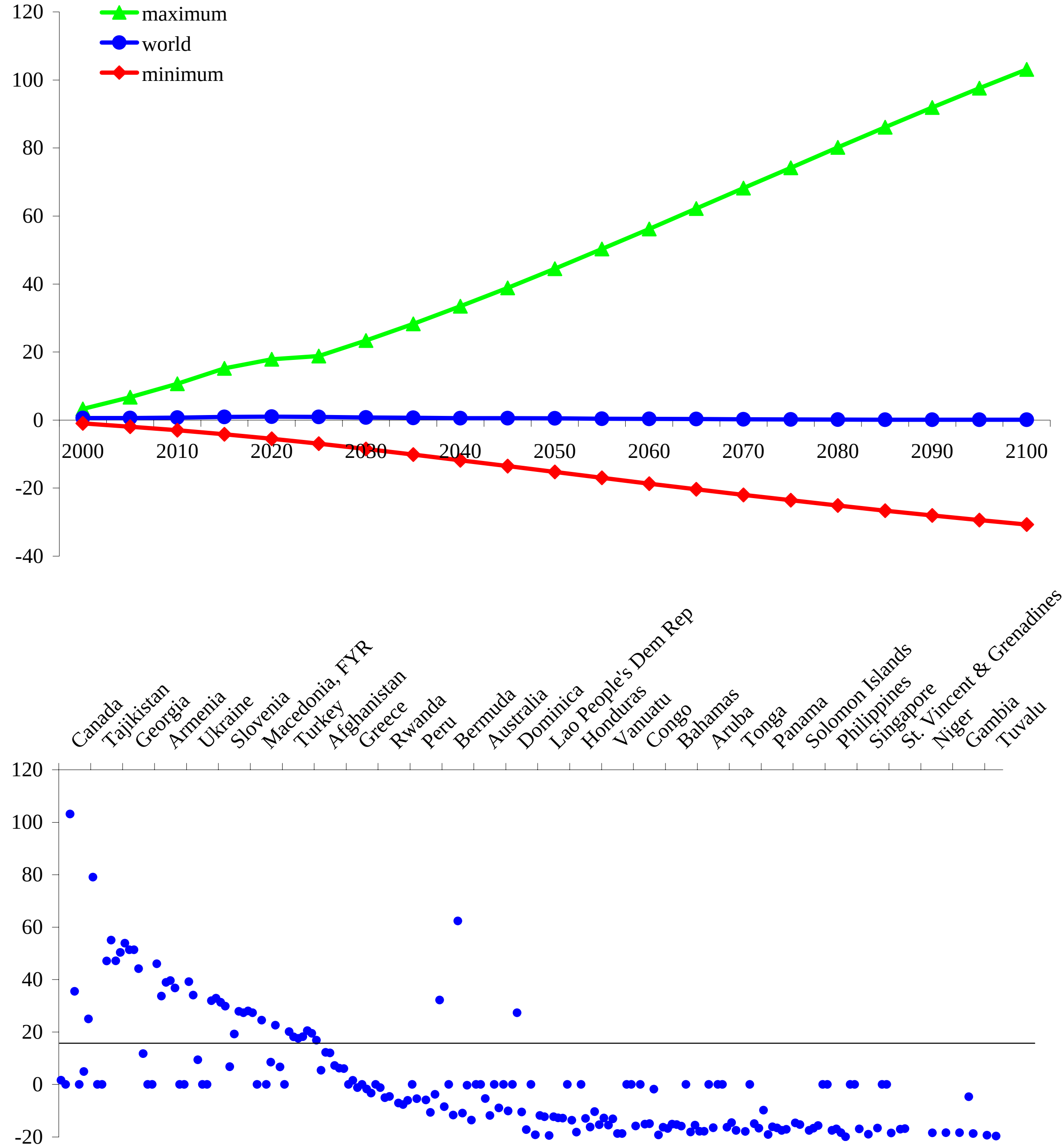

Figure 8-5: The effect of climate change on domestic tourist numbers, as a percentage of the numbers without climate change; top panel: world average, maximum impact (positive), and minimum impact (negative); bottom panel: impact in 2100, countries ranked to their annual average temperature in 1961-1990.

Figure 8-6 shows the impact of climate change on international tourism arrivals, both over time and over space. Aggregate international tourism falls because of climate change, reaching a minimum of 10% below the scenario without climate change at around 2025, and edging towards zero after that. Aggregate international tourism falls because more tourists stay in their home country (cf. Figure 8-5), particularly tourists from Germany and the UK, who make up a large part of international tourism; tourists from hot countries would increasingly prefer international over domestic holidays, and the share of such tourists gradually increases throughout the century. For individual countries, international arrivals may fall by up to 60%, or increase by up to 220% in 2100. Climate change increases the attractiveness of cooler countries, and reduces that of warmer ones.

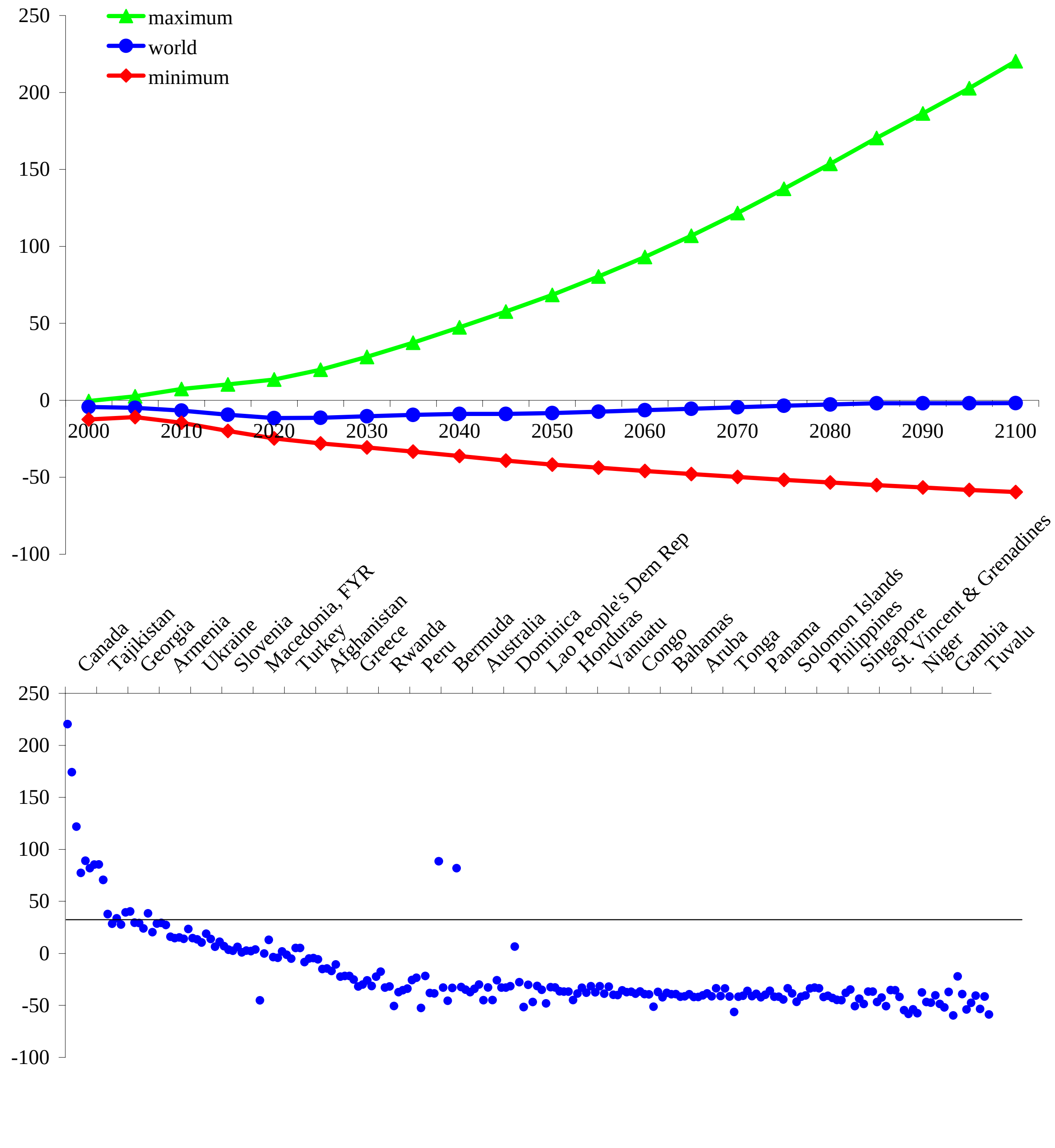

Figure 8-6: The effect of climate change on international tourist arrivals, as a percentage of the numbers without climate change; top panel: world average, maximum impact (positive), and minimum impact (negative); bottom panel: impact in 2100, countries ranked to their annual average temperature in 1961-1990.

Figure 8-7 shows the impact of climate change on total tourism expenditures, both over time and over space. World aggregate expenditures hardly change, first rising a bit and then falling a bit. The situation is different for individual countries, with a range of a negative 50% to a positive 130% by 2100. As expected colder countries can expect to receive more tourism money because of climate change, and warmer countries less. The relationship between current climate and impacts of climate change, however, is a lot noisier for expenditures than for international arrivals and domestic tourists.

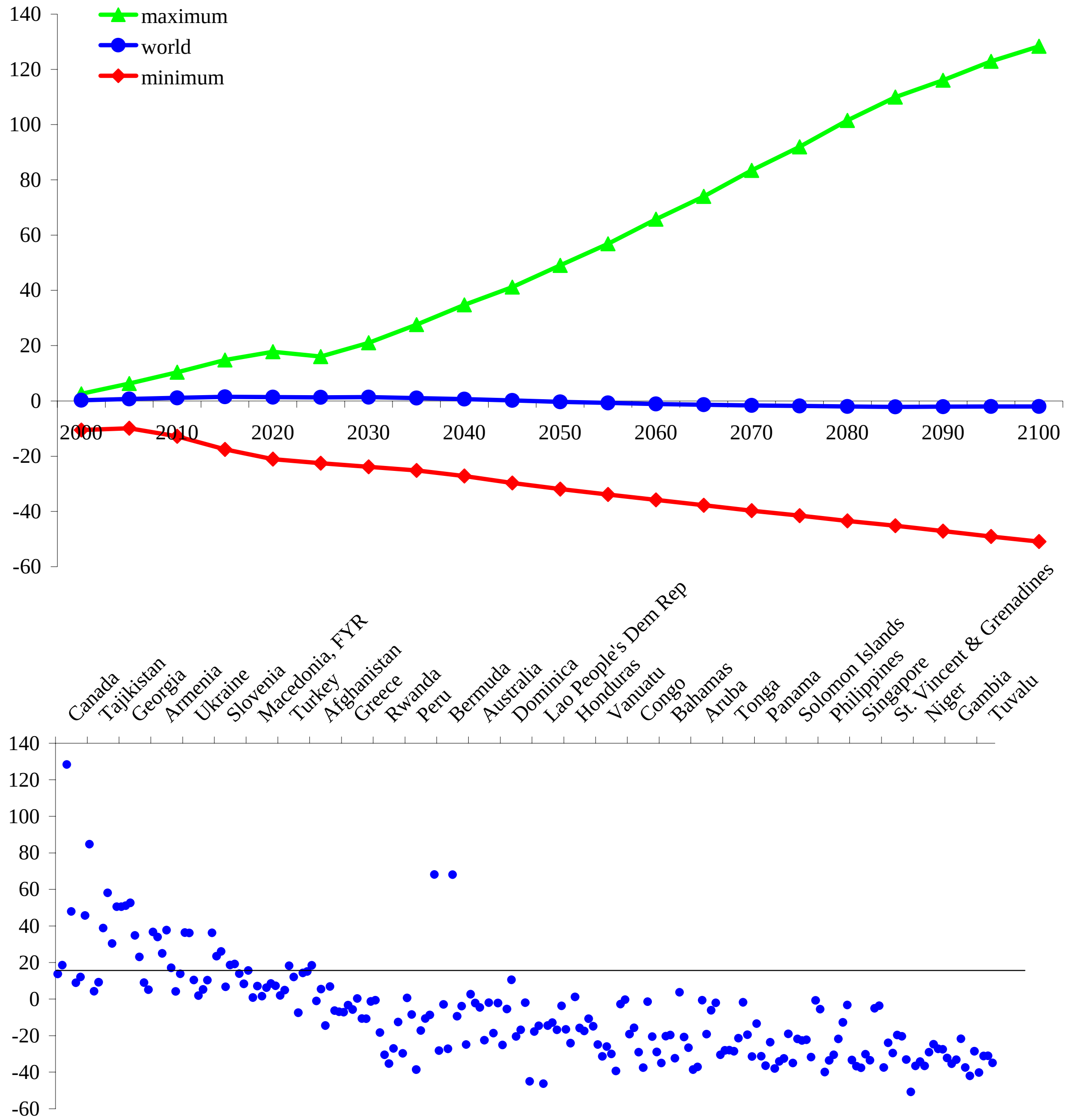

Figure 8-7: The effect of climate change on total tourism expenditures, as a percentage of the numbers without climate change; top panel: world average, maximum impact (positive), and minimum impact (negative); bottom panel: impact in 2100, countries ranked to their annual average temperature in 1961-1990.

8.4.2 Sensitivity analysis

Chapter 7 contains extensive sensitivity analyses on the behaviour of international tourists. These analyses do not harbour major surprises. If climate change is more severe, so is its impact. The uncertainty about the baseline is large (if there are more and richer people, there would be more tourism), but the effect on the *relative* impact of climate change is minor (although the effect on the *absolute* impact is large). The impact of climate change is sensitive to the specification of the climate preferences. Similar results hold for the current version of the model. The sensitivity analyses reported here focus on domestic tourists and on sea level rise, issues unexplored in the previous chapter.

Figure 8-8 shows the effect for the year 2100 of altering the income elasticity in equation 8-2. Specifically, the first (second) parameter was reduced (increased) by one standard deviation. With these parameters, the share of domestic in total tourism starts falling at an annual income of $71,000 per person (rather than $361,000). As a result, international tourism grows at the expense of domestic tourism. As international tourism is sensitive to climate change but domestic tourism is not, this increases the impact of climate change. Figure 8-8 shows the effects on arrivals and expenditures. Altering the income elasticity as described, the climate change impacts on arrivals increase everywhere. The climate change impacts on expenditures fall in some places, as the loss of domestic tourism outweighs the gain in international tourism; the climate change impact on global expenditure switches from a negative 2% in the base case to a positive 8% in the alternative case.

Figure 8-9 shows the effect of changing the temperature parameters in Equation 8-2; in fact, the parameters of Equation 8-2 rather than those of Equation 7-2 are used. Two things happen. Firstly, the optimal temperature for domestic holidays increases from 18°C to 30°C. This increases domestic tourism at the expense of international tourism. Secondly, the spread around the optimum is much more shallow; this reduces the effect of climate change. The second effect dominates, as is shown in Figure 8-9. The impact of climate change on domestic tourism is much reduced. The impact on international arrivals is much smaller; the global number of international tourists is only slightly different between the two cases, as in both cases the increases in domestic tourism almost cancel the decreases.

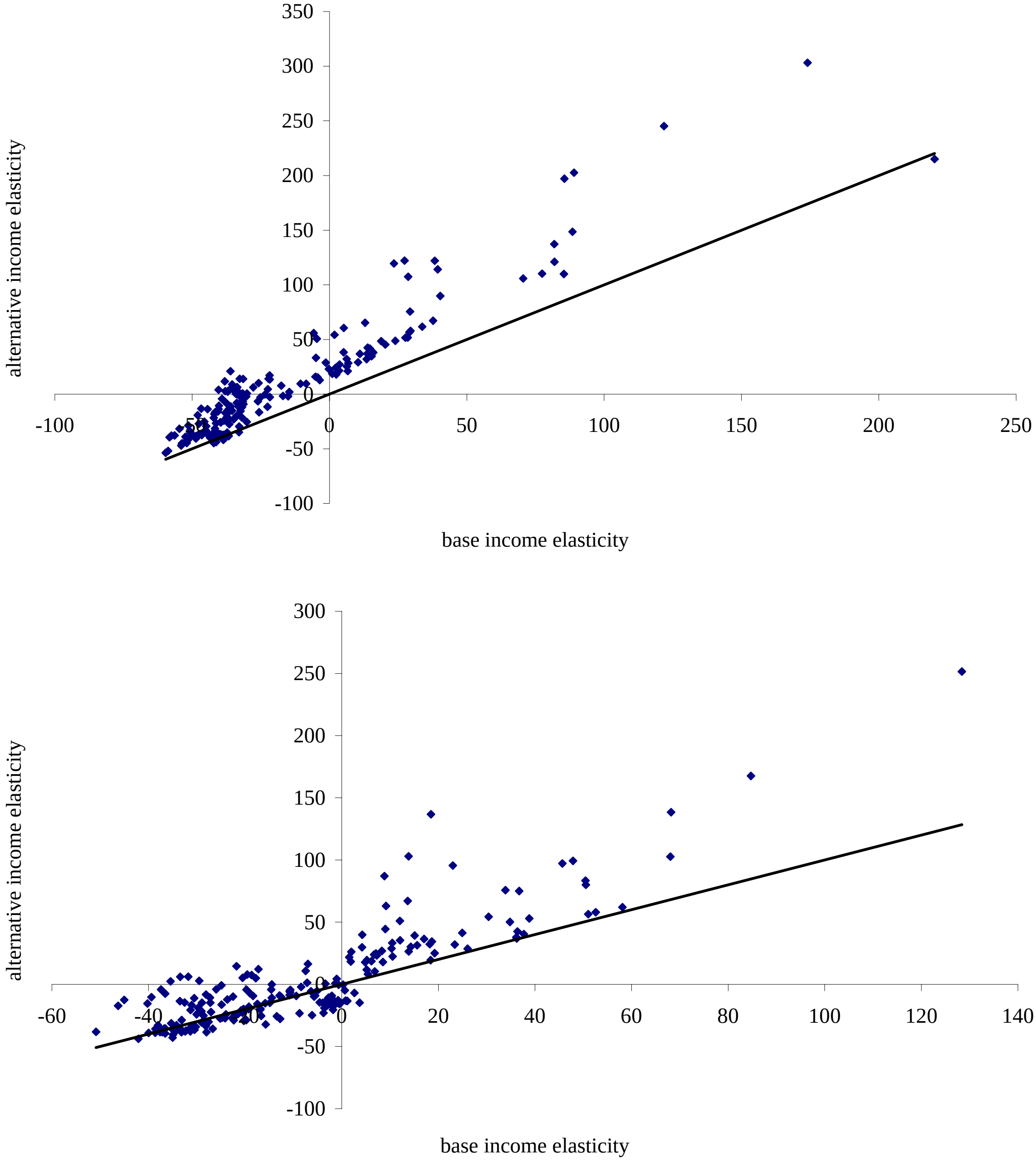

Figure 8-8: The effect of changing the income elasticity of Equation 8-2 on the impact of climate change on international arrivals (top panel) and tourism expenditures (bottom panel) in the year 2100.

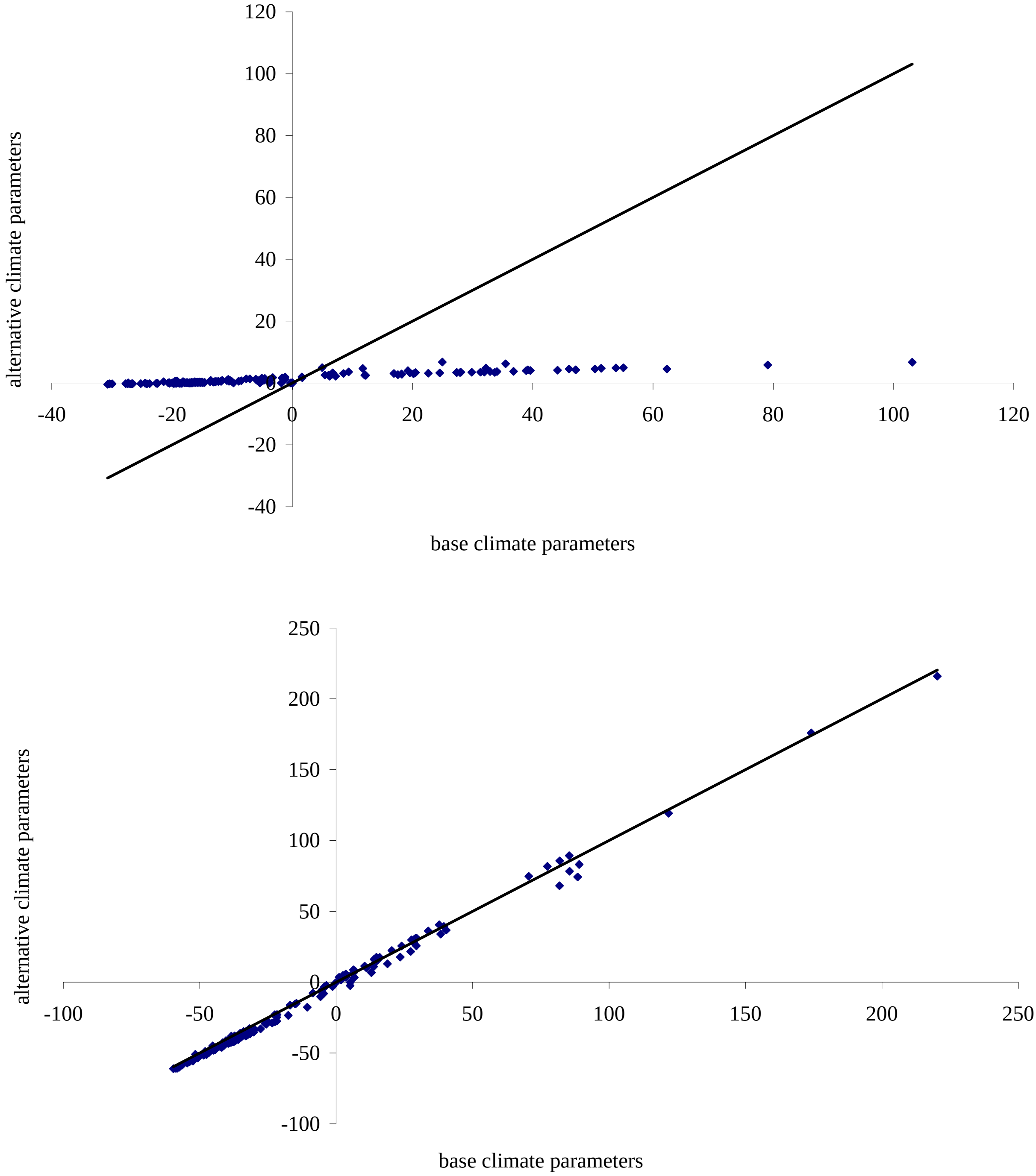

Figure 8-9: The effect of changing the temperature parameters of Equation 8-2 on the impact of climate change on domestic tourists (top panel) and international arrivals (bottom panel) in the year 2100.

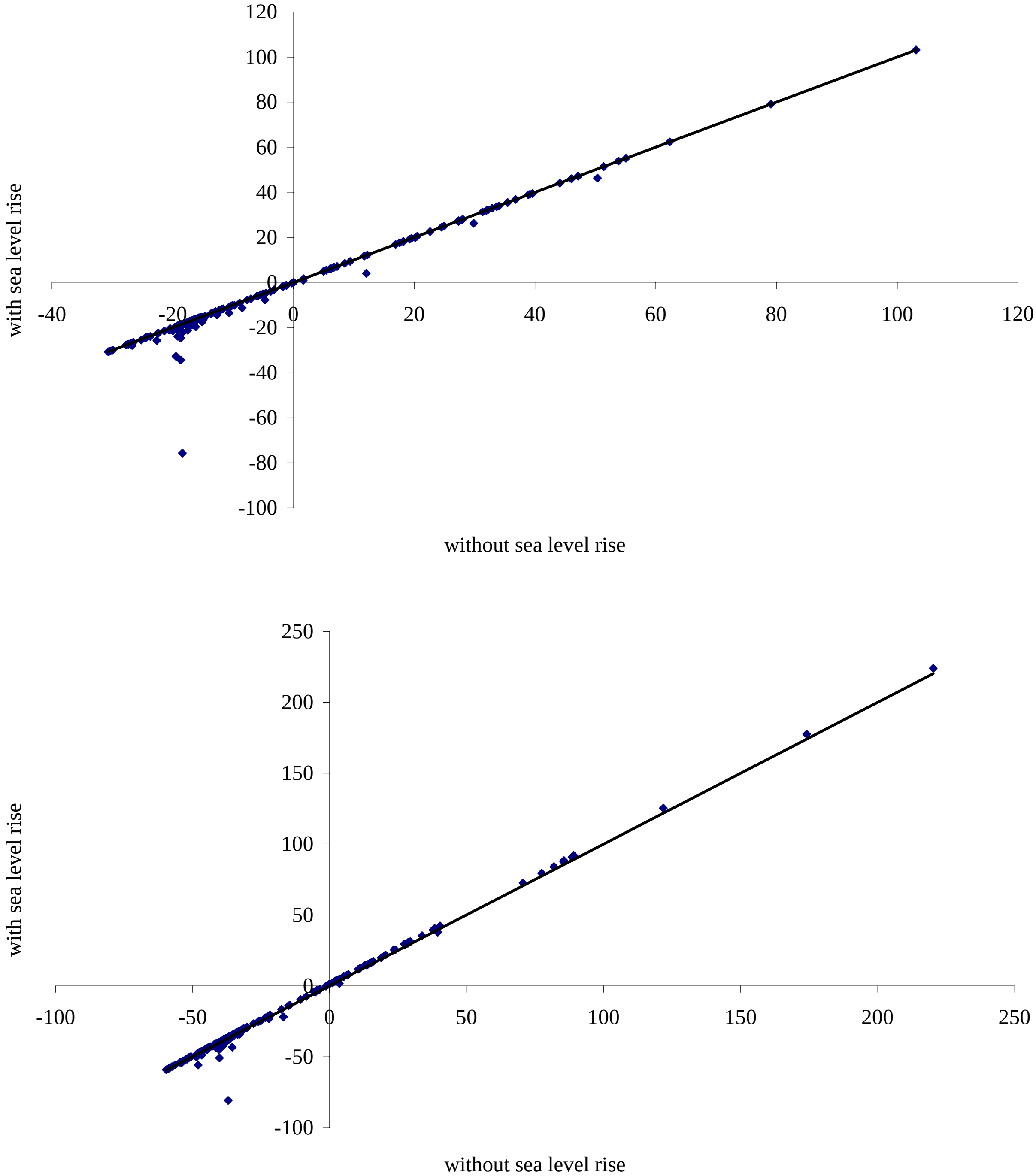

Figure 8-10: The effect of including sea level rise on the impact of climate change on domestic tourists (top panel) and international arrivals (bottom panel) in the year 2100.

Figure 8-10 shows the effect of including sea level rise. Taking the sea level rise scenario that corresponds to the temperature scenario used elsewhere in this chapter and the national land losses, without coastal protection, from Hoozemans *et al.* (1993; see also Tol, 2004), domestic tourism and the attractiveness to international tourists are scaled according to the proportional land loss. That is, if the Maldives loses 78% of its territory to sea level rise (this is what the scenario says), than its domestic to total tourism ratio and its international attractiveness index both fall by 78%. This crude approach serves only to illustrate the qualitative effect of sea level rise; more sophisticated analyses would take account of the interaction of beach and sun, and deliberate efforts to maintain commercially attractive beach in the face of sea level rise induced erosion. In most countries, the effect of sea level rise on domestic tourism is minimal, as the land loss is minimal. In some countries, however, the effect is dramatic. The same pattern can be seen in international arrivals; most countries gain a little, and some lose a lot. No country gains particularly from the partial loss of the small island states.

8.5 Discussion and conclusion

This chapter presents an updated and extended version of the Hamburg Tourism Model (HTM). As in chapter 7, it is found that climate change would shift patterns of tourism towards higher altitudes and latitudes. Domestic tourism may double in colder countries and fall by 20% in warmer countries (relative to the baseline without climate change). For some countries, international tourism may treble whereas for others it may cut in half. International tourism is more (less) important than is domestic tourism in colder (warmer) places. Therefore, climate change may double tourist expenditures in colder countries, and halve them in warmer countries.

However, in most places, the impact of climate change is small compared to the impact of population and economic growth.

The quantitative results are sensitive to parameter choices, both for the baseline and the impact of climate change. The qualitative pattern is robust, however. Interestingly, one finding is that climate change has a larger impact on tourism than sea level rise has. This is because the latter heavily affects only a few places and beach nourishment for tourism is a viable option in many countries.

The model described in this chapter and in chapter 7 is, to our knowledge, one in its kind. As all early models, it leaves much to be desired. Although the model is reasonably good at reproducing current and past patterns of international tourism, long-term and global studies of tourism demand are rare – and the empirical basis of the model is therefore weak. This is even truer for the effects of climate change on tourist destination choice, where the model is based on only a few studies from a limited set of similar countries. The projections neglect that changes in preferences, age structure, working hours and life styles would also affect tourist behaviour. The spatial resolution (national) of the model is crude, as is the temporal resolution (annual). A seasonal resolution would allow for the separate analysis of sun and snow seekers, and would allow tourists to shift their holidays not only in space (as they do in the current model) but also in time (from summer to spring and autumn). The economic impact does not extend beyond tourist expenditures. Improving on all this is deferred to future research. The results presented here demonstrate that this is a fruitful line of research.

Another potential application of the model is to sustainability analysis. On the one hand, tourists exert substantial pressure on the environment (Gössling, 2002) while ecotourism supports conservation (Gössling, 1999; Wilson and Tisdell, 2001). Immediate applications include an analysis of the relocation effects due to restrictions on tourist numbers in a particular country (e.g., Bhutan). In Hamilton *et al.* (2005b), carbon dioxide emissions from international travel are projected, but other emissions and resource use can be readily added (if the data are available) now that the model includes the length of stay as well. The implications of constraints on emissions and resource use could then be analysed too. In this model, the attractiveness of a tourist destination consists of a climate component, which changes, and a second, unspecific component, which is kept constant. Splitting the latter would allow for the analysis of other environmental changes – for example, the establishment of national parks. The analysis of price instruments to change the behaviour of tourists would require adding costs to the attractiveness index, and splitting “distance” into its price and time components. These are important topics for future research.

This chapter demonstrates that, erratic as individual tourists may be, mass tourist movements can be modelled and projected into the future. As tourism is an important driving force of global environmental change, this is a step towards the prediction of human impacts on the environment and, via climate change for example, of environmental change on human behaviour.

Chapter 9

Conclusion

Measuring the impacts of climate change on tourism necessitates a quantitative appraisal of the relationship between tourism demand and climate as well as other natural attractions, such as the coastal zone, which will be affected by climate change. In the young but growing field of research on tourism and climate change, quantitative studies are scarce. To go some way to reducing the scarcity and so improve the basis for climate change impact assessment for tourism, this thesis examines how demand, with particular reference to the coastal zone, will change in response to climate change. The realisation of the aims of this thesis, which were set out in the first chapter, is summarised below. This is followed by a discussion of the implications for the research field of tourism and climate change, for the tourism industry and for policy.

9.1 Realisation of aims

The first aim of this thesis, to review the historical evidence and the contemporary scientific literature on the importance of climate and the coastal zone for tourism demand, was met in chapter 2. A review of studies on the history of tourism shows that climate has been an important factor in the spatial and temporal location of holidays throughout history. Nevertheless, enjoying the sunshine first became the main purpose of a holiday in the 1920s. The coast, however, was not always appreciated: in fact, during the 17th century it was seen as being disgusting. By the beginning of the 19th century, this had changed and the coast became the focus of tourism in the industrialised nations. Contemporary studies show that climate is one of the decisive factors in destination choice; this can be seen in destination image studies as well as in studies of tourism demand. There are fewer studies on tourism and the coast. Nevertheless, the coast and the sea, in particular beaches, are important factors for tourists. In the review of the studies that have been carried out on the impact of climate change and tourism, it can be seen that there are fewer quantitative studies than qualitative ones. In the existing quantitative studies, there are several gaps. First, the coverage of countries and activities has been piecemeal. Second, substitution between countries has not properly been considered. Third, existing studies focus on particular origin countries or on particular destinations: the global picture is neglected. Fourth, there have not been any studies that examine directly and in a quantitative way the impact of sea-level rise on coastal tourism. Hence, a comprehensive assessment of the costs of climate change in the tourism sector is difficult.

The second aim, which was to provide quantitative evidence that climate and the coast are important destination characteristics that affect tourists' decisions for a particular destination**,** was achieved in chapter 3. For a survey of German tourists, it is found that climate is the *most* important factor in the decision for a particular destination. Access to the sea and lakes is found to be the second most important of the characteristics before other aspects such as price, cultural and historical attractions and landscape. This is the first study of its kind to provide quantitative evidence of climate's importance, which has been speculated on in many of the articles and books on climate and tourism, but which has not been backed up by survey data. Furthermore, the results confirm the use of temperature as the main determining variable in demand studies (for example, chapters 4, 5, 7 and 8 of this publication) and in the composition of tourism climate indices, such as that of Amelung *et al.* (forthcoming). Other, non-temperature variables were also important, which provides support for the use of several variables in the Tourism Climate Index (TCI). Nevertheless, there is no support for the specific combination of variables in the TCI.

Establishing quantitative relationships between climate and tourism demand as well as between coastal characteristics and tourism demand was the third aim, and this was met in chapters 4,5 and 6 with the focus on demand from Germany. In chapter 4 demand is estimated using, among other things, climate variables and beach length. Here demand for countries is found to peak when the average monthly temperature is 24°C. Furthermore, beach length is found to be positively related to demand. Using the estimated coefficients, an index of climatic attractiveness for destinations is calculated. Although the concept of an index of climatic attractiveness is not new, the index method developed in chapter 4 has an advantage over the TCI and other climate indices for tourism, since its composition is based on the observed behaviour of tourists and not on expert judgement. Index values for the main tourist generating countries as well as for the main receiving countries are calculated for the month of August. The most attractive climate is that of Spain closely followed by Greece and Portugal. The northern European countries have the least attractive climate. It must be borne in mind, however, that these values are for the demand from Germany as a whole; different activities, different lifestyles or the health status of tourists, for example may all affect preferences for climate and so different climatic indices would be necessary. And it is exactly this point that chapter 5 deals with. In that study, the tourism demand data used in chapter 4 is segmented according to phase in the life cycle, region of origin and activities and motivation. The optimal temperature, that is where demand peaks, ranges from 22°C to 24°C across the segments. More interestingly, the steepness of the temperature demand relationship is different for different segments. Even though the temperature optima are similar, changes in temperature will have a larger effect on demand depending on the steepness of the demand curve.

Chapter 6 examines the role that the coastal landscape has on the price of accommodation. Price reflects the interaction of supply and demand. Thus, this study does not solely estimate the relationship between demand and the coastal landscape. Nonetheless, chapter 6 estimates the value that tourists attach to various coastal types. It is found that an increase in the length of dikes in a given district would result in a reduction in the average price of accommodation. An increase in the length of open coast results in an increase in the average price of accommodation. The length of cliffs in a district has no effect on price.

The fourth aim was to use the relationships estimated in chapter 4 and 6 to examine the effects of climate change on tourism. In addition, chapters 7 and 8 examine the impact of climate change but do not directly use the results from chapters 4 to 6. In chapter 4, the effect of climate change on the estimated climatic attractiveness of countries is twofold. First, attractiveness increases for those countries whose average monthly temperature is below the calculated optimal. Second, attractiveness decreases for countries whose average temperature moves beyond the optimal value. The results for August show that Northern Europe will become climatically more attractive. Countries in Southern Europe will experience a relatively small increase in attractiveness compared to those in the north, and Greece and Portugal will even experience a reduction in attractiveness. In addition, chapter 4 shows that demand is positively related to the length of beach in a country. Therefore, if sea-level rise causes erosion of beaches in a particular country then demand for the affected country will fall unless measures are taken to prevent erosion. Another important finding of chapter 4 is the preference for domestic holidays, which combined with increasing climatic attractiveness in the major source markets of Northern Europe will weaken demand for the main destination countries and shift it to the source countries.

Chapters 7 and 8 examine the impact of climate change on global tourism, and the results of these chapters largely reflect those of chapter 4. The Hamburg Tourism Model predicts that climate change will lead to an increasing popularity of destinations in higher latitudes and altitudes. Nevertheless, the increases from climate change are relatively small compared to those resulting from economic and population growth. Domestic tourism is incorporated into the model in chapter 8. Domestic tourism is particularly important as the results of chapter 4 show. Compared to the baseline situation, climate change will cause domestic tourism to double in relatively cooler countries and, at the other extreme, to reduce by up to a fifth and relatively hot countries. In terms of tourism expenditures, the model predicts that changes in total expenditures will range from a doubling in the currently cooler countries to being halved in the relatively hot countries.

Turning to the impact of climate change on the coastal zone, chapter 6 examines the impact of sea-level rise, more specifically adaptation to sea-level rise, on accommodation prices. It is found that purely in terms of the impact on accommodation revenues, beach nourishment rather than dike construction is the more beneficial adaptation measure. The simulation results of chapter 8 are also used to explore the impact of sea-level rise. Proportional land loss is used to scale the number of tourists from a country as well as the numbers of tourists visiting that country. Even without considering coastal protection measures, the impact for the majority of countries is minimal. There are, however, some exceptions, such as the Maldives, which will experience a drastic reduction in the number of tourists.

The final aim, which was to examine the impact of climate change at various destination and source market spatial scales, was met in chapters 4 through to 8. In terms of destination scales, this ranged from districts within one of the coastal states of Germany (chapter 6) to groups of countries (chapter 4). Source market scales ranged from regions of Germany (chapter 5) to all countries of the world (chapters 7 and 8). The detail of the smaller scale studies provides contrast to the general nature of the country scale studies. Not only that, the results of the small-scale studies could be incorporated into the general models. For example, it was found in chapter 5 that the climate-demand relationship of tourists from the warmer parts of Germany is steeper than that of tourists from cooler areas of Germany. That is, demand is more responsive to changes in temperature. Bigano *et al.* (2006) find the same result for countries. The results could be used to differentiate the global model.

9.2 Relevance to the research field of tourism and climate change

The results summarised above are relevant to the research field. But it is the extension of existing methods and the application of new techniques that is of particular interest. Although surveys have been used elsewhere in the field of tourism and climate change research, chapter 3 is the first study to provide a comprehensive examination of climate and climate information in the tourists' decision-making process. It would be worthwhile to replicate this study for other times of the year – this study was carried out in the summer – and for other nations. A problem of the study was making sure that climate and weather are understood as distinct concepts by the respondents of the questionnaire. This blurring of concepts could be overcome in subsequent studies by verbally administering the questionnaire. An additional use of the survey method could be to investigate tourists' images of a destination's climate and if these diverge from the actual climate. Data on this was collected as part of the study in chapter 3, but an examination of this aspect is deferred for future research.

Segmentation, the hedonic price method and simulation modelling are new methodologies for research on climate change and tourism. Segmentation of tourism datasets provides information that can be used to quantify tourism scenarios. For example, using different climate- demand relationships for different age groups it would be possible to examine the effect that ageing populations - in the main source market countries - have on the flows of tourists. The major restriction to this is the availability of data that is detailed enough to allow segmentation. Nevertheless, segmentation could be applied to existing studies such as the study presented in chapter 3 or other tourism demand studies.

The hedonic price method was applied to the issue of coastal landscape change. However, this method could also be a fruitful way to estimate the willingness to pay for a certain climate. Package tours are one of the largest markets in tourism demand. Price, accommodation, location and climate data can be easily collected from the brochures produced by tour operators. Of course, it would be time consuming to prepare such a dataset. With the assistance of tour operators, however, it may be possible to access such data in digital form. The research network of éCLAT is trying to establish contacts with the tourism industry to procure tourism data and to provide information for the industry about climate change. It is also particularly important to gain empirical knowledge of the preference of tourists from such countries as Brazil, China and India. The fast-growing middle class will become an increasingly important player in the tourism market.

So far, the Hamburg Tourism Model, a global tourism demand simulation model, is the sole global model for predicting the effect of climate change on tourism. It would be useful if other global models were developed. Perhaps these could incorporate different representations of climate or different environmental attributes. It would then be possible to compare different scenario results and so give the tourism industry and policy-makers a better assessment of the likely range of impacts.

9.3 Relevance to the tourism industry

The results of chapters 7 and 8 show that population growth and economic growth will result in an absolute increase in the number of tourists travelling, both domestically and internationally, and that all countries will experience an increase in the number of tourists spending holidays within their borders. These results are projections of demand assuming that supply will expand to meet it. Expansion may not be physically possible or it may be restricted politically because of detrimental effects to other sectors or to the environment.

The discussion in this thesis has been about the effect of climate change on tourism demand. It has been shown that tourists will substitute one destination for another and one season for another. It is likely that this will also be the case for types of activities. For example, if skiing is no longer possible then another activity will gain in popularity. But, what will the change in demand mean for the tourism industry? The majority of the tourism industry consists of small to medium sized enterprises (SMEs), and many of these are family run businesses (Cooper *et al*., 1998). As well as accounting for a large share of the employment in tourism and sustaining many communities' livelihoods, the SMEs generate one third of total tourism revenue (Getz and Nilsson, 2004). In addition, the industry has high fixed costs, particularly in the accommodation and transport sectors. Changes in the patterns of demand, even over longer periods, will therefore be an important consideration in investment decisions. One of the results of this thesis is that climate change will reduce the attractiveness of certain countries during the hottest months but increase the attractiveness during the shoulder season. In other words, the season will lengthen. For countries that are relatively cool, climate change will increase the attractiveness of all of the seasons; again, there will be an increase in the length of the tourist season. Therefore, the seasonality of employment is reduced, which is likely to increase the amount of permanent positions available in the industry. In addition, facilities will have longer use periods, which will increase the owner's return on their investment.

Other parts of the tourist industry, intermediaries and large diversified suppliers with short payback times on their investment, are less vulnerable to climate change. They would have to adjust their behaviour, but profits would not be affected to the same extent as is likely to be the case for the small to medium sized enterprises.

9.4 Relevance to policy

Tourism development has considerable environmental, economic and social impacts at the local level. The task of tourism planning, to balance the positive and negative impacts of development, requires demand forecasts at the local and regional – not just at the national level. If the results of chapters 7 and 8 could be disaggregated further than individual countries. It would be highly useful for policy-making at the local level. For the supply of tourism services to meet demand, it is likely that the accommodation sector will have to expand, which implies the construction of new accommodation or the conversion of existing building stock. In other words, there will be land-use changes, which in turn will effect demand. Being able to estimate demand or accommodation prices using environmental characteristics makes it possible to weigh up the costs as well as benefits of the expansion of tourism services.

Tourism currently contributes to roughly 5% of CO_2 emissions (Gössling, 2002), and the bulk of this comes from emissions from transport both to and at the destination. Chapters 7 and 8 show that demand will continue to grow, which implies a growth in transport emissions. It was also shown in chapter 8 that climate change will increase domestic tourism in many of the main source markets, which will lead to a fall in the distance travelled. Nevertheless, the reduction in potential emissions will depend on the mode of transport that is used for domestic tourism. Short-haul flights have a much higher rate of emissions per passenger kilometre, as take off and landing involve considerable amounts of fuel. Therefore, reducing the distance travelled does not proportionally reduce the amount of emissions. Assessments of the impact on transport demand will be needed for both transport and tourism planning as well as climate change policies.

9.5 Outlook

This thesis has contributed to the research on tourism and climate change as well as the more general issue of incorporating the environmental characteristics of destinations into the understanding of tourist decision-making, tourism demand and the price of tourism services. The results and the methodologies developed are useful not only for climate change impact research but also more practically for the tourism industry and policy-makers at the local as well as national levels. In this thesis, the focus has mainly been on the direct impact of climate change and more specifically the expected increase in temperature. The ancillary effect of sea-level rise has also been examined. There are, however, other direct and indirect effects of climate change, such as a decrease in water availability, eutrophication or changes in landscape and ecosystems that are likely to have an effect on tourism demand. The methodologies and results presented in this thesis provide a good starting point to examine such issues.

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Summary

Climate change, whether through increased temperatures or sea-level rise, is likely to affect the spatial and temporal pattern of tourism demand. Despite the cultural and economic importance of tourism and its overwhelming dependence on climatic factors, relatively few studies have tackled the impact of climate change on tourism. In particular there are few quantitative studies on the effect that climate change will have on tourism. The aim of this thesis is to fill the research gap and so provide information for the tourism industry and policy makers.

Following a brief thematic introduction and statement of the aims of the thesis in chapter 1, chapter 2 provides background information on tourism, climate, the coast and climate change. Along with a sketch of the historical development of tourism with particular reference to climate and coast, chapter 2 reviews the contemporary literature on the relationships between tourism and climate and tourism and the coastal zone. Contemporary studies show that climate is one of the decisive factors in destination choice; this can be seen in destination image studies as well as in studies of tourism demand. The perspective is then shifted to the future. The causes and impacts of climate change are briefly discussed. A review of the literature on the impacts of climate change on tourism highlights the following gaps: First, the coverage of countries and activities has been piecemeal. Second, substitution between countries has not properly been considered. Third, existing studies focus on particular origin countries or on particular destinations: the global picture is neglected. Fourth, there have not been any studies that look directly at the impact of sea-level rise on coastal tourism.

The focus of chapter 3 is the role that information about the climate of destinations plays in the destination choice of tourists. Using data from a survey of German tourists it is examined if tourists actively inform themselves about the climate of their planned destination. The majority of tourists did inform themselves about climate, and the most common phase for doing this was during the planning of their holiday. In addition, preferred information sources and types of information are established. Another aspect of the survey is the ranking of the most important characteristics of the destination that were crucial for the tourist's decision to go to the chosen destination. It was found that climate is the most important factor in the decision for a particular destination followed by access to the sea and lakes.

Chapter 4 contains an application of the pooled travel cost model using data on the destination choices of German tourists. Tourism data from a representative survey of German citizens combined with data on climate, beach length and indicators of cultural, natural resource and economic attractiveness of the destination countries is used to estimate the destination demand function. Demand for countries was found to peak when the average monthly temperature is 24°C. Furthermore, beach length is found to be positively related to demand. Using the results of the statistical analysis, an index of climatic attractiveness is calculated. Under a scenario of climate change, in August Northern Europe will become climatically more attractive whereas the countries in Southern Europe will experience a relatively small increase in attractiveness and in some cases attractiveness will even reduce.

In chapter 5 the data set used in chapter 4 is segmented using phase in the life cycle; second, holiday motivation and holiday activities and region of residency. The optimal temperature, that is where demand peaks, ranges from 22°C to 24°C across the segments. More interestingly, the steepness of the temperature demand relationship is different for different segments. Even though the temperature optima are similar, changes in temperature will have a larger effect on demand depending on the steepness of the temperature-demand relationship. The climate index values are different across the segments: the segment containing those tourists who were swimming and sunbathing while on holiday has the highest index values of all of the segments.

Chapter 6 examines the role that coastal and other landscape features have on the attractiveness of destinations for tourism. In this study, the relationship between the average price of accommodation in the coastal districts of Schleswig-Holstein and the characteristics of these districts is examined using the hedonic price technique. An increase in the length of dikes in a given district would result in a reduction in the average price of accommodation. An increase in the length of open coast results in an increase in the average price of accommodation. The impact of sea-level rise is examined through an assessment of the financial losses in the accommodation sector through the modification of the coastline caused by the construction of different coastal protection measures. It was found that, purely in terms of accommodation revenues, beach nourishment rather than dike construction is the more beneficial adaptation measure.

Returning to the international scale, chapters 7 and 8 extend the examination of the impacts of climate change to global tourism, modelling both the demand from countries and the demand for countries. In chapter 7, the Hamburg Tourism Model (HTM), a simulation model of international tourism, is introduced. The current pattern of international tourist flows is modelled using 1995 data on departures and arrivals for 207 countries. Using this basic model, the impact on arrivals and departures of different scenarios of population and per capita income growth and climate change is analysed. The HTM predicts that climate change will lead to an increasing popularity of destinations in higher latitudes and altitudes. Nevertheless, the increases from climate change are relatively small compared to those resulting from economic and population growth.

In chapter 8, the HTM is extended to include domestic tourism and tourist expenditures. Compared to the baseline situation, climate change will cause domestic tourism to double in relatively cooler countries and, at the other extreme, to reduce by up to a fifth and relatively hot countries. In terms of tourism expenditures, the model predicts that changes in the total expenditures will range from a doubling in the currently cooler countries to being halved in the relatively hot countries.

In the final chapter, the results of the previous chapters are summarized, and their relevance to the research field of tourism and climate change, to the tourism industry and to policy is discussed.

Zusammenfassung

Klimawandel, ob durch steigende Temperaturen oder den Anstieg des Meeresspiegels, wird das räumliche und zeitliche Muster der touristischen Nachfrage verändern. Trotz der kulturellen und ökonomischen Bedeutung des Tourismus und dessen unmittelbarer Abhängigkeit vom Klima, befassen sich erst wenige Studien mit den Auswirkungen des Klimawandels auf den Tourismus. Insbesondere gibt es kaum quantitativen Studien. Diese Forschungslücke soll mit dieser Arbeit geschlossen werden und dadurch Informationen für die Tourismusindustrie und politische Entscheidungsträger zur Verfügung gestellt werden.

Nach inhaltlicher Einführung und Zielsetzung in Kapitel 1 führt das Kapitel 2 in die Thematik ein und bietet Hintergrundinformationen zu den Themen Tourismus, Klima, Küste und Klimawandel. Neben einem Abriss der historischen Entwicklung des Tourismus in Bezug auf Klima und Landschaft wird in Kapitel 2 die gegenwärtige Literatur zu den Themen Tourismus und Klima sowie Tourismus und Küste besprochen. Wie sowohl Destination-Image-Studien als auch Nachfrageanalysen zeigen, ist das Klima einer der ausschlaggebenden Faktoren bei der Entscheidung von Touristen für ein bestimmtes Reiseziel. Im Anschluss werden die Ursachen und Auswirkungen des Klimawandels diskutiert. Die Auswertung der Literatur zu den Auswirkungen vom Klimawandel auf den Tourismus deckt die folgenden Aspekte auf: Erstens, die Erfassung von Ländern und Aktivitäten ist nur stückweise erfolgt. Zweitens, die Substitution zwischen Ländern wurde nicht berücksichtigt. Drittens, Studien berücksichtigen nur ausgewählte Länder oder Ziele: das globale Bild fehlt. Viertens, es gibt bislang keine Untersuchungen, welche die Auswirkungen eines steigenden Meeresspiegels auf den Küstentourismus untersucht haben.

Der Fokus von Kapitel 3 ist die Rolle von Klimainformationen im touristischen Entscheidungsprozess. Anhand von Umfragedaten wird untersucht, ob Touristen sich aktiv über das Klima ihres Reisezieles informiert hatten. Die Mehrheit der befragten Touristen hatte sich tatsächlich informiert und dies passierte am häufigsten während der konkreten Planung des Urlaubes. Ergänzend wurden die bevorzugten Informationsquellen und Informationstypen ermittelt. Ein weiterer Aspekt der Umfrage ist die Rangordnung der Eigenschaften des Ziellandes, in der sie für die Wahl des Reisezieles ausschlaggebend waren. Es wurde festgestellt, dass das Klima der wichtigste Faktor für die Entscheidung war gefolgt von der Zugänglichkeit zum Meer oder zu Seen.

Kapitel 4 beschreibt die Anwendung der Reisekostenmethode auf Umfragedaten deutscher Touristen. Tourismusdaten aus einer repräsentativen Umfrage deutscher Staatsbürger wurden mit Daten zu Klima, Strandlänge, Kultur-, Umwelt- und Wirtschaftsindikatoren von Reiseländern verknüpft, um die Nachfragefunktion zu schätzen. Die Nachfrage für ein Land ist am höchsten, wenn die monatliche Durchschnittstemperatur 24°C beträgt. Ferner wirkt die Länge der Strände positiv auf die Nachfrage. Die Ergebnisse der statistischen Analyse bilden die Grundlage, um einen Index der klimatischen Attraktivität für die heutigen Klimadaten sowie für ein Zukunftsszenario zu errechnen. Ergebnisse des Klimawandelszenarios zeigen für den Monat August eine Steigerung der Attraktivität Nordeuropas, für die südeuropäischen Länder ist nur bei einigen Ländern eine relativ kleine Steigung zu verzeichnen, andere werden an Attraktivität verlieren.

In Kapitel 5 wird der Datensatz nach Alter und Familienstatus, Urlaubsmotivation und Aktivitäten sowie Herkunftsregion segmentiert. Für die einzelnen Segmente ergibt sich eine Spannbreite der attraktivsten monatlichen Durchschnittstemperatur von 22°C bis 24°C. Interessanterweise ist die Steilheit der Temperatur-Nachfrage-Beziehung unterschiedlich für die einzelnen Segmente. Auch wenn die Temperaturoptima ähnlich sind, werden Temperaturänderungen eine größere Wirkung auf die Nachfrage haben, wenn die Temperatur-Nachfrage-Beziehung steil ist. Die Werte des Index der Klimaattraktivität sind am höchsten für das Segment der Touristen, die Baden und Sonnenbaden als Urlaubsaktivität angegeben haben.

Kapitel 6 untersucht die Rolle von Küsten- und anderen Landschaftsattribute in der Attraktivität von Reisezielen. Mit Hilfe der Methode der hedonischen Preise wird die Beziehung zwischen den Durchschnittspreisen für Unterkünfte in Küstengemeinden Schleswig-Holsteins und der Attribute dieser Gemeinden analysiert. Eine Ausweitung der Deiche in einer Gemeinde verursacht beispielsweise eine Minderung des Durchschnittspreises. Andererseits verursacht die Ausweitung der offenen Küste eine Erhöhung des Durchschnittspreises. Die Auswirkung des Meeresspiegelanstiegs wird durch eine Bewertung der monetären Verluste in der Unterkunftsbranche für zwei Typen von Küstenschutzmassnahmen analysiert. Es wurde festgestellt, dass aus touristischer Betrachtung Strandvorspülungen dem Deichbau vorzuziehen sind.

Zurück auf der globalen Ebene erweitern Kapitel 7 und 8 die Analyse der Auswirkungen des Klimawandels auf den weltweiten Tourismus, indem die Nachfrage von und nach allen

Ländern der Welt modelliert wird. In Kapitel 7 wird das Hamburg Tourismus Modell (HTM), ein Simulationsmodell, vorgestellt. Dieses simuliert das gegenwärtige Muster der internationalen Tourismusströme anhand von Daten über die An- und Abfahrten nach und von 207 Ländern im Jahr 1995. Anhand dieses Basismodells wird durch unterschiedliche Szenarien von Bevölkerungs-, Wirtschaftswachstum und Klimawandel der Einfluss auf An- und Abreisen analysiert. Das HTM prognostiziert, dass der Klimawandel zu einem Nachfragezuwachs für die Zielländer in höheren Breitengraden sowie in höher gelegenen Ländern führt. Dennoch ist der Zuwachs klein im Vergleich zu den von Bevölkerungs- und Wirtschaftswachstum verursachten Zunahmen.

In Kapitel 8 wird das HTM erweitert, um Inlandstourismus und touristische Ausgaben einzuschließen. Im Vergleich zum Trendszenario wird der Klimawandel den Inlandstourismus in relativ kühle Länder verdoppeln und in relativ warme Länder um ein Fünftel reduzieren. Für Ausgaben sagt das Model, dass die Änderung der Gesamtausgaben pro Land von einer Verdoppelung bis zu einer Halbierung reichen wird.

Im letzten Kapitel werden die Ergebnisse der vorherigen Kapitel zusammengefasst und deren Bedeutung für Forschung, Tourismusindustrie und Politik diskutiert.

Curriculum Vitae

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Education and Qualifications

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