



## Climate change and tourism: Where will the journey lead?

April 11, 2008

**The new challenge of climate change.** For the global tourism industry, climate change brings more risks than opportunities. There will be regional and seasonal shifts in tourist flows, resulting in both winners and losers. However, it is undoubted that the tourism industry will continue to be a growth sector, despite the challenge of climate change.

**Mediterranean countries particularly affected.** In Europe, countries bordering the Mediterranean will particularly suffer from climate change. Higher temperatures and water shortages could put off tourists in the high season. This is particularly true for countries in the eastern Mediterranean. In contrast, those that could gain include: the Benelux countries, Denmark, Germany, and the Baltic countries. France and Italy will be slightly favoured, due to the diversified structure of their tourism offers. Our conclusions are based on a detailed scoring model.

**Poor countries on the losing side.** Outside Europe, most countries will suffer from climate change, albeit to differing degrees. Especially for the poorer countries in our investigation, which are putting great hopes on tourism as a driver of development, climate change will principally bring additional burdens. Canada, New Zealand and the USA are the only three further countries outside Europe whose tourist industries will be on the winning side.

**High economic dependence aggravates the problem.** Negative climatic consequences always have particularly serious effects if climate-sensitive tourism has major economic importance. In Europe this applies to Malta, Cyprus, Spain, Austria and Greece. In the Caribbean, e.g. the Bahamas and Jamaica are disproportionately affected; in Asia, Thailand and Malaysia and in Africa Tunisia and Morocco. The island states in the South Pacific and the Indian Ocean are particularly reliant on tourism. If tourists stay away from them, the economic setbacks are extremely serious.

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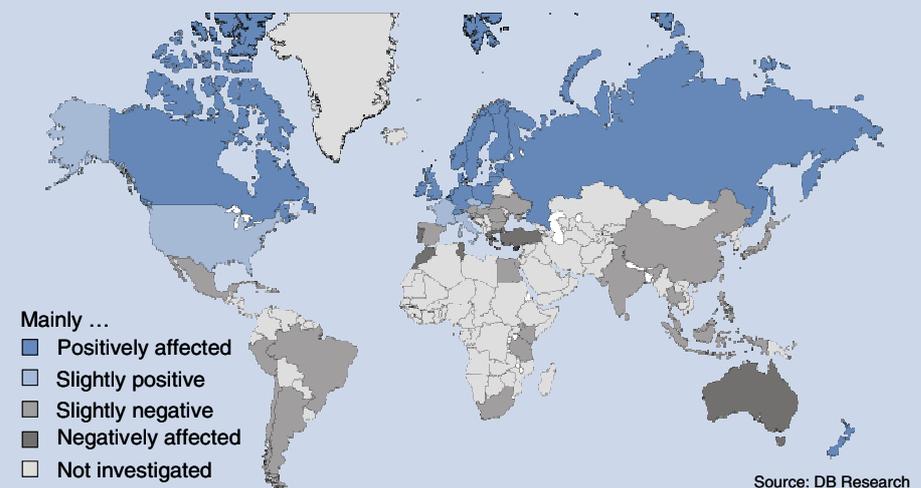
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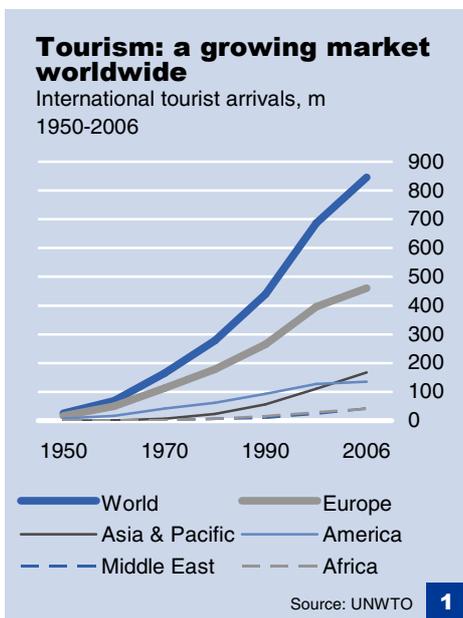
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### How climate change will influence tourism



## 1. Introduction: The tourism industry is expanding, despite turbulent times



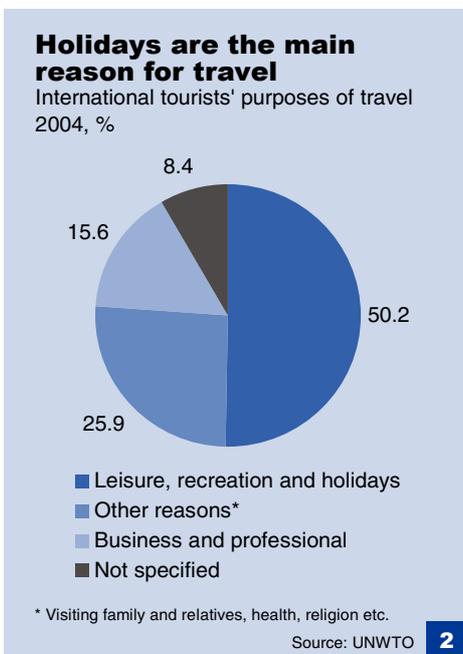
The international tourism industry has had to face many challenges in the recent past. These include the terrorist attacks of 11 September 2001, which disturbed air travel, as well as those in tourist destinations such as Bali (2002 and 2005), Djerba (2002), Morocco (2003) and Egypt (1997, 2005 und 2006) and in the important tourist cities of Istanbul (2003), Madrid (2004) and London (2005). In addition, tourism has been put under pressure by the lung disease SARS, the war in the Middle East and years of rising energy prices, which affected air travel in particular. In addition to these external shocks, the industry has also been marked by changes on both the supply and demand sides. The travel behaviour of many consumers has changed considerably. Some of the key factors characterising this change are: late bookings, increased price-consciousness, shorter holiday trips, the desire for more flexibility and individuality and the trend towards special and theme holidays. On the supply side, notable changes include the major success of the low-cost carriers and new distribution channels such as the Internet. All things considered, the tourism industry is looking back at turbulent times.

### Average growth of 4% p.a. in the sector since 2000

In the face of these difficult conditions, it is astounding that the tourism industry has been able to achieve extremely high growth during the last few years. For instance, according to the World Tourism Organisation (UNWTO), a United Nations agency, between 2000 and 2007 the number of international tourist arrivals increased by an annual average of about 4%, to almost 900 million. The only noticeable fall in arrivals was in 2003, in the wake of the SARS crisis. This shows that, in the period stated, the dominant drivers of growth at the end of the day were the dynamic global economy, unsatisfied demand in developing and newly industrialised countries and mankind's inherent desire for individual mobility.<sup>1</sup> It is also helpful for the tourism industry that many holidaymakers are prepared to return to affected regions only a relatively short time after a terrorist attack or natural disaster.<sup>2</sup>

### The new challenge of climate change

In climate change, the tourism industry is now confronted by a new challenge. Unlike natural disasters or terrorist attacks, this is not just a short-term effect that could then be quickly forgotten. Rather, climate change will permanently alter the attraction of some holiday regions and force them to take steps to adapt in the next few decades. It is taken for granted that there will be regional and seasonal shifts in both national and international tourist flows during the next few years. As a result it is also evident: there will be winners and loser from climate change. The remainder of the tourist value creation chain (e.g. tour operators, travel agencies, airlines, hotels) will not be left untouched by this.



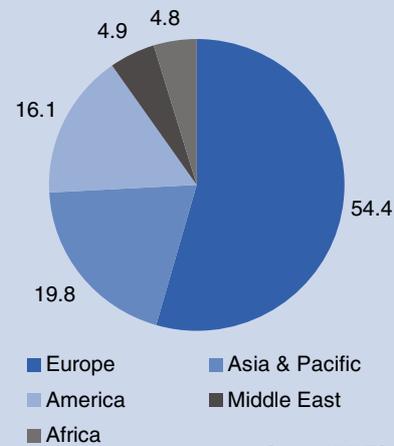
<sup>1</sup> The statistics for international tourist arrivals include holidays, which account for about 50%, but also business travel, family visits and travel on health or religiously motivated grounds.

<sup>2</sup> See: Heymann, Eric (2003). Tourism in the shadow of terrorism and sluggish consumer spending. Deutsche Bank Research. Current Issues. Sep. 12, 2003. Frankfurt am Main.



### Europe has over half of arrivals worldwide

Market share of international tourist arrivals 2006, %



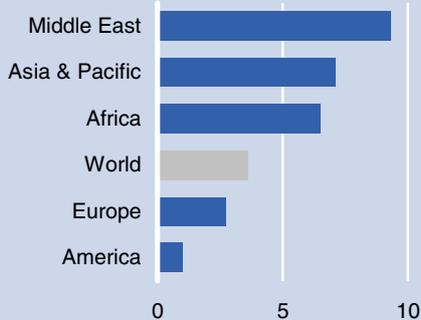
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### Newcomer with higher growth rate

International arrivals 2006, m



Average annual growth rates 2000-2006, %



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The focus of our investigation is the evaluation of particular holiday destinations. To do so, we take into account four factors that influence each of the tourist regions:

- the consequences of the climatic changes, including substitution effects;
- the consequences of regulatory measures to slow climate change and/or to mitigate its negative effects (in particular the increase in the price of mobility);
- the possibilities for adaptation to the changing conditions open to the individual regions;
- the economic dependence of the tourist destinations on (climate-sensitive) tourism.

To start off, we outline the ways in which the environmental-climatic and regulatory-market economy dimensions of climate change can affect the tourism industry.<sup>3</sup> In the final section, using a scoring model, we differentiate between the tourist regions that can profit from climate change and those that are expected to be on the losing side. The forecast horizon of our investigation is 2030.

#### Other factors are still important

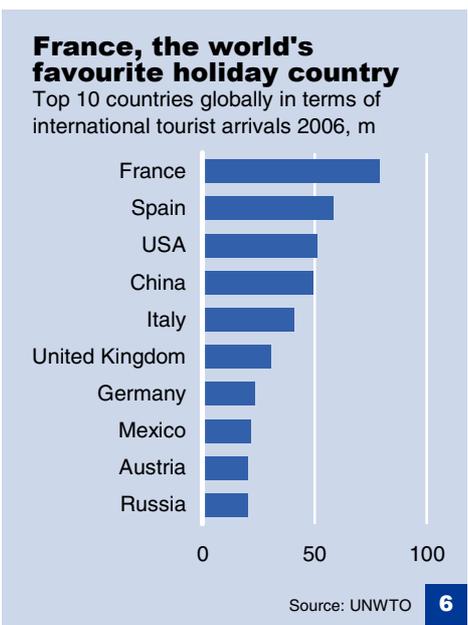
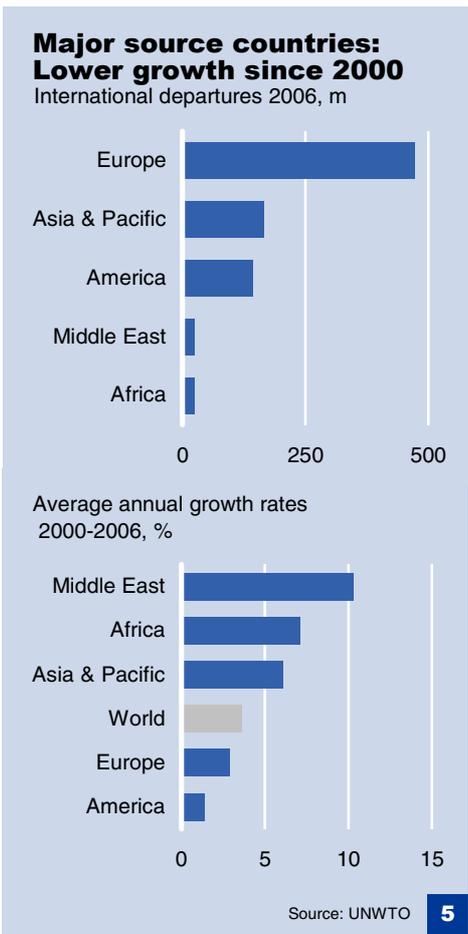
Of course, we are aware that not just the factors listed above will be relevant for tourism. The dynamics of the whole economy – in particular the trend and distribution of disposable incomes – as well as external shocks will continue to affect the sector decisively in the future. From a global view, tourism will definitely continue to be a growth sector, due to the pent-up demand already mentioned, rising global incomes and the trend towards increasing freedom to travel (e.g. in China). Up to 2020, we expect an annual average increase of around 3.5 to 4% in international tourist arrivals. Climate change will not lead, therefore, to a shrinking of the tourism industry. This is all the more valid as many types of travel (business travel) and culturally-motivated tourism may continue to be only slightly affected by climatic changes.

## 2. Climatic effects on holiday regions

Almost all scientists concur that human activities are playing a decisive role in causing and accelerating climate change. According to the Intergovernmental Panel on Climate Change (IPCC), the probable effects of climate change include a rise in the average global temperature<sup>4</sup>, an increase in extreme weather events (e.g. more frequent droughts and heat waves, more storms and heavy rain) as well as a change in regional and seasonal precipitation patterns. For instance, summers in central Europe may become drier on average (nevertheless with increased probability of short-term heavy rainfall), while damper winter months are expected. Precipitation in winter is likely to fall more frequently as rain and more rarely as snow. A further example: the Asian monsoon may strengthen, while the dryness in the remaining seasons will worsen. These phenomena will already be observable before 2030, although they will become more marked in the following decades. In the

<sup>3</sup> In this regard see Heymann, Eric (2007). Climate change and sectors: Some like it hot! Deutsche Bank Research. Current Issues. July 5, 2007, Frankfurt am Main.

<sup>4</sup> It must be taken into account that greater increases in temperature are expected for high northern latitudes and the winter months than for regions near to the equator or for the area of the southern oceans.



longer term, an appreciable rise in sea level is expected. Even in the short term, increased damage from storm surges is probable for many of the earth's coastal regions (e.g. as a result of flooding or coastal erosion).

***Differing ways climate change can impact – learning effect important***

There are a variety of ways in which the environmental-climatic dimension of climate change can affect the attractiveness for tourists and the economic prospects of individual tourist regions. For many holidaymakers – particularly from central and northern Europe – the chance of having “good weather” is one of the most important motives behind the choice of a holiday destination. If in the future the climate – i.e. the “statistical weather” – changes, tourists will learn from their own negative and positive experiences but also from media reports.<sup>5</sup> We consider it very likely that tourists will integrate the changes into their calculations and that they will adapt their travel behaviour accordingly. In the end this will lead to the seasonal and regional shifts in tourist flows already mentioned.

***Examples of changes in tourist flows***

The Mediterranean region, with its focus on seaside and beach holidays, loses attractiveness if there is an increased number of heatwaves in the summer months: during the past few years such events have already begun to increase in frequency in the region. People who repeatedly find that their holiday activities are restricted by extreme heat could be inclined to spend future holidays in other regions, or to go to the Mediterranean region in spring or autumn. In contrast, the North Sea and Baltic regions, the northern Atlantic coast of Spain and the Canary Islands are some of the holiday destinations that could become more popular with tourists due to (actual or expected) excessively high temperatures in the Mediterranean region.

Also in winter, shifts in tourist flows are likely. Anyone who frequently experiences lack of snow in the lower-lying ski resorts of the Alps, or the German Mittelgebirge hills, would tend to switch to higher-altitude or glacier skiing areas in the future. The transfer will be boosted because satisfactory artificial snow creation is not possible in lower-lying regions, or on south-facing pistes, if temperatures are too high. Also, in the future the winter season will be shorter. Of course, a slump in the demand for ski holidays is not expected, so that the higher-altitude ski resorts will increase their market share. Reliability of snow conditions will therefore become more important for the attractiveness of ski areas. By 2030, it is expected that the snow line in the Alps will rise by 300 m. The height above which ski areas can be regarded as having reliable snow conditions will then be around 1,500 metres.<sup>6</sup>

***Damage to tourist infrastructure and attractions***

Another way in which climate change affects holiday regions is more frequent damage to tourist infrastructure or particularly attractive regional draws. These could be caused as much by temporary extremes of weather as by the consequences of gradual climate change. More frequent storms and floods, for example, affect

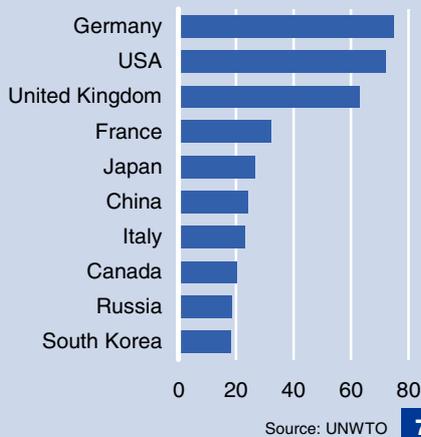
<sup>5</sup> Obviously, not all past and future weather extremes can be treated to climate change. It is rather a question of the higher probability of such extremes.

<sup>6</sup> By definition, in the northern hemisphere there is reliable snow cover if there is at least 30 cm of snow for at least 100 days during the period from December 1 to April 15.



### The Germans enjoy travel the most

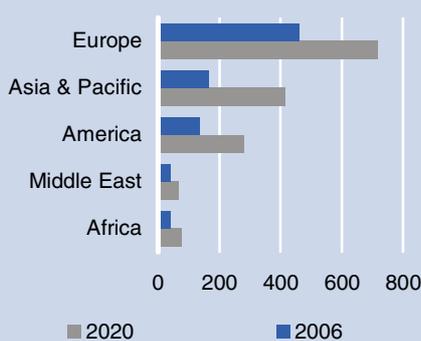
Top 10 spenders in international tourism 2006, USD bn



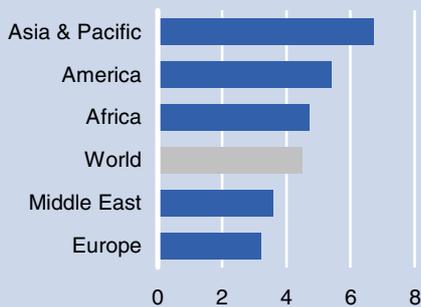
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### Europe's momentum losing steam

International arrivals 2006 and forecast for 2020, m



Average annual growth rates 2006-2020, %



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facilities like hotels and guest houses. Extreme cases of this are the destructions in Thailand and Indonesia following the Tsunami 2004 and in Cancún, Mexico, caused by Hurricane Wilma in 2005. Such events reduce – temporarily but severely – the income base of whole regions. Reconstruction is also linked to enormous costs.

Although such extreme experiences cannot be exactly forecast, they could nevertheless have an influence on the choice of holiday destination if there is a pronounced season for extreme weather events (e.g. the hurricane season from June to November in the western Atlantic).<sup>7</sup> Violent storms will accelerate beach and coastal erosion, which must be combated by expensive coastal defence measures to reinforce sections of the coast.

Longer heatwaves, and dry periods that can cause or aggravate natural disasters, are other negative factors for the attractiveness of tourist regions. For instance, large-scale forest fires scare off tourists, or make a visit impossible because of closures: this results in a considerable shortfall in receipts for the period of the fire. The extensive forest fires in the last few years in Greece and southern Italy, on Gran Canaria and Tenerife, in California and in the area around Sydney, could be a foretaste of the future.<sup>8</sup>

#### Other problem areas

Already, longer dry periods are causing difficulties for water supplies in some tourist regions (e.g. southern Spain, North Africa) particularly as many tourist facilities (swimming pools, golf courses) and the sheer number of tourists lead to a vastly increasing demand for water. This is in addition to competition for water from agriculture. In many regions, lower precipitation could mean that ensuring an adequate supply of water will be even more difficult or will involve considerably increased costs (e.g. desalination, dams).

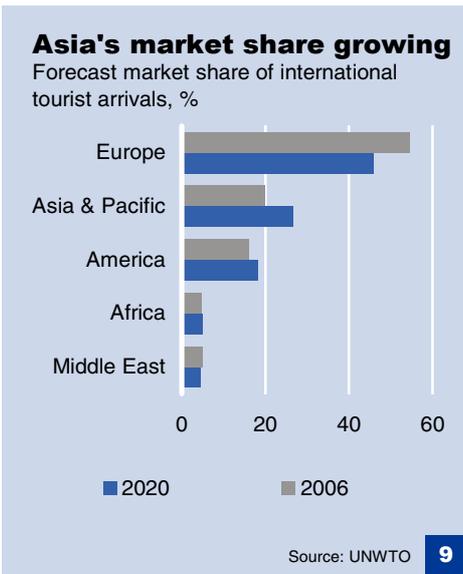
Climate change is leading to a warming of the world's oceans. As a result, regions in which diving plays an important part in tourism (e.g. the Red Sea, the Great Barrier Reef, the Maldives) will lose attractiveness as a result of the bleaching and death of the coral. In the long term – probably well after 2030 – without countermeasures, the rising sea level will endanger the existence of many island nations and atolls in the South Sea and the Indian Ocean (e.g. the Maldives) as well as low-lying coastal areas and cities.

In the future, climate change could also cause more damage to the infrastructure of winter sports regions. As many facilities (e.g. ski lifts) are anchored in permafrost soil, their stability could be endangered if the soil thaws. Increased investment to guarantee safety will probably be necessary in the future.

Lastly, climate change could make preventive measures necessary in the affected tourist areas (e.g. investment in safeguarding the water supply, improvements in coastal protection, more efficient fighting of forest fires) if these regions want to continue to use tourism as a driver of growth and employment.

<sup>7</sup> Scientists do not agree whether or not climate change will lead to more frequent hurricanes in the Caribbean. However, they agree that on average the intensity of cyclones will increase.

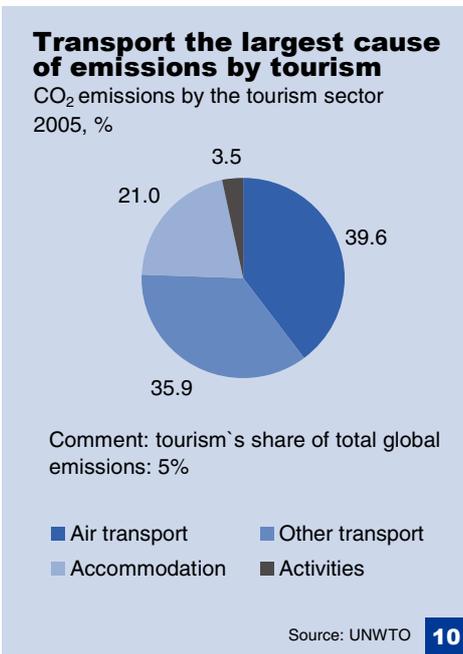
<sup>8</sup> In many of the regions referred to, the actual cause was arson. However, the extent of the damage was considerably increased by longer hot and dry periods.



**Types of travel affected to different extent**

Naturally, different travel types are affected to varying extents by climate change. While the classic summer package holiday in the Mediterranean tourist centres will noticeably suffer from rising temperatures, city trips, which are mainly enjoyed in the spring and autumn months, are generally independent of climatic changes. This is also true of cultural tourism, “wellness” holidays and many other types of theme travel. One thing is fundamentally valid: the more the main reason for selecting a holiday destination is that the holiday-maker hopes for “good weather” or favourable conditions for particular weather-dependent activities (e.g. skiing, diving), the more impact – in both the positive and negative senses – the climate will have on the region concerned in the future. Holiday resorts that will end up more strongly under pressure are those with distinct reliance on only a single (weather-dependent) high season, as possibilities to adapt are then extremely limited. For example, it is hard to attract families with school-age children outside the summer holiday period. The target of more balanced occupancy of tourist capacity over the year is then difficult to achieve. If, in such regions, there is also a high dependency on the tourism industry, the economic consequences are particularly devastating. We will also deal with this effect in our final scoring model.

**3. Government measures and higher energy prices hit the tourism industry**



According to the IPCC, the transport sector, with its roughly 13% of global greenhouse gas emissions, is contributing considerably to anthropogenic climate change. Of particular importance is the fact that the transport sector has grown rapidly worldwide in the last few years: the notable improvements in the specific energy consumption of the various means of transport have therefore been outweighed by the increased demand. The bottom line is that the proportion of global greenhouse gas emissions from transport is rising. The transport sector is therefore coming under political focus. As the tourism industry is closely interlocked with the transport sector, this industry is also coming under pressure from regulatory measures. UNWTO estimates that the global tourism industry is responsible for about 5% of human-induced climate change.

**Motor vehicles and aircraft the most important means of transport**

By a large margin, the most popular modes of transport in international tourism are by road and air. In nearly 88% of all international tourist arrivals, travel was by motor vehicle (cars and buses) or aircraft. Although motor vehicles are still slightly ahead of air travel, the gap between the two modes of transport has narrowed in the last few years. Shipping (ferries, inland waterway and cruise ships) and rail travel have only niche positions.

Road transport has been in the sights of environmental policy for a long period. The increases in mineral oil taxes in many EU countries during the last few years have also been ecologically motivated. By 2030, a noticeable increase in the rates of mineral oil taxes are expected, especially in eastern Europe, as the EU strives for a gradual harmonisation of tax rates. However, even in Western Europe, further increases, or higher charges for toll roads, are likely. This is on top of the increase in crude oil prices expected in the next



### Differing mineral oil tax rates in Europe

EUR per litre of fuel, March 2007



Source: Association of the German Petroleum Industry

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### Growing at the same pace

Trend of crude oil and kerosene prices



Sources: Daily Press, DB Research

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few years. An average annual increase of only 2% in the petrol price in Germany would result in a litre of petrol costing more than two Euro by 2030. In the last ten years the price of petrol in Germany has risen by 5% p.a. on average.

It's true that the energy efficiency of cars will steadily increase in the next few years – dependent also on EU directives for the reduction in CO<sub>2</sub> emissions by new cars. However, in the long term the price effects on petrol will have a stronger effect than savings following technical progress in vehicle and engine design. The longevity of cars also means that a sudden adjustment to increasing fuel prices is technically scarcely possible. All in all, therefore, by 2030 motoring will be more expensive. The example in Figure 16 shows that, if the price of petrol rises by 70 cents per litre, a holiday trip covering a total of 1,500 kilometres in a car consuming 7 litres per 100 km, would cost an extra 74 Euro. This would certainly reduce the disposable budget for the holiday. However, with increasing disposable incomes in the same period, it appears unlikely that there would be enough impetus to trigger dramatic substitution effects in favour of holiday resorts closer to home.

### Including air transport in emissions trading

When journeys are 1,000 to 1,500 kilometres or more one way, the choice of transport is likely to be by air rather than road. The liberalisation of European air transport, which paved the way for the enormous success of the low-cost carriers, has meant that many European destinations are now accessible and affordable even for private households on relatively low incomes.

However, air travel is currently being more intensively scrutinised by environmental policy. The European Commission plans to bring the sector into EU emissions trading by 2012 at the latest. The message is clear: the firms will be faced with costs that, depending on the way emissions trading is organised (e.g. scarceness of certificates, allocation mechanism), will lead to higher ticket prices. The level of CO<sub>2</sub> emission reduction costs and the intensity of competition in the air transport sector will also play a part in this. The EU commission expects that, by 2020, the price of a return flight will increase in a range of just under EUR 5 for short-haul to EUR 40 for long-haul flights.<sup>9</sup> This rise will not lead to a slump in the demand for air travel, although it will reduce its growth potential. Increasing fuel prices are more important for the trend of ticket prices, particularly as the price of kerosene correlates very strongly with the oil price because of the low tax burden (there is no mineral oil tax on kerosene).<sup>10</sup>

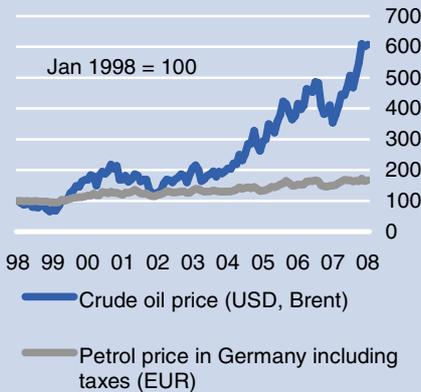
In air transport as well, technical advances will not be able to react sufficiently to the rising prices: aircraft have even longer operational lives than cars. However, the introduction of the new, extremely efficient generation of aircraft (B787, A380 and A350), the (long overdue) realisation of a "Single European Sky" and the further liberalisation of global air transport could slow the trend towards increasing ticket prices.

<sup>9</sup> The European Commission's estimate is based on a certificate price of EUR 30 per tonne of CO<sub>2</sub>.

<sup>10</sup> Fuel costs currently account for approx. 25% to 30% of airlines' total costs – with an increasing trend.

### Higher share of taxes dampens petrol prices

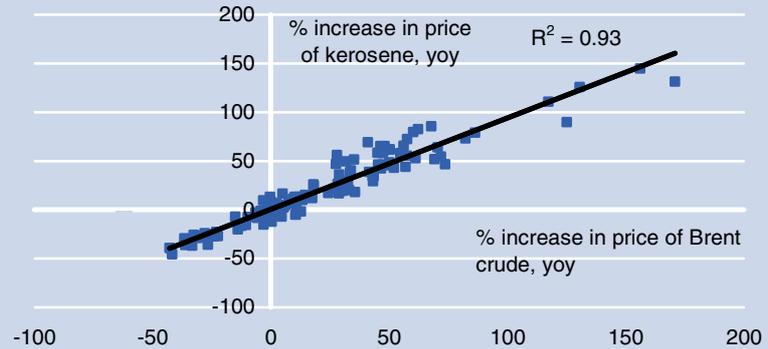
Trend of crude oil and petrol prices



Sources: Association of the German Petroleum Industry, Daily Press, DB Research

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### Oil and kerosene\* prices closely correlated

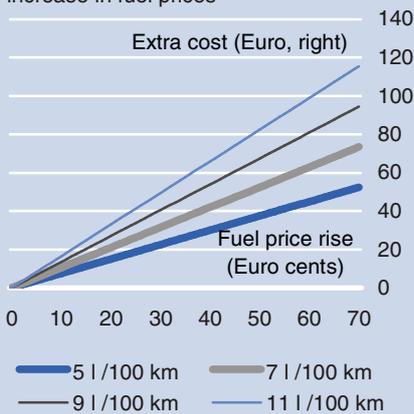


\* Monthly basis. Sources: Daily Press, DB Research

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### Holiday travel by car will be dearer

Additional cost of fuel\* depending on the increase in fuel prices

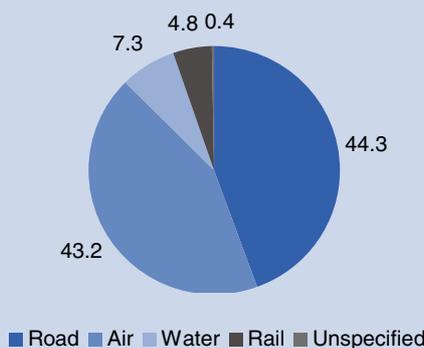


\* For holiday travel covering a total of 1,500 km by car; simulation. Source: DB Research

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### Road and air predominate

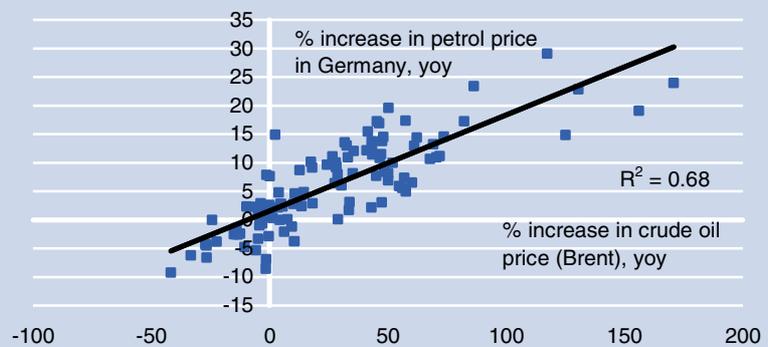
Modes of transport chosen by international tourists, 2004, %



Source: UNWTO

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### Only weak correlation between oil and petrol prices



\* Monthly basis. Sources: Association of the German Petroleum Industry, Daily Press, DB Research

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The bottom line is that flying will be more expensive in the future, as a result of regulatory measures and increasing fuel prices. The additional costs could influence the choice of a holiday destination, particularly for families taking intercontinental flights. Ceteris paribus, long-haul flights will in any case be more heavily affected than e.g. air travel within Europe.

### Rail and sea travel among the winners

Railways and ships are considered to be environmentally friendly modes of transport. In the current political environment, no regulatory measures to burden these modes of transport are being planned. Although it is intended to include maritime shipping in emissions trading, this primarily concerns freight traffic (tankers and container ships). Significant implications for the price of cruise tickets are not anticipated: in addition, the clientele for traditional cruises is usually affluent. For rail travel, environmentally-motivated reliefs are even conceivable in the next few years. However, rail companies will also have to contend with increasing energy and fuel prices. Because of the currently still low intensity of competition, they also have more possibilities to pass on increasing costs to consumers.

Overall, the relative price of rail travel could fall, in comparison with road and air travel. The expected further opening of the market in European rail transport and the increase in intensity of competition could, as with air travel, have a slowing effect on the trend of prices. In the longer term this could encourage innovative products,



### Europe the largest source market, by a wide margin

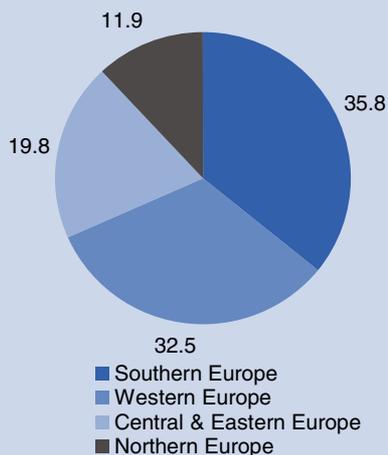
International departures 2006, %



Source: UNWTO **18**

### Northern Europe far behind

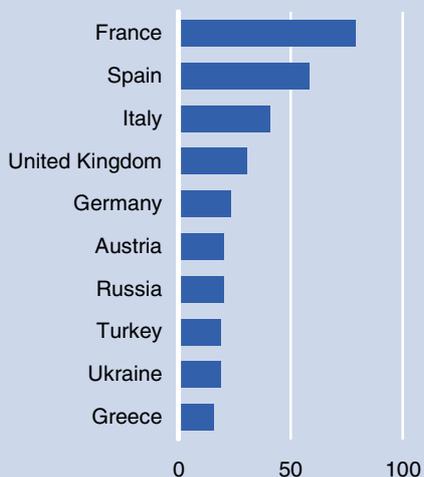
Market share of international tourist arrivals in Europe 2006, %



Source: UNTWO **19**

### Mediterranean countries beat the rest of Europe

International arrivals in European countries 2006, m



Source: UNWTO **20**

particularly in – currently still insignificant – cross-border passenger transport.

This means that regions that can be accessed by rail could benefit somewhat in the future. If such holiday areas also have attractive tourist products for cyclists, there is growth potential in the niche market. Nevertheless, up to now rail transport has only played a secondary part in holiday travel. According to the German Travel Association (DRV) in 2006 only 6% of Germans chose this means of transport for their holiday travel. In terms of international tourist arrivals, according to UNWTO rail travel accounts for just under 5%.

#### Long-haul destinations will be put at a disadvantage

The increasing price of mobility will affect longer-haul holiday destinations more than closer ones. As the industrial countries at the heart of Europe (in particular Germany, the U.K., France), the USA and Japan are some of the freest-spending nations, regions that are well away from these source markets are likely to be the first to lose. Climate-policy motivated government measures will reduce the purely economic attraction of long-haul destinations. In contrast, short-haul destinations will be relatively favoured. In addition to the increasing price of mobility, higher energy prices for tourist facilities (hotels, swimming pools, snow cannons, air conditioning, leisure parks etc.) will also play a part.

## 4. Assessment of individual tourist regions

In the following, we will take a more detailed look at individual countries and tourist regions, as well as their susceptibility to climatic changes. Although our main focus lies on Europe, we also examine the most important long-haul destinations. Of course, we realise that the degree of differentiation of this analysis is not sufficient in many cases: the regional tourist centres vary too much to allow this. However, it is possible to identify resilient trends for all the countries and regions that have been studied.

### 4.1 Europe and the Mediterranean countries

Europe is the most important tourist region in the world. According to UNWTO, in 2006 nearly 55% of all international tourist arrivals (461 million) were on the “old continent”. In the following comments, we concentrate mainly on the changes in climate and, in passing, on the possibilities for adaptation. The increasing price of mobility is less significant, as distances in Europe are of manageable dimension. After all, nearly all regions will be affected to a similar extent.

#### Southern Europe and Mediterranean regions: Trend to the north

**Southern Europe** and the **Mediterranean region** are the favourite holiday destinations in Europe. According to UNWTO, in 2006 about 165 million tourists visited these regions. Climatic changes may affect the various Mediterranean states in a similar way. The key factor for the attractiveness of this region is its Mediterranean climate. This is distinguished by its long, hot and dry summers. In the future, increasing average temperatures, together with the increasing probability of heatwaves, could result in temperatures exceeding comfortable levels more frequently. It is estimated that, by

2030, the region will have a noticeable increase in the number of days with temperatures above 40°C.

A further problem that many areas may have to confront is a shortage of water, resulting from lack of precipitation and the increasing use of irrigation in agriculture. This restricts the operation of tourist facilities (swimming pools, golf courses). In addition, the increasingly dry summers increase the risk of forest fires in many areas. The return of malaria to the southern Mediterranean region also cannot be ruled out.

**South and east coasts of Spain among the losers**

Spain is – in terms of international tourist arrivals – the second favourite holiday destination after France, with a global market share of approx. 7%. The country has a high proportion of foreign visitors (2006: 59%). The tourism sector, with its very high proportion of GDP – currently about 17% – makes a considerable contribution to Spain's economy.<sup>11</sup>

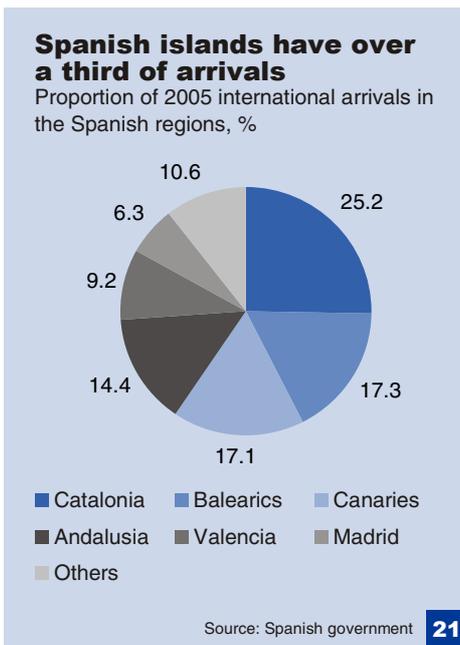
Spain's most developed tourist areas are close to the Mediterranean. In 2005, a quarter of international tourism was to the Catalonia region. Compared with the city of Barcelona, the Costa Brava and the Costa Dorada attract mainly seaside holidaymakers from northern and central Europe. The second and third most important holiday regions are the Balearic Islands in the Mediterranean (in particular Majorca) and the Canary Islands, off the Atlantic coast of Africa. Next come Andalusia and the Valencia region, which also borders the Mediterranean. According to the Spanish government, these five regions account for more than 80% of international tourist arrivals.

In the future, these tourist destinations will suffer from more frequent heatwaves, which will put off seaside tourists in the important high season. In addition, there could be problems with water supply, particularly as agricultural irrigation is playing a more important part in southern Spain. It is principally the Spanish mainland that is affected by climate change. According to estimates, temperatures could rise more sharply there than in other countries bordering the Mediterranean.<sup>12</sup> Although Andalusia in particular has many alternative attractions apart from purely seaside holidays (e.g. the Sierra Nevada, Granada, Seville), in the end the success of tourism in the whole Spanish coastal region is based around the beaches.

**The Canaries could benefit**

In contrast, the effects on the Canary Islands will be less pronounced. Their increased proximity to the equator and subtropical climate mean that temperatures will not rise so much and the differences between the summer and winter seasons will remain relatively small. Even in the future, this will guarantee balanced occupation of tourist capacity over the year and will increase the independence of this holiday destination from climate change.

However, the Canary Islands are suffering from increasing susceptibility to forest fires. An increase in what were formerly rare weather phenomena (e.g. cyclones, dry periods) could lead to increasing damage to the infrastructure and, on some islands (e.g.



<sup>11</sup> The figures are based on a relatively wide definition of the tourism sector. They include indirect multiplier effects and also products and services that are not directly and exclusively classified in the tourism sector (e.g. turnover in restaurants). Business travel is not included in these figures.

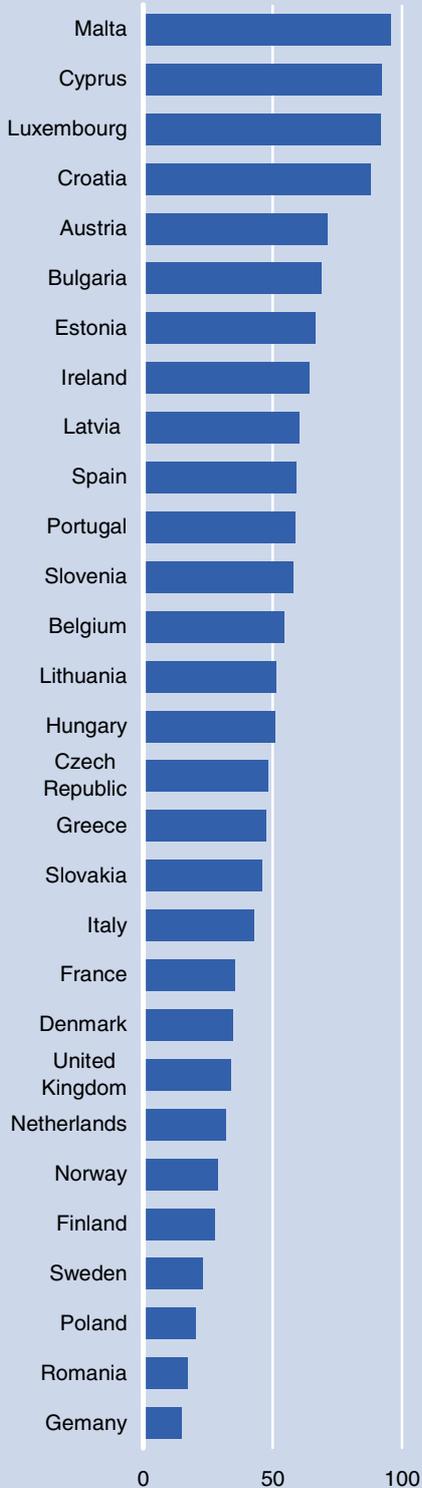
<sup>12</sup> See: Hein, Lars (2007). The impact of climate change on tourism in Spain. CICERO Working Paper 2007/02.



### France can achieve positive substitution effects

#### Foreigners very important for Mediterranean islands

% of foreign tourists, 2006



Source: Eurostat

22

Fuerteventura and Lanzarote), make the water supply, which is already complicated and costly, even more difficult and expensive (desalination, tanker ships). In addition, because of their increased distance from central Europe, the Canaries could suffer somewhat more from the increased price of mobility.

#### North Atlantic coast is likely to catch up

Within Spain, the southern and eastern mainland could lose the most from climate change. In comparison, the temperature rises in the Balearics and Canaries will be lower. The aim of the affected regions should be increasingly to attract tourists in the off-peak season, in order to balance losses at the height of summer. This is hardly likely to be completely successful, as summer tourism in particular is based on fixed holiday dates.

The winner in Spain is the northern Atlantic coast. Here, an increase in the moderate temperatures and lower levels of precipitation could have a positive effect on the attractiveness of holiday regions (e.g. Galicia, Asturias, Cantabria) that so far have mainly been favoured by domestic tourists. However, with its present approximately 5% share of Spain's international tourism, and considerably lower tourist capacity in comparison with southern Spain, the Atlantic coast will not be able to compensate for the setbacks in growth or losses of turnover suffered by the Mediterranean region. Overall, Spain's tourism industry will therefore be among the losers from climate change.

City holidays to Spain (especially Barcelona and Madrid) will generally be unaffected by climate change, as most visitors already travel there out of the summer month season.

#### Portugal at risk from tourist concentration in the south

Like Spain, **Portugal** also has a relatively high proportion of foreign visitors, almost 60%, in terms of overnight stays. It also has an above-average reliance on tourism (14% of GDP).

Portugal's most important holiday region, by a wide margin, is the Algarve in the south of the country, with its focus on "sea and sand" holidays. Its climatic conditions are generally similar to those on the south coast of Spain, even though the Algarve coast exclusively borders the cooler Atlantic. Nevertheless, the Algarve could also be negatively affected by climate change. The tourist sector is one of the major employers in the region – particularly in the high season. As a result, the economic consequences of any setbacks in tourism could be particularly serious. Holidays that are not dependent on climate (e.g. trips to Lisbon) can only partially mitigate this. In Portugal as well, the aim should be to direct tourist flows: firstly towards the off-peak season; and secondly to divert them to the northern part of the country, in which tourism is still relatively undeveloped.

#### France's variety has a positive effect

In terms of international tourist arrivals, **France** is the world's favourite holiday country. According to UNWTO, in 2006 79 million travellers arrived there (9.3% share of the world market in 2006). Only 36% of tourists in France are foreigners. This figure is considerably lower than in Spain and Portugal, which are much more focused on seaside holidays. In France, tourism accounts for around 9% of GDP, roughly in line with the global average.

In France, the Mediterranean region, with Provence and the Cote d'Azur, is particularly well developed for tourism. Even if climate

change were to have the expected negative consequences, after taking into account substitution effects the region could benefit. The increase in summer temperatures here could be less serious than in the still hotter countries of Spain and Portugal. Tourist flows could therefore be diverted from these countries to climatically similar – but on average more pleasant – locations, like the south of France. So far, the Mediterranean island of Corsica has only been a niche market for tourism. In the future it is only likely to be of moderate importance for the whole French tourist sector. It is more likely to be a destination for nature lovers than for beach holidaymakers.

**Many French holidays not dependent on climate**

A large proportion of tourism in France is largely independent of climate. City holidays to Paris<sup>13</sup> would therefore be as little affected as cultural holidays (e.g. visiting the chateaux of the Loire). The Massif Central and the hinterland of Provence are likely to be relatively unaffected by climatic changes, at least until 2030.

**French Atlantic coast could benefit**

The French Atlantic coast could benefit from climate change. Higher temperatures and lower levels of precipitation could extend the summer season and make the sometimes harsh climate more pleasant for sea and sand holidays. Apart from that, many tourists are drawn to this region primarily for its variety of landscapes. Tourists visit Brittany for – amongst other reasons – its individual atmosphere, with rugged coastal cliffs and fishing villages.

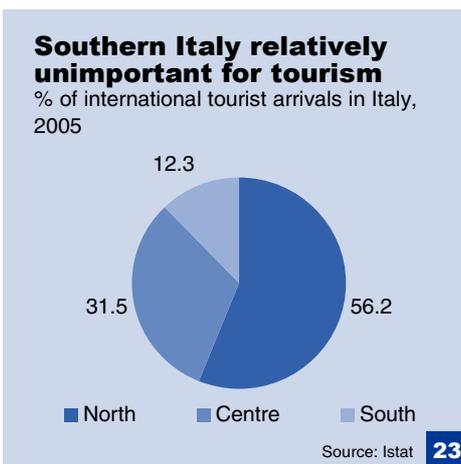
**Reliable snow cover in the French Alps**

Winter sports tourism in the French Alps could be left largely unscathed by climate change for the moment. Many important ski areas (e.g. Val d’Isère, Chamonix, Les Trois Vallées) are at high altitude: until 2030 lack of snow should normally either be no problem or could be compensated for by artificial snow production. Some of the glaciers provide year-round reliability for winter sports activity. In addition, substitution effects from other ski areas in the European Alps could mean that the winter sports areas in the French Alps will gain. In contrast, the reliable snow cover in the French Pyrenees is noticeably reducing.

Overall, tourism in France could benefit from climate change. The world’s favourite holiday country has a sufficiently diversified tourism structure. Besides the “summer sun, sea and sand” theme on the Mediterranean it has other options that are independent of climate, or could even benefit from climate change. The low proportion of international tourists provides a degree of stability, as domestic holidaymakers are usually less flexible in the choice of their destinations.

**Italy has a diversified structure of tourism**

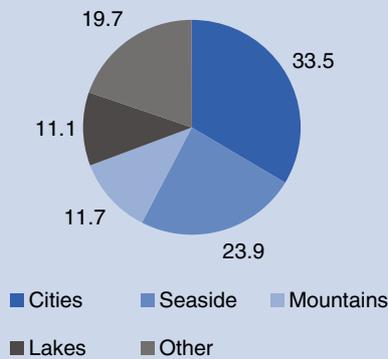
Italy is in third place in Europe and globally in fifth place in the ranking of favourite holiday countries, despite the fact that the country has had to accept considerable downturns in international arrivals in the last few years. Foreigners account for 43% of overnight stays. The tourism industry generates just under 9% of GDP.



<sup>13</sup> According to Eurostat, the Île-de-France is the EU region with the most overnight stays, more even than Catalonia and the Balearics.

### City tourism important in Italy

% of attractions visited by international tourists in Italy, 2005



Source: Istat **24**

Italy also has a strongly diversified structure of tourism. In addition to seaside holidays, e.g. on the Adriatic in Tuscany and on the Italian Riviera, which together account for about a quarter of international arrivals, culturally motivated city tourism constitutes the lion's share, with well over a third (e.g. Rome and the cities in Tuscany). Other important attractions are the Alps (in particular Alto Adige) and the Italian lakes (especially Lake Garda and Lake Maggiore) in the north of the country.

Italy's revenue from tourism is mainly generated in the north (including the Alps, the coasts and Tuscany) and the centre of the country, including Rome. According to the Italian office of statistics (Istat), southern Italy and the islands notch up barely 20% of tourist arrivals. Foreign tourists have an even stronger preference for the north of the country: this is unlikely to change in the future. This is because rising temperatures e.g. on the southern Amalfi coast and in Sicily could have a more serious effect than in Tuscany and the lakeland regions, where the climate is milder. The fact that international tourism is already concentrated at a higher latitude (comparable with Provence) leads to the assumption that Italy will be less disadvantaged by the effects of climate change. The shifting of tourist flows further to the north within Italy could continue, so that regions already having weak economies must be prepared for more serious setbacks.

The very low altitudes of many ski areas mean that winter sports tourism in the Italian Alps could well be more seriously affected by climate change than those in France. About half the ski resorts are below 1,300 m.<sup>14</sup> The location on the south side of the Alps means that even the higher-lying areas (e.g. in the Dolomites) are suffering from reduced snow reliability. However, the largest proportion of holidaymakers, about two thirds, visits in the summer season (April to September). In this period, the pleasant temperatures may mean that the Alpine region could even benefit.

The bottom line is that the extensive range of tourist destinations, partly independent of the weather, together with the possibility to attract tourists from regions whose climates will be worse affected, mean that the effects of climate change on Italy should be manageable.

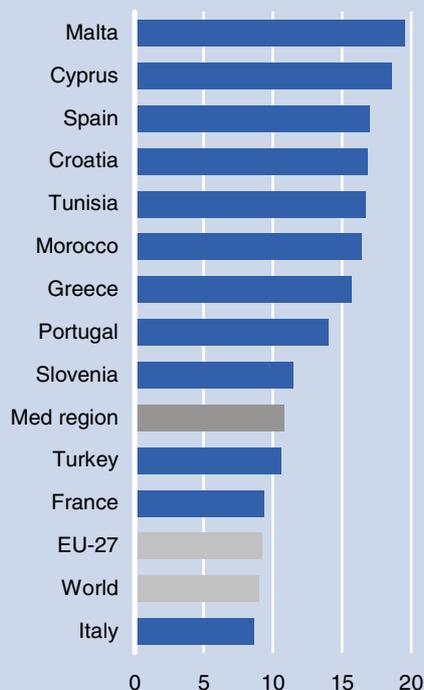
### Greece and Turkey too hot in midsummer

The tourism industry in **Greece** accounts for approx 16% of GDP. Within Europe, the country has over 3% of international tourist arrivals. The proportion of foreign holidaymakers is very high, at almost 75%.

Greece is also well-liked by beach holidaymakers because of its location on the Mediterranean. The Aegean islands and Crete in particular attract many tourists. However, in midsummer many tourists already find the heat extreme. By 2030 this will further increase. In addition, on many islands there are difficulties with water supply. The frequent forest fires are also a problem for tourism. In August 2007, the worst fires for decades, albeit started by arsonists, graphically demonstrated the country's susceptibility to fire as a result of its dry climate. The Ionian Islands (e.g. Corfu) should be better able to cope with rising temperatures, although they will not be able to escape the general trend. Culturally motivated travel to ancient Greece and trips to Athens are also popular. Taking into account its high ratio of international tourists and

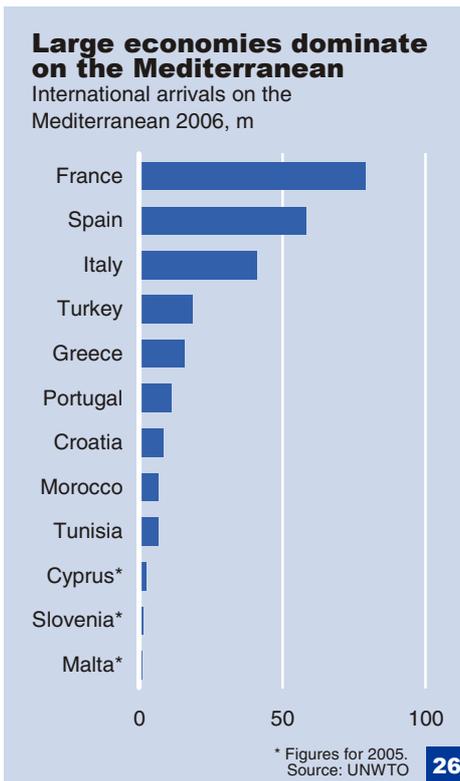
### Large countries less dependent on tourism

% of GDP from tourism, 2007



Sources: World Travel & Tourism Council, Oxford Economics, DB Research **25**

<sup>14</sup> See McGuire, Bill (2006). Holiday 2030.



the high proportion of employment (20%) from tourism, Greece will be one of the losers from climate change.

Tourism in **Turkey** is comparable with that in Greece. Overall, Turkey is the fourth most visited holiday country in the Mediterranean region, after France, Spain and Italy. (Tourism's contribution to GDP: 11%). Although it has numerous cultural and historic attractions, beach holidays on Turkey's Mediterranean (the Aegean and the Turkish Riviera) and Black Sea coasts are predominant. City tourism plays a part, particularly in Istanbul. As a result of increasing temperatures, Turkey could also be negatively affected by climate change.

***Croatia to gain from redistribution?***

Tourism is a very important economic sector in **Croatia** (17% of GDP). The exceptionally high proportion of international tourists in Croatia (88% of overnight stays) indicates that the sector has a high level of sensitivity to climate change.

The Adriatic coast and its offshore islands (e.g. Krk) in particular are the focus of tourist interest. Although increasing temperatures could make beach holidays less attractive, assumptions similar to those that apply to the French and North Italian coastal regions are valid here. The inconvenience suffered by tourists as a result of rising temperatures should be relatively limited, at least up to 2030. Positive repercussions are conceivable, if holidaymakers decide to change e.g. from the hotter Greece to Croatia.

***Water shortages on Malta and Cyprus***

The island states of **Malta** and **Cyprus** are both highly dependent on international tourism. Measured in terms of total employment, on each island the sector accounts for more than 25%. On both islands, the climate is predominantly very hot and dry, even in comparison with other southern Mediterranean locations. Both islands could be severely affected by climate change and will have to contend with increasing water shortages. Malta is already supplied with water by tanker ships, as the island has no sources of fresh water, in the form of streams or rivers, of its own.

***Economic setbacks to be expected in North Africa***

The North African countries with Mediterranean coasts are similarly heavily dependent on tourism. In **Morocco**, tourism accounts for 16% of GDP, in **Tunisia** the figure is 17%. In both countries, summer tourists are already subject to very high temperatures, so that – where possible – they switch to the off-peak season. However, with increasing temperatures even the off-peak season could lose in attraction. Although Morocco has a somewhat milder climate, due to its proximity to the Atlantic, it also has an increasing – although still low – risk of cyclones. In Tunisia the danger is of a further expansion of the desert. In these economies, which are poor in comparison with the EU, there are often inadequate funds to make investments in adaptation to climate change, e.g. for the protection of coastal regions or for the improvement of water supplies. Both countries are mainly visited by European tourists. Overall, Tunisia, which has a greater dependence on beach holidays, could be more seriously affected by climate change than Morocco.

**Malta and Cyprus will be seriously affected by climate change**

**Morocco and Tunisia heavily dependent on tourism**

**Winners and losers in the Mediterranean region**

Of course there may be gainers as a result of shifts within the Mediterranean region. However, considering the effects of climate change alone, this could turn out to be just the redistribution of slices of a shrinking pie. As a result of the worsening of the climatic



conditions for beach holidays, which up to now have been the primary reason for travelling there and are concentrated in the midsummer, overall the region will be negatively affected. Nevertheless, over the whole region, climate change ought not to lead to the tourist sector becoming a declining industry.

### Central Europe reaps the benefits

In comparison with the Mediterranean region, **central Europe** mainly has other types of tourist activities and therefore can also expect differing consequences from climate change. On the one hand, increasing temperatures could make tourist destinations there more attractive. On the other hand, they will lead to precipitation falling more frequently as rain and less often as snow during the winter months, shifting the snow lines to higher altitudes. This could endanger winter sports holidays in many mountain regions. Apart from that, the risks include possible increases in the numbers of storms and floods.

### North Germany – Europe's new beach destination?

The major tourist regions in **Germany** are in the north and south of the country. According to the DRV, in 2006 10 million Germans took their holidays on the North Sea and Baltic coasts: this is about a third of the total. The statistics show that 9.3 million Germans (31%) took holidays in Bavaria and Baden-Württemberg. For the Germans, therefore, their own country is still the favourite holiday destination.

According to the Federal Statistical Office, the two southernmost federal states accounted for almost 33% of overnight stays in Germany, by citizens and foreigners, in 2006. Lower Saxony, Schleswig-Holstein and Mecklenburg-Western Pomerania together accounted for 23.5%. The greater economic importance of Bavaria and Baden-Württemberg (more business travellers) are the reason for their lead. The proportion of foreign travellers making overnight stays is extraordinarily low, at 15%.

In 2006, measured by international tourist arrivals, Germany was in seventh place globally and in fifth place in Europe. The tourism industry accounts for approx. 8% of German GDP.

No negative effects from climate change are expected either for activity holidays or for seaside holidays on Germany's coasts – on the contrary: there could be positive effects resulting from the longer summer season. The North Sea and Baltic coasts will be favoured by climate change. An improvement in the conditions for seaside holidays (higher temperatures, less precipitation in summer) will more than compensate for the risks of climate change like more extreme weather events (e.g. storm surges) or coastal erosion.

In our view, the proportion of overnight stays taken by foreign tourists (currently 15%) will increase, as it should be possible to attract foreign holidaymakers to North Germany from the hot Mediterranean region in the summer months. For German nationals this applies anyway. A positive factor is that city tourism, which currently accounts for approx. 15% and is growing, will remain as unaffected by climate change as will the widespread tourism for treatment at health resorts.

### Winter sports in Germany on a knife edge

However, the German Mittelgebirge hills will be affected by a lack of snowfall. As early as 2030, many regions (e.g. the Harz, the upper Sauerland, the Black Forest, the Thuringian Forest) might be without snow, or at least may have to contend with a shorter season. The

### Southern federal states lead

Overnight stays\* in the top 10 federal states 2006, m

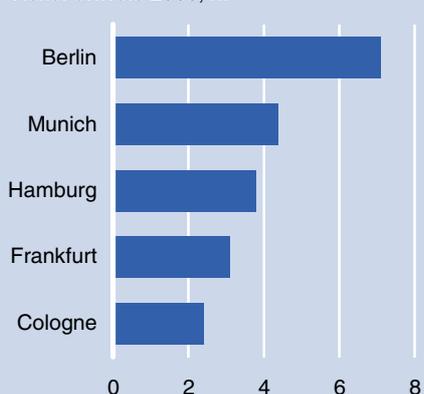


\* Overnight stays in facilities with nine or more beds, incl. camping. Source: Fed. Stat. Office

27

### Top 5 destinations for city tourism in Germany

Visitor arrivals 2006, m



Source: DRV

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**Alpine countries heavily dependent on tourism**  
% of GDP from tourism, 2007



Sources: World Travel & Tourism Council, Oxford Economics, DB Research **29**

**Better climatic conditions in the British Isles**

winters of 2006/07 and 2007/08 may have given a foretaste of this. Even in the Alps, only the higher-lying winter sports resorts (e.g. Zugspitze region) may be able to escape this general trend. It is highly questionable whether the winter sports regions will be able to compensate for any losses in winter by increased numbers of holidaymakers during the summer months. In winter, it is likely that holidaymakers will prefer alternative resorts, e.g. in Switzerland.

Nevertheless, the bottom line is that climate change is likely to have positive consequences for tourism in Germany. The Potsdam Institute for Climate Research Impact is predicting that climate change will result in long-term growth in demand, of the order of 30%. A positive factor for Germany is the very short distances to holiday resorts, not only for German citizens but also for Scandinavians and residents of the Benelux countries.

**Coastal areas of the Benelux countries could benefit**

The **Benelux** countries have lower-than-average dependency on tourism, which generates about 8% of GDP. In these countries, city and cultural tourism, which is not climate dependent, is predominant. Belgium and the Netherlands also have North Sea coasts; the coastal regions will benefit. The Netherlands are threatened by rising sea levels and the risk of flooding. However, the risks could be mitigated by preventive measures, so that climate change can be expected to have positive effects on tourism in these countries overall.

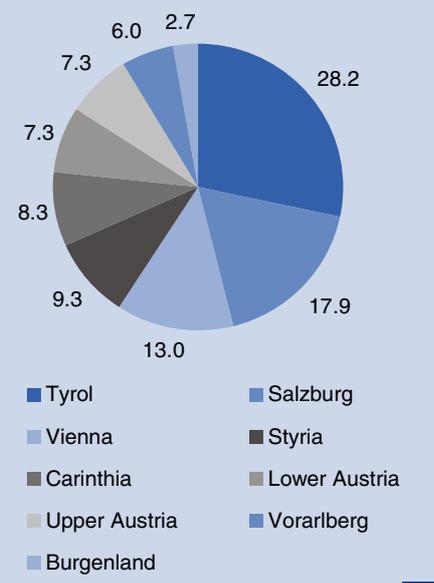
**British Isles less dependent on the seasons**

The **UK** and **Ireland** are well known for tourism, in particular for their rugged landscapes. They have no pronounced high- and off-peak seasons for tourism. Visitors travel to the region the whole year round and relatively irrespective of the weather. A large proportion of tourists are attracted to rural areas, as well as to cities like London and Dublin. There are relatively few seaside holidaymakers, however.

Much of tourism in Great Britain is centred on England, especially on the south of the country, including Cornwall in the southwest and the London conurbation in the southeast. Climate change could result in a high risk of coastal erosion for Britain's coasts. However, dramatic consequences could be avoided by making appropriate investments. The conditions for seaside holidays on English beaches will improve. Tourists who wish to visit the unspoilt countryside, e.g. in the Scottish Highlands, the numerous villages and small towns, or British country houses, will be undeterred by climate change. In general, climate change may bring, if anything, positive effects for Great Britain and Ireland.

**Three regions with nearly 60% of all arrivals**

% of tourist arrivals in Austria, 2006



Source: Statistik Austria **30**

**Massive shifts in Austrian winter sports**

**Austria** is highly dependent on its tourist industry, which generates 15% of GDP. In 2006, this small country was in a respectable ninth place in terms of international tourist arrivals. Less surprising is the proportion of foreigners making overnight stays, which is very high at over 72%.

Winter sports tourism in the Alps is very important for Austria's tourist sector. Despite the forecast of increasing amounts of precipitation in the winter months for this region, as a result of global warming, this is likely to fall more often as rain at lower and medium altitudes. Only at high altitudes is it guaranteed to fall as snow, so the reliability of the snow cover in many ski areas will be affected.

**Ski areas at high altitude will gain market share**

This is a particular problem if the season is shortened so much that the lucrative opening period is increasingly delayed until after Christmas or New Year.

Many of the major Austrian ski areas are at low altitude – e.g. Kitzbühel at about 800 metres altitude, with pistes below 2,000 metres – and will therefore suffer from reduced snow reliability. At the moment, there is reliable snow at altitudes above about 1,200 metres. This critical boundary could increase to 1,500 m by 2030. Artificial snow is often only an inadequate method of adaptation, as it requires specific temperature and air conditions to function optimally. On top such adaptation measures could be difficult for smaller resorts, for financial reasons. The alternatives, e.g. concentration on “wellness” or cultural holidays, are also limited for most of the ski areas: after all, ski holidaymakers mainly want to go skiing. However, this naturally means that there are winners as well as losers from climate change: in this case, the winners are the ski areas with reliable snow, such as Obertauern and Ischgl, as well as the Ötztal and Stubaital with their glaciers. Relatively low-lying areas (e.g. the “Salzburger Sportwelt” or the “Tiroler Zugspitzarena”) may become less attractive as a result of deteriorating winter sports conditions. A shifting of tourist flows within Austria is probable consequently.

**Summer holidays in Austria will be more attractive**

Tourist arrivals in Austria are split roughly evenly between the summer and winter seasons. Winter is, however, more important in terms of income from tourism. Higher temperatures will mean that summer tourism in Austria will increase in attractiveness: the mountain and lakes landscapes offer an alternative to the hot Mediterranean destinations. The opportunities for walking holidays and tourism in spas and health resorts will improve. City tourism, for instance in Vienna or Salzburg, is less climate-sensitive and will remain attractive. The bottom line, however, remains the expected negative effects on winter tourism, so that the Austrian tourism industry will be one of the overall losers from climate change.

**Swiss ski resorts have better snow reliability****Little risk to snow reliability in Switzerland up to 2030**

Winter sports tourism in **Switzerland** should be less negatively affected by climate change. The ski resorts in the Swiss part of the Alps are generally higher. The most important (and also high-lying) ski areas of Switzerland are in the south and southeast of the country (Wallis and Graubünden). Because of their high altitudes, both cantons will be less severely affected by climate change (e.g. Davos, St. Moritz, Zermatt). Up to 2030, they will largely retain their snow reliability. However, even in Switzerland, in the future low-lying ski resorts will lose their snow reliability and therefore attractiveness (e.g. in central and eastern Switzerland and in Ticino). According to one estimate, by 2030 the proportion of ski areas with reliable snow will fall by around 10 to 15 percentage points.<sup>15</sup> However, the regions with reliable snow could be successful in attracting tourists both from other parts of Switzerland and from the more seriously disadvantaged areas, such as Germany and Austria. The bottom line is that Swiss winter sports tourism could even benefit from climate change up to 2030.

In terms of overnight stays, in Switzerland the summer and winter seasons are of roughly equal importance. However, because winter sports holidays are relatively expensive, just as in Austria, income from winter tourism is significantly greater. In summer, Switzerland's

<sup>15</sup> See: Beratendes Organ für Fragen der Klimaänderungen (2007). Klimaänderung und die Schweiz 2050. Bern.

**The whole alpine region benefits in the summer months**

range of attractions is very similar to Austria's: in particular the lakes (Lake Geneva and Lake Constance) and summer tourism in the mountains attract visitors. In addition, almost a fifth of overnight stays are accounted for by the less climate-sensitive city tourism. Overall, tourism accounts for about 13% of Swiss economic output.

**Summary on the Alpine region: The altitude makes the difference**

Over the whole Alpine region, an increase in average temperature of 1°C could reduce the proportion of ski areas with reliable snow from today's 91% to about 75%. An increase of 2°C could bring this down to just under 61%.<sup>16</sup> A transfer of tourist flows from the lower-altitude resorts to higher-lying holiday regions is very likely. There could be a redirection of tourists, from Germany, Italy and Austria to Switzerland and France, because of their larger number of skiing areas with reliable snow. In summer, the whole Alpine region will increase its attractiveness.

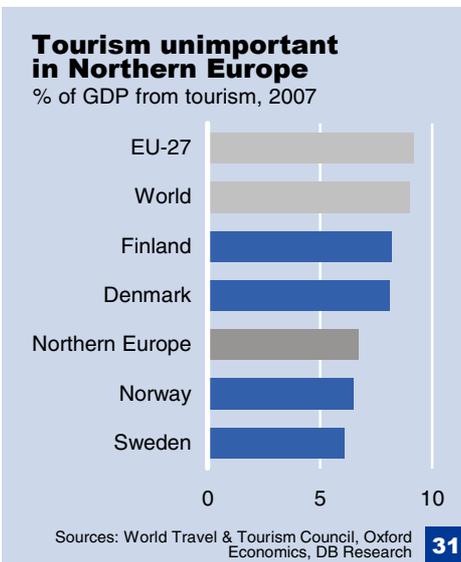
**Northern Europe will be more attractive for tourists**

An increase in temperature would be beneficial for summer tourism in the **northern European** countries, as it would extend the summer season. Here as well, though, winter sports conditions could deteriorate at low altitudes. In sufficiently high locations there will be advantages for winter sports tourism, as precipitation and therefore snow amounts will increase in the winter season. Snow reliability in Scandinavia will remain higher than in many parts of the Alps. As a result, the region could increase its market share in alpine and Nordic ski sports.

**Denmark** benefits from its location in a temperate climate zone and is an attractive destination for summer holidays. Overnight stays in holiday homes, which account for about 40% of overnight stays, are particularly popular. Tourism in Denmark is highly seasonal: about 75% of stays are in the summer months of June, July and August. Seaside holidays are a main pillar of the tourist industry. Climate change will have positive effects for Denmark. Global warming will increase the attractiveness of the important summer months and extend the season. However, whether Denmark could be suitable as an alternative destination for visitors to the Mediterranean region is doubtful. There are major differences, both in terms of the tourist products on offer and the target groups, between e.g. package tours to Majorca and travel to Denmark. In the future, Denmark could further strengthen its leading role in tourist arrivals in northern Europe. The tourist sector could increase its presently below-average contribution (8%) to Danish GDP.

**Scandinavia is probably no substitute for the Mediterranean region**

In both **Sweden** and **Norway**, tourism generates a lower than average proportion of GDP: 6% and 7% respectively. In **Finland** the figure is just over 8%. Of these countries, Sweden still has the best conditions for summer holidays. The south of the country, which is the most developed for tourism, provides the best environment. Still, there is hardly any traditional seaside tourism. Tourism based on the coastal landscapes, the unspoilt state of the countryside and the Swedish culture is more important. As a holiday destination, Norway is best known for its fjord landscapes and for the North Cape at the



**Tourism in northern Europe still insignificant**

<sup>16</sup> See: Kreilkamp, Edgar (2007). Auswirkungen des Klimawandels auf den Tourismus. Lüneburg.

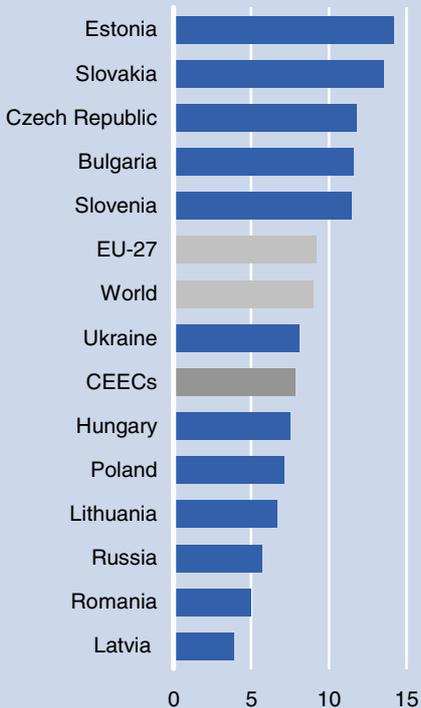


northernmost end of the country. In Finland, tourism for nature lovers is also predominant.

Overall, Norway, Sweden and Finland are very similar as tourist destinations. The emphasis is on nature. Although the summer months are predominant, these countries also offer good winter sports opportunities. Norway and Sweden in particular have their own large ski areas. Reliable snow cover is assured at least until 2030. In the important summer months, the countries in northern Europe could enjoy growing incomes from tourism in future, due to the longer season. All in all, therefore, these countries are amongst the gainers.

### Dependency on tourism differs in Eastern Europe

% of GDP from tourism, 2007



Sources: World Travel & Tourism Council, Oxford Economics, DB Research

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### City tourism important in Eastern Europe

The majority of tourists in **central and eastern European countries** are attracted by the culturally important cities, such as Prague, Budapest, Warsaw, Moscow, St Petersburg and the Baltic capitals. From this point of view, the region is less sensitive to climate change. However, with rising incomes, tourist centres are increasingly being built and expanded in favourable geographic locations. Parts of these regions will experience climate change. In the future, for instance, the Baltic States – so far characterised by cultural and rural tourism – could attract more seaside tourists. The Polish coast could also benefit. Countries bordering the Black Sea (Bulgaria, Romania and the Ukraine) could also expect beneficial effects from climate change for their regions. Primarily, they could attract seaside holidaymakers away from the hot eastern Mediterranean area – e.g. Greece and Turkey. Low prices will help this. Climatic conditions will also improve in Russia, which attracted more than 20 million foreign tourists in 2006 – as many as Austria. Nevertheless, it is usually dominated by types of travel that are highly insensitive to climate.

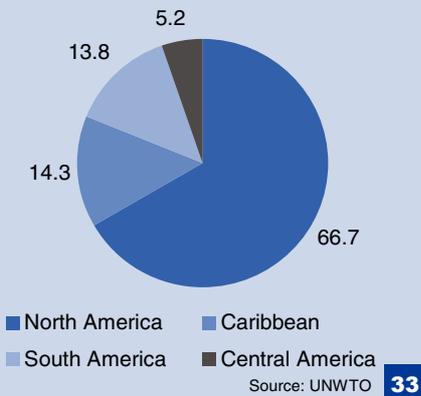
The summer convalescence and health tourism in lake and mountain landscapes is the second most important in Eastern Europe. Lake Balaton in Hungary – the largest lake in central Europe – is, for instance, an immensely important tourist destination in the country. However, rising temperatures and reduced amounts of precipitation represent a risk for the very shallow lake: increased evaporation would make it even shallower. In the long term, this could interfere with water sports.

Winter sports tourism is widespread in a few areas of the Carpathians. However, many of the skiing areas in these countries are at such low altitudes that, like parts of Austria, they could have problems with snow reliability by 2030. Nevertheless, winter sports tourism represents only a small part of the total revenues from tourism.

Overall, climate change could increase the touristic appeal of the central and eastern European countries. Only minor effects are expected from climate change though, as cultural tourism, which is not dependent on climate, is more important. Increasing summer temperatures will result in a positive effect for northern regions like the Baltic. However, in many regions summer tourism is still in its infancy.

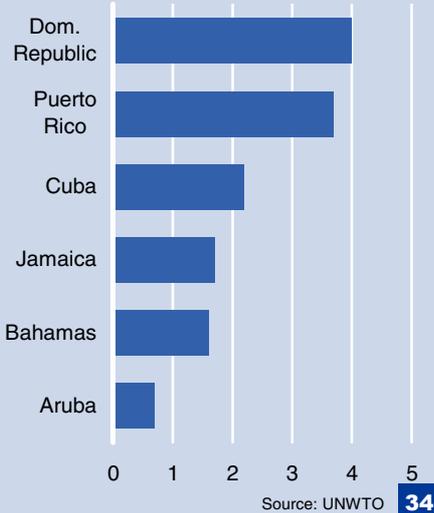
### North America dominant

Market share in international tourist arrivals in America 2006, %



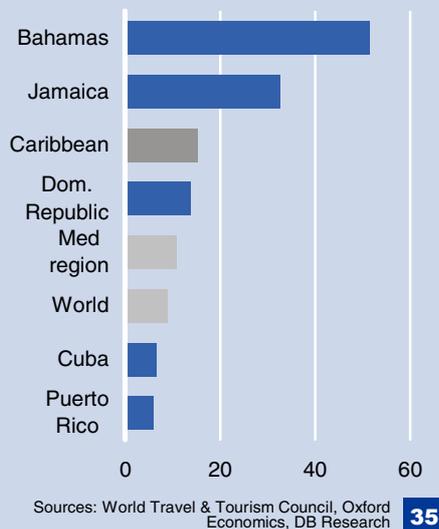
### Caribbean market leaders

International arrivals in Caribbean countries 2006, m



### Tourism important in the Caribbean

% of GDP from tourism, 2007



## 4.2 America

### The Caribbean suffers from the hurricane season

The individual countries of the **Americas** will probably be affected very differently by climate change. The expected temperature rises present no major problem for the island nations of the **Caribbean**. This important holiday region, which benefits in particular from its proximity to the affluent USA, is confronted in climate change terms mainly by water shortages, coastal erosion and coral bleaching. In addition, the Caribbean holiday resorts will also be regularly threatened by a relatively clearly defined hurricane season, lasting from June to November. As, in the opinion of the scientists, tropical storms will further increase in strength by 2030, in this period the region could become less attractive for tourists and overall could be among the losers from climate change. The major destinations have very different levels of economic dependence on tourism. In Puerto Rico and Cuba, for example, where tourism generates only between 6% and 7% of GDP, disadvantages induced by climate change would be of hardly any importance. In the Dominican Republic (14% of GDP) they would be more important while in Jamaica (33%) and particularly the Bahamas (51%) they would give rise to serious changes.

### Highly diversified structure of tourism in North America

In contrast, however, the countries of **North America** could, on average, benefit from climate change. Visitors to **Canada** could be classified as nature lovers and partly as adventure tourists. The most popular holiday destinations are the Niagara Falls, cities such as Vancouver, Toronto and Quebec, and also the mountainous regions of the west. In addition to hiking tourism in summer, winter sports are also widespread. In the majority of the Rocky Mountains areas these could be less severely affected than in the European Alps. Ski areas, for example in Canada's Banff National Park, will probably not suffer from shortages of snow, because of their lower temperatures and sufficient altitude. Most of the ski areas in the USA could also be largely spared from problems.

Summer tourism in Canada will benefit from climate change. Rising temperatures will contribute to extending the summer season and moderating the sometimes harsh climate to a degree. However, on a regional basis, particularly hot summers could reduce the attractiveness of that season. Overall, Canada will benefit from the expected changes. By global comparison, the country has below-average economic dependence on tourism: less than 10% of GDP.

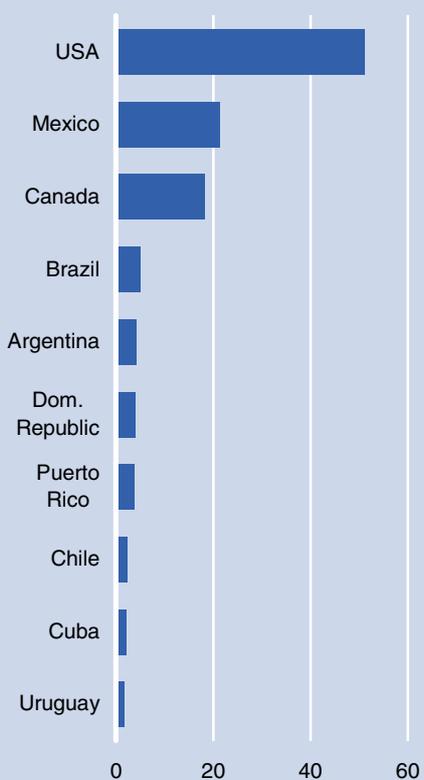
The **USA** is the most important tourist country in the world, measured by income from tourism. In terms of international tourist arrivals it is in third place, although, with tourism accounting for approx. 9% of GDP, measured by that indicator it is in the midfield. The USA is – also in tourism – a land of opportunities. Besides classic seaside holidays with diving possibilities, especially in Florida but also on other coasts, the country has winter sports resorts in the Rocky Mountains, mainly with good snow reliability, as well as natural spectacles: for instance, in the many national parks (e.g. Yellowstone National Park and the Grand Canyon). Tours by foreign holidaymakers play an important part. The cities, in particular New York, Los Angeles, Las Vegas and San Francisco, hold a dominant position as attractive holiday destinations.

Some parts of tourism in the USA are, however, very climate sensitive. According to the U.S. Department of Commerce, for



### North and South America are not in the same league

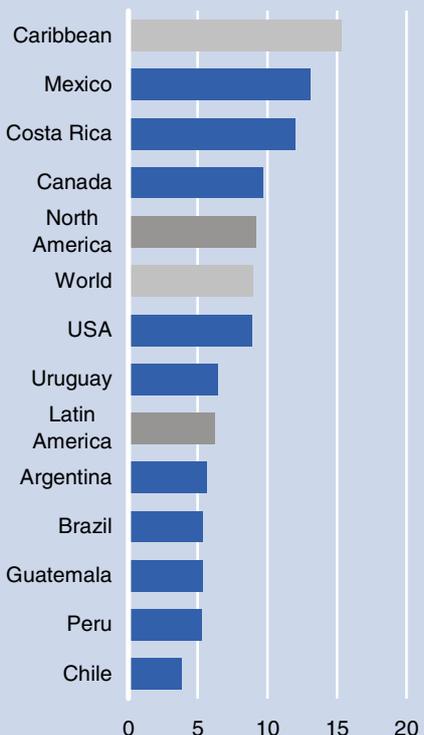
International arrivals in American countries 2006, %



Source: UNWTO 36

### Tourism in Latin America relatively unimportant

% of GDP from tourism, 2007



Sources: World Travel & Tourism Council, Oxford Economics, DB Research 37

instance, nearly 15% of international tourist arrivals are in the “Sunshine State” of Florida. That state could be negatively affected by climate change, e.g. if temperatures rise too much, or if an increase in the intensity of hurricanes causes more devastation. In the southwest of the country, the already high risk of forest fires is increasing as a result of lower precipitation, as are problems with the water supply. Overall, however, the proportion of climate-sensitive tourism in the USA is rather small. The states of California and New York combined account for around 37% of international tourist arrivals. Less climate-sensitive tourist products are important there. This is also true of e.g. the New England states, which to an extent could actually benefit. The diversification of tourism in the USA could therefore mean that it is relatively little affected by climate change.

#### Latin America hit by climate change

In comparison with the USA, tourism in **Mexico** is more strongly climate-dependent. Two types of tourism are particularly common in Mexico. Firstly, it is an attractive destination for tours based on landscape and cultural factors (e.g. the Maya ruins). Secondly, many seaside holidaymakers travel to the Mexican coasts. Combinations of these two types of holiday are popular. Cancún attracts about a fifth of international tourists. The vast majority of foreign visitors are from North America (85%). Four-fifths of tourists are Mexican, however. Mexico, which has above-average dependency on tourism (13% of GDP), will be burdened by climate change on the whole. The loss of comfort that rising temperatures present for seaside tourists will cause negative effects. Growing water shortages will increase the cost of water supply, while more intensive hurricanes will lead to underuse of capacity and/or damage to infrastructure.

According to UNWTO, in 2004 nearly 22 million international tourists visited the American mainland south of Mexico. This is roughly in line with the number of visitors to Mexico alone. The leaders – and also the largest countries – are **Brazil** and **Argentina**. Tourism there is mainly dominated by cultural tours and by adventure tourists, who appreciate the variety of landscapes. Particularly popular destinations for cultural and historical reasons include e.g. the ancient Inca cities (for instance Machu Picchu in Peru). Seaside and water sports holidays are more frequent in Central America (e.g. in **Costa Rica**), although they also play a part in Brazil. In principle, the negative climatic effects on tourism are more serious for Central America and the Caribbean than they are for South America. Another factor to take into account is that many South American countries have only low dependence on tourism (as a proportion of GDP: Argentina: 6%; Brazil: 5%).

#### 4.3 Asia

There are widely varying motives for holiday travel to countries in **Asia**. Tours concentrating on culture and landscape are very popular with Western tourists and are less climate-sensitive. This is also true of city tourism, e.g. trips to Hong Kong, Singapore and Tokyo. In contrast, beach and diving holidays will be more seriously affected by climate change. Coral bleaching will reduce the attractiveness of diving regions. Seaside resorts will be negatively affected by rising temperatures. Floods caused by heavy rainfall in the monsoon season could worsen and cause e.g. landslides. In some regions, there could be increasing problems of water supply and the severity of cyclones.

### China dominant in the Asian area

International tourist arrivals in Asia and Oceania 2006, m



Source: UNWTO **38**

### South Asia has only little dependence on tourism

% of GDP from tourism, 2007



Sources: World Travel & Tourism Council, Oxford Economics, DB Research **39**

In **Indonesia**, because of its proximity to the equator, the prevailing climate is hot and tropical. The high- and off-peak periods are defined more by the rainy and dry seasons. The island of Bali is, by a large margin, the most important tourist destination in the country. It could suffer from climate change as a result of excessive temperatures and worsening conditions for diving. Although the island is very highly dependent on tourism, the tourist sector as a whole accounts for only a small proportion (6%) of Indonesian economic output. Indonesia is therefore a good example of a country with very pronounced regional differences in respect of its economic dependence on tourism. There are also large regional differences in Thailand. The country's coasts and islands are popular with seaside tourists. Bangkok and the mountainous northwest of the country also play an important part. **Thailand**, which has above-average dependence on tourism (13% of GDP), could be affected in a way similar to Indonesia.

The same goes for the **Philippines** (proportion of GDP generated by tourism: 6%), **Sri Lanka** (8%) and **Malaysia** (12%), where seaside holidays are also the most important. The Philippines in particular could be affected by climate change in the form of increasing extreme weather events. The country holds the not-very-desirable top place in the Global Climate Risk Index, as compiled by Germanwatch.

#### Proximity to growing source markets an advantage

The example of Malaysia, however, demonstrates an advantage for the Asian destinations. More than three-quarters of the tourists that visit the country come from the ASEAN countries. Therefore, as the Asian countries are not just destinations but also important source countries, with expanding economies, the effect of the increasing price of mobility on tourism is less pronounced.

The regions of Goa and Kerala, on the southwest coast of **India**, which are well known as beach resorts, are particularly low-lying and also suffer from the usual problems of seaside resorts, with particularly serious coastal erosion. Although India may well be more badly affected by climate change than e.g. **China** or **Japan**, the overall effect will be less serious as the tourist sector generates only just over 4% of the country's GDP. China and Japan will also be affected by climate problems by 2030, although the consequences for tourism will remain limited: city and cultural tours predominate. Nevertheless the problems in China, e.g. with water supply, could become more serious. The Asian tourist market is a good example to demonstrate how, notwithstanding the challenges of climate change, the tourist industry will remain a growth sector.

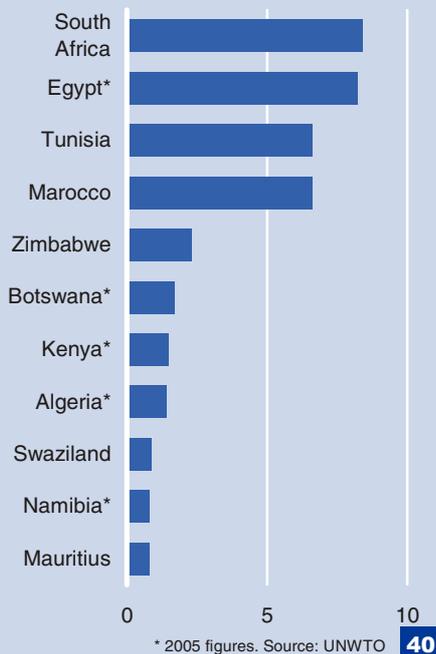
#### Islands threatened by water shortages

Tourism is of outstanding importance in certain **island states**. In the **Maldives**, more than 58% of GDP is generated by this sector. On the **Seychelles** the figure is around 55% and for **Mauritius** 24%. Although, in comparison with other holiday locations, rising temperatures will be less serious for these destinations, possible reductions in precipitation are of greater importance. Water supply problems could increase, not least for tourist facilities like hotels. Coral bleaching could put a damper on diving-based tourism. By as early as 2030, parts of the particularly low-lying Maldives archipelago could face rising sea levels. Paradoxically, however, at first this could actually increase the attractiveness of the islands to



### South Africa and the north of the continent dominate

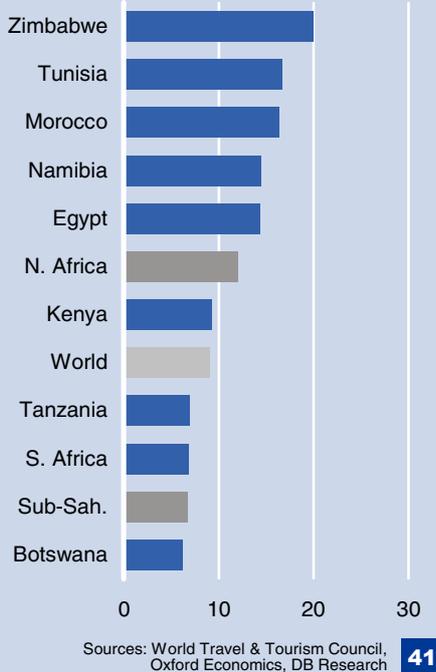
International arrivals in African countries 2006, m



40

### North-south differentials in Africa

% of GDP from tourism, 2007



41

tourists, who will want to visit the destination while it still exists in its present form.

#### 4.4 Africa

Many scientists and economists consider that **Africa** will be the continent most seriously affected by climate change. This is only partly true of the tourist sector. The climatic effects on Africa as a tourist destination are rising temperatures and increasing aridity – at the same time as more frequent short-term periods of heavy precipitation. However, high temperatures are nothing unusual for holidaymakers in Africa. Increasing water shortages instead could be relevant to tourism. A problem for African tourist destinations is that the (financial) adaptability of many countries is lower than e.g. in Europe.

##### *African wildlife is the main attraction*

Adventure holidays and wildlife safaris predominate in Africa. It can therefore be concluded that climate change would particularly damage tourism in Africa if it were to change the natural characteristics of the countries. A possible increase in desertification could reduce the variety of landscapes. Food sources for animals could also fall victim to climate change, or essential climatic conditions for the animals could be altered. All in all, the African countries are among the losers from climate change. For the vast majority of tourists, African countries are long-haul destinations. In addition to the negative climatic effects, the increasing price of mobility would therefore also make these destinations less attractive.

**Tanzania** and **Kenya** could be particularly badly affected if there are severe climate-related problems for the wildlife in their nature reserves and national parks. However, the current political unrest in Kenya, in the wake of the elections at the end of 2007, impressively demonstrates how factors other than climate change can have a more serious effect on the tourist sector. **South Africa** could fare somewhat better, as, in comparison with other African countries, it has more heterogeneous and less climate-dependent products to offer tourists.

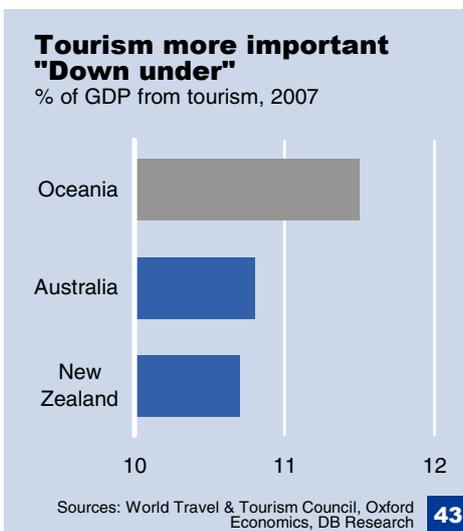
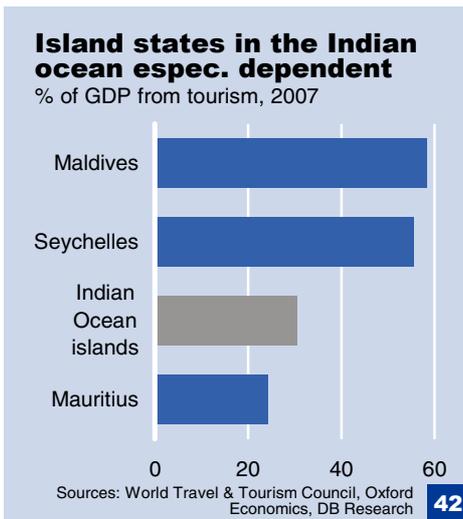
#### 4.5 Australia/Oceania

Tourism in **Oceania** will be affected by the expected increase in the price of long-haul travel, even though visitors to e.g. Australia are primarily from Australia itself, or from New Zealand, Japan and the USA. Europeans play only a small part.

##### *Great Barrier Reef still favoured up to 2030?*

In **Australia**, rising temperatures will affect beach and water sport holidays on the country's east coast. The problem of high UV radiation already exists. In the future, coral bleaching will reduce the attractiveness of the Great Barrier Reef to tourists. However, up to 2030 the consequences could still be manageable. A change in marketing tactics, on the lines of "Come and see it before it's too late!" could even lead to increasing visitor numbers. Many other Australian attractions are less climate-sensitive. For instance, many visitors travel to the cities of Sydney and Melbourne, want to experience the vastness of the Australian outback or explore the tropical north. Nevertheless, the higher temperatures there will also limit the well-being of the tourists.

For Australia, in addition to the regulatory effects, there will be long-term negative consequences from climate change. As well as the



**UAE can afford adaptation measures**

consequences mentioned, extreme weather conditions could also increase. Even now, coastal regions in Queensland are subject to flooding, while forest fires are more numerous in New South Wales, where Sydney is situated. Droughts and water shortages could also have negative effects on the tourism sector in the future. At 11% of GDP, Australia has slightly above average dependence on the tourism industry.

**Destinations in Oceania well off the beaten track**

Tourism is an important economic factor in **New Zealand**, particularly on the sparsely-populated South Island. Adventure holidays, close to nature, are the centre of interest. The North Island has striking landscapes and, in Auckland, an attractive destination for city tourists. Cultural tours are still of little importance in New Zealand. Like the north European countries, New Zealand is positioning itself as a "green" holiday destination. The isolated geographical location of the country is, however, problematic.

The country has an average level of dependence on tourism (11% of GDP) and will tend to experience positive consequences from climate change up to 2030. Increasing temperatures and lower amounts of precipitation could have a beneficial effect on the sector. However, of great importance will be the regulatory and indirect consequences of climate change, which will have a negative influence on tourism in the whole of Oceania, although tourists visiting New Zealand include a very high proportion from Australia and Asia. The archipelagos in the **South Seas** will have similar problems to those of the island states in the Indian Ocean. In **Polynesia**, most of the islands have above-average reliance on tourism.

**4.6 The Near East**

The regions developed for tourism in the **Near East** are primarily in Egypt and the United Arab Emirates. The effects of climate change on tourist resorts in this part of the world will mainly be in the summer months, as they are faced with loss of comfort resulting from rising temperatures and with water shortages. However, the region is nevertheless well known for high temperatures in the summer months, so that holidaymakers have a higher tolerance threshold.

**Egypt scores with independence from the seasons**

The major seaside resorts in **Egypt** are on the Sinai Peninsula and on the Red Sea. They are distinguished by very small temperature variations between summer and winter. These offer the tourist industry an opportunity to provide an attractive holiday destination even in winter for affluent Europeans who enjoy travel. Overall, Egypt benefits from a very balanced pattern of arrivals over the year. Diving on the coral reefs in the Red Sea will be somewhat affected. On the other hand, the Cairo area, with the pyramids of Giza and tours on the Nile and to the pharaohs' tombs in the Valley of the Kings, is less susceptible to climate change.

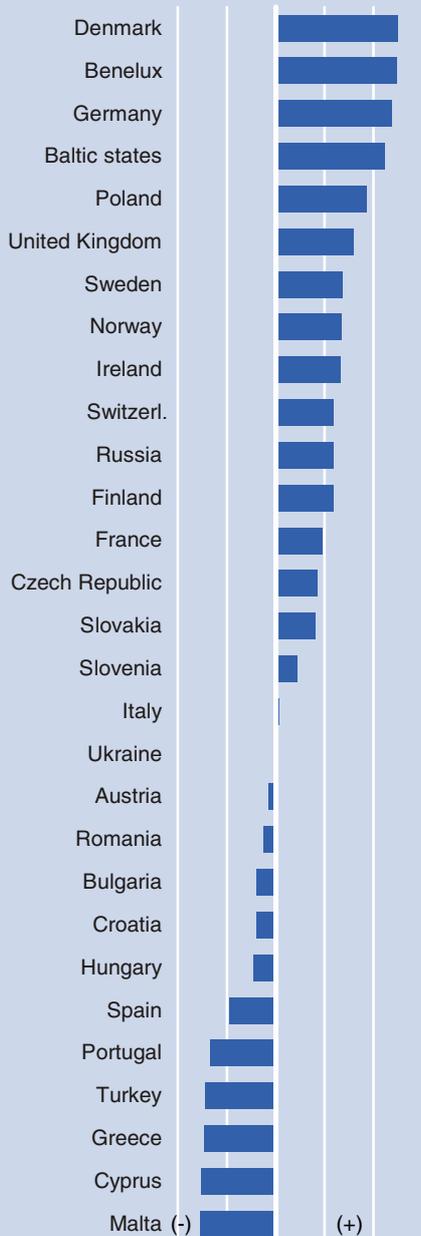
**Tourism in the UAE heavily concentrated on Dubai**

The range of tourist products in the **United Arab Emirates (UAE)** is narrower. As in Egypt, however, tourists are not restricted to a high season. Nevertheless, by 2030 rising temperatures could increase seasonal differences: as a result, seaside tourists would increasingly avoid the summer months. In the UAE, tourism is geographically concentrated very strongly on Dubai. Risks to the water supply



### Winners (+) and Losers (-) in Europe

Results of the scoring model for Europe



Source: DB Research

44

could be lessened by substantial investment in appropriate preventive measures (e.g. seawater desalination plants). The necessary finance for this is available. In the UAE, the tourism industry is seen as a future market, which is why enormous investments are being made in a variety of attractions that are partly independent of climate, but may become even more expensive.

## 5. Repercussions on the tourist value creation chain

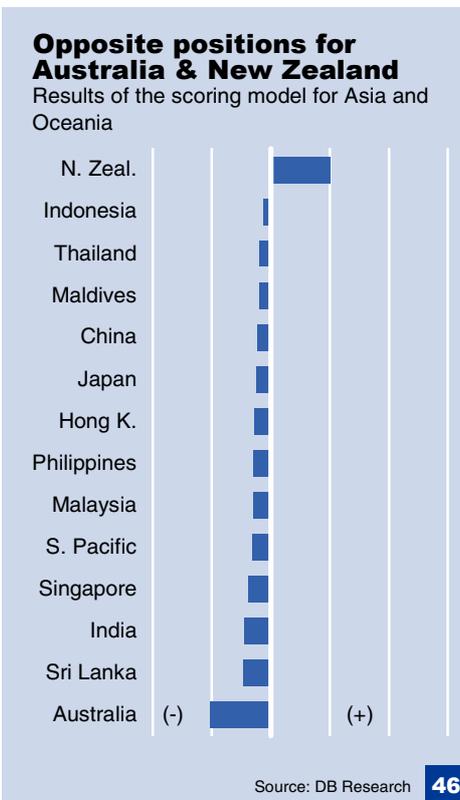
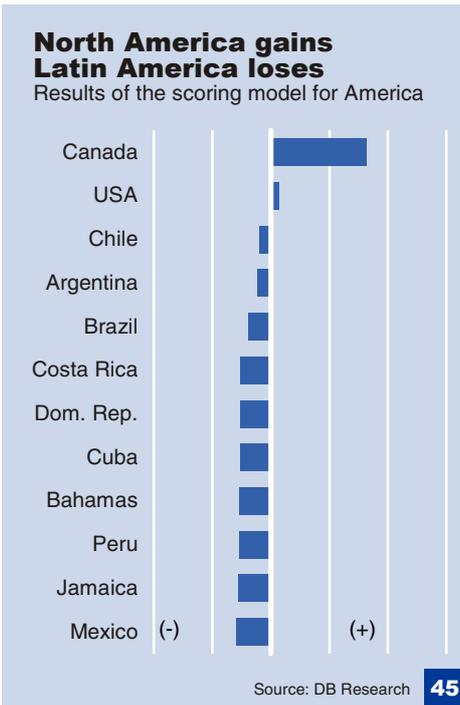
The climatic changes discussed above and their consequences for holiday destinations have repercussions on the tourist value creation chain. In addition to the regional and seasonal shifts of tourist flows, in the future holidaymakers could wait until later before booking their travel. Travel agents and tour operators must therefore develop stronger incentives for earlier bookings: price could well be the most important factor. The increasing risk of extreme weather could be diminished by the use of specific financial products. Weather derivatives, promising financial compensation in the event of “bad weather”, are possible, as is holiday cancellation insurance that would allow the holidaymaker not to set out on the journey if weather conditions at the holiday destination are likely to be poor.

Hotels and tour operators will have to concentrate their own marketing activities on attractions that are less climate- and weather-sensitive. Theme holidays (e.g. “wellness” and health, golf, rambling or cycling, literature, culture, viticulture) are possible alternatives. This would enable tourist flows to be more evenly spread over the year. However, it is also obvious that such diversification would not be successful in every holiday region or for every hotel. Large hotels in the Mediterranean region have a particular problem, as high fixed costs often mean that it does not pay to open the hotel for only a few holidaymakers. Additional costs would be incurred in coping with climate-related problems (e.g. water supply).

For the air-traffic industry, more uniform seasonal tourist flows would smooth out the normal current peaks of demand in the summer months: this would be beneficial for the sector. Depending on how it is set up, emissions trading could cause disadvantages in terms of price competition for European airlines on intercontinental flights. This would be the case if connecting flights in the destination country were not subject to emissions trading, unlike the direct flights from Europe that certainly would be. However, for the time being the negative effects should still be limited.

## 6. Conclusion: Winners and losers from climate change

In order to better assess the countries in which the tourism industry will benefit from climate change and those in which negative effects can be expected, we have compared the most important countries with the aid of a scoring model. This model is based on four parameters, which we have assessed, quantitatively or qualitatively, for all the countries: firstly, direct climatic effects; secondly, substitution effects resulting from climate; thirdly, regulatory burdens and consequent geographical substitution effects; and fourthly the possibilities each country has to adapt to climate effects. The parameters were assessed with different weightings and broken down into



subcategories, in order to differentiate better between the countries. The time horizon is 2030. In a subsequent step (see graphic at the end of this study) we have also identified the countries in which economic reliance on climate-relevant tourism is particularly high, as the overall economic effects are particularly relevant for these.

Figures 44 to 47 show the results of our scoring model.<sup>17</sup> On the losing side in Europe are, in particular, the countries bordering the Mediterranean, with the countries in the eastern Mediterranean being particularly negatively affected. Those that could gain include the Benelux countries, Denmark, Germany and the Baltic States. Scandinavia and Great Britain are also amongst the winners. As a result, the North-South alignment of Europe will be weakened. An interesting factor is that, up to 2030, despite the completely negative effects of higher temperatures in the Mediterranean region, France and Italy will benefit slightly as a result of their diversified tourism structures, as described above. Up to 2030, Switzerland will also be one of the gainers, in particular due to its high snow reliability in comparison with the other Alpine countries (keyword: substitution effect), while Austria will tend to lose.

Outside Europe, most countries will suffer from climate change, albeit to differing degrees. Climate change predominantly means additional burdens for all the poorer countries in our investigation that are putting great hopes on tourism as a driver of development. Canada, New Zealand and – with reservations – the USA are the only three further countries outside Europe whose tourism industries will be on the winning side.

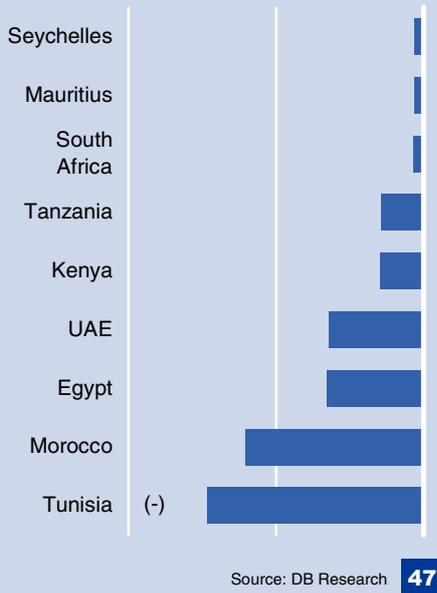
At this point we must remind the reader that our investigation is only a partial analysis. We therefore do not expect that the turnover from the tourism will inevitably fall in countries that are on the losing side of our scoring model; in most instances the sector could even continue to expand, for the reasons stated earlier. At the same time, our results can be seen as a warning signal, as it is impossible that the climatic situation after 2030 will improve in the countries that have negative prospects. This is not unimportant, as tourist infrastructure that is being invested in today (e.g. hotels, ski lifts) will mainly still be in existence after 2030. The possibilities of their continued use after 2030 should therefore already be taken into account today when making investment decisions, not least because there are frequently no possibilities for adaptation. Another factor is that many climatic consequences will not take effect until after 2030.

Of course, our scoring model has limits. After all, uncertainties concerning the extent, speed, and specific consequences of climate change are still too great. There are regional peculiarities in individual countries, particularly in the countries outside Europe, that we have been able to reflect only fragmentarily. By focusing on the dominant form of travel in each of the countries under investigation, we have only partly addressed this problem. Also, in many countries there are individual regions that are very differently affected by climate change. The aggregate values from our scoring model at country level are therefore an average, which cannot tell the whole story. Finally, we nonetheless consider that results are reliable on the whole, provided that they are understood as being indicative of trends. In addition, we have recalculated our model using different

<sup>17</sup> The scaling in figures 44 to 46 is uniform. In figure 47 we have omitted the positive section, as all the countries in Africa that were studied are on the losing side.

### North Africa is a loser from climate change

Results of the scoring model for Africa and the near East



weightings, with no change to the basic conclusions. The core conclusions are accordingly robust.

### **Countries with high economic dependence on tourism particularly affected**

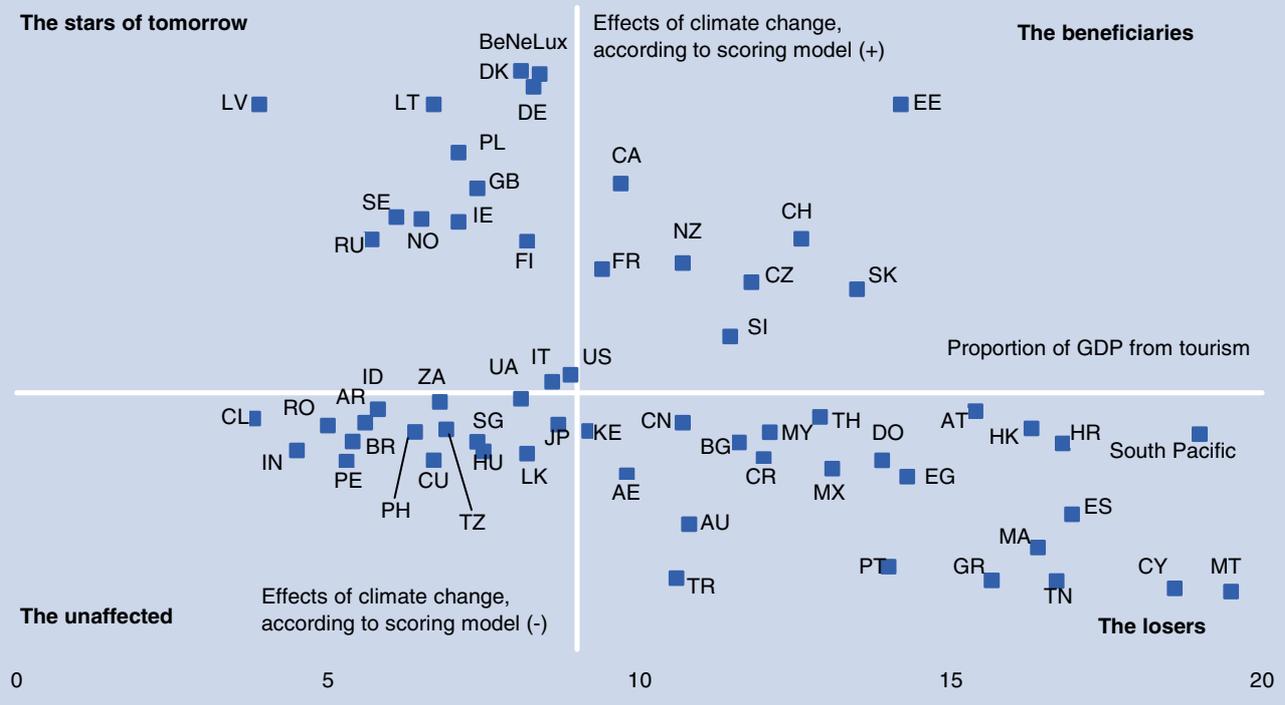
Negative climatic consequences always have particularly serious effects where climate-sensitive tourism has a large economic weighting (see figure 48). In Europe this is in Malta, Cyprus, Spain, Austria and Greece. In the Caribbean, this category includes e.g. the Bahamas and Jamaica. In Asia this applies to Thailand and Malaysia; in Africa to Tunisia and Morocco. Countries particularly dependent on (climate-sensitive) tourism are the island states in the South Pacific and even more so those in the Indian Ocean (primarily the Maldives and the Seychelles). Even though the climatic effects will not be “life threatening” there until 2030, the message is however clear: if climate change means that the tourists stay away, there are considerable negative effects on the whole economy. Among the countries that will experience positive climatic effects by 2030, Estonia (partly because of its proximity to Finland), Slovakia, Switzerland and New Zealand are the most dependent on tourism. In the European countries, in Canada and in the USA, tourism is of below average significance. Due to the expected substitution effects, the significance of the tourism industry in many “winning” countries could, however, increase in the coming decades as a consequence of climate change.

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### More losers than winners from climate change

Assessment based on the effects of climate change according to the DBR scoring model (ordinate) and % of GDP from tourism (abscissa: global average: 9%)



The graphic shows all the countries that we have investigated in our scoring model, with the exception of the island states in the Indian Ocean (Mauritius, the Seychelles and the Maldives), Jamaica and the Bahamas. These five countries are also in the group of losers. They are negatively affected by climate change and have a particularly high economic dependence on tourism. For reasons of scale we have not included them in the graphic. According to our survey, other gainers include the Czech Republic, Slovakia and Estonia. It must be pointed out that the predominant forms of travel in these countries are less climate-sensitive than for instance in the Mediterranean countries.

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