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CLIMATE CHANGE AND THE POTENTIAL IMPACTS ON TOURISM

J. P. Palutikof* and M.D. Agnew
Tyndall Centre for Climate Change Research and Climatic Research Unit,
University of East Anglia, Norwich, UK

1. INTRODUCTION

Climate change due to the enhanced greenhouse effect is likely to have substantial impacts on tourism. At the regional scale, it is not possible to say with any precision what the changes in climate will be, although given the mechanisms operating, there is a high probability that at most locations temperatures will increase. Such changes should impact on tourism. For example, in terms of impacts at the destination, summer holidays may become unpleasantly hot at traditional beach resorts, and insufficient precipitation in the form of snow at low altitudes may severely affect winter sports resorts. Climate changes at the source may encourage tourists to remain closer to home, if summers become warmer and/or drier.

Evaluating the likely magnitude of these impacts is not straightforward. Here we explore two, very preliminary, approaches to the problem:

i. Statistical models of the present-day relationship between weather fluctuations and the responses of measures of tourism activity;
ii. Surveys amongst the general public to explore perceptions of seasonal extremes of weather, and the potential impacts on vacation planning.

Both approaches are based on present-day responses to short-term (monthly/seasonal) weather fluctuations. As such, they are an imperfect tool for exploration of climate change impacts on tourism. However, in the absence of alternatives, and in view of the lack of information surrounding the relationships between climate and weather fluctuations and tourist behaviour, they should produce insights.

This paper is based on work carried out by researchers from four European countries (Palutikof, 1999, and see www.cru.uea.ac.uk/projects/wise/). We concentrate primarily on the results from the UK, and make comparisons with the results of the Dutch, German and Italian teams. We expect that the response of tourism to weather fluctuations will be moderated by national climate. For example, responses in Italy, with its hot Mediterranean climate, should be different from those in northern Europe.

2. STATISTICAL MODELS

2.1 *Domestic tourism*

Transfer functions were constructed to explain the relationship between climate predictors (regional monthly means of temperature and precipitation) and tourism predictands in the UK. The predictors were Central England temperature (CET), England and Wales rainfall (EWR), and England and Wales sunshine (EWS). Table 1 shows, for each month, the most important predictor of monthly bed nights for domestic tourists (expressed as the residual from the long-term trend).

TABLE 1 Principal predictors of domestic tourism (* significant at .05 level, ** significant at .01 level)

Month	Predictor Variable	Corr. Coeff.
January	*CETSEP	-0.51
February	*EWSOCT	0.58
March	*CETFEB	-0.57
April	**CETAPR	0.66
May	**CETSEP	-0.63
June	**CETMAR	-0.65
July	**CETMAR	-0.70
August	**EWRJUN	-0.63
September	*CETMAR	-0.58
October	**EWRJUN	-0.69
November	**CETMAR	-0.70
December	**CETMAR	-0.66

The importance of temperatures in the shoulder months, March and September, is clear. CETMAR is the most important predictor of bed nights in five months, and CETSEP in two. June rainfall is the most important predictor in August and October. For all of these, the relationship with tourism is negative.

Monthly stepwise multiple regression models were constructed between contemporaneous and lagged (up to 12 months) predictor variables and domestic bed nights. These models were used to explore the effect of a 1^{o}C increase in temperature and a 10mm decrease in rainfall, as shown in Table 2. This shows that, annually, the overall estimated impact of our assumed 'climate change' is an increase of 177 million Euro in tourism expenditure (assuming a linear relationship between bed-nights and expenditure).

TABLE 2 'Climate change' Impacts on domestic tourism, averaged by quarter

Quarter	% change in bed-nights relative to 1990-4	Estimated impact (Million Euro)
JFM	+6.7	+9
AMJ	+3.6	+10
JAS	+1.6	+14
OND	+7.3	+23

* Corresponding author address: Jean Palutikof, Climatic Research Unit, University of East Anglia, Norwich NR4 7TJ, UK; e-mail: j.palutikof@uea.ac.uk.

2.2 *International tourism*

Stepwise regression models were constructed for annual inward and outward tourist numbers to and from the UK. These included models for individual countries, and for all tourist numbers. Measures of wealth, including retail price indices, GDP and exchange rates, were included.

Inward tourism models demonstrate a clear preference for autumn climate variables, particularly temperature and sunshine. Temperature variables are more frequently positive and rainfall variables more frequently negative in their association with tourism.

In the outward tourism models, spring and autumn climate predictors are more common than summer or winter predictors. For all outward tourist numbers, the single most influential factor is annual rainfall in the previous year, with wetter conditions encouraging more trips abroad.

2.3 *Optimal temperatures*

The Dutch team developed a global tourist destination model, with the temperature of the warmest month as the climate predictor. Their model was non-linear, allowing them to extract optimal temperatures for tourism. These are shown in Table 3 for a range of destinations and for all tourists. Globally, the optimal summer temperature for the destination country is estimated to be 21^{o}C, and individual countries show little deviation from this.

TABLE 3 Optimal temperature, *T*, in tourism destination countries

	T	**S.D.**	***N***	**R^2**
World	20.8	1.73	1730	0.43
Netherlands	21.2	4.34	414	0.31
Japan	21.7	2.24	145	0.51
France	21.7	1.60	156	0.80
Germany	21.5	1.60	170	0.75
Canada	21.9	1.94	158	0.62
Italy	21.2	1.61	140	0.77
USA	20.4	1.44	159	0.62
UK	21.5	1.63	157	0.68

3. PUBLIC PERCEPTIONS

Surveys of the public perception of climate extremes were carried out. UK residents identified the tourism industry as the only clear 'winner' during unusually hot summers (see Fig. 1). A similar result was also found in the Netherlands and Germany (these questions were not asked in Italy).

In all four countries, respondents were asked about the effect of an unusually hot/dry summer on their holiday decisions with respect to:

- Day trips
- Short holiday breaks
- Main summer holiday
- Main summer holiday next year

Whereas more than half of respondents in all four countries changed their behaviour with respect to day trips, and over 30% with respect to short holiday breaks, the proportion for whom the unusual weather affected their main summer holiday plans was very small (<10%) and there was essentially no impact on next year's plans. Between-country differences were found when people were asked whether they made fewer or more day trips in response to the unusually hot/dry weather. More day trips were taken in the northern countries, but fewer in Italy.

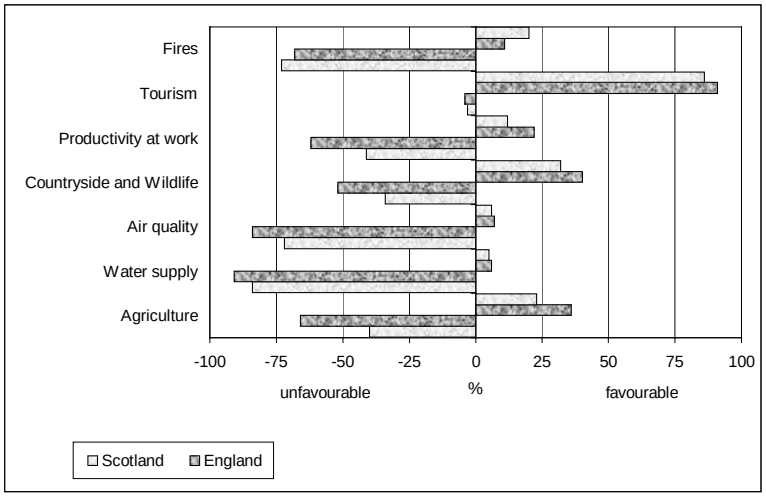

Figure 1 % respondents believing the sector impacts for the country as a whole of a hot/dry summer were favourable or unfavourable

4. CONCLUSIONS

Both from statistical analyses and perception surveys, we have shown that tourist decisions are affected by weather fluctuations, especially with regard to short breaks in the shoulder seasons of spring and autumn. These results need to be incorporated into quantitative models of climate change impacts in order to draw robust conclusions regarding the impacts of climate change on tourism.

REFERENCES

Palutikof, J.P. (ed.), 1999: *Weather Impacts on Natural, Social and Economic Systems (WISE) Final Report.* Available from Climatic Research Unit, University of East Anglia, UK.

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