Climate change and tourism in Germany – North Sea and Black Forest

Andreas Matzarakis and Christina Endler
Meteorological Institute, University of Freiburg, Germany

1. INTRODUCTION

Nowadays, the discussion about climate change becomes more and more important in public. Hereby, the relation between tourism and maritime climate and between tourism, climate, mountains and forests respectively are predominately focused for two German climatically sensitive study sites: the North Sea and Black Forest region. Low mountain ranges and forests are highly affected having impacts on health, recreation and tourism as well. The German coastal region is highly dependent on tourism accounting for 20 % of GDP and is intensely affected by climate change (Gätje, 2006). Therefore, two central questions arise, in what extend will tourism benefit from climate change in the North Sea region and do the forests of the Black forest still have a sufficient function of recreation and leisure in the following 30 years?

2. DATA AND METHODS

Climate model data for tourism purposes has to be at least at a meso scale resolution (best resolution at the moment is 10 km) (i.e. Jacob et al., 2001). Therefore, we used the high resolution data carried out by the regional climate model REMO from the Max Planck Institute for Meteorology in Hamburg. The climatic tourism potential for the North Sea and Black Forest region is calculated by the A1B and B1 emission scenarios covering the time span 1961 till 2050 (Jacob et al., 2001, UBA, 2005). Thereby, the means of 1961 till 1990 and 1971 till 2000 are the base periods for future climate projections (2021-2050). The data has a spatial resolution of 10 km and a temporal resolution of hours and encompasses Germany and the Alps. The data has been processed, analysed and visualized by tools, that have been developed for the CAST-Project (Bartels et al., 2007) and Startclim.2006.D2 (Matzarakis et al., 2007b) projects (Matzarakis et al., 2007a). The analysis is based on the facets of climate in tourism (de Freitas, 2003, Matzarakis, 2007) and on the consideration of aesthetical, physical and thermal comfort parameters in the assessment of climate for tourism and recreation.

For the computation of the climatic tourism potential the following parameters are chosen:

a) Thermal acceptability (18 °C < PET < 29 °C),
b) Thermal stress (T_a > 30 °C),
c) Cold stress (PET < 0 °C),
d) Heat stress (PET > 35 °C),
e) Humid-warm conditions (vapour pressure > 18 hPa),
f) Sunshine (cloud cover < 4 octas),
g) Fog (relative humidity > 93 %),
h) Less precipitation (RR ≤ 1 mm),
i) Long rain (RR > 5 mm),
j) Wind (v > 8 m/s),
k) Ski potential (snow cover > 10 cm).

3. RESULTS

Considering the North Sea region we present here two bioclimatic parameters based on PET: cold and heat stress (fig 1). Heat stress is not important at present (1971-2000) (fig 1a). Only in bigger cities like Hamburg or Bremen there is a marginally low number of heat stress (8 days). In future (2021-2050), heat stress will not be important in both emission scenariosA1B and B1 (fig 1b, c). Due to a rising air temperature cold stress will decrease. While the number of days with cold stress is about 80 days per year in Lower Saxony, 100 days in Schleswig-Holstein and about 110 days close to coastal regions for 1971-2000, the number of days with cold stress is decreased by 18 days in the hinterland and 22 days inshore and on the islands (A1B) (fig 1e). On average, the changes in the emission scenario B1 are lower. The reduction of cold stress is at most about one and a half week (fig 1f).

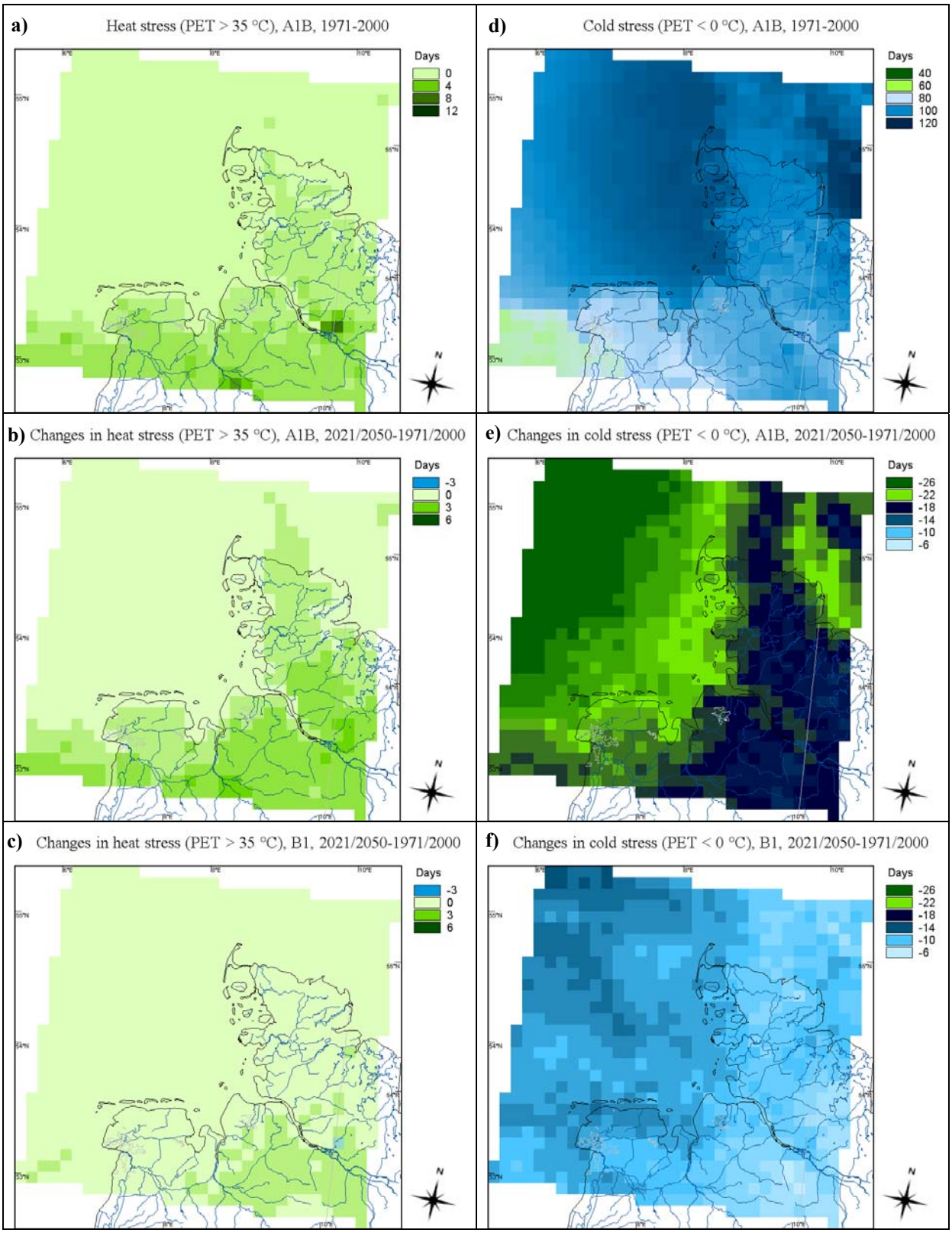

Fig 1. ***left*****:** Number of days with heat stress (PET > 35 °C) for the North Sea region for the base period a) 1971-2000 and its changes for b) 2021/2050-1971/2000 (A1B) and c) 2021/2050-1971/2000. ***Right:*** Number of days with cold stress (PET < 0 °C) for the North Sea region for the base period d) 1971-2000 and its changes for e) 2021/2050-1971/2000 (A1B) and f) 2021/2050-1971/2000.

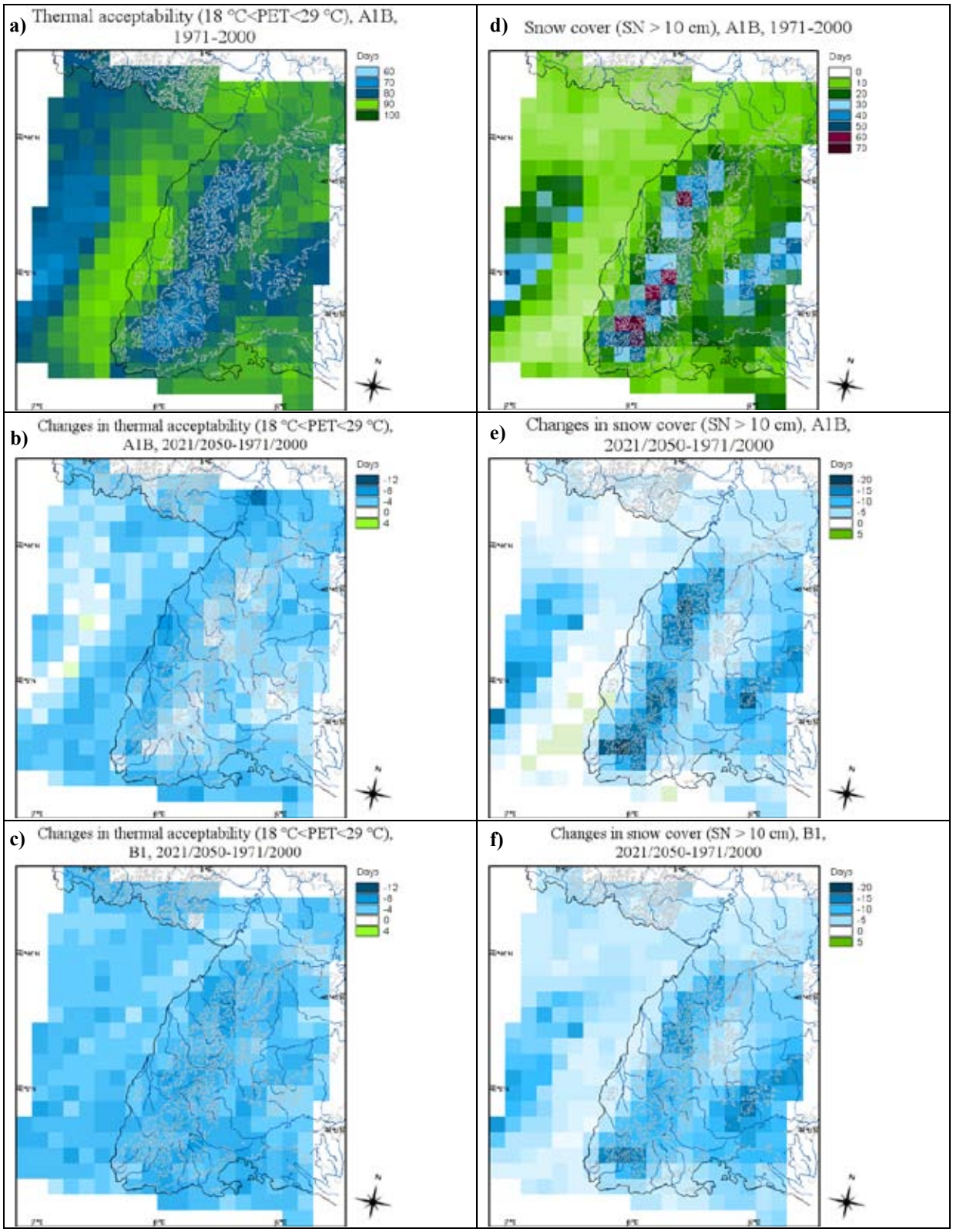

Fig. 2. left: Number of days with thermal acceptability (18 °C < PET < 29 °C) for the Black Forest region for the base period a) 1971-2000 and its changes for b) 2021/2050-1971/2000 (A1B) and c) 2021/2050-1971/2000. ***Right:*** Number of days with ski potential (SN > 10 cm) for the Black Forest region for the base period d) 1971-2000 and its changes for e) 2021/2050-1971/2000 (A1B) and f) 2021/2050-1971/2000.

The most climatic as well as relevant for tourism significant changes in the Black Forest correspond to thermal acceptability and ski potential (fig. 2). Thermal acceptable conditions occur at 80 days per year,

in higher regions at 70 days in the time frame 1971-2000 on average (fig 2a). The lower lying regions of the Black Forest will not benefit. The number of days with thermal acceptability will reduce by 6 days (A1B). The higher altitudes will not or negligibly be affected (fig 2b). In the more ecological emission scenario B1 thermal acceptable conditions will more obviously decrease as well. Considering the ski potential in higher altitudes there are averaged 50 up to 60 days with a snow cover greater than 10 cm in the base period (fig 2d). The lower lying regions have 20 up to 30 days with snow reliability. Changes in ski potential will be visible in both scenarios (fig 2e, f) with a reduction up to 20 days in the highest and up to 10 days in lower levels (A1B). Changes based on B1 scenario will be slightly lower.

4. CONCLUSIONS

Due to climate change and global warming the number of hot and humid-warm days will rise at the expense of thermal comfortable conditions, especially in the lower regions of the Black Forest. Additionally, the days with sufficient snow reliability for winter sports will be markedly reduced to the middle of 21st century. This denotes a higher accumulation of high altitude areas of the Black Forest for tourism and recreation due to a present and sufficient function of recreation. Tourism and tourism industry are forced to rethink considering winter as well as summer tourism. Due to the compensative cooling impact of the sea and continuous wind systems the North Sea region will benefit, especially in summer. Heat and thermal stress will be irrelevant further on. Additionally, days with cold stress will be reduced by 10 (B1) and 20 days (A1B) respectively. To what extend the health component (e.g. stimulating climate) will change, has not been discussed yet.
The present results are based only on one regional model, additional analysis with data of other regional models are planned.

ACKNOWLEDGEMENT

This research is supported by The Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF) in the Framework of Klima*zwei*.

REFERENCES

Bartels, C., Heinrichs, H., Barth, M., Kreilkamp, E., Matzarakis, A., Möller, A., 2007: Climate trends and sustainable development of tourism in coastal and low mountain range regions (CAST). In: A. Matzarakis, C. R. de Freitas, D. Scott (Eds.), Developments in Tourism Climatology, 207-213.

Gätje, C. 2006: Tourismus und ERholung im Wattenmeer. In J. L. Lozan, E. Rachor, K. Reise, J. Sündermann, H. v. Westernhagen (Eds.), Warnsignale aus Nordsee und Wattenmeer: Eine aktuelle Umweltbilanz, Wissenschaftliche Auswertungen, Hamburg, 117-121.

Jacob, D., Andrae, U., Elgered, G., Fortelius, C., Graham, L. P., Jackson, S. D., Karstens, U., Koepken, Chr., Lindau, R., Podzun, R., Rockel, B., Rubel, H.B., Sass, R.N.D., Smith, B.J.J.M., Van den Hurk, X. Yang, X., 2001: A Comprehensive Model Intercomparison Study Investigating the Water Budget during the BALTEX-PIDCAP Period. Meteorology and Atmospheric Physics 77, 19-43.

de Freitas, C. R., 2003: Tourism climatology: evaluating environmental information for decision making and business planning in the recreation and tourism sector. Int. J. Biometeorol. 48:45-54.

Matzarakis, A., 2007: Assessment method for climate and tourism based on daily data. In: A. Matzarakis, C. R. de Freitas, D. Scott (Eds.), Developments in Tourism Climatology, 52-58.

Matzarakis, A., de Freitas, C. R., Scott, D., (Eds.), 2007a: Developments in Tourism Climatology. ISBN 978-3-00-024110-9.

Matzarakis, A., Koch E., Rudel, E., 2007b: Analysis of summer tourism period for Austria based on climate variables on daily basis. In: A. Matzarakis, C. R. de Freitas, D. Scott (Eds.), Developments in Tourism Climatology, 122-128.

UBA, 2005: Klimawandel in Deutschland. Vulnerabilität und Anpassungsstrategien klimarelevanter Systeme. Climate Change 08/05.