Climate and tourism: Urban tourism potential in Freiburg, Germany

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Abstract

Climate and tourism are strong correlated. Urban areas have a relevance concerning not only to cultural tourism but also for recreation. The high discussed topic of global change is focused in the tourism climatology as well. We analyzed exemplarily the climate potential and its variation of Freiburg. The analysis is based on the simulations of the regional climate models REMO and CLM for the A1B and B1 scenarios. The results are presented in form of the Climate-Tourism-Information-Scheme (CTIS).

Key words: RayMan, CTIS, PET, Freiburg, REMO, CLM

1. INTRODUCTION

According to the AR4 of the IPCC (2007) a possible increase of global air temperature of about 1.1 °C in the best case (B1) and 6.4 °C in the worst case (A1FI) is expected to the end of the 21st century. The Southwest of Germany will be affected by a rising air temperature of 3.5 °C (IPCC, 2007). In every country, tourism and recreation build an economic factor. In Germany, for example, the tourism sector values about 6 to 8 %. The German tourism potential becomes also noticeable in the Black Forest (Southern Germany). Considering the climate change discussion, Southern Germany will be affected more amongst others by increasing air temperature. The city of Freiburg lies in the foothills and is the entrance of the visitors to the famous Black Forest. Beside to the local income, the tourism and recreation sector builds an important economic factor. Therefore, climate change discussion and impacts on tourism scare tourism industry and local authorities. They want and have to be informed about the possible damages and future climate conditions. Therefore, we analysed exemplarily the climate potential for tourism purposes and its variation of Freiburg (Matzarakis and Endler, 2009).

Additionally, Freiburg is one of the most important and visited city in the Black Forest and also with long tradition in urban climatology. Nevertheless the analysis of the tourism potential for urban areas is more complex than for traditional tourism areas i.e. snow tourism or summer vacation for beach tourism. Therefore we present an example of the general and specific quantification of climate for urban tourism. Urban tourism is connected with urban climate because of the modified conditions in urban areas. The question is also how to integrate urban climate material and information for urban tourism.

2. DATA AND METHODS

Initially, we used the regional climate model REMO in a high spatial resolution of 10 km for Germany (Jacob, 2001). These model calculations have been conducted on behalf of the Federal Environment Agency (Umweltbundesamt, UBA). In addition, the CLM model with a resolution of approx. 20 km has been applied (Böhm et al., 2006). For a comparison of these modelled data observed data of the German Weather Service (DWD) has been used for the period 1961 – 1990.

Within the analysis the modelled data are used for the analysis of tourism potential for 1961-1990 and for future climate trends (2021-2050). Hence, the SRES scenarios A1B and B1 are considered. The used model data builds the base for thermal, physical, and aesthetic computations being used for the validation of both thermal comfort and tourism and recreation potential (de Freitas, 2003).

The thermal component is expressed by the Physiologically Equivalent Temperature (PET; Matzarakis et al., 1999). Moreover, frequency classes and frequencies of extreme weather events are generated based on a monthly interval. The derived results, in terms of climate tourism information schemata (CTIS), and maps shall be allocated for stakeholders (Matzarakis, 2007).

Here, we only present the CTIS. Our analysis of the climatic tourism potential is based on particular thresholds and meteorological parameters (Tab. 1, e.g. Matzarakis and Mayer, 1996; Matzarakis 2007).

Tab. 1: Selected meteorological parameters and their thresholds for describing and calculating the climatic tourism potential (* PET = Physiologically Equivalent Temperature)

Parameter	Threshold
Thermal acceptance*	18 °C < PET < 29 °C
Heat stress*	PET > 35 °C
Cold stress*	PET < 0 °C
Sunny	Cloud cover < 5 octas
Fog	Relative humidity > 93 %
Sultry	Vapour pressure > 18 hPa
Less precipitation	Precipitation < 1 mm
Long rain	Precipitation > 5 mm
Strong wind	Wind velocity > 8 ms^{-1}
Ski potential	Snow cover > 10 cm

3. RESULTS

The results based on the DWD data are shown in Fig. 1. The REMO data for the area of Freiburg (9 grid points have been used in order to get the mean conditions of Freiburg) have been processed for the A1B- and B1-scenario. The CLM data for the area of Freiburg (5 grid points have been used) have been processed for the same scenarios. Fig. 2 shows the climatic tourism potential in terms of CTIS for the modelled data (REMO A1B, upper panel and CLM A1B, lower panel) for the period 1961-1990. The results for the same scenario for the period 2021-2050 are shown in Fig. 3. The underlying thresholds of each parameter are listed in Tab. 1.

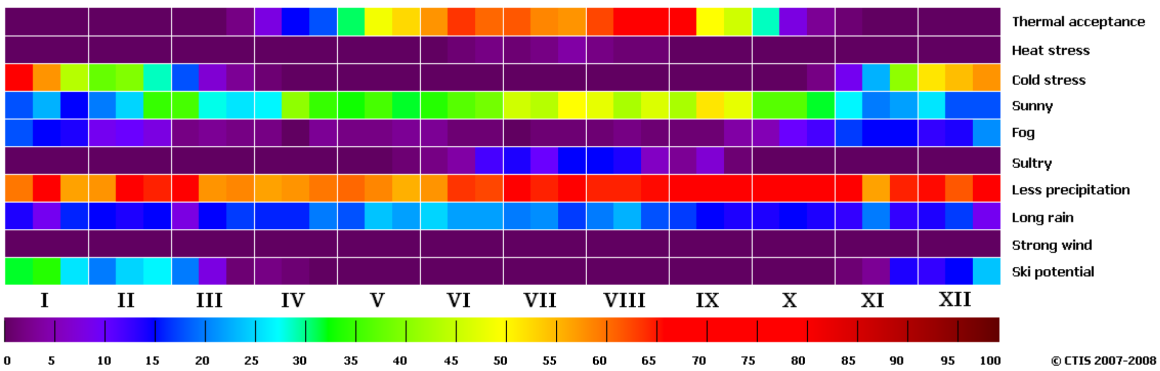

Fig. 1: Climate-Tourism-Information-Scheme for Freiburg for the base period 1961-1990 based on measured data of DWD.

The results for the DWD CTIS are shown on a 10-day interval and cover the real conditions for the area. Compared to the simulations of the same period the thermal acceptance is higher for the measured data. Concerning the heat stress conditions there is an overestimation of the models and for cold stress there is a good agreement with the REMO model; CLM show higher cold stress levels. For the sunny conditions there is an overestimation of CLM and a good agreement with REMO. For the fog conditions there is no clear picture for the models, with the tendency that CLM shows better agreement. For sultriness both models show similar pattern like the measured data.

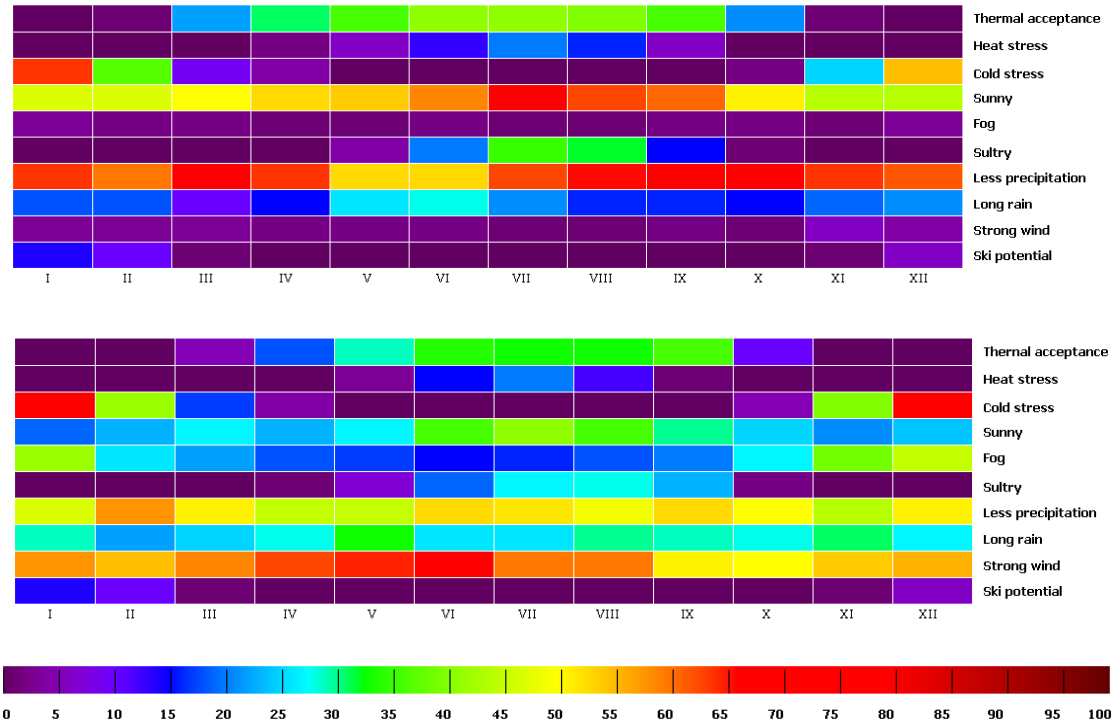

Fig. 2: Climate-Tourism-Information-Scheme for Freiburg for the base period 1961-1990 based on modelled data of REMO (upper panel) and CLM (lower panel)

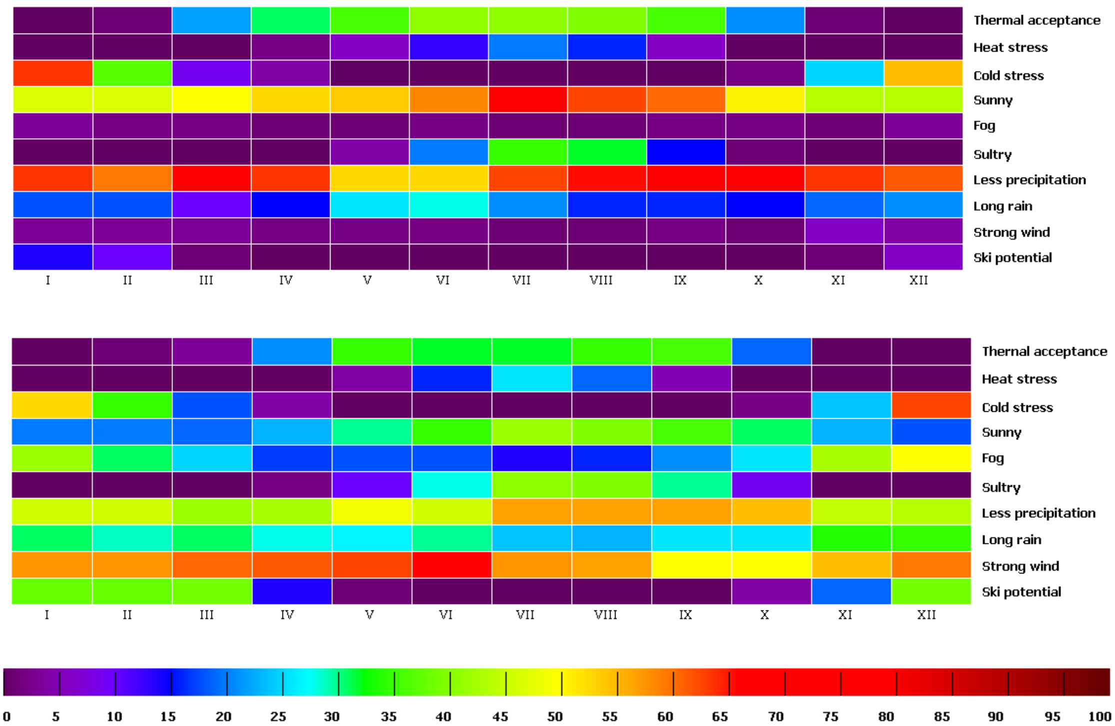

Fig. 3: Climate-Tourism-Information-Scheme for Freiburg for the period 2021-2050 based on modelled data of REMO (upper panel) and CLM (lower panel)

For dry days (less precipitation) both models show a similar pattern with the tendency that REMO shows more agreement of these conditions. For the long rain conditions the pattern is similar as for the dry days. CLM shows a higher tendency of days with strong wind speeds as the measured data and REMO model. For the ski potential both models show an underestimation.

The CTIS based on the REMO and CLM A1B simulation for the 2021-2050 period (Fig. 3) show that there is an increase in the heat stress and sultriness. For snow cover and thermal acceptance there is a decrease. For the other parameters and factors there are only slight or no changes detected.

4. CONCLUSIONS

The used data and models have different uncertainties. The height of the DWD station and the model grid used are in different heights. The spatial resolutions of the models are different: for REMO 10 km and for CLM 18 km and thus dynamical processes are simulated in a different way. The trend for both models is clear that the thermal comfort conditions are changing with more heat stress and lower cold stress. There is an increase of the humid conditions and a decrease of snow conditions. Fog and storm events will not obviously occur more in the future. The increase in thermal discomfort will affect tourism and recreation as well. Concerning climate change conditions and urban tourism several aspects, i.e. how much time is used indoors or does higher frequency of heat stress during day and night conditions have to be considered and included in the simulations. Adaptation measures have to be developed to guarantee the pleasant climate for urban tourists.

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