Assessment of Weather and Climate for Tourism and Health in the Alps

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It is common knowledge that weather and climate affect human beings. Beside weather and climate other factors such as geographical location, topography, landscape, vegetation, and fauna are factors that influence decisions regarding areas to be visited for tourism. It is a fact that weather/climate and tourism/recreation are interconnected in diverse ways, and tourists, tour organizers, travel agencies, tourism planners, and stakeholders for example need to be reliably informed and educated about the role of weather and climate in tourism and health issues (Matzarakis 2006). This knowledge of weather and information about climate and its application can assist tourism planning and tourism industries in reducing negative effects in the economy sector (Scott et al. 2009). General knowledge of climate parameters (based on thresholds) and their appropriateness for tourism and recreation are basic information, i.e. too much high sun load or strong winds. Climate extremes, e.g. heat waves or storms are most relevant because of the possible damages on infrastructure and human life. A useful climate advisory service will help to prepare and protect tourists and groups at risk (e.g. retirees, sick people, and children).

Since the discussion about climate change and its implications in tourism and human health is still ongoing, an additional aim is to quantify expected bio-climatological and relevant tourism climatological factors. This can be performed by using the Climate-Tourism-Information-Scheme, which includes the most relevant and reliable parameters and tourism-climatological factors. The quantification of climate can be performed by the use of existing climate data set modeled for the present or for the future (Matzarakis et al. 2009).

The recent discussion on climate change issues is focused on the development of mitigation and adaptation strategies. But information about climate change is presented in form of changes in the mean air temperature or changes in precipitation amounts for future climatic periods on a global and on regional scales. More relevant is the quantification of extreme events, not only the trend of climatic variables. Concerning tourism there is a lack of different spatial and temporal scales. The effects of climate change will occur based on events and will take place on the local level where humans live and spend their time during the day and the year. Recent adaptation possibilities are focused on climate protection issues.

In order to assess the climatic tourism potential for human health air temperature and precipitation are not sufficient enough. For example, winter sports enthusiasts and tourists desire snow as well as sunshine, beneficial thermal conditions, and recreation in their holidays. Nowadays, the assessment can be performed by facets of climate in tourism (thermal, aesthetical and physical facet) (de Freitas 2003). The thermal facet of climate is based on a complex thermal index, e.g. PET, which is based on the human energy balance. It describes the effect of the climate not only for cold but also for warm conditions. In general, PET (physiologically equivalent temperature) describes the effect of the thermal surroundings of the human body and includes the energy exchange between humans and environment and assesses the effect of the thermal environment. The other two facets, the aesthetical and physical, can be covered by simple and easy extracted parameters and factors, e.g. snow height and daily sunshine duration from data records or networks (Matzarakis 2006).

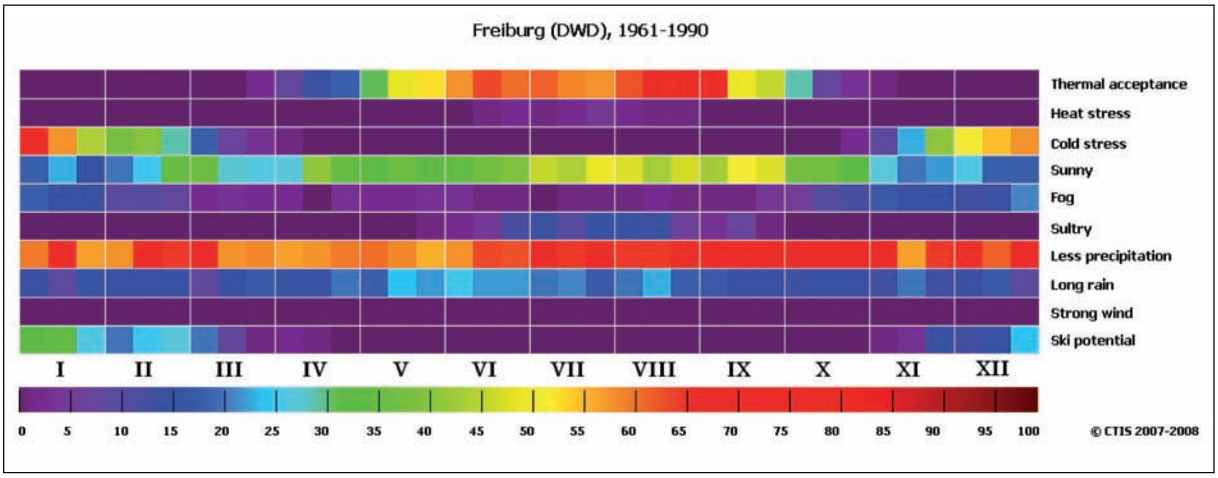

Fig. 1: CTIS for Freiburg for the Period 1961–1990.

Depending on the objectives of the evaluation, these meteorological parameters can be measured or calculated in a grid-net by numerical models.

Here, a new approach based on climate thresholds (Climate-Tourism-Information-Scheme) is presented. The method combines meteorological and tourism related components. Thus, besides the two variables most frequently used in impact assessment studies (air temperature and precipitation), also physiologically equivalent temperature (PET), cold stress (PET < 0 °C), heat stress (PET > 35 °C), thermal comfort (18 °C < PET < 29 °C), sunshine/cloud cover conditions in terms of the number of days with a cloud cover < 5 octas, vapour pressure > 18 hPa, wind velocity > 8 m/s, relative humidity > 93 %, precipitation < 1 mm as well as precipitation > 5 mm, and snow cover > 10 cm are considered. In general, the definitions of the several threshold values do not necessarily correspond to the universal meteorological threshold values and are adjusted to applied tourism climatology and human health applications. For example, under meteorological aspects, a stormy day is given by a wind strength of at least 8 Bft, which corresponds to a wind velocity greater than 17.2 m/s, while in tourism climatology a wind velocity of 8 m/s (5 Bft) is perceived as unpleasant and uncomfortable. All the above-mentioned factors have been included in an information scheme in order to describe these factors in a high temporal resolution.

The Climate-Tourism-Information-Scheme (CTIS) (Matzarakis 2007) was derived to integrate and simplify climate information for tourism. CTIS contains detailed climate information which can be used by tourists to anticipate thermal comfort as well as aesthetical and physical conditions for

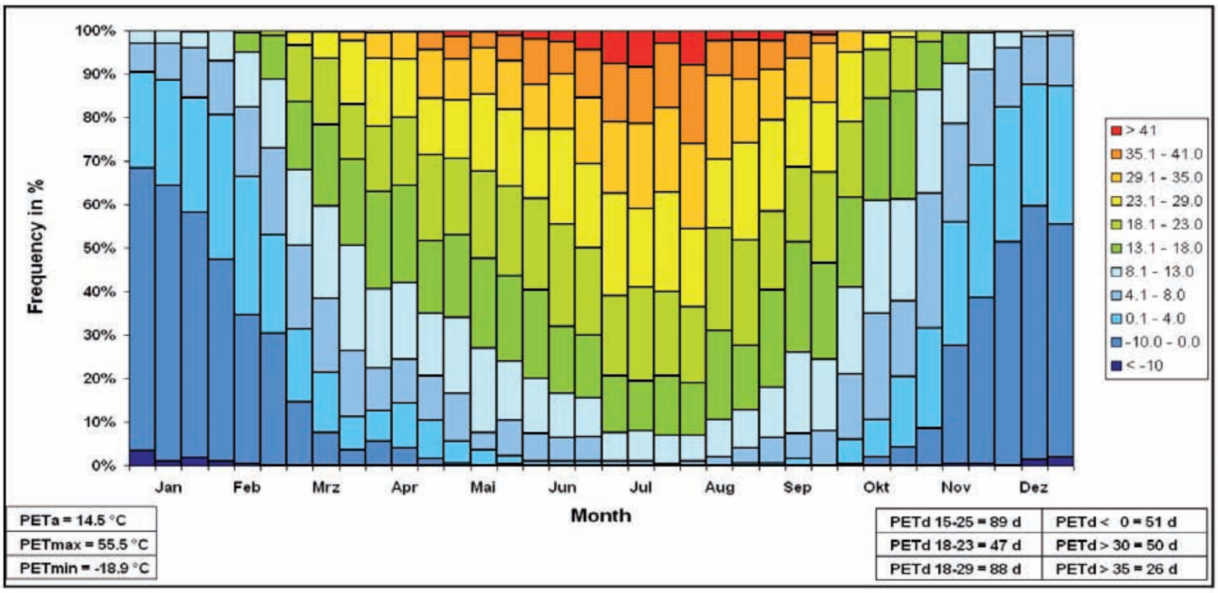

Fig. 2: Bioclimate Diagram (PET) for Freiburg for the Period 1961–1990.

planning their vacations. CTIS provides all-seasonal frequency classes and frequencies of extreme weather events on a 10-day or monthly time scale (Matzarakis 2007). This method is preferred for analysing climate stations or grid points. Since the results presented here are based on models and thus influenced by the models' uncertainties, a temporal resolution finer than 1 month is not considered to be useful. Each coloured column describes the corresponding frequency of any parameter or factor. A frequency of 100 % indicates that each day in a month is characterized by the respective condition listed on the right hand side. A frequency of 50 % corresponds to an occurrence of the indicated condition during 15 days, 10 % to 3 days of the considered month etc. Considering the second row in Fig. 1, heat stress occurs from June to September with an average frequency between 20 % and 40 %, meaning that approx. 6 to 12 days are characterized by heat stress. In Figure 1 the CTIS for Freiburg for the period 1961–1990 is presented as an example. More detailed information concerning thermal comfort, cold and heat stress can be derived analysing the thermal bioclimate conditions based also on frequencies as shown in Fig. 2, where PET-conditions are shown in 10-day intervals in terms of frequencies of thermal stress classes including the annual mean and extremes in amount of days of occurrence and providing information for a destination analysis.

Additional information based on regional climate modelling can determine possible changes and, in discussion with specific scientific disciplines, actions can be taken. In addition, specific kinds of tourism possibilities based on CTIS can be assessed and quantified and periods with occurrences of specific extremes, e.g. heat waves or periods of strong wind, can be detected.

In addition, in order to get any information about adaptation possibilities to climate change conditions, two options have been analysed: a) the effects of trees in urban areas and b) the modification by wind speed (Fig. 3), based on the assumption that in urban structures the parameters modified most are radiation fluxes (primarily by trees and buildings, here expressed by Tmrt) and wind speed. These two parameters are also the possibilities that can easily be modified or changed by urban planning measures.

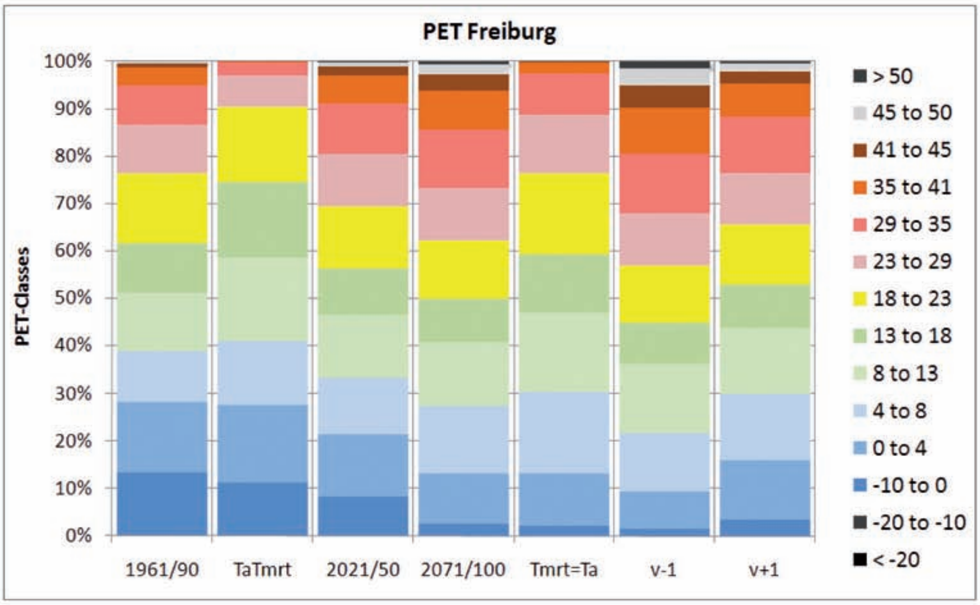

Fig. 3: PET for Freiburg for Different Periods by Modifying Radiation and Wind Conditions Based on REMO-Simulations and the A1B IPCC Scenario.

Based on the assumption that air temperature is in the same level like mean radiant temperature (Tmrt =Ta, more or less shady conditions) changes in heat stress are very high. If wind speed is modified by an increase of 1 m/s, days with heat stress will decrease compared to original PET conditions. Possible changes of heat stress days (PET > 35 °C) are shown in the A1B scenario. If radiation is reduced (here Tmrt=Ta), heat stress days will decrease significantly until the end of the century (for A1B). If wind is reduced, heat stress days increase in all cases, with highest changes for A1B for the period 2071–2100 and an amount of 30 days. If wind speed is increased by only 1 m/s, a decrease of days with heat stress is indicated. The present analysis for Freiburg shows that, in general, days with heat stress will increase and days with cold stress will decrease in expected future climate conditions. The changes are much bigger when radiation fluxes are modified (here Ta=Tmrt). These changes can be arranged by planting specific and relevant vegetation types that produce shade in summer and allow short wave radiation to reach the surface or the areas where humans spend their time in winter. If wind is modified, the result is not as effective, but it is relevant to know that increased wind speed in complex structures can reduce thermal conditions of hot conditions.

Based on results such as these, tourists, the tourism industry, health resorts and authorities can be prepared or protected in order to avoid negative developments in the economic sectors of tourism and health.

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More infos: http://www.urbanclimate.net/climtour and on the website of the Commission on Climate, Tourism and Recreation of the International Society of Biometeorology (http://www.urbanclimate.net/cctr).