Transferring Climate Information for Application and Planning: The Climate-Tourism/Transfer-Information-Scheme

A. Matzarakis

Abstract A new approach based on climate thresholds, the Climate-Tourism-Information-Scheme CTIS, which is appropriate for destination analysis of present climate conditions and for future climate changes is shown here. In particular, the method combines meteorological and tourism related components. All factors are included in one single information scheme in order to describe these factors in a high temporal resolution. The CTIS intends to integrate and simplify climate information for tourism. It contains detailed climate information which can be used by tourists to anticipate thermal conditions (including thermal comfort, cold stress, heat stress, cold stress and sultriness) as well as aesthetical (sunshine) and physical conditions (wind, rain) when planning their vacations. CTIS provides all-seasonally frequency classes and frequencies of extreme weather events on a 10-day or monthly time scale. The included factors and parameters are shown in terms of thresholds and frequencies. In general, the definitions of the threshold values do not necessarily correspond to universal meteorological threshold values and are adjusted to applied climatology purposes e.g. tourism, health and urban planning.

1 Introduction

It is a fact that weather/climate and several economic braches like tourism/recreation are interconnected in diverse ways. 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). The knowledge of weather and information about climate and

A. Matzarakis (✉)
Meteorological Institute, Albert-Ludwigs-University Freiburg, Werthmannstr. 10, Freiburg D-79085, Germany
e-mail: andreas.matzarakis@meteo.uni-freiburg.de

C.G. Helmis and P.T. Nastos (eds.), *Advances in Meteorology, Climatology and Atmospheric Physics*, Springer Atmospheric Sciences,
DOI 10.1007/978-3-642-29172-2_84,

its application can assist tourism planning and tourism industries to reduce the adverse 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. if too high sun intensity 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).

2 Methodological Approaches

The effects of specific climate conditions in tourism areas occur not only in the meso scale but more in the micro scale, where visitors and local population spend most of their time during day and night (Matzarakis 2006; Matzarakis et al. 2010). Therefore information about climate in high temporal and spatial resolution is of importance and interest. In addition, the knowledge of possibilities for mitigation and adaptation of current and expected climate conditions require interdisciplinary approaches and solutions. Many climate phenomena and conditions have been adequately studied qualitatively but not quantitatively so far. Current research focuses on the quantification of strategies for reductions of extremes and frequencies as well as thresholds in tourism areas.

The interactions of weather and climate in tourism are shown in Fig. 1. It is known that tourism, especially summer tourism, can be described by the triple S (sun, sea and sand). Many of the tourism factors creating the triple S are dependent on weather and climate (Fig. 1). An additional factor that can be added to the triple S, or used as single winter S, is snow, the main decision factor for winter tourism. Figure 1 shows the relevance and importance of weather and climate factors in the tourism sector.

In order to assess the climatic tourism potential for human health air temperature and precipitation are not sufficient. 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 (Fig. 2) 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 easily extracted parameters and factors, e.g. snow height and daily sunshine duration from data records or networks (Matzarakis 2006; Matzarakis et al. 2010).

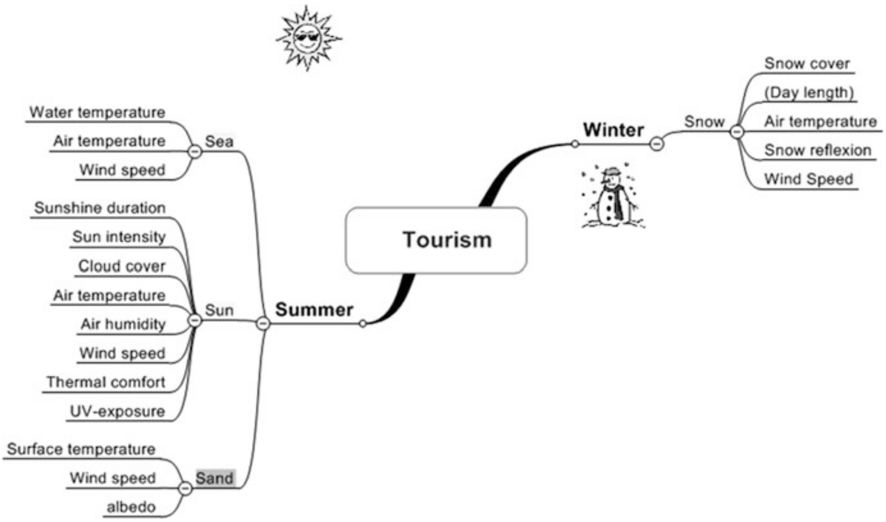

Fig. 1 Relations between climate and tourism and important parameters and factors (Matzarakis 2006)

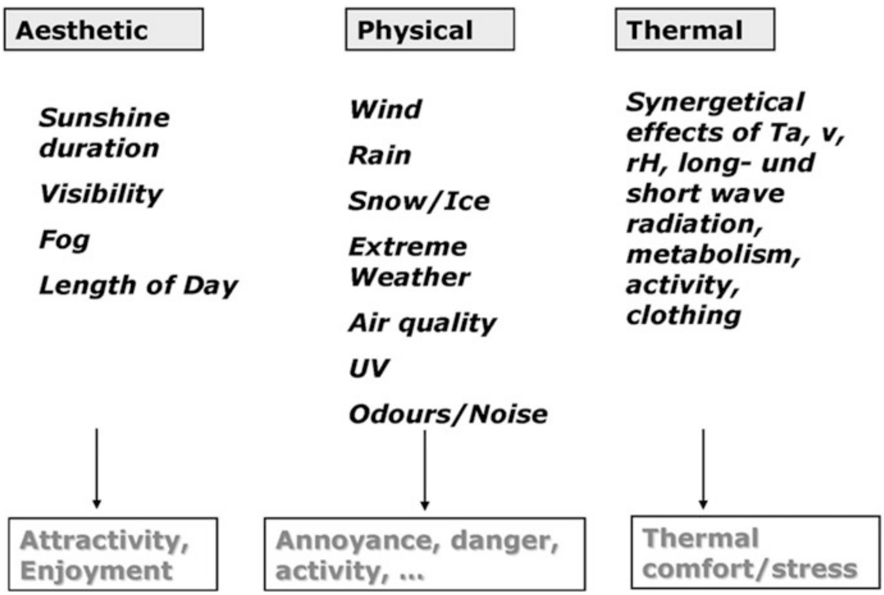

Fig. 2 Facets of climate in tourism (After Matzarakis et al. 2010)

Depending on the objectives of the evaluation, these meteorological parameters can be measured or calculated in a grid-net by numerical models. The most relevant parameters and factor important for tourism and recreation can be found in Fig. 2.

In order to quantify and visualize the facets of climate in tourism, a new approach based on climate thresholds (Climate-Tourism-Information-Scheme) has been developed. The method combines meteorological and tourism related components. It integrates and simplifies climate information for tourism. 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 acceptability ($18°C <$ 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 (Matzarakis 2007).

CTIS contains detailed climate information which can be used by tourists to anticipate thermal comfort as well as aesthetical and physical conditions for 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 analyzing 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.

3 Results

For the integral quantification of climate and tourism purposes in terms of a destination analysis the CTIS builds a valuable method, because it includes the most relevant parameters and factors in high temporal resolution (Matzarakis 2007; Lin and Matzarakis 2008; Zaninovic and Matzarakis 2009).

Each coloured column describes the corresponding frequency of any parameter or factor (Fig. 3). 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. 4, heat stress occurs from June to September with an average frequency between 20%

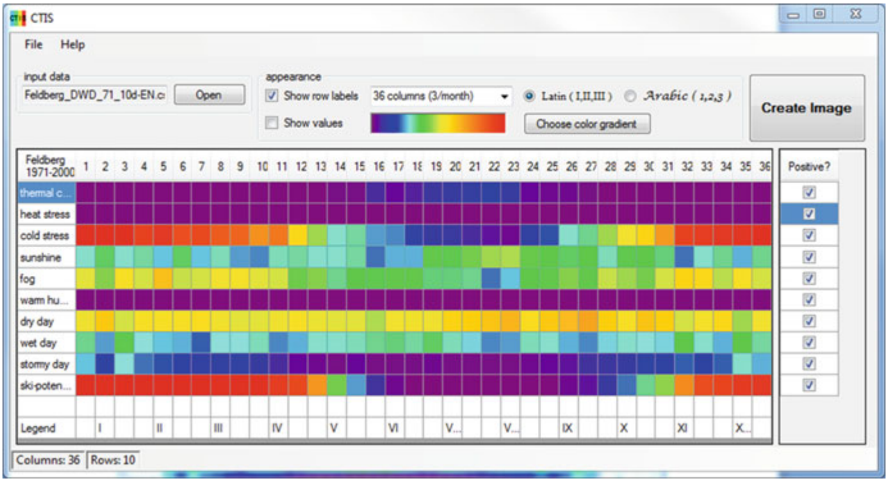

Fig. 3 CTIS main window for import of data, visual options and preparation of the factors (positive or negative)

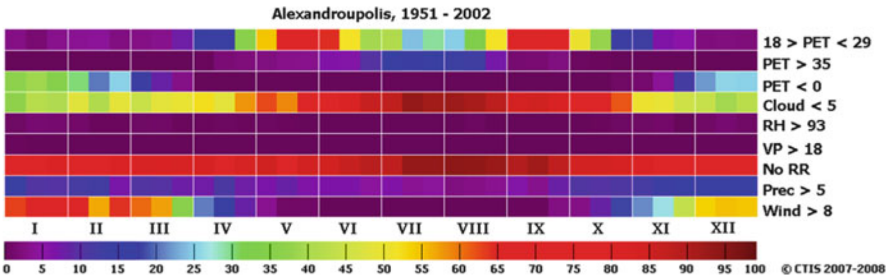

Fig. 4 CTIS for Alexandroupolis for the period 1951–2002

Table 1 Description of the range of rating for CTIS

color	range of per cent values	description
	< 14%	very poor
	14 % - 28 %	↕
	28 % - 42 %	↕
	42 % - 56 %	moderate
	56 % - 70 %	↕
	70 % - 84 %	↕
	> 84 %	ideal

and 40%, meaning that approx. 6–12 days are characterized by heat stress. In Fig. 4 the CTIS for Alexandroupolis for the period 1951–2002 is presented as an example.

As seen in Fig. 3 factors may be rated as positive or negative resulting in an inversion of the assessment scale for those rows. To make the information provided by the CTIS diagrams easier to understand a probability scale (Zaninovic and Matzarakis 2009) expressed in seven climate classes (with 14% probability in each class) from “very poor” to “ideal”, is incorporated (Table 1). This rating is intended for use with classification coloring.

A small software module which is able to provide the graphs has been developed in a user friendly way (Matzarakis et al. 2010). It reads text based data files that contain frequencies of all climatic factors the user wants to present in his diagram. These factors have to be scaled on a uniform scale like 0–1 or 0–100. The CTIS program consists of two parts: the main window including data import and basic preparation and second, the report window for fine tuning the resulting image in size and font with real-time preview.

CTIS-software can be also used for other kind of analysis and visualizations in applied climatology and related disciplines.

4 Conclusions

Climate and climate relevant information has to be presented and visualized in an easily understandable way for non experts. Because of different forms of tourism and the diverse requirements on climate information an integral assessment of weather and climate in one single factor or value is very difficult and too complex to understand. A single value would fail to consider all factors and information. This lack can be filled by CTIS including the most relevant factors based on the climate facets in tourism and recreation.

Current and expected climatic conditions can nowadays be described with methods from human biometeorology and tourism climatology. Specific kinds of tourism possibilities based on CTIS can be assessed and quantified for different destination. Periods with occurrences of specific extremes, e.g. heat waves or periods of strong wind, can detected. Based on results such as these, tourists, the tourism industry, health resorts and authorities can be prepared or protected in order to avoid negative consequences in the economic sectors of tourism, recreation and health.

References

de Freitas CR (2003) Tourism climatology: evaluating environmental information for decision making and business planning in the recreation and tourism sector. Int J Biometeorol 48:45–54. doi:10.1007/s00484-003-0177-z

Lin TP, Matzarakis A (2008) Tourism climate and thermal comfort in Sun Moon Lake, Taiwan. Int J Biometeorol 52:281–290. doi:10.1007/s00484-007-0122-7

Matzarakis A (2006) Weather and climate related information for tourism. Tour Hosp Plann Dev 3:99–115. doi:10.1080/14790530600938279

Matzarakis A (2007) Assessment method for climate and tourism based on daily data. In: Matzarakis A, de Freitas CR, Scott D (eds) Developments in tourism climatology. Commission Climate, Tourism and Recreation. International Society of Biometeorology, Freiburg, pp 52–58

Matzarakis A, Schneevoigt T, Matuschek O, Endler C (2010) Transfer of climate information for tourism and recreation – the CTIS software. In: Matzarakis A, Mayer H, Chmielewski FM (eds) Proceedings of the 7th conference on biometeorology. Ber Meteorol Inst Univ Freiburg no. 20, pp 392–397

Scott D, de Freitas CR, Matzarakis A (2009) Adaptation in the tourism and recreation sector. In: McGregor GR, Burton I, Ebi K (eds) Biometeorology for adaptation to climate variability and change. Springer, Dordrecht, pp 171–194

Zaninovic K, Matzarakis A (2009) The biometeorological leaflet as a means conveying climatological information to tourists and the tourism industry. Int J Biometeorol 53:369–374. doi:10.1007/s00484-009-0219-2