Climate and bioclimate information for tourism in Greece

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Abstract

Weather, climate and tourism are interconnected in many different ways. All of them are of local as well as of global significance. Weather and climate information is of interest to both tourists and the tourist industry. Information on climate is useful for planning vacations. This information can be obtained via popular media (e.g. tourist guides) or weather services. During the vacation period actual weather information is more important than climate information. In this period climate information does not play an important role. Examples of climate information that is often available are air temperature, relative humidity, precipitation, daily sunshine duration and water temperature on a monthly basis. Additional information that is recommended (especially with high spatial resolution) includes data on UV-radiation, air pollution, noise and bioclimatic conditions. Climate, bioclimate and weather information for tourism in Greece is presented.

Keywords: climate, tourism, recreation, human biometeorology, Physiological Equivalent Temperature, Greece

Introduction

Weather, climate and tourism are interconnected in diverse ways (Lecha and Shackleford 1997, Shackleford and Olsson, 1995). Tourists and tour organizers need to be reliably informed about the role of weather. One usually feels bad having to cancel a weekend trip because of crazy weather. Or what experience could be worse than a vacation with never-ending rain? Travel organizers and tour operators also know - through bad experience - about the important role played by the weather: rainy summers and less snowy winters adversely affects tourism and consequently have a grave effect on the schedules and cash-box of tourism industry.

Tourists and tourism industry need weather and climate information before, during and after the vacation period. In the pre-vacation time weather information can be provided from the media and weather services. Climate information from books and brochures about the climate of the vacation area is usually limited and provide only general information. During the vacation period, weather

information is available from public media services and climate information does not play an important role. After the vacation period weather and climate information is not of substantial interest.

Methods

Weather and climate have the following characteristics in relation to tourism (Abetz 1996):

- Weather and climate are limiting factors in tourism

  The characteristics of weather and climate could scarcely disrupt human activities absolutely but could constitute a very important financial factor. When viewed in the light of tourism, this implies that practically some regions of the world have a minimum tourism potential since their climatic conditions do not allow opportunities for tourism. Tourism administrators do not patronize such kind of areas since this does not yield significant profit. The traveller, however who tours these regions would have to get on with high costs (e. g. transport costs) or physical inconvenience (e. g. body strain). Financial strain can also result from weather variations and changes. Rainy summer or less snowy winters can have grave consequences on tourism.

- Weather and climate are dominating factors of touristic demands

  Weather and climate does not only shape the touristic offers but also touristic demand. They influence among other factors the decision about the destination or the kind of activities to be during the holiday season. The climatic factors play a significant role in the three phases of a trip: before, during and after. The meteorological conditions affect also the design/construction of the day's program.

- Weather, climate, health and tourism

  Trips in climatically stressed areas can result in health problems (e. g. heat stress, UV-radiation, air pollution and heat stroke). A purposeful climate advisory service can help to prepare and protect travellers and particularly risk groups (elderly people, sick people, children) against the above mentioned climate stress.

Cause and effect relations between the atmospheric environment and human health or human comfort can be analysed by a human biometeorological classification that distinguishes (VDI 1998):

- thermal complex
- air pollution complex
- actinic complex
- odours

- noise
- wind comfort

The classification presented above can be used for the climate and tourism relationships. In this paper only the thermal complex will be discussed.

Examples for climate information that is often available in tourism guides is in reality limited (see Table 1, example of the Greek island Santorini in the Aegean Sea). In most cases monthly values of air temperature, air humidity, precipitation, daily sunshine duration and water temperature are given. This information are not sufficient. More information like the amount of days with storm or days with precipitation are needed. Such kind of data is available from the national weather service networks which include more climatic parameter and more detailed information (see Table. 2, available parameters for the island of Santorini).

This information (Tab. 1 and 2) does not have a spatial component are needed for tourists and tourism industry for detailed information. Elementary meteorological and climatic parameters give a good Information (Fig. 3), but the combined effect is missing.

Table 1 Climate values for Santorini/Greece taken from a tourism guide book (Adams 1996)

Month	Mean air temperature (°C)	Mean maximum air temperature (°C)	Sunshine duration/day (h)	Precipitation (mm)	Relative humidity (%)	Water temperature (°C)
Jan	11	15	4	74	74	16
Feb	11	16	5	52	73	15
Mar	12	17	5	41	72	15
Apr	15	20	8	21	71	16
May	19	24	10	12	69	19
Jun	22	28	11	2	65	22
Jul	25	29	13	0.1	61	24
Aug	25	29	12	1.5	60	25
Sep	22	27	9	9	68	23
Oct	19	23	7	26	72	21
Nov	16	20	6	52	73	19
Dec	13	16	4	74	74	17

Tab. 2 Climate parameters for Santorini taken from the Greek climate network on monthly basis (Andreakos 1978)

Parameter	Data		Mean value of days of	Data
Air pressure (hPa)	Yes		Precipitation	Yes
Mean air temperat. (°C)	Yes		Rain	Yes
Mean max. air temperat. (°C)	Yes		Snow	Yes
Mean min. air temperat. (°C)	Yes		Snow rain	No
Absolute max. air temperat. (°C)	Yes		Rainstorm	Yes
Absolute min. air temperat. (°C)	Yes		Hail	Yes
Absolute mean max. air temp. (°C)	Yes		Snow cover	Yes
Absolute mean min. air temp. (°C)	Yes		Fog	No
Mean relative humidity (%)	Yes		Dew	Yes
Mean precipitation (mm)	Yes		Frost	Yes
Maximum precipitation in 24 h (mm)	Yes		Mean min. air temperat. < 0.0 °C	Yes
Mean cloud cover (Octas)	Yes		Mean max. air temperat. < 0.0 °C	No
Sunshine duration (h)	No		Wind speed > 6 Bf	Yes
Cloud cover (0-1.5)/8	Yes		Wind speed > 8 Bf	Yes
Cloud cover (6.5-8)/8	Yes		Wind direction	Yes
			Mean wind speed in Bf	Yes

Many possible combinations of meteorological and climatological parameters for tourism issues are given in Abetz (1996), two examples are given for summer conditions (Davies 1968 and Mieczkowski 1985). One example is the Climate-Index of Davies (Davies 1968) (Eq. 1) where the mean daily maximum air temperature from June to August T_{amax} , sunshine duration from June to August S and the sum of precipitation from June to August is included. An example of the summer index of Davies (1968) is given in Fig. 2 for the area of Greece.

$$I = 18 * T_{amax} + 0.217 * S - 0.276 * N + 320 \quad (1)$$

Another climatic index is given by Mieczkowski (1985) with a combination of seven parameters, three of them aalone and two as a bioclimatic combination (Eq. 2).

$$TCI = 8 * Cld + 2 * Cla + 4 * R + 4 * S + 2 * W \quad (2)$$

Where, Cld is daytime comfort index, consisting of the mean maximum air temperature (°C) and the mean minimum relative humidity (%), Cla the daily comfort index, consisting of the mean air temperature (°C) and the mean relative humidity (%), R the precipitation (mm), S the daily sunshine duration (h), W the mean wind speed (m/s). Contrary to other climate indices all the contributing parameters are assessed, each factor can reach 5 points, because of a weighting factor (a value for TCI of 100). Values >= 80 are excellent, values between 60 and 79 can be regarded as good to

very good. Lower values (40 – 59) are acceptable, while values (< 40) imply bad conditions for tourism (Abetz 1996, Mieczkowski 1985).

The shown climatic indices have some deficits since they do not include the effects of short and long wave radiation fluxes which are generally not included in climatic records. These fluxes can be calculated by the use of synoptic data and theoretical calculations from astronomical data (VDI 1998, Matzarakis et al 2000).

A full application of thermal indices on the energy balance of the human body gives detailed information about the effect of the thermal environment on humans (VDI 1998). One possibility is the application of PMV (Predicted Mean Vote) and PET (Physiologic Equivalent Temperature) (VDI 1998, Höppe 1999, Matzarakis et al 1999). Both thermal indices are well recommended and include all the important meteorological and thermo-physiological parameters (Matzarakis 2001).

In general the availability of national climatic networks of basic meteorological and climatological data is required. Also data needed for some bioclimatic purposes is available but not in a spatial resolution as is needed for touristic purposes.

The link between the point data as temperature or PET can be done by the construction of maps. For the construction of climatic and bioclimatic maps, a stochastical-statistical model, by the application of linear multiple regression has been used. On the one hand, we used as input data air temperatures or Physiological Equivalent Temperature of the stations was used as dependent variables on the statistical analysis and on the other hand as independent variables the following parameters: latitude, longitude, elevation above the sea level, shortest distance of each grid to the sea (as an indicator for continentality) and a factor of land/sea coverage in percent for parts of the area with a diameter of approximately 40 km were used (Matzarakis 1995, Matzarakis and Mayer 1997).

Results

Results based on point stations for climate and bioclimate information are given and described in Matzarakis (2001). But this kind of information give information only for a small are. Single point information is limited in spatial scale. Spatial scale information can be generated by the use of the point information. The following results and maps are generated for the meso scale resolution in minutes of degree for the whole area of Greece (Matzarakis 1995).

Greece is a country with an extended tourism but also with unused touristic potential especially before and after the main touristic season. The topography of Greece is very complex and highly variable (Fig. 1). This holds many possibilities and not only beach or summer activities during the main touristic season.

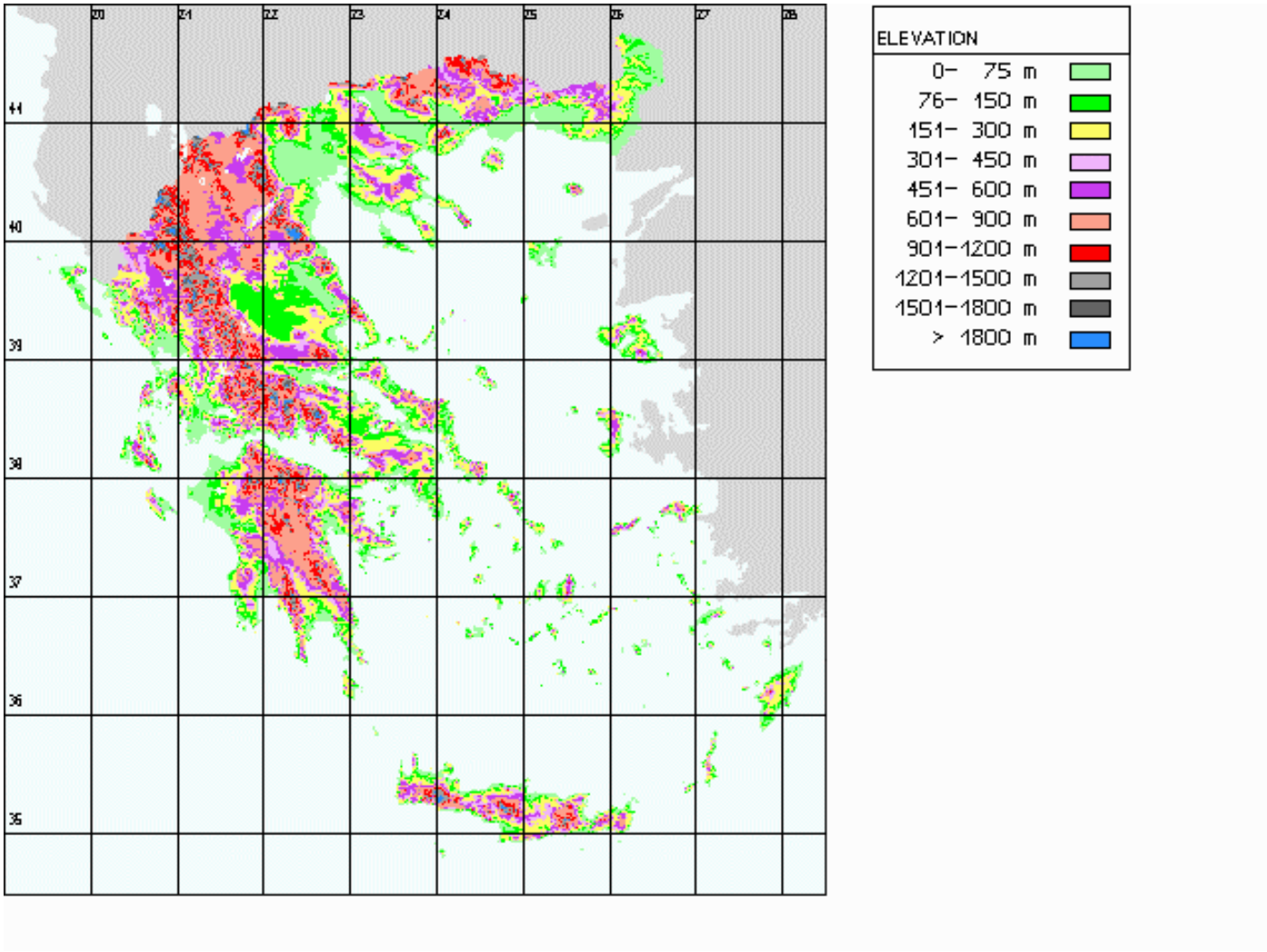

Fig. 1 Digital terrain model of Greece

The Fig. 2, 3 and 4 show the geographical distribution of the mean air, mean maximum and mean minimum air temperature of July. The distribution shows the differences between the inner mainland of Greece and the coasts and Greek islands. During July the conditions on the Greek islands are quite comfortable and the air temperatures are less than in the inner parts of the Greek mainland. The mean minimum air temperature (Figure 4) is for the biggest part of Greece, especially for elevations lower than 600 m above see level higher than 18 °C. This is the area where the population of Greece is living and tourists usually spend their vacations.

The maps of monthly mean air, monthly mean maximum and monthly mean minimum air temperature for the other months have been developed by the same way and also existing under http://www.mif.uni-freiburg.de/tourclimgr.

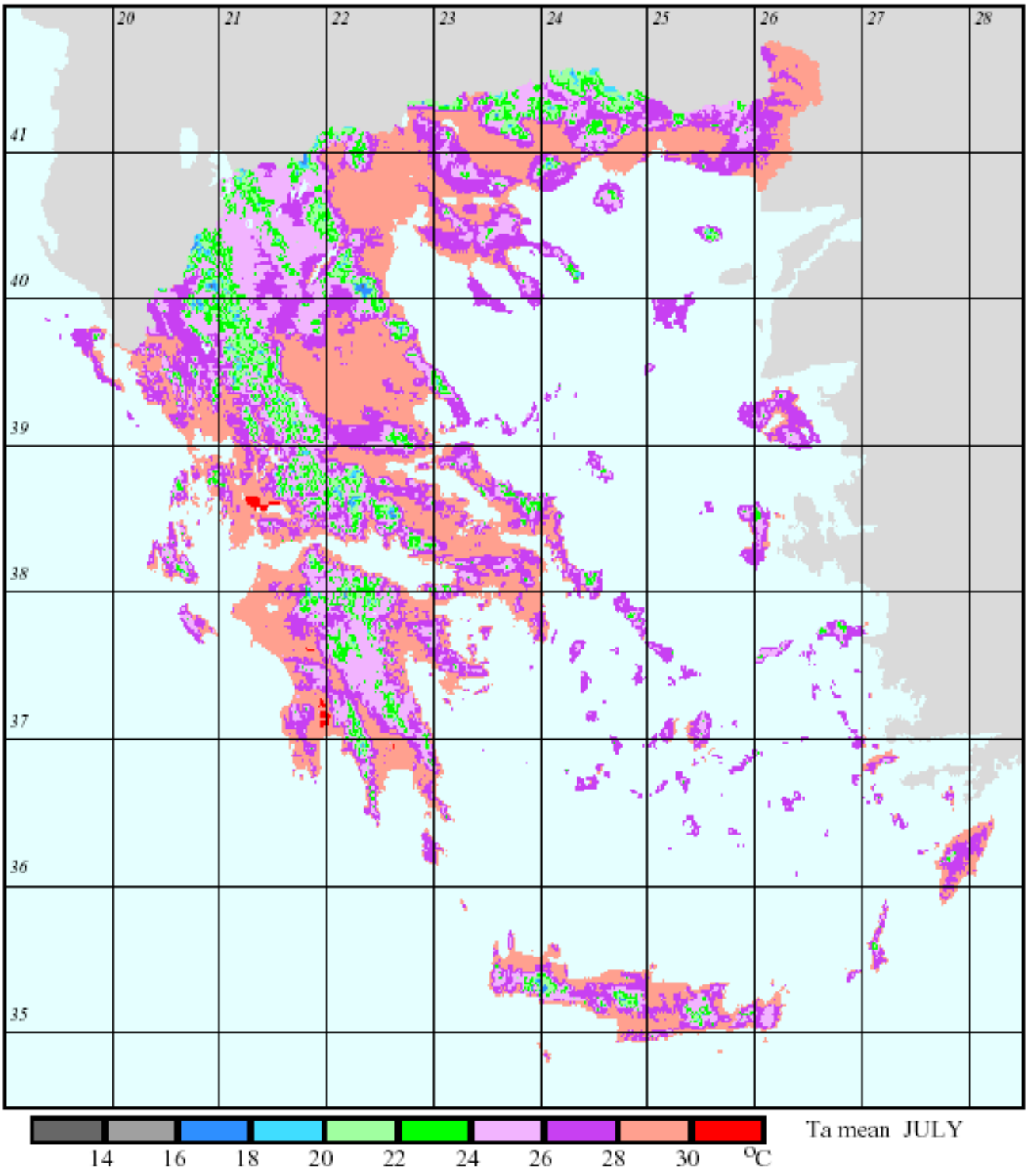

Fig. 2 Geographical distribution of mean air temperature in July for Greece

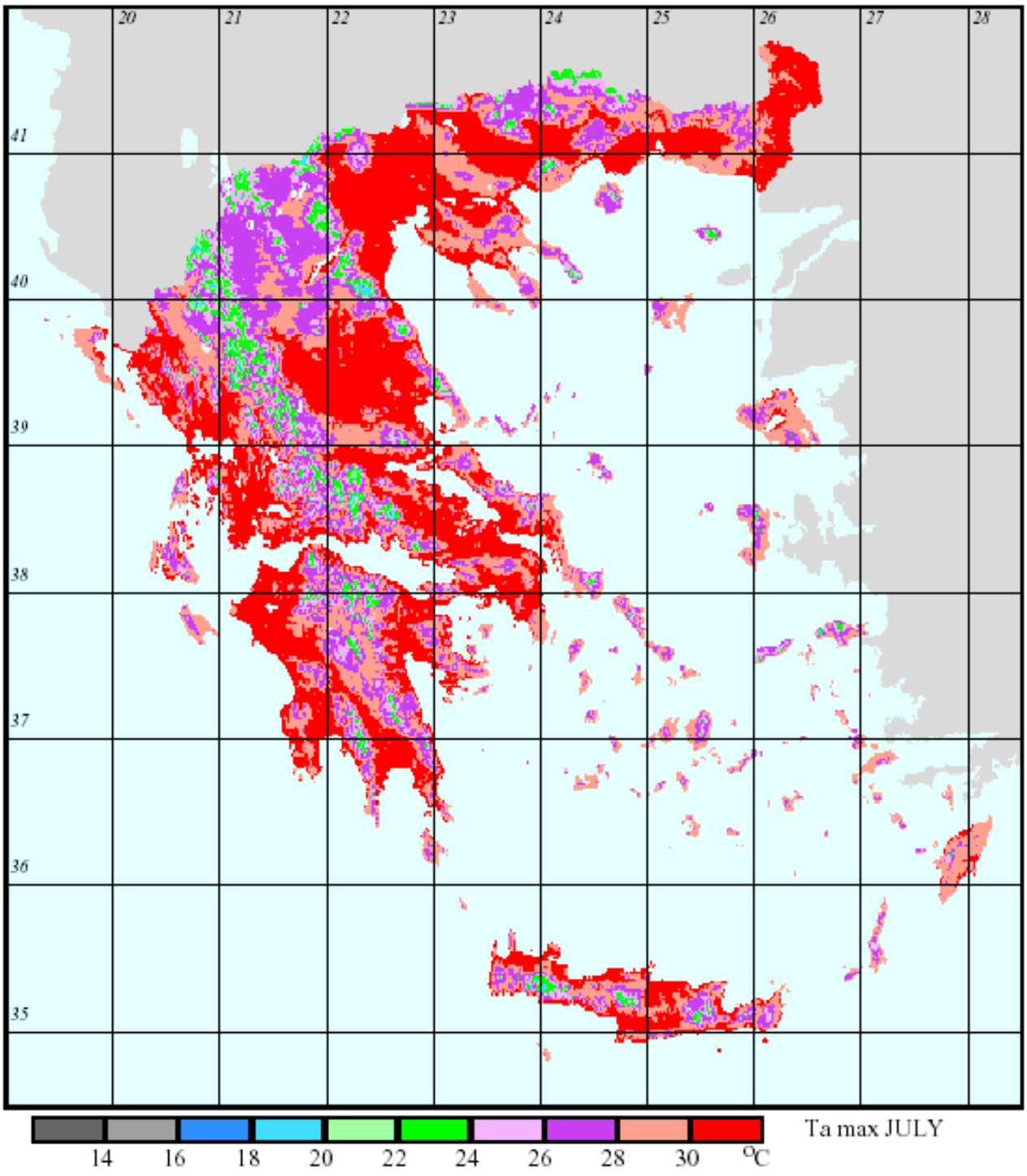

Fig. 3 Geographical distribution of mean maximum air temperature in July for Greece

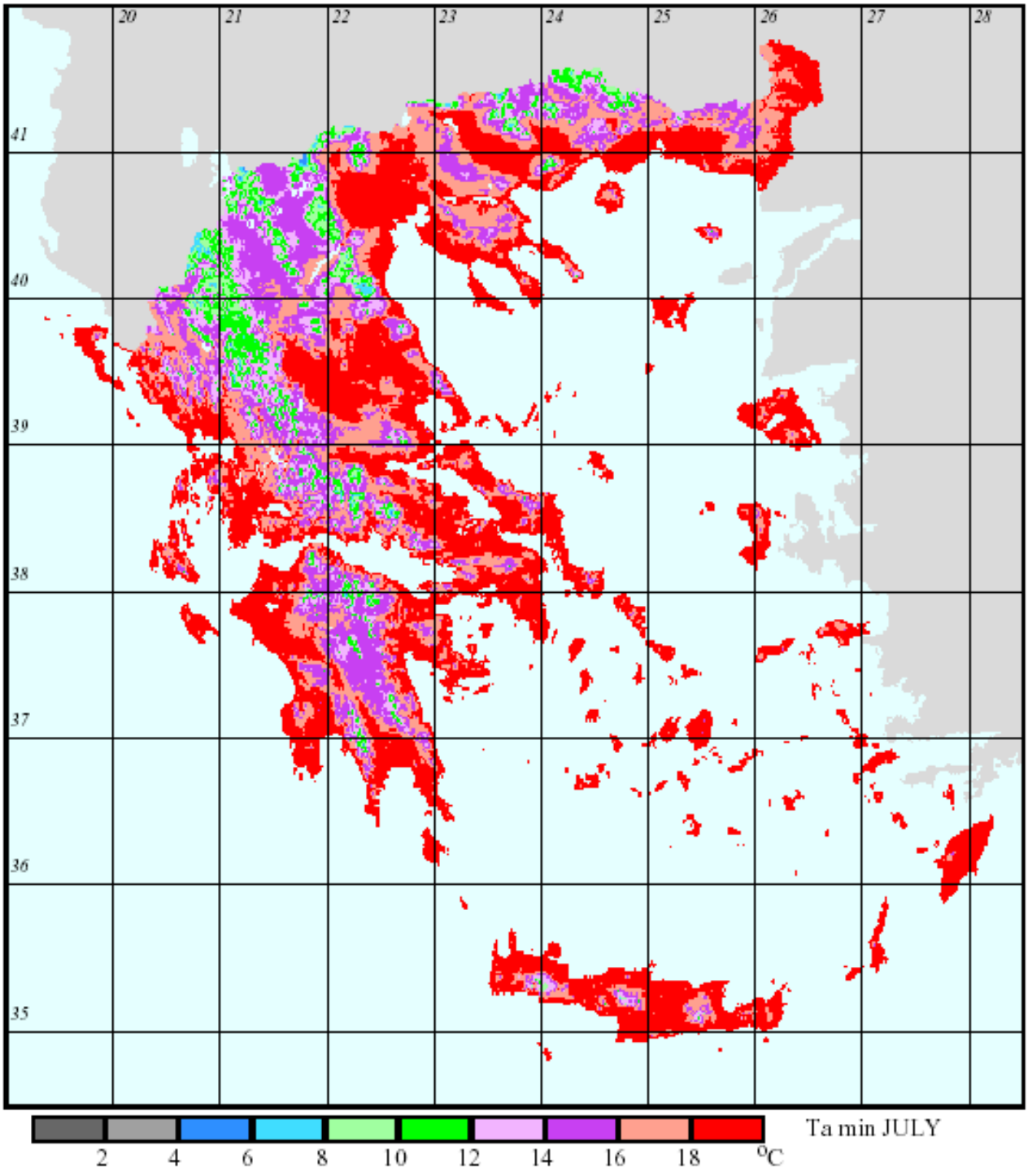

Fig. 4 Geographical distribution of mean minimum air temperature in July for Greece

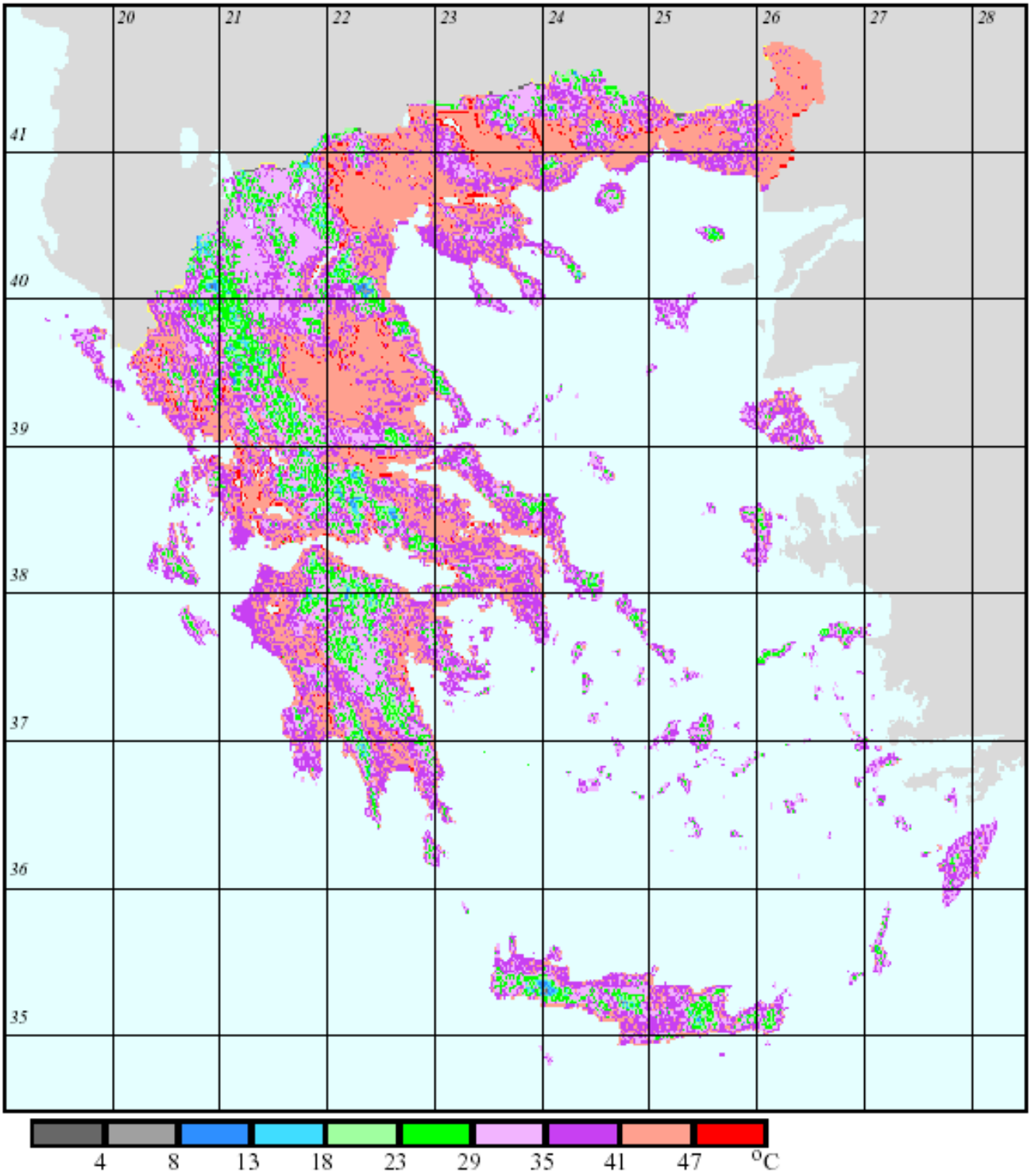

Fig. 5 Geographical distribution of PET in July in Greece

In Figure 5 the geographical distribution of PET of Greece is shown. With this kind of presentation it is possible to quantify areas which are suited for touristic purposes and which are not. As example the inner part of the mainland of Greece is characterised by higher values of PET than the islands of the Aegean Sea does not suffer so much higher values which mean heat stress because of the existence of the Etesian Winds System, which provide better bioclimatic conditions in this area.

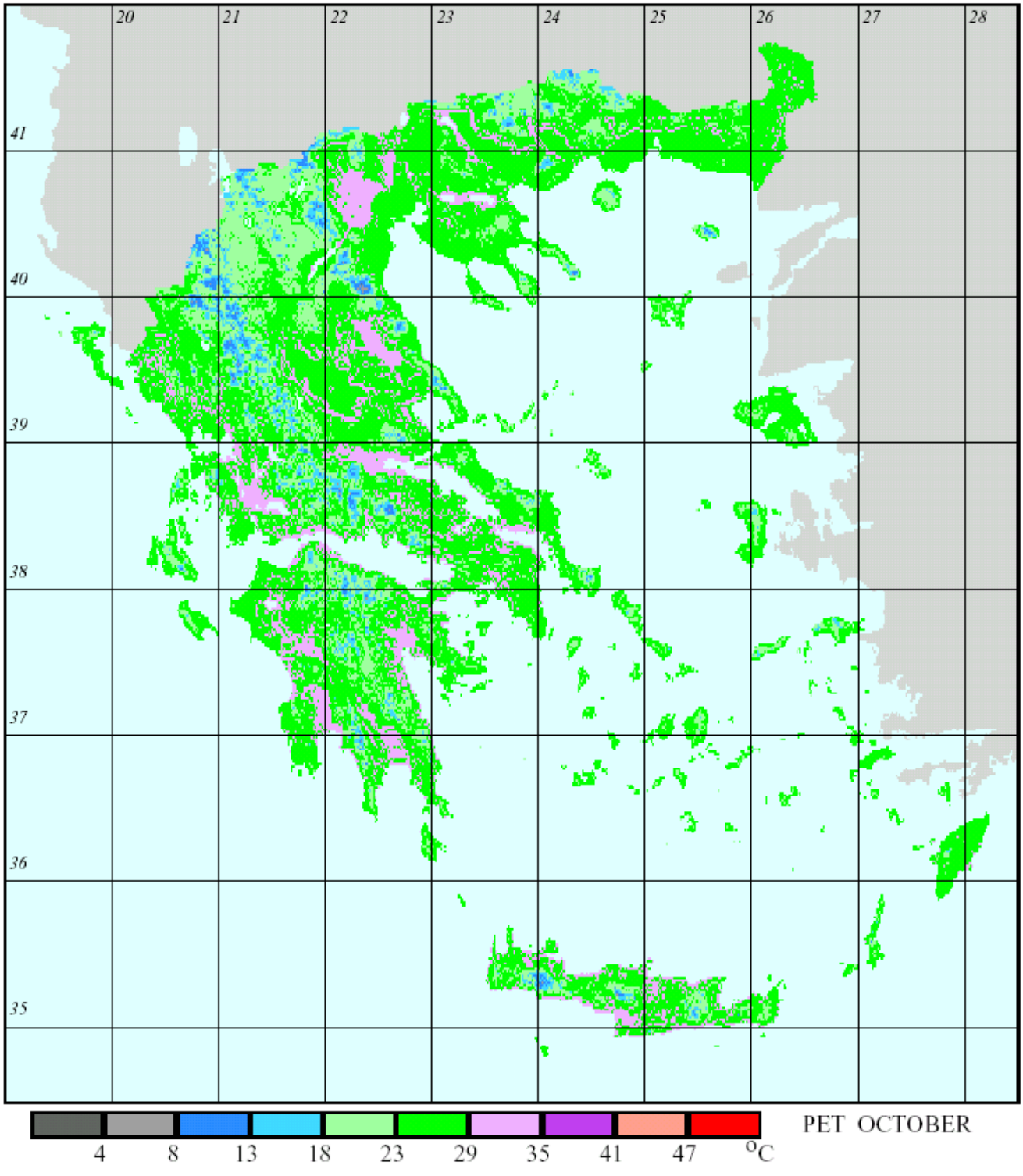

Fig. 6 Geographical distribution of PET in October in Greece

Figure 6 shows the geographical distribution of PET in October. From Figure 6 it can be seen that the values of PET during midday are not lower than 18 °C which means that in the areas for recrea-

tion and tourism during this period of day the conditions are at the level of thermal comfort or slightly warm. This evokes no physiological or slight thermal stress (Matzarakis and Mayer 1997, Matzarakis 2001).

Conclusions

Meteorological data from the point of view of tourism has to be available not only on a monthly or qn annual basis but also in form of frequency of exceeded values of thermal indices or parameters which can quantify special bioclimatic conditions to avoid stress conditions in specific areas which are not suited for touristic purposes.

For the characterization of climatic and bioclimatic conditions of areas often visited by tourists, it is not just enough to quantify only climatic variables or climatic indices. Detailed temporal and spatial bioclimatic analysis of the most important meteorological parameters (air temperature, wind speed, air humidity, short and long wave radiation fluxes) and thermo-physiological parameters (activity and clothing) should be included.

Existing meteorological and climatological information for tourism purposes contained in most tourism guides and books are not adequate for tourists and tourism industry. The full climatic data set from the national climate networks of the weather services gives detailed information for some areas. Spatial information with a monthly resolution including the combination of climatic parameter, thermal or climate indices as well as human biometeorological thermal indices (like PMV and PET) can describe the thermal environment of humans and give detailed meteorological and climatological information for diverse tourism purposes (http://www.mif.uni-freiburg.de/tourclimgr).

The thermal component is needed to compliment the air pollution component. Additional information about the air pollution conditions in holiday countries is also needed. Other information from the actinic parameters (UV-radiation), noise pollution and odours can also be very helpful for tourists and travellers.

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