

**METHODOLOGIES TO ASSESS THE EFFECTS OF CLIMATE ON TOURISM:  
WEATHER TYPE AND INDIVIDUAL PERCEPTION**

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**ABSTRACT** Tourism is an important activity in many countries. The climatic conditions are part of the image created about these places, mainly as a factor of attraction but sometimes also as a risk factor. The climatic information available for tourism purposes usually comprises the mean values of some specific variables. However, it must be kept in mind that the individuals are sensitive to particular combinations of meteorological parameters, rather than to single ones. This paper provides a review of some different methods used to assess the influence of weather and climate on tourism.

It is important to carry out the assessment of the relationship between climate and tourism by considering the frequency of weather types and/or indices, as well as their time variation. In general, the use of a thermo-physiological index, such as the Physiological Equivalent Temperature, is advantageous as it allows the evaluation of the combined influences of the atmospheric parameters, defining the thermal aspects of the atmospheric environment. This index can be combined with physical parameters and aesthetical aspects (such as cloud cover) to form weather type classes. Two examples are given, one from Funchal (Madeira Island) and the other from a sea-side resort in Sintra, western Portugal.

The second step of the research should involve a validation of the weather perception by tourists; this can be achieved by means of questionnaires, which must include subjective factors (motivation, individual preferences and cultural aspects), as they influence the perception of weather conditions and level of bioclimatic comfort.

The use of both methodologies (weather typing and questionnaires) will enable us to assess more accurately the weather perception of different groups of tourists.

**KEYWORDS:** *tourism, weather types, weather perception, climatic information, spatial representativeness*

## **INTRODUCTION**

Tourism is an important source of income for several countries. The climate influences the way the image of a destination is formed in the mind of a tourist, particularly when seeking to undertake leisure activities outdoors.

Many climatic variables affect tourist activities, namely air and water temperature, sunshine duration and intensity, long wave radiation, rainfall and wind speed. Climate and weather are factors that may increase or decrease the attractiveness of a specific tourism destination. Weather and climate may also constitute risk factors, through air pollution, extreme temperatures, storms, etc. (Matzarakis, 2006).

Most of the available climate information (in tourist brochures and guides, internet sites, but also in scientific publications) is related to mean values of individual parameters (with a large prevalence of data on temperature and rainfall). However, one must bear in mind that individuals do not react to “mean values”, but rather to real conditions, that is, to particular combinations of meteorological parameters. This combined effect can be evaluated by indices, either specific to tourism purposes (as the Tourism Climate Index - TCI) or more general thermophysiological indices, such as the Physiological Equivalent Temperature (PET) (Höppe, 1999, Matzarakis *et al.*, 1999), the Predicted Mean Vote (PMV) (Fanger 1972, Jendritzky and Nübler 1981, Parsons, 1993) or the Standard Effective Temperature (SET) (Parsons, 1993). The more recent thermophysiological indices include all atmospheric parameters relevant for the energy balance of the human body (including the main personal factors – clothing and physical activity) and are particularly useful when evaluating the thermal component of climate. But the weather conditions that matter to tourism are not only thermal, but also physical (determined mainly by wind speed and rainfall) and aesthetical factors (de Freitas, 2003): a cloudy or very windy day may not be adequate for outdoor leisure activities, even if thermal conditions are very pleasant.

There are several methods to include “non thermal” variables in the information used for tourism purposes. In this paper, we will mention and give examples of some of these methods.

## **THE WEATHER TYPE METHODOLOGY**

The “weather type” methodology was developed by Besancenot *et al.* (1978), with a first application to the Iberian Peninsula. This method was improved and applied in posterior studies in Portugal (Alcoforado *et al.*, 1999, 2004).

The weather type method has several advantages:

- it describes real weather conditions to which tourists are submitted;

- it allows the inclusion of risk factors (such as strong winds, high UV levels, etc);
- it can be adapted to leisure activities that have different climatic needs.

The methodology of weather types defined to suit tourism purposes was applied to study the climate of Funchal (Madeira – Portugal) (Alcoforado et al., 1999); 7 weather types were assigned to the summer period and 6 to the winter period, with thresholds based on the sunshine hours, rainfall, maximum air temperature, as well as vapour pressure and wind speed, measured at noon. Winter tourism is important in Madeira, and it can be seen that weather types favourable for tourism and outdoor leisure activities (types 1 to 4) reach a global value above 50% in December and January, being less frequent in February. The study was based on 3 single years: 1977/78, 1980/81 and 1984/85 (Fig. 1).

Weather type classification can integrate thermophysiological indices, which give the thermal component of the perception. This method has been applied to study the affect of weather conditions on seaside recreation activities in Praia Grande, Sintra (Fig. 1 – Alcoforado et al., 2004). Thermal conditions were assessed using PET, considering 3 classes, which were cross-tabulated with 3 classes of cloudiness to include aesthetical components (Fig. 2).

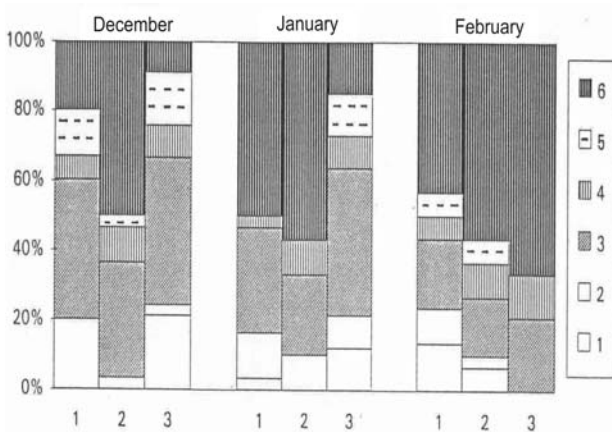
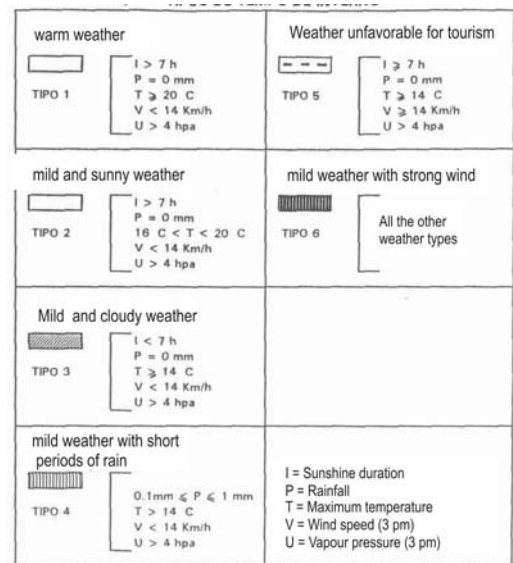


Figure 1: Winter weather types in Funchal



Physical aspects of wind speed and rainfall were not included, since these elements were not important during the days studied, but weather type classifications can be modified to include these aspects. Perception of weather conditions were considered indirectly, through the number of visitors at the beach (number of cars counted) and consumer behaviour at the nearby restaurants (Fig. 3).

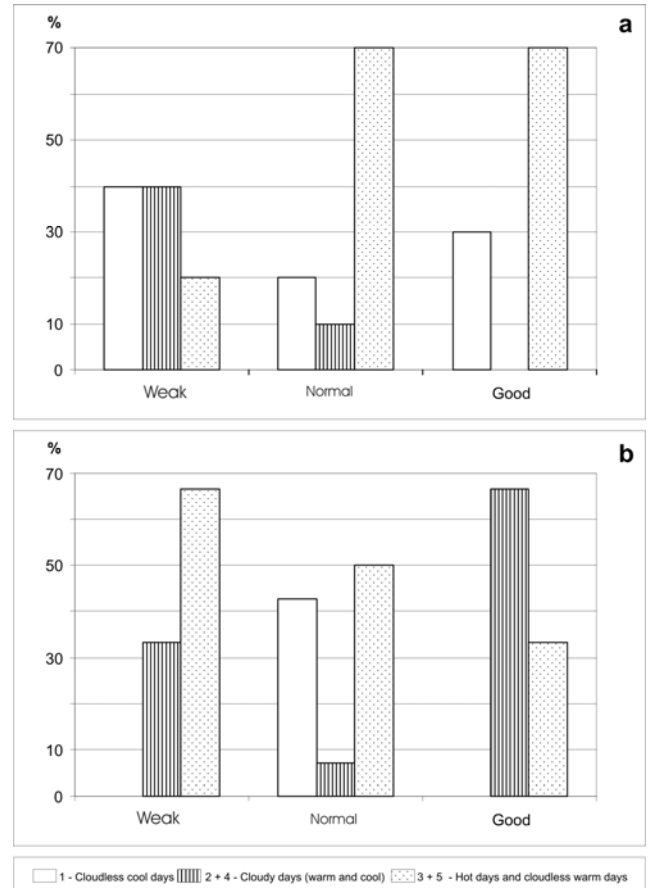
Cloudiness (octas)	PET (°C)		
	$\leq 30$	30 to 40	$\geq 40$
< 4	1 (23)	3 (30)	5 (15)
4 to 6	2 (21)	4 (11)	
> 6			

Class identification ← 1 (23) → Frequency (%) 5

Figure 2: Weather type classification at Praia Grande

## SPATIAL REPRESENTATIVENESS OF METEOROLOGICAL DATA USED FOR TOURISM PURPOSES

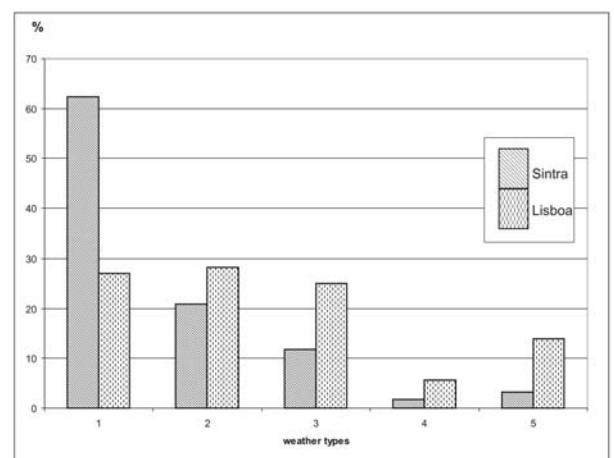
Much of the climatic information used for tourism is based on data obtained at synoptic stations of the meteorological services. Although in many situations this is the only available information, it is necessary to be aware that these data are frequently not representative of the local conditions experienced by tourists. This becomes obvious when we compare the frequency of weather types with seaside leisure, calculated after Alcoforado et al. (2004 – Figure 3), in the stations of Sintra/Granja (near Praia Grande) and Lisboa (Lisboa/Gago Coutinho - Figure 5). The two stations are 20 km apart; data from Lisboa/GC are frequently used as being representative of regional conditions. As it can be seen (Fig. 6), the coolest weather type (type 1- legend in Figure 3) is much more common in Sintra than in Lisbon (more than double the frequency). The use of data from Lisbon/Gago Coutinho as climatic information of the western seashore can therefore lead to misinterpretations.



**Figure 3: Weather types versus business.**  
**a. In a coffee shop in the beach; b In a restaurant**



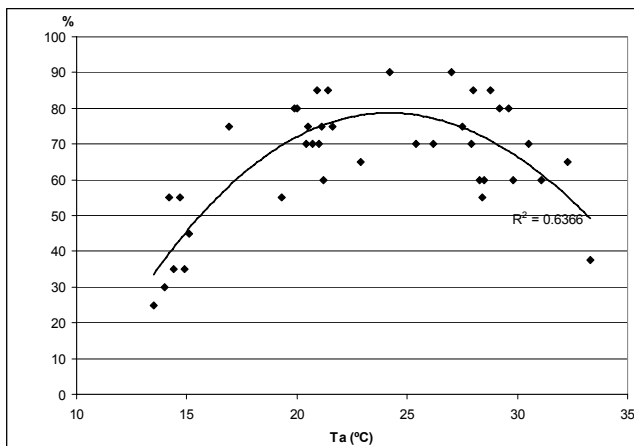
**Figure 4: Location of Meteorological stations of Lisboa/GC and Sintra**



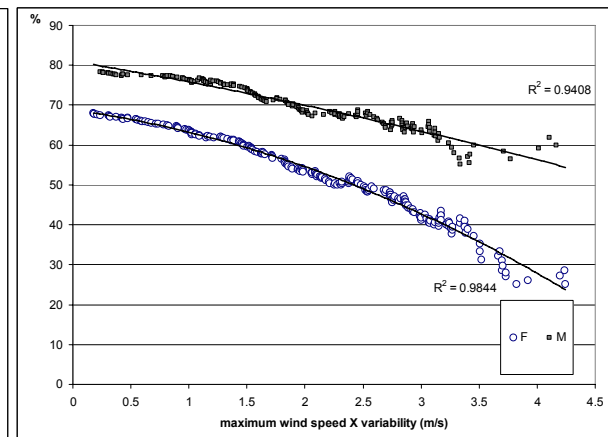
**Figure 5: Frequency of weather types in Lisboa/GC and Sintra (legend in Fig. 2)**

## THE PERCEPTION OF WEATHER CONDITIONS

Another important issue with regards to the assessment of the relations between climate and tourism is the knowledge of how tourists (or other persons involved in leisure activities) perceive the atmospheric conditions. Independently of the adequacy of the meteorological measurements to tourism purposes, it is the perception of the tourists that leads to the construction of the climatic image of the destination. The perception of atmospheric conditions is a very complex question, that involves not only thermophysiological factors (that can be objectively assessed through the bioclimatic indices), but also psychological (subjective) factors. These subjective factors, such as motivation, individual preferences and cultural aspects, also influence the way the tourists perceive the weather at the destination and judge it as more or less comfortable. All these aspects are very difficult to assess (Oliveira and Andrade, 2007, Höpfe, 2002), but the perception of the climatic variables can be assessed through interviews or behaviour observation (de Freitas, 2003).



**Figure 6: Percentage of persons that declared satisfaction with air temperature**



**Figure 7: Percentage of persons that declared satisfaction with wind speed, by gender**

A methodology to assess the perception of atmospheric conditions and the sensation of thermal and mechanical comfort was described in Oliveira and Andrade (2007) and in subsequent works. Surveys about individual perception of atmospheric conditions have been carried out, simultaneously with meteorological parameters measurements (air temperature, relative humidity, wind speed and solar and infrared radiation). Nearly 900 inquiries were made to users of the leisure Lisbon riverside areas during 2006 and 2007, in all seasons. The analysis took into account the complex relations between measured values, personal characteristics (including gender, age, clothing, and geographic origin, among others) and the level of comfort declared by interviewees (Oliveira and Andrade, 2007). The results showed

that, in spite of a large level of acceptability of outdoor atmospheric conditions by persons involved in leisure activities, it is possible to define boundaries beyond which this acceptability greatly decreases (Fig. 7). It was also possible to demonstrate the obvious significance of personal characteristics (such as geographical origin and gender – see Figure 8) and of the subjective parameters in the perception of atmospheric conditions.

## CONCLUSION

The image of a tourist destination and the preference of the tourists for specific places are greatly influenced by the climatic conditions, including the physical, aesthetical and meteorological aspects. Therefore, it is extremely important to consider the combination of these variables in the climatic information available for tourism purposes. Furthermore, it is also important to consider the way tourists perceive the meteorological parameters, since this contributes to the construction of the mental image of the tourism areas.

There are several methodologies available to incorporate these different variables; the “weather type” methodology can be combined with bioclimatic indices. In addition, surveys about the perception of atmospheric conditions, carried out simultaneously with measurements of climatic variables, can complement the climatic information available for tourism.

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