

## **WEATHER LIMITATIONS FOR WINTER AND SUMMER TOURISM IN EUROPE**

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**ABSTRACT** Weather is a factor that influences the possibility of outdoor recreation and tourism. However, the typical feature of climate in Central Europe is great and frequent change of weather that can influence outdoor activity. The aim of the paper is to discuss possible weather limitations for tourism, their frequency and seasonal pattern. A special bioclimatic typology of weather was used for this purpose. The examples are taken from the Polish lowlands, the Alps, the Carpathians and the Hungarian Plain. In summer the most frequent and the most dangerous weather conditions for humans are related to extreme hot as well as prolonged and heavy rains. In winter outdoor recreation is hindered by frosty weather and intensive snow falls and/or lack of snow cover. The frequency of unfavourable weather in summer has increased during the last decade. The frequency also increases from the North to the South of studied region. In the winter season inter-annual variability of snow cover is the greatest limitation in the mountain areas. However, extreme frost can limit outdoor recreation as well.

**KEYWORDS:** *Tourism, Mountains, Lowland, Europe*

### **INTRODUCTION**

Over the last decades a significant increase in the number of people interested in tourism and recreation was observed. Tourism and recreation are also important for national economies. When choosing location and time for recreation we should consider climate and weather features, paying particular attention to their seasonality (Blazejczyk, 2001, Kozłowska-Szczesna et al., 1997). They are the key elements for outdoor recreation abilities and they affect our satisfaction/dissatisfaction as well as human's health (Blazejczyk 2000, 2005, Matzarakis and Mayer, 1991, 1997, Parsons, 2003). Favourable climate and weather conditions are essential advantages for recreation and tourism activity (Blazejczyk, 2001, de Freitas 1990, 2003).

The aim of the paper is to assess weather limitations for outdoor recreation that occur in Europe

## MATERIALS AND METHODS

The research is based on daily meteorological data for 10 stations located across Europe that represent various climate types: Helsinki, Stockholm, London, Krakow, Paris, Zurich, Budapest, Valencia, Rome and Athens. The data is analysed for the period 1991-2000.

The weather features were defined based on the human heat balance model MENEX\_2005 for each day of the studied period with the use of BioKlima©2.5 software package. The used bio-thermal classification of weather provides two kinds of information: about the thermophysiological state of the human body caused by daily weather and about the occurrence of meteorological situations that can affect outdoor recreation.

The weather information is described by a seven-digit code (Tab. 1). For example, the code -2\_2C0\_011 indicates cold weather (-2) with moderated radiation stimuli (2), cold physiological strain (C), non sultry (0) with insignificant daily thermal contrast (0), rain (snow) fall (1) and snow cover (1).

Daily weather conditions were assessed regarding certain types of recreation: sun baths (staying in a sunny place – SB), air baths (staying in a shaded place- AB), mild recreational activity (e.g. walking, light plays, shopping – MR), intensive recreation and summer tourism (e.g. football, biking, climbing, jogging etc. – AR), and ski tourism (ST). Each weather situation was evaluated using the Weather Suitability Indices (*WSI*) as follows: 0 – unfavourable, 1 – favourable with limitations, 3 – favourable without limitations.

**Table 1: The scheme of bio-thermal weather classification**

	Weather component						
	Weather type	Weather subtype			Weather class		
	Thermal sensation	Radiation stimuli	Physiological strain:	Sultriness intensity	Daily thermal contrast	Precipitation	
Site of weather indicator	1	2	3	4	5	6	7
Weather indicator	-3 (very cold) -2 (cold) -1 (cool) 0 (comfortable) 1 (warm) 2 (hot) 3 (very hot)	1 (weak) 2 (moderate) 3 (great)	C (cold) T (neutral) H (hot)	0 (non sultry) 1 (moderate) 2 (great)	0 (weak) 1 (significant)	0 (no precipitation) 1 (precipitation >1 mm)	0 (no snow) 1 (snow cover > 10 cm)

Because of its nature, *WSI* is not calculated with a mathematical formula but by using a lookup table. Such a table contains the *WSI\_XX* (i.e. SB, AB, MR, AR, ST) values corresponding to each weather class (see BioKlima©2.5. help file).

## RESULTS

Several features of weather that can limit tourism activity were found:

- extreme thermal conditions (both in summer and in winter),
- sultriness (summer),
- strong radiation stimuli at hot physiological strain (summer),
- weak radiation stimuli at cold physiological strain (winter),
- precipitation (summer and winter).

### Winter weather limitations

The largest amount of days with extreme cold physiological strain was found for Cracow (southern Poland) because of its location in the sub mountain basin of the Vistula river. Severe weather that involves intensive thermoregulatory reactions to the cold are also frequent in Helsinki due to its northern location. In the Mediterranean as well as in London such situations are observed sporadically (Fig. 1).

In humans the influence of cold weather is also manifested by the thermal sensations “cold” and “very cold”. They are observed in about 20 % of days per year in Helsinki. In Stockholm and Cracow its frequency is 8-10 %. However, in the Mediterranean such sensations are not observed (Fig. 2).

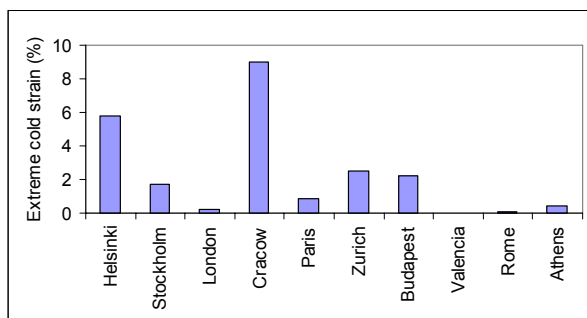


Figure 1: Annual frequency of days with extreme cold physiological strain

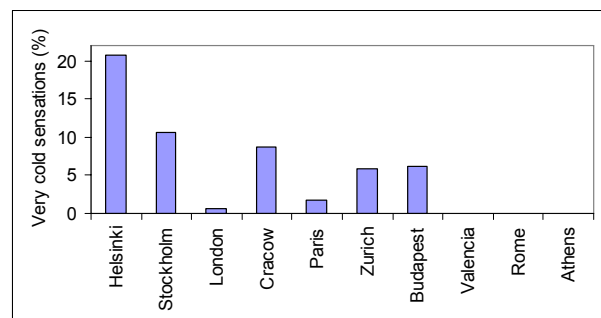
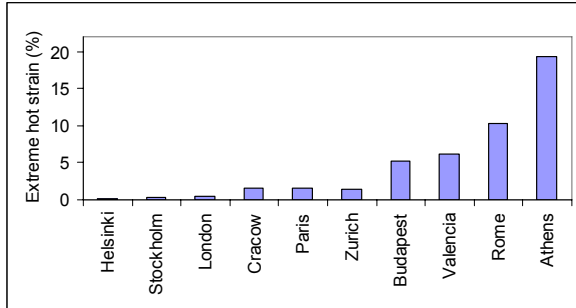


Figure 2: Annual frequency of days with thermal sensations „cold” and „very cold”

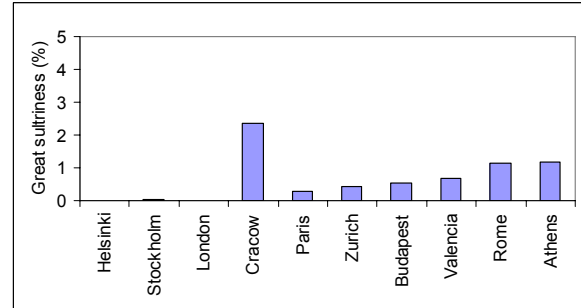
### Summer weather limitations

Active recreation in summer is limited by high air temperature and humidity. They involve very intensive adaptation reactions in an organism defined as an extreme hot physiological

strain. It occurs on about 20 % of days in Athens, 10 % of days in Rome and about 5 % of days in Valencia and Budapest. In other cities its frequency is very small (Fig. 3). The subjective reaction to hot and wet weather is sultriness. The greatest number of sultry days (2.5 % of days per year) was found in Cracow. However, in Scandinavian cities and in London sultry days are not observed (Fig. 4).

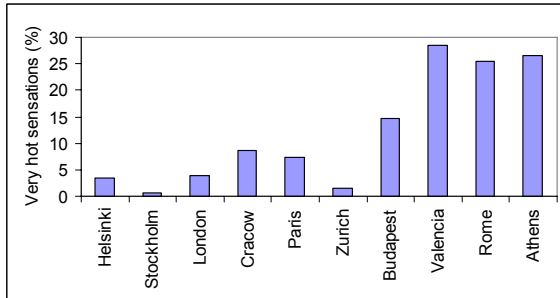


**Figure 3: Annual frequency of days with extreme hot physiological strain**



**Figure 4: Annual frequency of days with great sultriness**

Hot weather in summer is also manifested by the thermal sensations “very hot” and “sultry”. In the Mediterranean cities they occur up to about 30 % of days per year. Such sensations are very rare in Stockholm, Zurich, Helsinki and London (1-4 % of days per year) (Fig. 5).



**Figure 5: Annual frequency of days with thermal sensations „very hot” and „sultry”**

### Whole year weather limitations

There are also weather features that limit recreation throughout the year. The first is precipitation. A precipitation day is defined by the weather classification as a day with rain/snow fall > 1 mm. Precipitation days are rather frequent in northern, western and central Europe (30-34 % days per year). In the Mediterranean cities and in Budapest rain or snow fall occurs only during 10-25 % of days per year (Fig. 6). Radiation stimuli are very important in recreation. Weak stimuli can limit outdoor activity throughout the year. The greatest number is observed for Scandinavian cities (due to low sun altitudes) and in London (because of frequent cloud cover and low sun altitudes in winter). In southern Europe weak radiation stimuli occur only from September until May with a frequency of 20-40 % per month (Fig. 7).

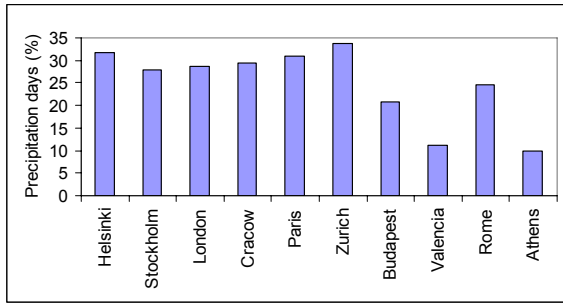


Figure 6: Annual frequency of precipitation days

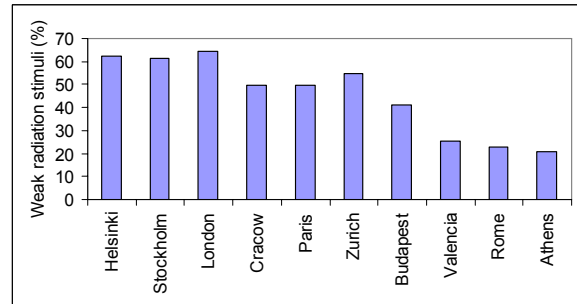


Figure 7: Annual frequency of days with weak radiation stimuli

### Weather suitability for various forms of recreation

To assess the suitability of weather for various forms of outdoor recreation, the *WSI* indices can be considered for consecutive pentads of the year. As an example the annual course of mean pentad values of *WSI* for Cracow is presented. The weather suitable for passive recreation (sun and air baths), although some limitations apply, occurs from the 23 until the 58 pentad of the year. In winter they are limited by low temperatures, rain/snow fall and wind. Active recreation can be carried out all year round. However, the period from mid autumn until the end of April is most favourable for intensive forms of recreation. In summer intensive recreation is limited by high air temperatures and sultriness (Fig. 8).

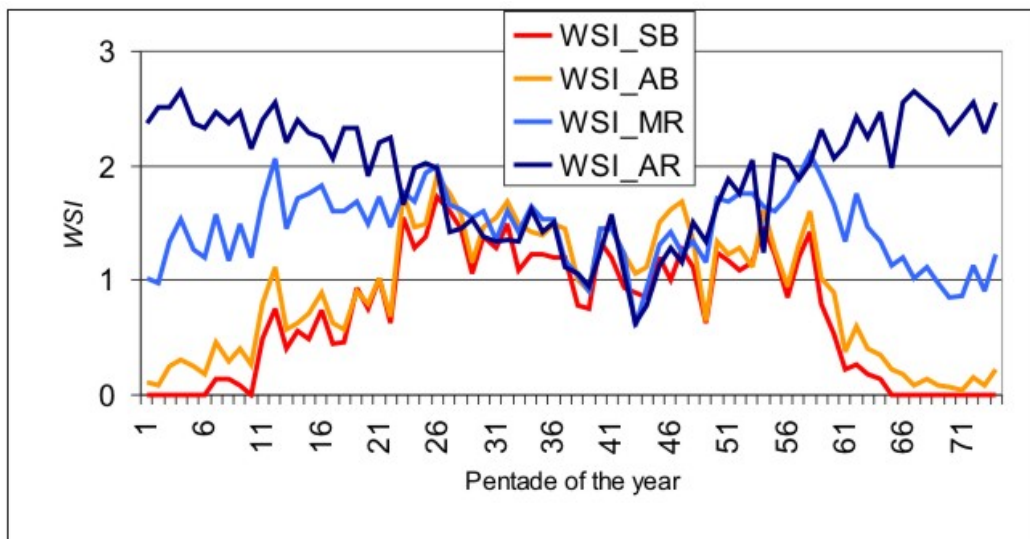


Figure 8: Mean values of Weather Suitability Indices for various forms of outdoor recreation at consecutive pentads of the year, Cracow 1990-2000

### CONCLUSIONS

Several weather limitations for outdoor recreation occur in various climatic regions of Europe. In summer the weather conditions in the Mediterranean are not suitable for active outdoor recreation due to the high temperatures and strong radiation stimuli. Also in central Europe hot physiological strain is the principal weather parameter that limits outdoor

recreation. However, in northern and central Europe passive recreation (sun and air baths) is limited by weak radiation stimuli and rain.

In winter both cold physiological strain and cold thermal sensation occur in Scandinavia and central Europe, as low temperatures and high wind speed limit mild outdoor recreation. However, in the Mediterranean the bio-thermal features of weather are favourable for both mild and intensive recreational activities.

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