BIOCLIMATE INFORMATION FOR ISTANBUL

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ABSTRACT Information about climate and bioclimate is important due to the effects of climate and weather conditions on several aspects of daily life. They are of particular importance for areas in which the economy dependence on tourism and recreation. Data from the City of Istanbul was analysed in order to quantify the climate and bioclimate conditions for applications in health, tourism and recreation issues.

KEYWORDS: *Istanbul, RayMan, spa climatology, thermal comfort*

INTRODUCTION

The climate conditions vary on a spatial and temporal scale. Thus information on day-to-day meteorological conditions and long term climate conditions are required in order to determine the positive or negative effects of the atmospheric conditions on humans. Climatic conditions are of particular importance for tourism and recreation (Matzarakis et al., 2004). People are exposed to different climatic conditions when they are on holidays or recreation. Istanbul is an internationally well known and attractive tourist city (Bahadir et al., 1999). We aimed to quantify the climate conditions required for a health(y) tourist stay in Istanbul.

METHODS AND DATA

Daily data on air temperature, air humidity, wind conditions and cloud cover for the period October 2000 to December 2006 were obtained for the western part of Istanbul (old city) in Turkey from the Turkish State Meteorological Service. The data were analysed and processed by use of the RayMan model. Thermal indices (Matzarakis and Rutz, 2005, Matzarakis et al., 2007) were calculated for the description of the thermal bioclimate (Physiologically Equivalent Temperature) of humans based on their energy balance (VDI, 1998, Höppe, 1999, Matzarakis et al., 1999). The results were analysed not only in terms of mean conditions, but

also for threshold classes to describe frequencies, extremes and negative effects in a better way and to determine acceptable conditions for a healthy stay in Istanbul.

RESULTS

The results were analysed by the use of the following parameters:

- Air temperature (Fig. 1)
- Relative humidity (Fig. 2)
- Vapour pressure (Fig. 3)
- Wind speed (Fig. 4)
- Mean radiant temperature (Fig. 5)
- Physiologically Equivalent Temperature (Fig. 6)

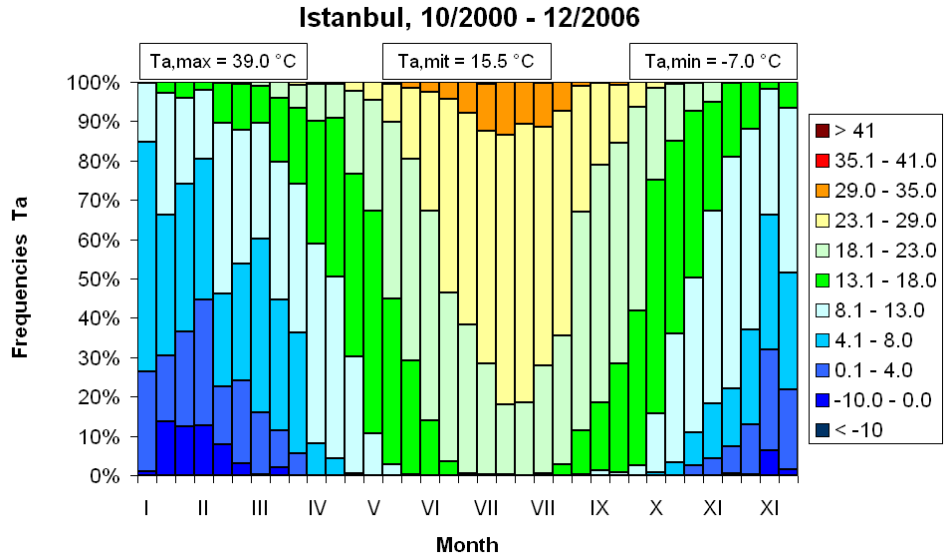

Figure 1: Frequency diagram of air temperature classes for Istanbul for the period October 2000 to December 2006

Fig. 1 shows the frequency diagram of air temperature, for the examined period based on classes. The highest air temperature in Istanbul was 39.0 °C and the lowest -7 °C. Air temperature at times exceeds 29 °C between the end of May and the end of September. Negative air temperatures are obtained only in the period from mid November to March with the highest percentages (about 10 %) in mid January to mid February.

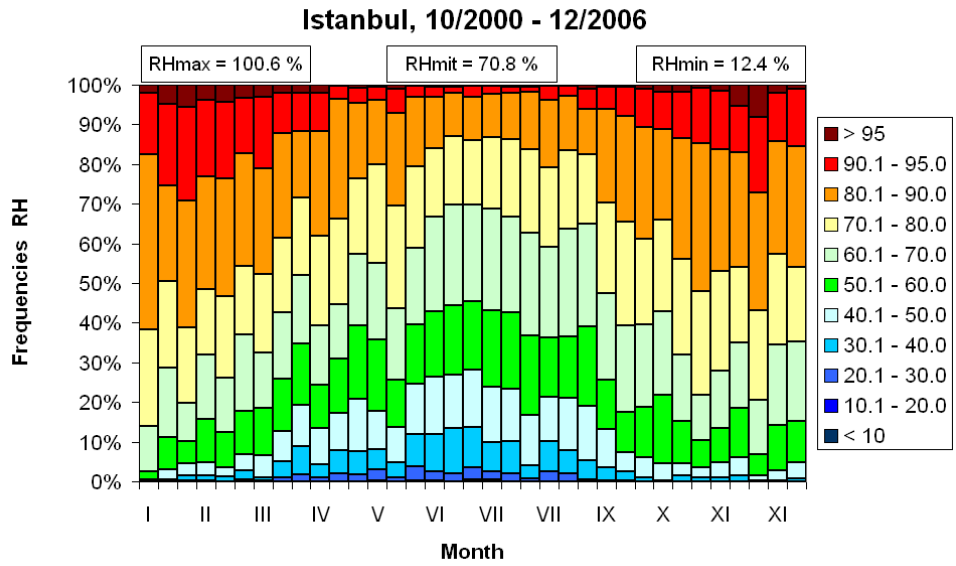

Figure 2: Frequency diagram of relative humidity classes for Istanbul for the period October 2000 to December 2006

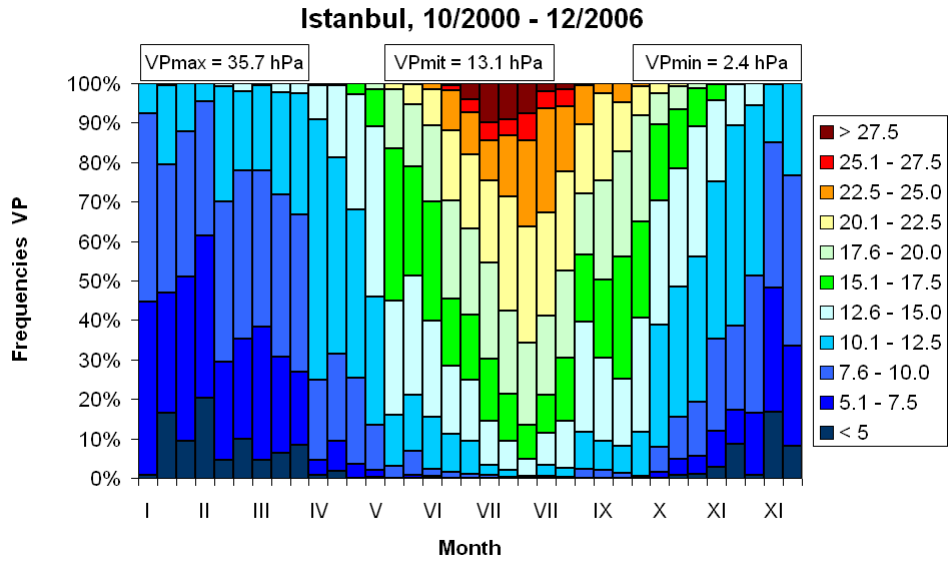

Figure 3: Frequency diagram of vapour pressure classes for Istanbul for the period October 2000 to December 2006

Here the humidity conditions are analysed in terms of relative humidity and vapour pressure. Fig. 2 shows that relative humidity conditions with high values are obtained in winter and low frequencies with less than 30 % humid days of all days are observed in the summer months. Vapour pressure conditions (Fig. 3), expressed in terms of sultriness (Bahadir et al., 1999) occur in Istanbul during the summer period. Days with vapour pressure higher than 20 hPa can be find from June to October, with maxima in July and August (more than 50 % of all days) and less than 10 % at the beginning of June and October.

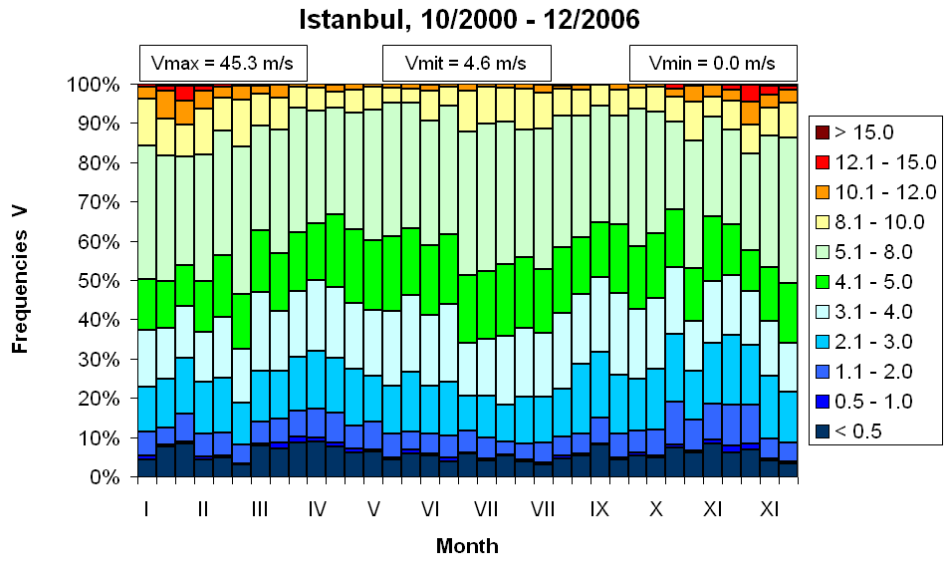

Figure 4: Frequency diagram of wind speed classes for Istanbul for the period October 2000 to December 2006

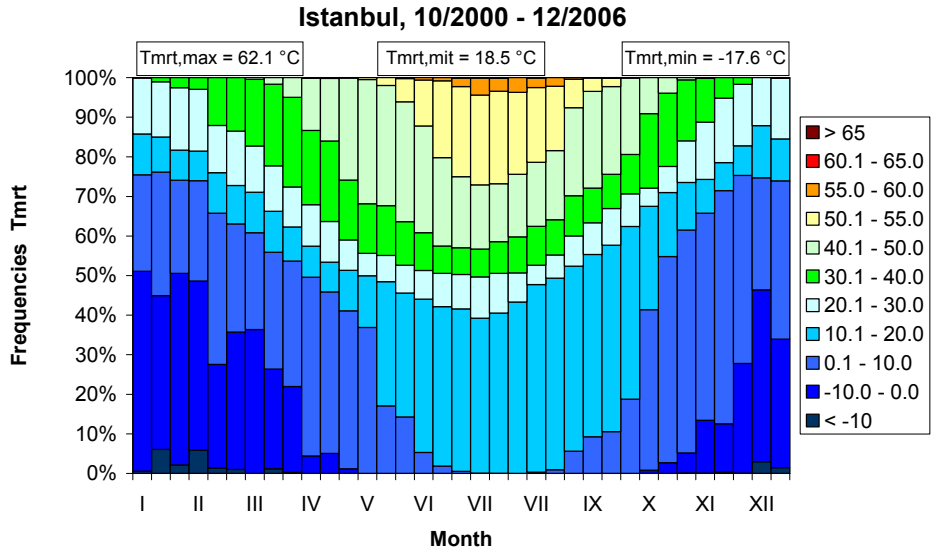

Figure 5: Frequency diagram of mean radiant temperature classes for Istanbul for the period October 2000 to December 2006

In general, the mean wind conditions are 4.5 m/s and the highest measured wind for the examined period was 45.3 m/s. About 25 to 30 % of the days can be described as calm days with wind speed lower than 3 m/s (Fig. 4).

The radiation fluxes are expressed here by the mean radiant temperature with a mean of 18.5 °C, which is 3.0 °C higher than the mean air temperature (Fig. 5).

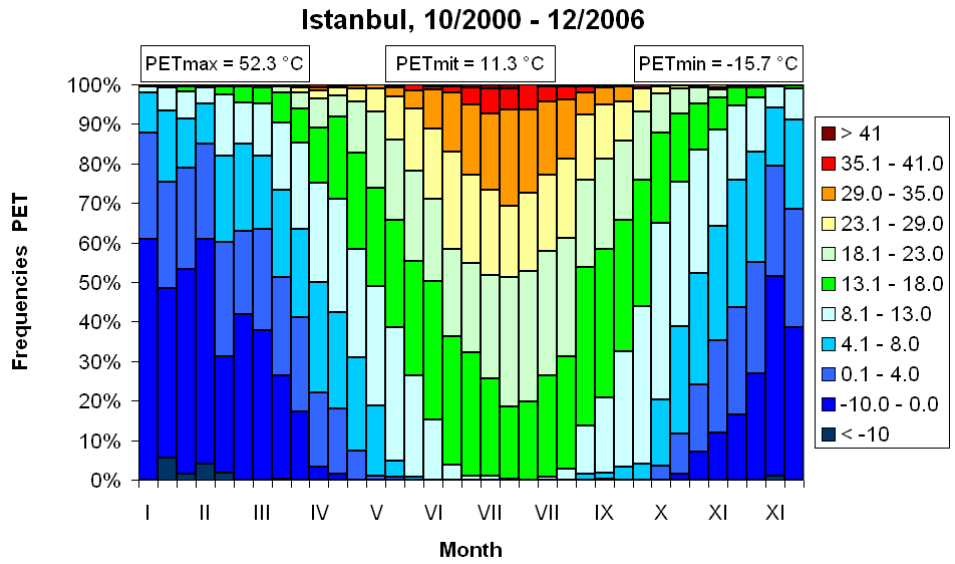

Figure 6: Frequency diagram of PET classes for Istanbul for the period October 2000 to December 2006

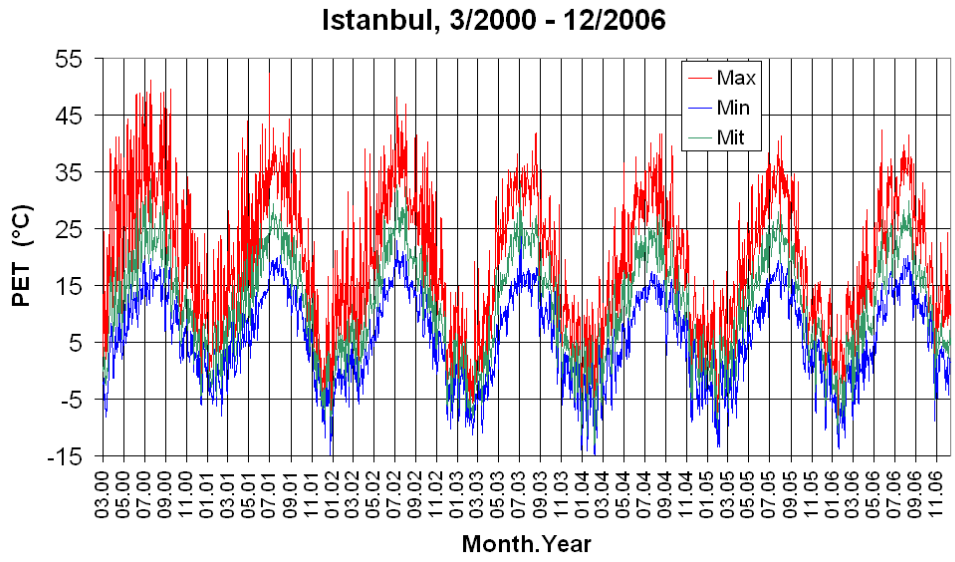

Figure 7: Daily max, min and mean of PET in Istanbul for the period October 2000 to December 2006

The physiologically equivalent temperature, which describes the effect of the thermal environment on humans, is shown in Fig. 6. Cold stress (PET < 0 °C) can be found in Istanbul in the period from end of October to the beginning of April, with the highest percentages of days in February (about 60 %). On the contrary, heat stress is observed from the beginning of June until the end of October. Thermal comfort conditions do not exist during the main winter months.

In addition, the daily min, max and mean PET are presented in Fig. 7.

The results show that the description of mean, maximum and minimum conditions based on climatological elements does not represent the only possibility to describe the climatic conditions in Istanbul. The "visualisation" of classes of basic climatic parameters and thermal bioclimatic indices, howerver, is a valuable alternative to traditional methods.

CONCLUSIONS

The presented analysis is the first step in the development of a data base with biometeorological information for the public and the tourist institutions concerned with spa holidays or health-related visits to Istanbul. The results were presented using frequencies, which are based on thresholds of simple climate and bioclimate parameters. This allows a detailed and relevant description of the climate conditions. The results can be used not only for health tourism and recreation uses, but also for analyses of the urban climate and other applied climatological studies.

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REFERENCES

Bahadir, S., Karagülle, M. Z, Aslan, O. (1999) Frequency, intensity and duration of sultriness in Istanbul. ICB10.4. Proceedings of the 15th International Congress of Biometeorology & International Conference on Urban Climatology. November 8 - 12, Sidney.

Höppe, P. (1999) The physiological equivalent temperature in a universal index for the bio-meteorological assessment of the thermal environment. Int. J. Biometeorol. 43: 71-75.

Matzarakis, A., Mayer, H., and Iziomon, M.G. (1999) Applications of a universal thermal index: physiological equivalent temperature, Int. J. Biometeorol. 43: 76-84.

Matzarakis, A., Rutz, F. (2005) Application of RayMan for tourism and climate investigations. Annalen der Meteorologie 41: Vol. 2, 631-636.

Matzarakis, A., Rutz, F., Mayer, H. (2007) Modelling Radiation fluxes in simple and complex environments – Application of the RayMan model. Int. J. Biometorol. 51: 323-334.

Matzarakis, A., de Freitas, C., Scott, D. (2004) (eds.) Advances in tourism climatology. Ber. Meteorol. Inst. Univ. Freiburg Nr. 12.

VDI (1998) Methods for the human-biometerological assessment of climate and air hygiene for urban and regional planning. Part I: Climate, VDI guideline 3787. Part 2. Beuth, Berlin.