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COMPARISON OF CLIMATE AND SYNOP MEASUREMENTS FOR THE BIOCLIMATE OF AUSTRIA

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1 INTRODUCTION

The project Austrian Climate and Health Tourism Initiative (ACTIVE) was aimed to improve the utilization of climate resources for tourism especially health tourism (Koch et al., 2005). The data used come from the climate-data archive (only Austrian stations) of the Central Institute of Meteorology and Geodynamics (ZAMG) as well as from the synoptic data archive including Austrian records and records from the neighbouring countries. The data cover the period from 1. January 1996 until 31. December 2000 with daily measurements of 201 climate stations and 278 synoptic stations. We emphasised the comparison of these two station and data types. The available meteorological parameters were: air temperature (°C), relative humidity (%), wind velocity (m/s) and cloud cover. Cloud cover is given in octas for synoptic and in 1/10 for climate stations. Climate data is measured at 7, 14 and 19 local mean time while synoptic observation hours are 6, 12, and 18 UTC. Aim of this analysis was to detect the differences in the input data, which are required for the calculation of Physiological Equivalent Temperature (PET) and their effects on PET.

2 METHODS

For the evaluation of the thermal component of humans, well-established methods of human-biometeorology have been applied. From the thermal indices PMV, PET and SET*, which are part of the calculation of the RayMan model (Matzarakis et al, 2000), we selected here PET, which is based on the Energy Balance of Humans as well all the other above mentioned thermal indices. For the calculation of PET air temperature (T_a), vapour pressure (V_P), wind velocity (v), as well as short and long-wave radiant fluxes from the thermal environment to the human body as the mean radiant temperature (T_{mrt}) are required (Höppe, 1984, 1993, 1999). PET is based on the calculation of Energy Balance of Humans for outdoor conditions (Höppe, 1993). According to the definition of PET the calculations have been run for a male, 35 years, height of 1,75 m and a weight of 75 kg. Mean radiant temperature and PET have been calculated by RayMan (Matzarakis et al., 2000).

201 stations from the Austrian climate network and 278 stations from the synoptic network in Austria and nearby countries for the calculation of PET have been used. The comparison was done for 19 locations, which have a climate and a synoptic station. Based on daily data at midday, monthly means were calculated. This time of the day is most important for tourists and for research, because it represents the most favourable thermal conditions during winter and the “worst” conditions during summer. Then the differences between the meteorological parameters in the different types of data sets have been analysed.

To visualize, the differences for the whole area of Austria, multiple linear regression analysis has been applied, which allows the construction of maps based on longitude, latitude, elevation, aspect, slope and land use. The grid resolution is 1 km x 1 km. For each monthly map of PET and the differences between climate and synop data have been constructed.

3 RESULTS

Figure 1, 2 and 3 show the monthly mean values of the air temperature, mean radiant temperature and PET for 19 locations with a climate (14 local mean time) and synoptic (12 UTC) observations. The air temperature of the synoptic stations is in every month lower than at the climate stations. On the other hand the mean radiant temperature of the climate stations is always smaller than at the synoptic stations. Climate stations show during the most time of the year higher PET values than synoptic stations. Only in December the 12 UTC PET value is higher than the 14 mean local time value, from January to March there are only slight differences.

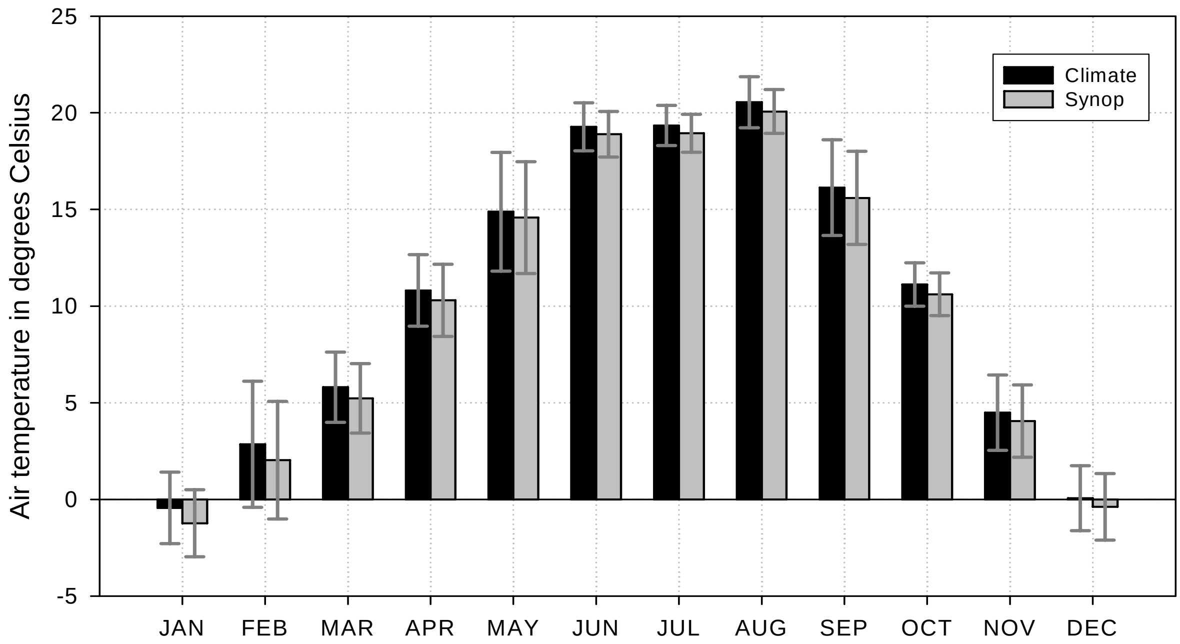

Figure 1. Monthly mean values of air temperature for 19 locations with climate (14 local mean time) and synoptic (12 UTC) stations

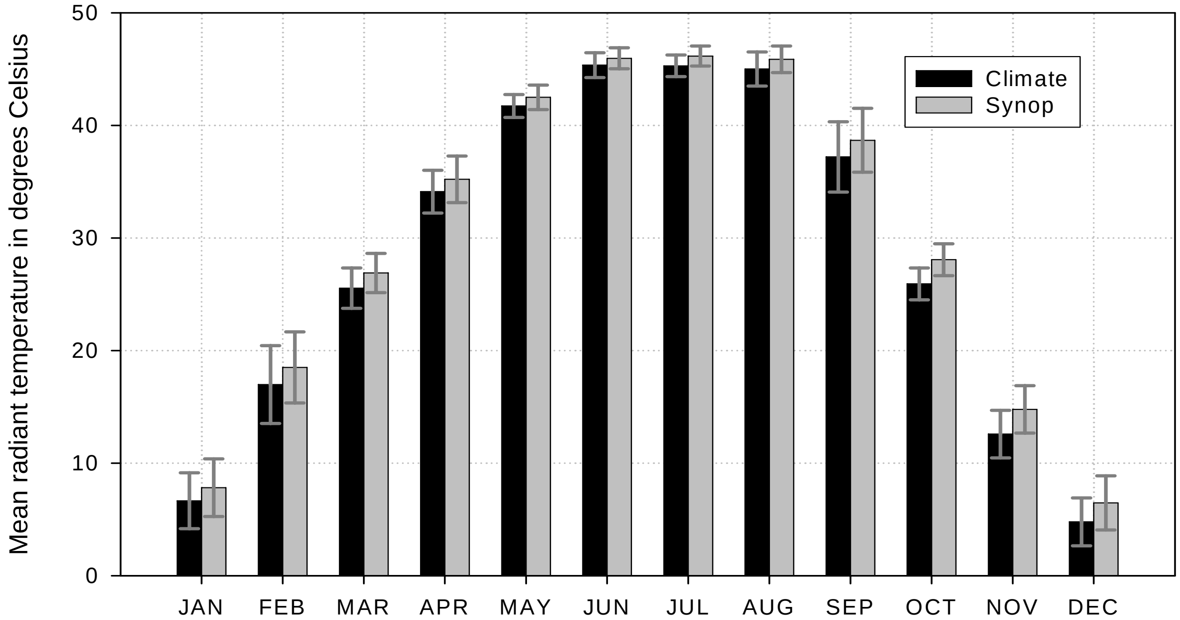

Figure 2. Monthly mean values of mean radiant temperature for 19 locations with climate (14 local mean time) and synoptic (12 UTC) stations

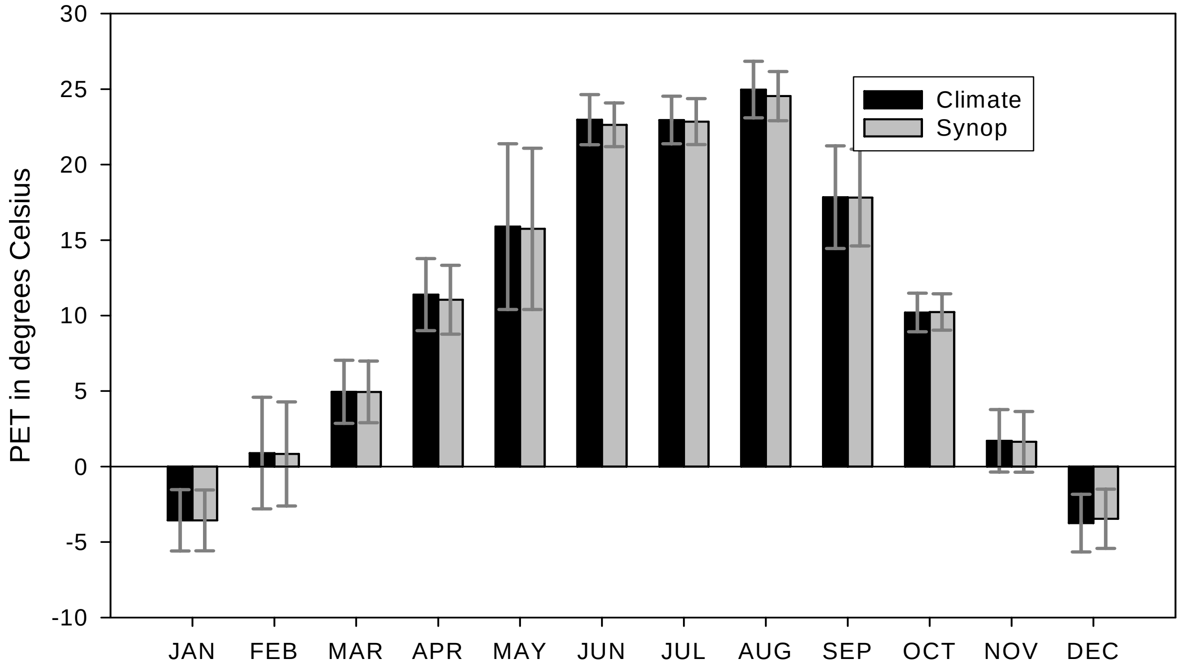

Figure 3. Monthly mean values of PET for 19 locations with climate (14 local mean time) and synoptic (12 UTC) stations

In figure 4, the absolute difference of climatic stations at 14 local mean time minus synoptic stations at 12 UTC in July for PET in degrees Celsius is presented. The lowest differences in the PET values are less than 2.1 °C and can be observed on higher elevation areas in the Alps and in the plains in the northern parts of the country. In the valleys in the Alps the highest differences raises up to 6.4 °C, especially in the Rhine Valley and other western regions of Austria.

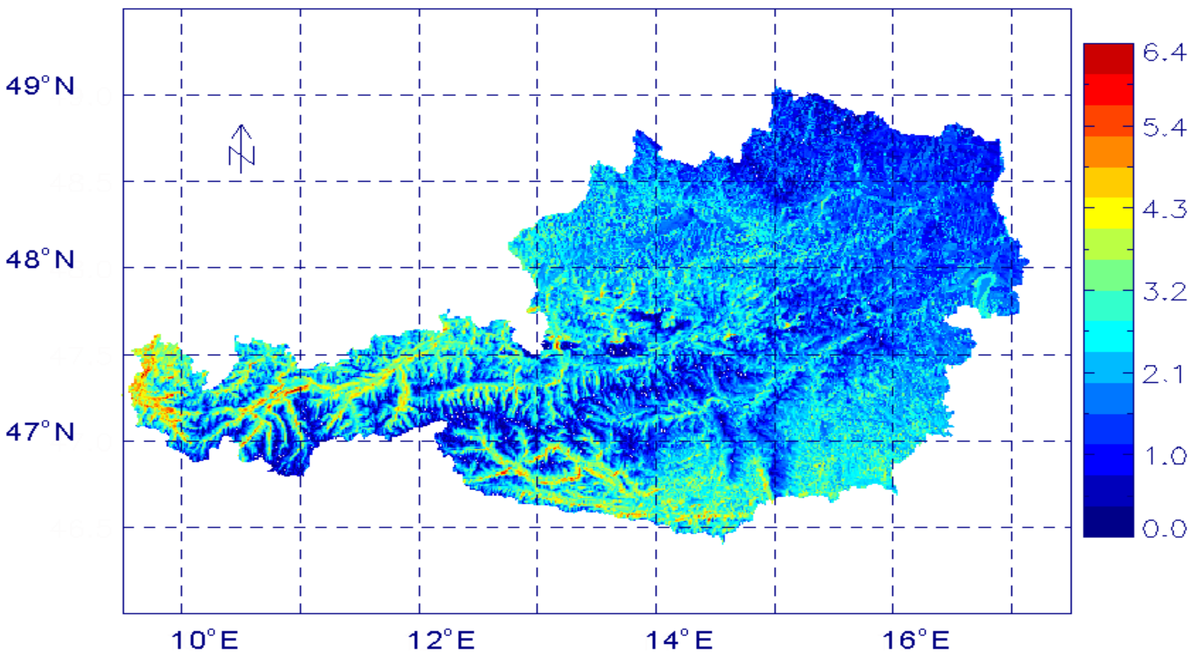

Figure 4. Absolute difference of PET in degrees Celsius between climate (14 local mean time) and synoptic (12 UTC) station-data in July for PET (1996-2000)

4 DISCUSSION

The maximum of radiation fluxes can be observed at high noon and therefore the time shift of the observation hours at the different station types explains the different results of PET. According to the diurnal variation of the sun, T_{mrt} is always lower at the climate stations than at the synoptic. The effect of different observation time is also responsible for the differences in air temperature between climate and synop stations. Here the maximum of T_a usually occurs two or three hours after noon where the maximum of T_{mrt} is reached. Therefore T_a is higher at the climate stations where air temperature is measured at 14.00 local time which is usually closer to the maximum of air temperature than 12.00 UTC.

The differences in the described meteorological parameters lead to the differences of PET presented in figure 3. From April to September the differences are positive which means that all calculated PET values for climate stations are higher than for the synoptic stations. It seems that in this time of the year (at least in this climate zone) air temperature has a stronger influence on PET than the mean radiant temperature provided that no significant changes in air humidity and wind velocity are recorded. One reason for this has been shown by the distribution of the differences. The great differences of the calculated PET between the different data sets in the Alpine valleys can be explained by slope effects: depending on inclination and aspect slopes can get more radiant energy thus leading to much higher PET values. Local wind systems like the Föhn can enhance the thermal effects as for instance in the Rhine Valley. The change to a more continental climate supports this too which has been shown for the southeast of Austria.

5 CONCLUSION

The different observation times of climate and synoptic stations lead to differences in the meteorological parameters measured. Especially air temperature and radiative fluxes have a significant daily course and have an influence on PET. The effect of air temperature on the calculated PET values seems to be bigger in the warm season than that of the mean radiant temperature as can be seen from the quantification of the differences between synoptic and climate stations. Higher PET values at climate stations are the result. Other topographic and orographic effects have to be considered too. Their influence on the meteorological parameter has been shown and quantified.

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