Geophysical Research Abstracts, Vol. 9, 05751, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05751

Temporal and spatial evolution of air temperature patterns in a Mediterranean mountain (Serra da Estrela, Portugal)

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The Serra da Estrela is a mountain massif located in Central Portugal rising to 1,993m ASL and is part of the Iberian Central Cordillera. It is a plateaux mountain with deep glacial sculpted valleys and steep slopes. The local climates of the Estrela are complex and haven't been studied before, with the climatological studies having focused only on data from individual meteorological stations for mesoclimate descriptions. In this study we have installed a network of air temperature data loggers with the objective of studying the climate characteristics at the local scale.

Instantaneous air temperatures were collected at 2-hour intervals during the year 2000 with a network of automatic data loggers placed in different topographic positions. A k-means classification was used to classify the air temperatures and 4 major types of patterns were identified: (1) the temperature in the valley floors was lower than in the interfluves (from 20h to 10h in the coldest nights - 27%), (2) the interfluves were colder than the valley floors (during the day in the warmest months - 43%), (3) the interfluves were colder than the valley floors (at any hour during the coldest months – 23%), (4) the Zêzere valley site shows the lowest temperatures (early morning with shadow in the valley - 7%). The control effect of the geographic and meteorological factors on the 4 temperature patterns was evaluated using meteorological screen data, NCAR/NCEP reanalyses 1 data and spatial modelling results from the digital elevation model. The analysis was conducted using one-way ANOVA followed by discriminant function analysis.

One-way ANOVA results show that types (1) and (4) are typical of atmospheric stability events with low wind speeds. Type (2) occurred during the day in unstable events

with higher amounts of precipitable moisture. Type (3) events are linked to the more unstable atmospheric conditions with stronger winds. The more significant variables from the ANOVA were chosen for the discriminant function analysis. The obtained functions model correctly 74% of the cases, with function 1 discriminating between diurnal and nocturnal events and function 2, discriminating the events according to relative humidity and wind speed.

Besides identifying the main patterns of the air temperature in the Serra da Estrela this study showed that: (i) during 2000 in 66% of the cases the air temperature was lower in the interfluves than in the valleys, (ii) in 27% of the cases there were cold air accumulation in the valleys (nocturnal events) and (iii) that in 7% of the cases there were cold air accumulation events during the morning due to shadow effects. It has been shown that cold air drainage is strong even during the summer and that the insolation patterns during the morning are extremely important for the air temperature regimes in the valleys. Statistically, the main controlling factors on the temperature patterns are the insolation regime, the wind speed, relative humidity, omega and precipitable water.