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Diurnal Temperature Variations in Low Mountain Ranges - Comparison of Model Data and measured Warming and Cooling Rates

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Within the subproject „Scale-consistent Two-way Coupling of Land-Surface and Atmospheric Models“ of the SFB / Transregio 32 „Patterns in Soil-Vegetation-Atmosphere Systems: Monitoring, Modelling, and Data Assimilation“ of the Deutsche Forschungsgemeinschaft temperature data of several automatic weather stations at distinct locations in the low mountain ranges of the project area are analysed and compared with model output from COSMO in consideration of differences in the daily temperature cycle.

The area of investigation is located in the Eifel low mountain area (Rhenish Slate Mountains) in north-west Germany and its vicinity. The Eifel forms a peneplain at a level of 400 – 600 m above sea level with partly steep valleys. Predominant land use is agriculture on the peneplain respectively on the bottom of the valleys and mixed forest on the slopes. Automatic weather stations are situated in several valleys as well as on the peneplain and the surroundings. The data used (measured and modeled) cover several periods in 2008.

Hourly temperature differences can be interpreted as representing the hourly heat flux into an air volume. A qualitative approach (as „warming or cooling rates”) was first introduced by Oke and Maxwell (1975) for purposes of urban climatology. A special analysis procedure for Stevenson screen and similar temperature time-series was developed to identify „finger prints“ of urban structures; one main result of this preceeding investigation was that the diurnal course of air temperature may be subdivided into different phases of accelerated energy exchange. Under non-condensating circumstances and for smaller air volumina latent heat as well as radiative processes can be neglected. In this case warming and cooling rates represent approximately the sensible heat flux into the air volume considered.

Motivation for the present study is the hypothesis that warming and cooling rates not only contain significant information on urban effects but on variations of thermal surface-air interaction related to topography as well. Depending on relief position the phases of energy exchange processes differ both, in intensity and duration. The results are used for the climatological characterisation of the different sites as well as for the validation of model output in terms of air temperature near the ground as generated from runs of the COSMO LM model at a resolution less than 1 km.