Abstract of the doctoral dissertation

Extreme precipitation is related to flooding which is one of the most frequent natural hazards in Central Europe. Detailed understanding of extreme precipitation is the precondition for an efficient risk management and more precise projections of precipitation, which include uncertainties, especially at regional scale. The thesis focuses on extreme precipitation in the Ore Mountains (OM) and the Vosges Mountains (VG); two low mountain ranges in Central Europe experiencing orographic effect on precipitation. Based on state of the art about precipitation in OM and VG, a currently missing analysis of the temporal distribution of precipitation in VG was needed prior to the analysis of extremes. The original dataset of daily precipitation totals from 14 weather stations used in the initial study was extended to 168 stations covering a broader area of VG. The study of temporal distribution of precipitation during 1960—2013 led to a classification of stations: (i) mountainous stations with winter maxima and highest mean annual totals due to orographic enhancement of precipitation, (ii) stations on leeward slopes with two maxima (summer and winter), (iii) lee side stations with summer maxima and lowest mean annual totals due to rain shadow and more continental character, and (iv) stations on the windward side with no major influence of the mountains and even (oceanic) regime with autumn maxima.

The analysis of extreme precipitation was based on 1—10 days non-zero totals during 1960—2013 from 168 stations located in VG and 167 stations located in OM. Three common pointwise approaches (i.e. Peaks over Threshold, Block Maxima, and Return Period) were firstly employed in VG to select extreme precipitation totals. The results of the seasonal distribution of the totals were dependent on a criterion and suggest that the orographic influence on extreme precipitation is more perceptible at higher selected threshold. In the end, the selection of 54 extreme precipitation events (EPEs) in OM and VG was conducted based on the areal assessment of precipitation, the so-called Weather Extremity Index (WEI). WEI was firstly employed at the regional scale and its values converted to be comparable between regions using maximum theoretical value. The results showed that the EPEs lasted mostly 1—2 days in both regions, whereas affected a larger part of OM (up to 100 %) as compared to VG. Stationary fronts occurred most frequently during EPEs in VG, while lows in OM. Lows in OM during EPEs often originated from cold air cut-off and most of them had Vb track from Mediterranean towards the northeast, which is typical for widespread precipitation and flooding in Central Europe. Even during two of the ten strongest EPEs in VG, the extreme precipitation was related to Vb lows, this time strongly deflected westwards. The comparison of the characteristics of EPEs between OM and VG show strong relationships between the temporal and synoptic attributes, while the spatial attributes are rather site-specific. The results of the thesis contribute to broaden the current knowledge about extreme precipitation in Central Europe and might be helpful not only for projections of extreme precipitation but also for risk managers and engineers, who deal with risks related to atmospheric precipitation.

Keywords: heavy rainfall, Weather Extremity Index, Grosswetterlagen, weather types, continentality, Erzgebirge, Vosges Mountains, Krušné hory