Geophysical Research Abstracts
Vol. 13, EGU2011-11378-1, 2011
EGU General Assembly 2011

Investigating the variability of precipitation in a mountainous catchment using data-driven approaches

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This study presents an analysis of the spatial and temporal variability of precipitation in a mountainous catchment in Styria, Austria that previously has been investigated for flash floods. For the analysis, data from a rain gauge network as well as weather radar estimates of rainfall were used. In addition to the correlation analysis, neural network based approaches were applied.

In general, precipitation is characterised by a high spatial and temporal variability. It depends amongst others on the precipitation generation type. A convective precipitation event with small shower cells typically shows the highest variability. In the studied catchment the complex orography has an essential influence. This becomes apparent during orographic precipitation events with much rainfall on the windward side of a mountain and less or even no precipitation on the leeward slope.

In order to determine the variability of precipitation, the parameters of the measuring system are crucial. The density of the rain gauge network in the study area is approximately of the order of one rain gauge station per 100 km^2. Data from eleven rain gauges are available. The rain gauges are situated at altitudes between 320 and 1245 m above mean sea level. The mean annual precipitation obtained from these gauges varies from about 740 to 1130 mm. Weather radar data originate from a C-band weather radar network which provides data on a $1 \times 1 \times 1$ km grid.

The results indicate that the spatial and temporal variability of precipitation in the study area is high and shows significant seasonal changes. Even between rain gauge stations, which are less than 10 km apart, the correlation coefficient rarely lies above 0.5. However, the seasonal variations are quite pronounced. On average the correlation is lowest in spring and summer because of convective precipitation events that often occur at this time of the year. The highest figures were typically measured in the last quarter of the year. Here even at distances over 30 km the correlation coefficient frequently exceeds 0.5, based on an integration time of the time series of 15 minutes. The temporal variability of precipitation also showed a seasonal dependence. The precipitation amount at the same location changes most rapidly in the summer months. On average even after 15 minutes the auto-correlation decreases to about 0.5. The decrease is not so dramatic in the first and last quarter of the year. It lies around 0.8 after 15 minutes and in the mean over 0.5 after one hour.

When comparing rain gauge and weather radar based data, their different sampling characteristic must be taken into consideration. Aim of ongoing research is a better characterisation of the deviations between these two the measuring systems.