Geophysical Research Abstracts
Vol. 21, EGU2019-5348, 2019
EGU General Assembly 2019

Improving the precipitation forecast in mountainous regions to mitigate rain-induced hazards

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High precipitation events are particularly hazardous for mid-sized alpine catchments where runoff rapidly increases after strong precipitation events, leaving very limited time for warning. A high-quality forecast of heavy precipitation with sufficient lead times is thus crucial for risk anticipation and hazard mitigation procedures. However, global weather forecast models remain relatively coarse in resolution in mountain terrain and higher resolution regional model forecasts have limited lead times thereby posing challenges for regions with complex topography. In addition, model output for mountainous areas is often affected by a bias (systematic over- or underestimations). These shortcomings can have severe implications for decision makers. False alarms, but also missed events, are not well perceived and may reduce public awareness of precipitation-triggered impacts.
We developed a statistical approach including a two-step method with the aim to adjust forecast model data operationally. We combine a kriging method to interpolate station data with Model Output Statistics (MOS). For a representative calibration of the MOS routine, we need a long enough time series of past forecasts. To address this issue, we included a weight function to take account of different historical model versions of ECMWF precipitation forecasts. The downscaling method is then verified in the two mid-size Alpine catchments of the rivers Emme (940 km2) and Simme (594 km2) for selected events. Results indicate that the statistical downscaling approach used here can improve areal precipitation forecast considerably. We show the improvement of skill scores (false alarms, hit rate) and assess events in the past to discuss advantages and limitations of a statistical MOS. Based on selected events of strong precipitation, we discuss how a bias correction might help improving hazard mitigation measures.