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Enhanced estimation of areal precipitation in an alpine catchment by combining a meteorological nowcasting and analysis system with a hydrological model

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In mountainous terrain such as the Alps, elevation differences strongly contribute to the small-scale spatial variability of precipitation. While there have been many studies on long-term elevation-precipitation relationships, little is known about such relationships at shorter time scales. In spite of the generally high rain gauge density in Central Europe, medium and upper elevations are generally under-represented by measurements. As a consequence the high spatial and temporal variability of precipitation fields, especially the altitudinal dependency of precipitation, is not measured sufficiently yet.

In the presented study coupled runoff simulations between the INCA analysis and nowcasting system, using meteorological observations, and a conceptual distributed runoff model are performed in high spatial and temporal resolutions. In addition to point measurements from raingauges and radar data, a newly developed, intensity-dependent parameterization of the elevation-gradient of precipitation is used in the nowcasting analysis system for the generation of precipitation fields as input to the hydrological model. Since the continuous runoff simulation represents a closed water cycle on the Earth´s surface, the simulated runoff can be seen as the integral over the precipitation in a catchment over a certain period. By comparing the simulated and observed runoff on a long-term, seasonal and single event-basis, different elevation-dependency parameterization experiments can be validated.

Results of the ongoing study show, that the hydrological model is sufficiently sensitive for the validation of different realizations of precipitation fields and that the variations of the height dependency have a clear effect on runoff simulation. Further work aims at taking into account uncertainties in rainfall measurements, the hydrological model parameters and integration of a height dependency parameterization scheme as a function of meteorological conditions.