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Spatial uncertainty in precipitation and its impacts on hydrological modeling

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The performance of hydrological models is strongly dependent on precipitation input. Nevertheless, with high regional and temporal variability of precipitation many uncertainties occur, especially with localized heavy precipitation events in small catchments. The WegenerNet Feldbach region in the southeastern Alpine forelands of Austria allows to analyze variable station densities as well as spatial interpolations of precipitation data. The WegenerNet is a network that measures precipitation and other variables at 150 climate stations ($\sim$ one per 2 km^2) at 5-min resolution in an area of about 22 km x 16 km since January 2007. We complement its data with stations of the Austrian weather service (ZAMG, 5 stations) and Austrian hydrographic service (AHYD, adding another 3 stations).

With this highly resolved network we investigate the effects of spatial resolution and interpolation of precipitation data on simulated runoff within the Raab catchment (in an area of about 500 km^2) and in sub-catchments (areas of about 30 to 70 km^2). The hydrological modeling is performed with the process oriented model WaSiM (www.wasim.ch). To get a closer look at the impact of station density on runoff, we first model only with ZAMG stations (5 stations), then including also the AHYD stations (i.e. 8 stations in total), and then with intermediate steps model the full network of ZAMG + AHYD + WegenerNet (in total 158 stations). Beside the station density, we analyze the impact of the interpolation methods Inverse distance weighting and Thiessen polygon. Our focus is on local-scale extremes (example convective events in 2009, 2010, 2011), but for comparison we also include larger-scale frontal extreme events.

Our first results suggest an influence of the interpolation method, depending on the station density, however neither over- nor under-estimation predominates. The amount of runoff strongly depends on the station density. The biggest runoff variation is within the smallest number of stations (only 5 ZAMG stations).
With this study, we hope to get a better understanding about the uncertainties in rainfall-runoff modeling with a focus on spatial variability of precipitation. The highly resolved station network helps us to deepen insight on local extreme precipitation events and their hydrological response.