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Evaluation of precipitation nowcasting using a very dense rain gauge network in southeast Austria

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An Increase of the intensity and frequency of heavy rainfall events is one of the expected consequences of global warming. As rainfall plays a major role in triggering floods, these consequences will enlarge the risk of flood damage. Therefore, nowcasting precipitation becomes increasingly more important as an input of flood warning systems.
The Integrated Nowcasting through Comprehensive Analysis (INCA) of the Central Institute for Meteorology and Geodynamics (ZAMG) provides high-resolution precipitation analyses and nowcasts in Austria by combining ground station data, remotely sensed data, forecast fields of numerical weather prediction models and high-resolution topographic data. The system provides precipitation rate and type with a 1 km spatial grid resolution and 15 minutes temporal resolution. Based on the leading time, INCA uses three different algorithms to predict precipitation. By referencing an observational-based extrapolation and using consecutive cross-correlation analyses, motion vectors are computed for the first hour of nowcasting. From +1 to +4 hours, the nowcast is combined with the NWP forecast by applying linearly decreasing, global weights. Beyond +4 hours lead time, a weighted combination of the two operational LAM model, ALARO and AROME, is used to predict precipitation.
The WegenerNet Feldbach region is a dense climate station network located in southeast Austria. The Feldbach region is part of the southeastern Alpine forelands with a moderate hilly orography. The network includes 155 ground stations, almost uniformly spread over an area of about 22 km $\times$ 16 km. Since 2007, it provides station time series and gridded datasets of temperature, precipitation, humidity and other parameters with 5-min time sampling. Since WegenerNet is a highly dense gauge network (i.e. about one station per 2 km2), it can be considered as delivering close to true rainfall for the validation of model outputs.
The main aim of this study is to compare and evaluate INCA nowcasting rainfall data with the observed data from the WegenerNet high-density network. Using the 12 years of rainfall data since spring 2007, we started to investigate the uncertainties of nowcasting rainfall for each INCA algorithm, with focus on extreme events. The performance of the INCA precipitation forecasts is evaluated using standard measures (e.g., root-mean-square-error, absolute error, bias and correlation coefficient), skill scores and a spatial verification method called Structure-Amplitude-Location (SAL). The results of this study will help to improve the algorithms of precipitation forecasts.