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Improvement of Rainfall Nowcasting at Fine Temporal and Spatial Scale

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The short term forecast of rainfall intensities for fine temporal and spatial resolutions, has always been challenging due to the chaotic nature of rainfall. Commonly at such scales, radar data are employed to track and extrapolate rainfall storms in the future. Studies have shown that for short lead times linear extrapolation of rainfall storms produces reliable results, however for higher lead times the error increases considerably, limiting so the predictability of rainfall for urban application to 25-30min. Therefore, the aim of this study, is to investigate if this boundary can be pushed further on by including better radar input, and considering non-linear extrapolation as learned by past observed rainfall storms.

First the quality of radar data is improved by merging on real time the station data with raw radar data at the 5min and 1 km2 resolution. These data are later fed into an existing linear extrapolation forecast (HyRaTrac) and the importance of the radar quality on forecast performance is assessed. To account for the non-linear motion and transformation of the rainfall storms captured by the radar data, a nearest neighbour method is integrated in HyRaTrac which uses certain predictors to estimate similar patterns in the past and uses these patterns to predict rainfall intensities of the current storm from 5min up to 2 hours horizons. The benefit of including such non-linear transformations, is discussed by comparing directly the two forecast methods both on Lagrangian (area, intensity, direction and velocity of storm) and Eulerian scale (intensities at the recording gauge). The study area is the Hannover radar range (Lower Saxony, Germany) where several storms from the period 2002-2018 are selected in order to train, validate and compare the forecasts method. The data used in the study include the C-band radar data (1km2 and 5min) and 81 recoding stations (5min) provided by DWD.

The results show that the radar-station merging cannot increase significantly the predictability of rainfall, however for lead times up to 30 min it can improve the forecast performance (at point scales) considerably. On the other side, the applied nearest neighbour method improves the rainfall forecast for lead times higher than 15 min (up to 1 hour). Overall the methods employed exhibit better forecast skill than the linear extrapolation of raw radar data at such small scales, however as they are triggered by the recognition of storms from radar data, the predictability of rainfall (especially of convective storms) is still bounded by the birth of storms.