



## **Probabilistic rainfall warning system with an interactive user interface**

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A real time 24/7 automatic alert system is in operational use at the Finnish Meteorological Institute (FMI). It consists of gridded forecasts of the exceedance probabilities of rainfall class thresholds in the continuous lead time range of 1 hour to 5 days. Nowcasting up to six hours applies ensemble member extrapolations of weather radar measurements. With 2.8 GHz processors using 8 threads it takes about 20 seconds to generate 51 radar based ensemble members in a grid of 760 x 1226 points. Nowcasting exploits also lightning density and satellite based pseudo rainfall estimates. The latter ones utilize convective rain rate (CRR) estimate from Meteosat Second Generation. The extrapolation technique applies atmospheric motion vectors (AMV) originally developed for upper wind estimation with satellite images. Exceedance probabilities of four rainfall accumulation categories are computed for the future 1 h and 6 h periods and they are updated every 15 minutes. For longer forecasts exceedance probabilities are calculated for future 6 and 24 h periods during the next 4 days. From approximately 1 hour to 2 days Poor man's Ensemble Prediction System (PEPS) is used applying e.g. the high resolution short range Numerical Weather Prediction models HIRLAM and AROME. The longest forecasts apply EPS data from the European Centre for Medium Range Weather Forecasts (ECMWF). The blending of the ensemble sets from the various forecast sources is performed applying mixing of accumulations with equal exceedance probabilities. The blending system contains a real time adaptive estimator of the predictability of radar based extrapolations. The uncompressed output data are written to file for each member, having total size of 10 GB. Ensemble data from other sources (satellite, lightning, NWP) are converted to the same geometry as the radar data and blended as was explained above. A verification system utilizing telemetering rain gauges has been established. Alert dissemination e.g. for citizens and professional end users applies SMS messages and, in near future, smartphone maps. The present interactive user interface facilitates free selection of alert sites and two warning thresholds (any rain, heavy rain) at any location in Finland. The pilot service was tested by 1000-3000 users during summers 2010 and 2012. As an example of dedicated end-user services gridded exceedance scenarios (of probabilities 5 %, 50 % and 90 %) of hourly rainfall accumulations for the next 3 hours have been utilized as an online input data for the influent model at the Greater Helsinki Wastewater Treatment Plant.