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Experiences with DMI's operational short-range ensemble prediction system

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The Danish Meteorological Institute (DMI) has run short-range ensemble forecasts operationally since 2011 with a focus on improved prediction of high-impact weather. Until 2017 the ensemble prediction system was based on the HIRLAM model, but since then it has gradually been upgraded to the convection permitting HarmonEPS system with a horizontal grid spacing of 2.5km and continuous production of new ensemble members. Currently, we run a control run (using both upper air and surface data assimilation) and four new perturbed HarmonEPS members every hour and include in an ensemble forecast members from the latest six runs, i.e. 24 perturbed members + 1 unperturbed run. Forecast uncertainty is accounted for by perturbing initial and lateral boundary conditions and selected surface parameters such as soil moisture, soil temperature and SST. Use of alternative schemes for turbulence and shallow convection and, for some members, modifications to the microphysics, orographic roughness and/or condensation contribute to uncertainty related to the model physics.
In order to assist forecasters we generate probabilistic products such as upscaled probability maps and quantile maps and verify them against observations. Based on the balance between hits and false alarms we provide recommendations to forecasters regarding the use of the probabilistic products for issuing severe weather warnings. As we move towards impact based warnings, costs and losses associated with false alarms and missed forecasts also need to be taken into account in the recommendations.
In addition, DMI's ensemble forecasts are also tested or in use as input to several applications, including storm surge forecasting, urban runoff forecasting and dispersion of radioactive isotopes (in the event of a nuclear accident).