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Probabilistic dispersion modelling with an ensemble dispersion model using Flexpart and the limited area ensemble model COSMO-E

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Since 10 years, MeteoSwiss operates a system for the surveillance of the nuclear power plants consisting of a dedicated remote sensing upper air network, which is assimilated into a high resolution numerical weather prediction model. In the framework of its modernization, two main goals have been defined: 1) improvement of the analysis and forecast of the meteorological field through the assimilation of additional boundary layer measurements of wind, temperature and humidity and 2) the operational quantification of the uncertainty of the dispersion calculation using an ensemble dispersion system. The uncertainty of the atmospheric dispersion model results is an important information for emergency response applications, because countermeasures are based on the model predictions. The major part of the total uncertainty stems from the meteorological prediction, yet it is not included in the decision process. The uncertainty of the meteorological prediction is modelled with an ensemble model, running the same forecast with varying initial conditions and perturbations imposed on the model run. The European Centre for Medium-Range Weather Forecasts uses a 50 member ensemble ENS to simulate the uncertainty of the forecast. Embedded into this ensemble, MeteoSwiss routinely runs a 20 member limited area ensemble COSMO-E with 2.2 km grid spacing. These COSMO-E forecasts are available twice daily with a forecast range of 120 hours (5 days). Because the importance of meteorological variables for the dispersion calculation are mutually depending on each other, the relation between the meteorological and dispersion uncertainties are highly non-linear. Differences in wind direction for example have a bigger influence with high wind speeds than with small wind speeds, and vice versa. The direct derivation of the uncertainty of a dispersion simulation using the spread of the meteorological ensemble is therefore difficult if not impossible. Thus a better approach to simulate the uncertainties of the resulting concentrations is to actually calculate them as an ensemble prediction based on the meteorological ensemble. At MeteoSwiss, the operational feasibility of a dispersion ensemble with the Lagrangian particle dispersion model Flexpart is tested, taking advantage of the meteorological limited-area ensemble model COSMO-E.