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FOGCAST: Probabilistic fog forecasting based on operational COSMO-DE model

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The presence of fog can have a critical impact on shipping, aviation as well as land transport and increases the risk of serious accidents. The improvement of localization, duration and variations in visibility therefore holds an immense operational value.

Fog is generally a small scale phenomenon and mostly affected by local advective transport, radiation, turbulent mixing at the surface as well as its microphysical structure. Sophisticated three-dimensional fog models, based on advanced microphysical parameterization schemes and high vertical resolution, have been already developed and give promising results. Nevertheless,the computational time is beyond the range of an operational setup. Therefore, mesoscale numerical weather prediction models are generally used for forecasting all kinds of weather situations. In spite of numerous improvements, a large uncertainty of small scale weather events inherent in deterministic prediction cannot be evaluated adequately. Probabilistic guidance is necessary to assess these uncertainties and give reliable forecasts.

In this study, fog forecasts are obtained by a diagnosis scheme similar to Fog Stability Index (FSI) based on COSMO-DE model outputs. The FSI and the respective fog occurrence probability is optimized and calibrated with statistical post-processing in terms of logistic regression.
In a second step, the predictor number of the FOGCAST model has been optimized by use of the LASSO-method (Least Absolute Shrinkage and Selection Operator). The results will present objective out-of-sample verification based on the Brier score and is performed for station data over Germany for the year 2011.

Furthermore, the probabilistic fog forecast approach, FOGCAST, serves as a benchmark for the evaluation of more sophisticated 3D fog models. Besides the COSMO-DE operational forecasts (50 vertical layers, dz_min=20m) several versions have been set up varying the grid resolution and the physical parameterization. The results will quantify the impact of vertical grid resolution, and the importance of detailed cloud microphysics, considering explicitly cloud droplet distribution and sedimentation processes.