Geophysical Research Abstracts
Vol. 13, EGU2011-5832, 2011
EGU General Assembly 2011

Modeling and Forecasting the Onset and Duration of a Fog Event during Frost Conditions

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A case of severe radiation fog under frost conditions in the Netherlands is analyzed as a benchmark for the development of a very high resolution NWP model for airport capacity prognoses. Results of the mesoscale models WRF and Hirlam are evaluated to determine the state of the art in fog forecasting and to derive requirements for further research and development.
For this case, WRF has difficulties to simulate the fog for most of the permutations of parameterizations selectable in its framework. On the contrary, Hirlam does model the onset of fog but is unable to let the fog grow beyond the lowest model layer, which directly leads to an early dispersal of fog at the morning transition. The sensitivity of fog forecasts to model formulation is further analyzed with a high resolution single column version of Hirlam, and with an additional single column research model, which was specifically designed for fog forecasting. The single column results are found to be sensitive to the proper specification of initial conditions and external forcings. High vertical resolution is essential for the formation and growth of the fog layer and when the fog lifts for the maintenance of a stratus deck. The properly configured column models are able to accurately model the onset of fog and its maturation, but fail in the simulation of fog persistence and subsequent dispersal. Details of the turbulence parameterization appear to be important in this process. It is concluded that, despite advances in numerical weather prediction, fog forecasting is still a challenge.