Geophysical Research Abstracts
Vol. 19, EGU2017-5663, 2017
EGU General Assembly 2017


# COSMO-PAFOG: Three-dimensional fog forecasting with the high-resolution COSMO-model

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The presence of fog can have critical impact on shipping, aviation and road traffic increasing the risk of serious accidents. Besides these negative impacts of fog, in arid regions fog is explored as a supplementary source of water for human settlements. Thus the improvement of fog forecasts holds immense operational value.
The aim of this study is the development of an efficient three-dimensional numerical fog forecast model based on a mesoscale weather prediction model for the application in the Namib region. The microphysical parametrization of the one-dimensional fog forecast model PAFOG (PArameterized FOG) is implemented in the three-dimensional nonhydrostatic mesoscale weather prediction model COSMO (COnsortium for Small-scale MOdeling) developed and maintained by the German Meteorological Service. Cloud water droplets are introduced in COSMO as prognostic variables, thus allowing a detailed description of droplet sedimentation. Furthermore, a visibility parametrization depending on the liquid water content and the droplet number concentration is implemented.
The resulting fog forecast model COSMO-PAFOG is run with kilometer-scale horizontal resolution. In vertical direction, we use logarithmically equidistant layers with 45 of 80 layers in total located below 2000 m. Model results are compared to satellite observations and synoptic observations of the German Meteorological Service for a domain in the west of Germany, before the model is adapted to the geographical and climatological conditions in the Namib desert.
COSMO-PAFOG is able to represent the horizontal structure of fog patches reasonably well. Especially small fog patches typical of radiation fog can be simulated in agreement with observations. Ground observations of temperature are also reproduced. Simulations without the PAFOG microphysics yield unrealistically high liquid water contents. This in turn reduces the radiative cooling of the ground, thus inhibiting nocturnal temperature decrease. The simulated visibility agrees with observations. However, fog tends to be dissolved earlier than in the observation. As a result of the investigated fog events, it is concluded that the three-dimensional fog forecast model COSMO-PAFOG is able to simulate these fog events in accordance with observations.
After the successful application of COSMO-PAFOG for fog events in the west of Germany, model simulations will be performed for coastal desert fog in the Namib region.