An atmospheric model prediction system for very short range forecasts.

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1. The model setup

At the Danish Meteorological Institute (DMI) the atmospheric limited area model DMI-HIRLAM (Sass et al. 2002) is used in a special setup to produce very short range forecasts of cloud cover, precipitation, 2m temperature, dew point and road surface temperture for many ($\approx$ 370) road-weather stations in Denmark. New forecasts are produced hourly and the forecast range is 6 hours. The goal of producing accurate local weather parameters is difficult due to the small scales involved in both space and time.

The model is set up for a limited area around Denmark. Currently the model resolution is 0.15° using 40 model levels in the vertical. The lateral boundary conditions are supplied hourly with time interpotation from the operational model DMI-HIRLAM-E covering a much larger domain. Every time step of the DMI-HIRLAM forecast a special road-weather module (RWM) is called. This module (Sass 1997) completes the special forecasts of the weather parameters mentioned above. The computations involve a local energy budget for a road surface, and site specific features are taken into account. More details about the model setup can be found in Sass and Petersen (2004).

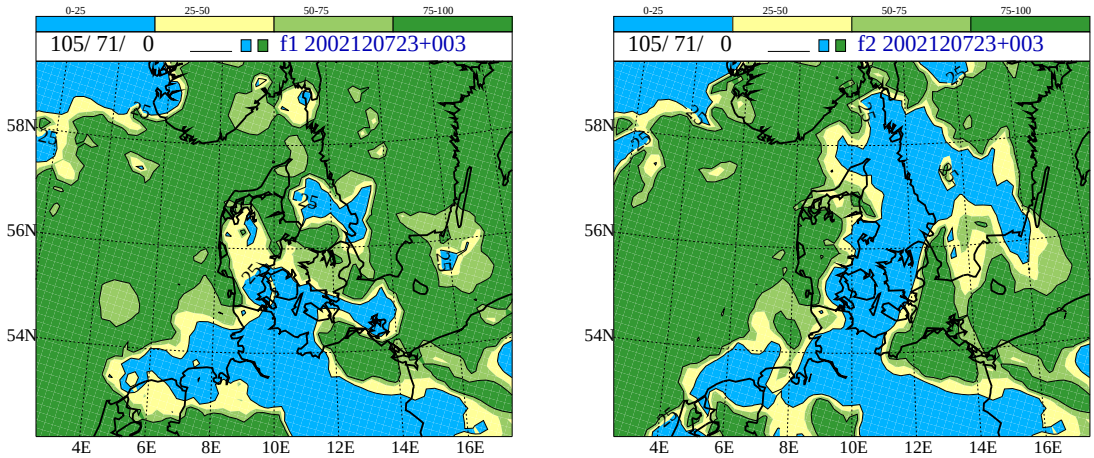
Since the goal is to improve the short range forecast of DMI-HIRLAM the challenge is to assimilate new data which is not already used in the boundary generating model DMI-HIRLAM-E. Currently an assimlation period of 3 hours prior to the forecast initial time is performed. The model is run through this period using a nudging technique (Sass and Petersen 2002a) where the model tendencies of humidity and cloud condensate are modified such that the difference between model predicted and hourly analyses of cloud cover and precipitation is reduced. Close to the surface the DMI-HIRLAM lowest model level temperature and humidity are modified along with the surface temperature and moisture in proportion to the difference between analysed and currently model diagnosed 2m temperature and humidity, respectively. There is a distinction between the size of the nudging coefficient for the lowest model level and the coefficient used for the surface variable, according to their relative importance for the diagnosed parameter at 2m height.

The analysed state used during nudging is determined from a reference forecast (without nudging) combined with synoptic data in an analysis procedure (Sass and Petersen 2002b) using relatively simple weighting procedures for analyses at 2m. The 3-D cloud analysis involves vertical overlap assumptions to utilize synop observations. Recently,

satellite data (SAF based cloud mask from NOAA 16 and 17) has been incorporated in the analysis procedure. The precipitation intensity analysis is at an early stage of development, with many precautions taken.

2. A forecast example

The system described above has been operational since October 2003. However, the use of satellite data is not yet operational. An example showing simulated total cloud cover with and without analysis nudging is shown in Fig.1a (left) and 1b (right), respectively. The result applies to a forecast initial time of 02 UTC on 8 December 2002. The figures confirm that 'nudging' of additional information can lead to important differences in the initial state of the cloud cover. Synoptic observations of total cloud cover during the night on 8 December 2002 (not shown) reveal that the run with cloud assimilation is the most realistic one. Cloud cover differences between the two runs remain throughout a 6-hour forecast, but the differences get smaller later in the prediction. In some cases a positive impact of cloud cover assimilation can be seen beyond a forecast range of 12 hours.



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