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A regional atmospheric reanalysis for studying weather and climate in Svalbard

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Meteorological observations, and hence climate data, are scarce in remote regions like the Arctic. The constantly improving capabilities of numerical weather prediction (NWP) models and freely available global data sets offer the opportunity to reduce this problem by providing data on meteorological variables at high spatial and temporal resolution. Longer time periods of years to decades can be simulated by NWP models by successive model runs of shorter periods, which can be described by the term “regional atmospheric reanalysis”.

We present a regional atmospheric reanalysis for Svalbard by using the Polar Weather Research and Forecasting (PWRF) model. Input data sets are the standard final analysis (NCEP GDAS FNL, 1.0°, 6 h) data from the Global Forecasting System (GFS) with additional sea surface temperature (NCEP RTG SST, 0.5°, daily) and sea ice concentration (AMSR-E/Aqua L3 Sea Ice Concentration, 12.5 km, daily) input.

The simulations are composed of daily re-initialised runs. Each run starts at 12:00 UTC, and time integration is performed for 36 hours. The output for the first twelve hours is discarded since the model results may be negatively affected by spin-up effects.

The simulations are conducted with a set of nested domains at three different spatial resolutions of 30, 10 and 2 km. First, we have applied a simple two-way nesting approach for the three nesting levels, but tests have shown that the improvements in the child domains arising from the two-way nesting are counteracted by artefacts in the parent domains. Therefore, we are now using a cascade of simulations: the first simulation is performed for the 30 km grid without nesting, the second one is using a two-way nesting of the 30 km grid as parent domain and the 10 km grid as child domain, while the third simulation uses two-way nesting for the three nesting levels (the 30 km, the 10 km grid and six 2 km grids). In any of the simulations only the results for the highest spatial resolution is used for further analyses, thus avoiding the aforementioned artefacts.

Model output is stored at hourly intervals for the 10 and 2 km grids, while three-hourly intervals are used for the 30 km grid. So far, the model period spans from 2006 to 2010, and will be extended back to 2000. We intend to continuously update the regional atmospheric reanalysis on a near-real-time basis, and to make the data set available to the public as soon as the validation studies are finished.

The presentation will discuss the new methodology in detail, as well as selected results, which demonstrate the wide field of scientific analyses and applications of the regional atmospheric reanalysis.