

# On The Use Of Regional Dynamical Models in Climate Research

Lennart Bengtsson  
Max Planck Institut für Meteorologie

One of the reasons why forecast skill has improved so much in the recent decade is related to the increase in model resolution with the associated reduction of numerical truncation errors and associated detailed description of the lower boundary conditions including orography. The operational experience by the meteorological services has shown that the improvement in weather prediction does not necessarily require running global models as long as a time sequence of boundary conditions from large-scale model integration can be used to drive a limited area model. Such an approach has now been in operational use in over 30 years. Alternatively, local forecasts are also obtained using large-scale parameters from numerical models as predictors.

The central question in this workshop is to consider the relevance of this approach for regional and local climate simulations. There are two different key questions to consider in this context.

- 1) Will numerical or other problems be building up because of the successive insertion of boundary data over very long periods or will problems occur because of other numerical inconsistencies and thereby making the high-resolution integration obsolete?
- 2) Are the systematic and other errors of large scale climate models so severe that the limited area integration are of very limited use?

I believe the experience so far has shown that we now practically can handle the problems implicit in the first question. Although we never can compensate for using a high-resolution global model we can nevertheless obtain useful insight in regional and local processes by using a regional high-resolution grid. A statistical approach is a good complement, but is no replacement, since it requires long data series. The second issue is essentially a question of the general confidence we can have in climate simulations and the evaluation of the limited area simulation therefore anticipates an intelligent evaluation of the climate experiment per se.

I believe a sensible way to explore these questions is by an heuristic approach, via the use of systematic experiments. Firstly, I will show results of multi-year integrations for limited areas over Europe undertaken in recent years. Some of the studies have been related to the GEWEX sub program BALTEX. In the first set of these experiments operational analyses or re-analyses data have been used as boundary conditions. The agreement with independent data such as

GPS water vapor measurements, observed precipitation and river run-off used for validation is surprisingly good.

Secondly, I will show some recent result from the Swedish Rossby Centre, which recently have undertaken simulation with a fully coupled atmosphere-ocean-hydrological model using atmospheric large-scale data from reanalysis and from large-scale simulations as horizontal boundary conditions. These studies demonstrate convincingly that detailed data, for example, from river run-off of minor catchments can be obtained.