SEASONAL DYNAMICAL DOWNSCALING WITH ERA-40 DATA

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One of the main objectives for employing the Regional Climate Model (RegCM, Giorgi et al; 1993a,b) at the Croatian Meteorological and Hydrological Service (CHMS) is to dynamically downscale the operational seasonal forecasts of the European Centre for Medium-Range Weather Forecast (ECMWF). Since the ECMWF seasonal data archive contains only a limited amount of meteorological parameters available at a limited time frequency and at a restricted number of pressure levels, it was necessary to assess the sensitivity of RegCM to degrading forcing imposed by initial conditions (ICs) and lateral boundary conditions (LBCs). The testing has been done by using the following fields from ECMWF re-analysis data (ERA-40): surface pressure, geopotential height, temperature, u and v wind components and specific humidity.

In our experiments, the horizontal resolution was 50 km in an area of 60x50 grid points, centred over Croatia (at 45N, 16E). In the control experiment, the vertical number of levels was 18, extending from the surface to 100 hPa. The Lambert conformal projection was used. For the convection, the Grell scheme (Grell; 1993) was chosen with both Fritch-Chappel (Fritsch and Chappel; 1980) and Arakawa-Schubert (Arakawa and Schubert; 1974) closures tested. First, we made changes in the ICs by increasing the horizontal resolution from T42 to T159. Then the LBCs were changed by reducing the frequency of updating from 6-hour to 12-hour intervals. Finally, changes in the model were introduced by lowering the top of the model from 100 to 200 hPa and reducing the number of vertical levels from 18 to 14. The details of the experimental design and the results are given in Branković et al. (2005).

Although the simulations have been carried out for the two seasons only (DJF 1993/94 and JJA 1997), the following can be concluded. The increase in the ICs and LBCs horizontal resolution reduces the geopotential, cools the upper-air and lower atmosphere and reduces the summer convective precipitation. The reduced frequency of the LBCs update mostly shows the opposite results, i.e. an increase in geopotential and temperature. When the top of the model is lowered, both upper and low level summer winds are strengthened. This effect is partly offset when the number of model levels is reduced. The changes in the vertical configuration cause on average much weaker effects on surface fields than the changes in LBCs. The Arakawa-Schubert closure reduces the amount of summer convective precipitation in the given domain when compared with the Fritsch-Chappel closure.

The verification of the model configuration closest to the seasonal forecasts archive (T159 horizontal resolution, 12-hourly updates with model top at 200 hPa and 14 vertical levels) against ERA-40 data shows that the model underestimates geopotential heights and low-level temperature, but overestimates temperature at upper levels (Fig. 1). The precipitation is overestimated over the central and southern parts of the integration domain (mainly over the mountains) when compared to the CRU observational data. These differences do not critically affect seasonal downscaling. The first experience with the RegCM in the CMHS is certainly encouraging and further testing and assessment of model integrations will be continued.

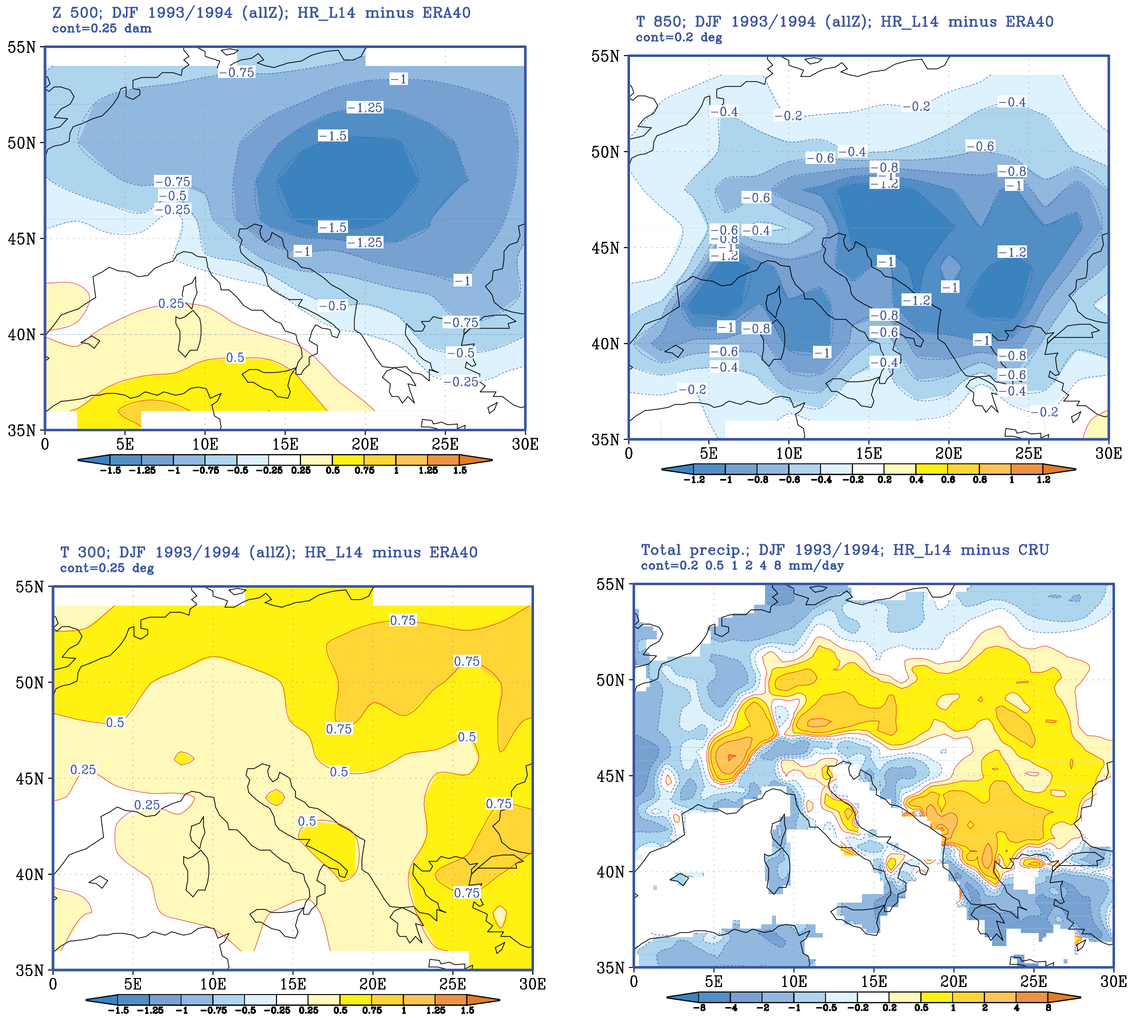

Figure 1. Verification of the RegCM experiment (T159 horizontal resolution, 12-hourly updates with model top at 200 hPa and 14 vertical levels) for DJF 1993/94: for 500 hPa geopotential height (top left), 850 hPa temperature (top right), 300 hPa temperature (bottom left) and total precipitation (bottom right). Contours for geopotential every 0.25 dam, for 850 hPa temperature 0.2 deg, for 300 hPa temperature 0.25 deg and for total precipitation at 0.2, 0.5,1, 2, 4, 8 mmday^{-1}

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