Operational implementation of the new turbulence parameterization

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During the last years a lot of effort was put into the development of a new level 2.5 turbulence parameterization and a new surface layer formulation for the non-hydrostatic limited area model (LM) of the German Weather Service (Raschendorfer, 2001). A great number of test runs as well as a parallel suite to the operational models were used to further examine and tune these new parameterizations. All experiments included the whole data assimilation procedure and the variational soil moisture analysis, which tunes soil moisture content in order to minimise the error of the 2m temperature during clear sky conditions at noon. In order to improve the interpolation of the 2m dewpoint temperature as well, some parameters of the surface scheme were tuned appropriately. The operational verification showed improvements over the then operational versions both in the 2m temperature and in the 2m dewpoint temperature forecasts.

In April 2001 the level 2.5 turbulence parameterization and the new surface scheme became operational. The schemes ran without problems during summer and autumn. In winter some problems occurred with the dewpoint temperature, showing occasionally somewhat too large spread, causing problems in the interpretation of fog. This problem could not yet be finally fixed. In the 2m temperature interpolation in very stable situations sometimes a flip-flop like change between values close to the temperature at the surface or close to the temperature of the lowest prognostic model layer occurred. This could be cured by slightly altering the interpolation procedure.

As an example Figure 1 shows the predicted distribution of turbulent kinetic energy in a cross section covering the lowest 3 km of the model atmosphere. Despite of the only moderate wind speed over land the varying surface height connected with large values of the roughness length produce considerable amounts of turbulent kinetic energy. Conversely, over the Baltic Sea the turbulent kinetic energy remains small although wind speeds are rather high. But even the small height of the northern tip of the isle of Öland in the Baltic Sea (close to horizontal grid point number 270) produces large values of turbulent kinetic energy.

References:

Raschendorfer, Matthias, 2001: The new turbulence parameterization of LM. In: G. Doms and U. Schättler (Edts.): COSMO Newsletter No. 1, 89-97 (available at www.cosmo-model.org).

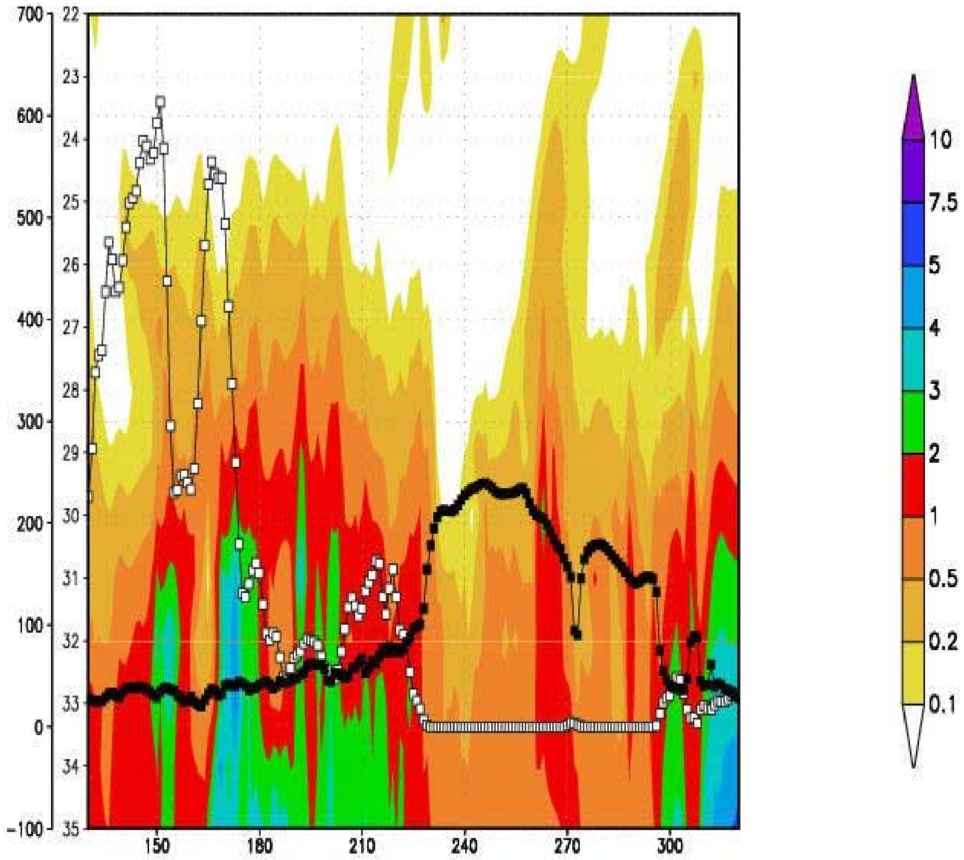

Figure 1: Cross section of predicted turbulent kinetic energy (in J/kg, shaded), predicted wind speed at 10 m height (0.1 m/s, leftmost scale, black squares), and surface height (m, leftmost scale, open squares) along a line from north-western Austria (left) to the Swedish coast of the Baltic Sea (right). The numbers from 22 to 35 represent model layers between 3 km height and the surface, the numbers at the abscissa are model grid points. 12 hours forecast, starting at 21 Dec 2001, 00.00 UTC.