SPECIFICATION OF THE TURBULENT LENGTH SCALE l FOR THE COSMO MODEL BOUNDARY LAYER SCHEME

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The original version of the scheme has been proposed by Bougeault and Lacarrere (Bougeault P., Lacarrere P., 1989).

They postulate that for each level in the atmosphere turbulent length scale l can be related to the distance that air parcel originating from this level, and having an initial kinetic energy equal to the mean turbulent kinetic energy (TKE) of the layer, can travel upward and downward before being stopped by buoyancy effects. If l_{up} and l_{down} are the bounds of integrals from temperature stratification (buoyancy) which equal to the mean TKE of the layer (given function), we can find these values taking the integrals.

The main advantage of Bougeault-Lacarrere method is to allow for remote effects of stable zones on the definition of l. For instance, using the integral with upper bound, the vertical depth of an unstable layer capped by a strong inversion is selected as the length scale for turbulence. Close to the surface, the low bound for the integral is zero and height above the surface is relevant length scale, then $L = \left(l_{up} \cdot l_{down}\right)^{1/2}$.

Finally following interpolation formula is employed: $1/l = 1/kz + 1/L$, (k is Karman constant). This method allows the length scale at any level to be affected not only by the stability at this level, but by the effect of remote stable zones (“non-local” l).

The algorithm of non-local calculation of l has been implemented in 1-D and 3-D COSMO-RU models.

The 3-D Mesoscale model COSMO-RU with the grid step of 14 km is adapted to the weather technological line of the Hydrometeorological centre of Russia and release of forecasts meteelements on 78 h on the European territory of Russia in an quasi-operative mode on the current initial data and conditions on borders is organized two times in day (00 and 12 hours UTC) on 1 node (2 processors Xeon 5345, 2.33GHz, with 4 cores each and 32 Gb operative memory on node, 64-bit, OS - RHEL5 (Red Hat Enterprise Linux 5), Intel C++ 10.0.26, Intel Fortran 10.0.26, Intel MPI 3.0). For these forecasts the HMC of Russia receives by *ftp* GME data from DWD and produces the forecasts for 78 h for the European part of Russia. Time of the run with 8 cores (1 x 8 - topology) is 3h 35 min (Rivin G., Rozinkina I., 2009).

The first runs show reasonable results for main meteorological fields in the atmospheric boundary layer. For instance, the fields of temperature and relative humidity at 1000 gPa after 78h forecast are shown in Figs. 1 and 2. The work will be continued and verifications for different meteorological situations will be done, as a comparison results with COSMO-RU current turbulent length scale (Blackadar formula).

Acknowledgements

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References

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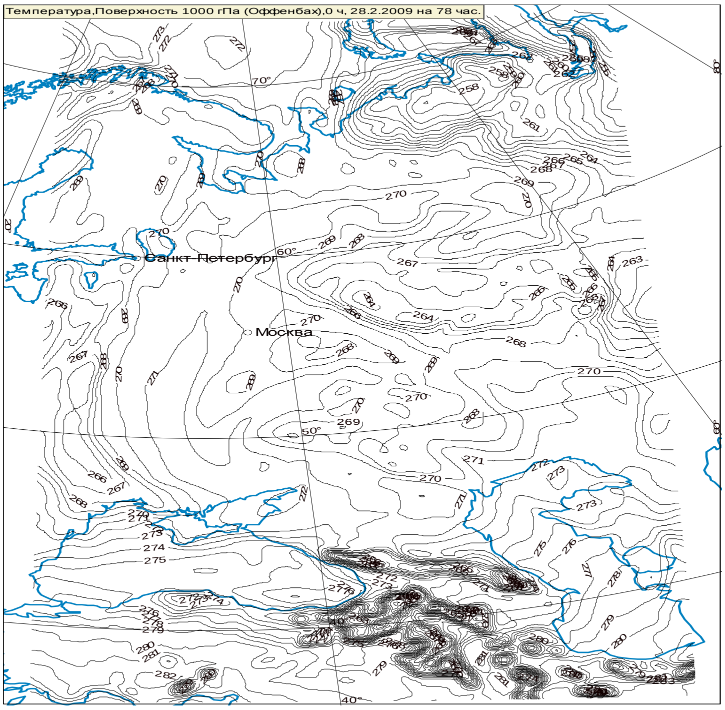

Fig. 1 Temperature at 1000 gPa after 78 hours forecast

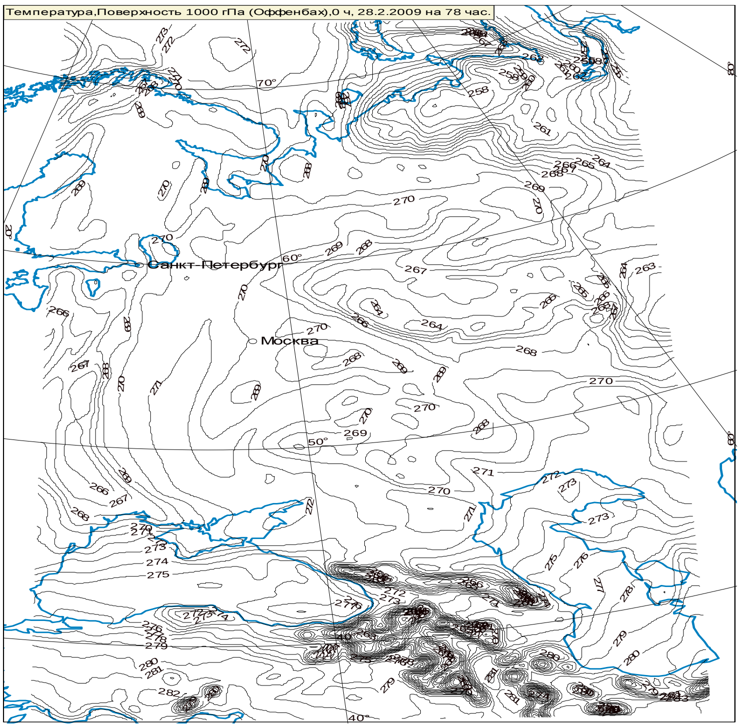

Fig. 2 Relative Humidity at 1000 gPa after 78 hours forecast