A New Version of the Operational Global Spectral NWP Model of the Hydrometcenter of Russia

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1. Introduction

The spatial resolution of the global spectral model of the Hydrometcenter of Russia, used for operational medium-range forecasts, was improved from T85L31 to T169L31 in 2009. The step of the new Gaussian grid is about 0.7°. A more detailed shoreline description in the land-sea mask was introduced and the relief was adjusted to the new spectral resolution T169. The procedures of horizontal and vertical interpolation in preprocessing were modified. A new algorithm of defining initial meteorological values on lower model layers was developed.

The effects of these changes are analyzed in the present paper based on the results of numerical experiments with T85L31 and T169L31 models.

2. Improvement of horizontal resolution

The T169L31 model outperforms T85L31 in predicting dynamical fields in the free atmosphere. The advantage of T169L31 is seen in the behavior of most verification scores (see Fig. 1). The improvement is less pronounced for upper-tropospheric and stratospheric levels.

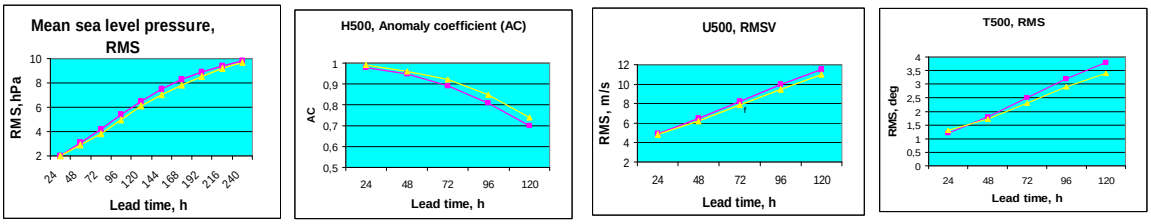

Figure 1: Verification scores for T169L31 (yellow) and T85L31 (magenta). Northern hemisphere. July-December 2008.

The increased horizontal resolution also resulted in better and more detailed prediction of near-surface weather elements. The precipitation fields now better correspond to the regions of atmospheric fronts, lines of instabilities, including those of orographic origin. Figures 2a and 2b demonstrate “the appearance” of really observed precipitation over the Caucasus in T169L31 forecasts.

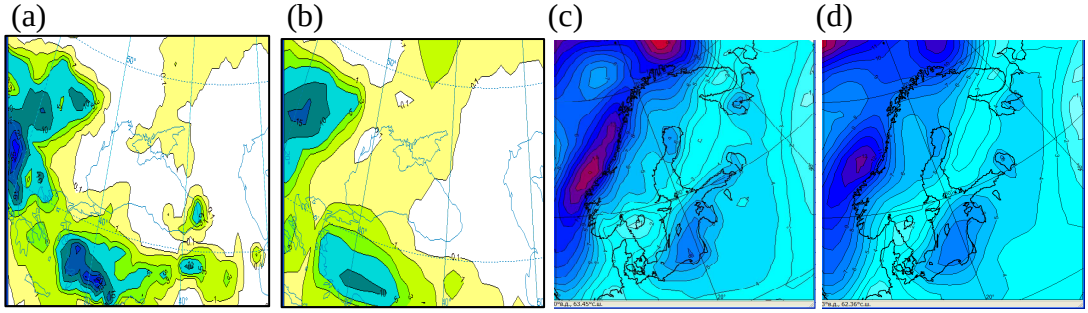

Figure 2: 6-h precipitation totals predicted by T169L31 (a) and T85L31(b). The 24-h forecast of the surface wind over sea by T169L31 (c) and T85L31 (d). The storm-wind regions are colored red.

The surface wind over sea is another resolution-sensitive element. The storm-wind regions are predicted much more realistically in the new model (Figs. 2c and 2d). Figure 3 demonstrates a successful T169L31 forecast of the storm wind zone with wind velocities of up to 40 m/s in the cyclone that approached Kamchatka in December 2008.

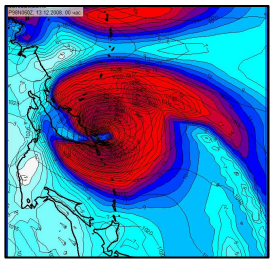

Figure 3. A T169L31 successful forecast of strong winds (red area) in the cyclone near Kamchatka in December 2008.

3. Modifications in model preprocessing

As the objective analysis data used for constructing initial datasets for the model is presented on a grid and levels that are different from those applied by the model, an accurate horizontal and vertical interpolation becomes of great importance. A new procedure has been developed for the spectral interpolation of two-dimensional fields on a sphere. Instead of traditionally applied associated Legendre polynomials, the Chebyshev polynomials of the first and second kinds are used in this procedure. The vertical interpolation scheme was also modified, and now vertical interpolation is performed using the Chebyshev-Laguerre polynomials combined with spline methods for the upper model levels. With this new scheme, the model spin-up was reduced. Higher-resolution model was more sensitive to the changes in the interpolation procedures.

4. Further research

Numerical experiments showed that the model is highly sensitive to initial fields of surface characteristics (sea surface temperature, albedo, roughness, soil moisture). Therefore, a new high-resolution archive of land-surface properties has been prepared using some results of the Institute of Geography, Russian Academy of Sciences. An example of information from this archive is given in Fig. 4. The new archive will help to prepare better initial surface data for the model.

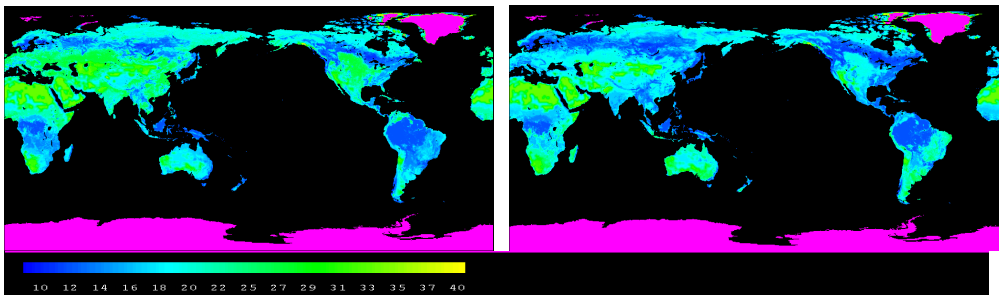

Figure 4: An example of information from the detailed archive of land-surface properties. Surface albedo for June (left) and December (right). Glaciers are shown in magenta.

Acknowledgements

The study was supported by the Russian Foundation for Basic Research (project 07-05-13607-ofi_ts).