Quasioperational tests of the SL-AV model

Mikhail Tolstykh
Russian Hydrometeorological Research Centre,
and Institute of Numerical Mathematics Russian Academy of Sciences
Moscow Russia
Email: tolstykh@inm.ras.ru

The global finite-difference semi-Lagrangian model of Russian Hydrometeorological Research Centre (SL-AV) developed jointly with the Institute of Numerical Mathematics, Russian Academy of Sciences was described in [1, 2]. Its specific features include:

- semi-Lagrangian advection with SETTLS scheme, semi-implicit scheme with direct FFT solver;
- vorticity-divergence formulation on the unstaggered grid;
- fourth-order compact finite-difference schemes for horizontal derivatives, including semi-implicit scheme and U-V reconstruction.

The model resolution is 0.9x0.72 degrees (lon x lat), 28 sigma-levels. The SL-AV model uses parameterizations from Meteo-France ARPEGE/IFS model with minor modifications [3]. The model starts from the analyses produced by OI-based data assimilation system which uses the same model [4]. Among satellite data, only SATOB and some SATEM data are used.

Some results from quasioperational tests of the model during December 2004-August 2005 are presented in Fig. 1. For comparison, the results for Russian operational spectral Eulerian T85L31 model are also presented as well as the difference between two results. The scores for other regions demonstrate similar behavior, though the difference between two models is smaller; however, the scores for H500 at Northern extratropics at the range of 24 hours are better for spectral model.

It is necessary to keep in mind that somewhat different set of observations is used in OI analyses for both models. The analysis of the spectral model indirectly uses all satellite observations carried out 12 hours backwards. At the same time, SL-AV forecast starts 50 min later and at that time there are on average 5% more TEMP data and 10 % more AIREP data, the amount of SYNOP and SATOB data being the same.

Overall, the SL-AV model demonstrated advantage over Eulerian spectral model. However, the spurious orographic resonance occurred in some areas during test period, despite Eulerian treatment of orography and temporal uncentering. This resonance was eliminated by careful unification of fourth-order finite-differences and interpolation operators used throughout the model and also by changing the orography.

Based on these results, the constant resolution version of the SL-AV model was recommended for operational implementation.

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REFERENCES

1. M.A. Tolstykh, Semi-Lagrangian high resolution model of the atmosphere for numerical weather prediction, Russian Meteorology and Hydrology, N4, 1-9 (2001).

2. M. Tolstykh, Vorticity-divergence semi-Lagrangian shallow-water model on the sphere based on compact finite differences, J. Comput. Phys. **179**, 180-200 (2002).

3. J.-F. Geleyn, E. Bazile, P.Bougeault et al, Atmospheric parameterization schemes in Meteo-France's ARPEGE N.W.P. model. In Parameterization of subgrid-scale physical processes, ECMWF Seminar proceedings (1994), 385-402.
4. M.D. Tsyroulnikov, M.A. Tolstykh, A.N. Bagrov, R.B. Zaripov, Development of a global data assimilation system with variable resolution, Russian Meteorology and Hydrology, N4, 5-24 (2003).

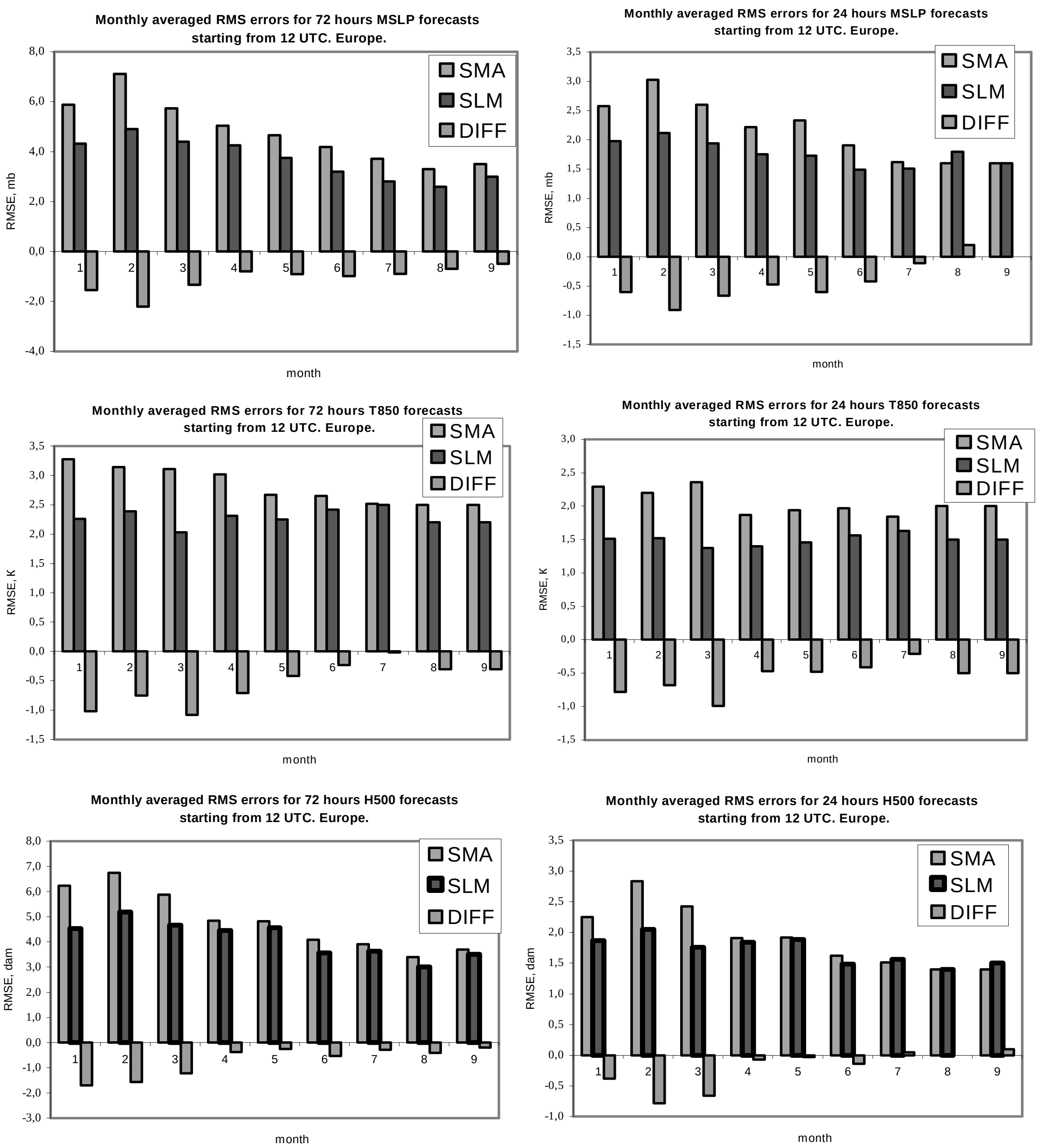

Fig.1 RMS scores for different variables and ranges of 72 hours (left) and 24 hours (right) over Europe for months between December 2004 (1) and August 2005 (9). SMA –RHMC Eulerian spectral model T85L31, SLM – SL-AV model, DIFF – difference between these models.