NWP activities at SHMI 2009/2010

32th EWGLAM & 17th SRNWP Meeting, 4-7 October, 2010, Exeter, United Kingdom

nwp@shmu.sk Martin Belluš Rastislav Bujňák Mária Derková Richard Habrovský Edita Janíková Ján Kaňák Milan Káčer Ján Mašek Michal Neštiak Oldřich Španiel Jozef Vivoda

ALADIN/SHMU - computer and model characteristics

HPC IBM p690 Regatta, 32 CPUs POWER 4+ 1.7 GHz, 32 GB RAM, 1.5 TB IBM FAST Storage Server, OS AIX 5.2, Queueing system LoadLeveler

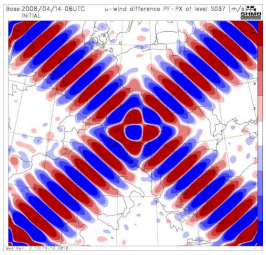
ARCHIVE IBM Total Storage Tape Library 24 TB, SW: IBM Tivoli Storage Manager

MODEL AL32T1, ALARO+3MT, SLHD, envelope orography, blending DOM: LACE, 9km dx, 37 vlev, 3h coupling, 72h forecast length

Main operational highlights since last workshop

09/2010 New products based on ECMWF medium range weather forecast
06/2010 New version of Visual Weather visualization software
05/2010 Upgrade of operational monitoring system
05/2010 Changed resolution of ARPEGE Telecom LBC files (15.4->10.6km)
05/2010 Precipitation probability in lagged-ensemble meteograms
03/2010 Bugfix related to "X-pattern" problem
12/09 – 02/10 Gradual transfer of operational suite to the new server
12/09 – 02/10 Transfer of web-based monitoring system to the new server
15/03/10 New procedure to include local orography to clim-files
08/03/10 Packing in historical files switched off (NVGRIB=0) to avoid X-pattern
23/11/09 Summary of precipitation & temperature over last 24 hours per river basins
08/10/09 Migration to new visualization software
03/08/09 Production of GRIB-files for Slovak power plants
28/07/09 768 hours probability forecast for energy company computed once a week
15/07/09 Optimization of operative suite

Fixing bug in xrd library causing X-pattern, J. Mašek



From time to time, particular step of DFI blending (change from low to full spectral resolution via configuration EE927) produced spurious X-pattern for some spectral fields and model levels. R. Brožková detected that the bug was triggered by GRIB packing. Further debugging showed that the reason was wrongly formulated error criterion used in determining optimal Laplacian power for scaling of spectral coefficients before packing. Bug was fixed on cy35t1 and adapted by F. Váňa to cy36t1. It entered official code in 5th bugfix of cy36t1. It was backphased also to operational version of ALADIN/SHMU, which still uses cy32t1. Detailed bug report can be found on RC LACE forum:http://www.rclace.eu/forum/ -> Bug and Problem Reports -> X-pattern produced by configuration ee927

Testing of DTHETAE2 index in the framework of GII software, R.Habrovský & J.Kaňák

Based on EUMETSAT satellite data and data from ALADIN model, calculation of DTHETAE2 index has been included in actual GII software. This index with combination of K, Lifted-index and Total precipitable water content index is useful for forecasters in large scale diagnostics to predict severe atmospheric events.

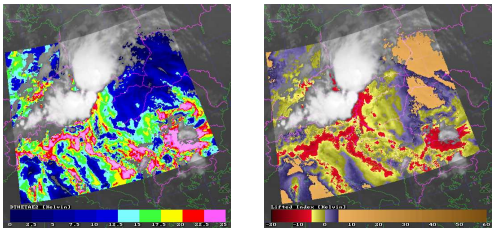
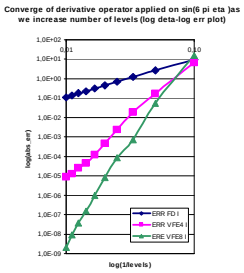


Fig.: The composite image of derived product of Lifted index (right figure) and DTHETAE2 index (left figure) over clear areas and MSG IR 10.8 μm channel (over cloudy areas).

New B-spline based finite element vertical operators, J.Vivoda



The existing approach of definition of finite element (FE) operators requires introduction of additional artificial boundary conditions. New approach has been developed which overcomes this problem. The set of basis functions (splines) is defined over the set of knots (points in eta domain). The number of knots fulfills following relation

knots = model_levels + # BCs + order_of_splines.

New approach exploits all input degrees of freedom and does not require any additional artificial condition to be fulfilled. A function can be represented by different set of basis functions as its derivative or its integral.

On the figure we see the convergence properties of finite difference derivative operator and equivalent operators constructed with B-splines of order 4 (cubic splines) and order 8.

Fig.: Log-log plot of mean error of derivative operator applied to sin(6 pi eta) as we increase the number of levels. (FD – finite difference; VFE4 – FEs with splines of order 4; VFE8 – FEs with splines of order 8)

RC LACE stay in Prague, J. Mašek, 19/10 – 13/11/09

Discretization of horizontal PGF (Pressure Gradient Force) in ALADIN-NH

Well known problem of terrain following coordinate is almost complete cancellation of two big terms (pressure and geopotential gradients along sloped model levels) in computation of horizontal PGF above steep orography. Numerical evaluation of resulting PGF in discretized model is therefore connected to considerable loss of accuracy. Content of the stay was error analysis for current ALADIN-NH PGF discretization in idealized cases (2D vertical plane, sigma coordinate, resting and hydrostatically balanced isothermal or polytropic atmosphere, bell shaped mountain). It was shown that while in isothermal case PGF error is zero, in more general polytropic case it consists of two contributions – error coming from vertical discretization (vanishes in the limit of infinite number of levels) and error coming from spectral fitting of nonlinear terms (remains nonzero as the number of levels tends to infinity). Second contribution can be minimized either by using higher truncation for prognostic fields than for orography (linear grid with quadratically truncated orography gives very satisfactory results) or by suitable orography filtering.

Planned future steps are single timestep experiments with vertical plane 2D model in order to confirm semi-analytical results and testing some alternative PGF discretizations (e.g. Simmons and Jiabin 1990 PG scheme or dirty coded finite volume approach).

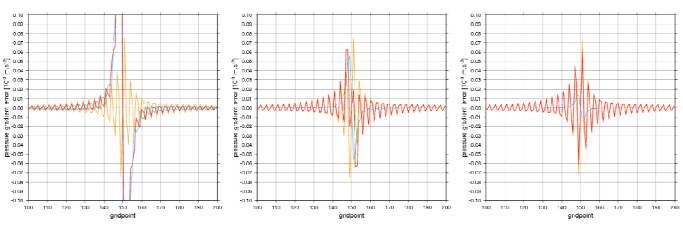
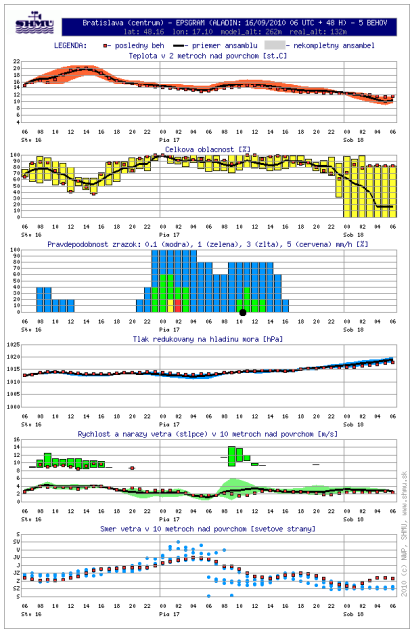


Fig.: Decomposition of horizontal PGF error on lowest model full level: left – 20 levels, middle – 50 levels, right – 100 levels. It can be seen that for sufficient vertical resolution error becomes dominated by contribution coming from spectral fitting. (blue – error from vertical discretization; orange – error from spectral fitting; red – total error)



05/2010 Precipitation probability in lagged-ensemble meteograms

Probabilistic precipitation forecast based on five subsequent integrations of ALADIN model valid within the same two days period (3rd diagram from above). Shown probabilities are for the thresholds 0.1mm/h (blue), 1mm/h (green), 3mm/h (yellow) and 5mm/h (red).

Local implementation of VERAL package, R. Habrovský

In second half of the year 2010, the first working implementation of VERAL (verification of ALADIN) was used for computing of statistic characteristics (rmse,stde,bias) for some test cases. The original KornShell script which works on AL32 cycle was rewritten for AL35t4 cycle. The first results are shown bellow, where ALADIN operational data are compared with SYNOP data. We would like to thank A. Trojáková from CHMI for very useful help and discussions.