

### **3. RESEARCH & DEVELOPMENTS**

#### **3.1. SLOVAKIA**

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During his stay in Budapest, Michal Neštiak was investigating the use of non-GTS SYNOP reports in the ALADIN/HU CANARI + 3D-VAR system.

The aim of his work was to assess the impact of non-GTS SYNOP reports from LACE countries (LSND) in data assimilation. Experimental period was from 10 to 20 May 2005. ALADIN CY30T1 was used. Scores are generally very neutral near the surface. There are some differences on higher levels. The differences can be found for temperature and humidity scores, but the impact is not relevant. For some levels and variables LSND is slightly better for some others it is worse. Scores against the ARPEGE analysis show some improvement for LSND for almost all the variables for the 00 UTC runs, but practically there are no differences. For the 12 UTC run, the impact is not clear and it seems that the quality of 42-48 hour forecast is even worse. Because it is only 10 days comparison it is not possible to draw definitive conclusions. Bigger impact of surface assimilation is expected during winter and spring, where the wrong snow coverage has big impact on ground temperature. More information can be found in the report

[http://rclace.eu/File/Data\\_Assimilation/2009/report\\_MN\\_2009.pdf](http://rclace.eu/File/Data_Assimilation/2009/report_MN_2009.pdf)

Michal Neštiak used knowledge acquired from LACE stage in Budapest for successful non-operative tests of CANARI on cycle 35T1 in Slovakia. Results were compared against CHMI and OMSZ. Tests were done on 9km current operative resolution. Preliminary tests were done on new planed resolution and on special high resolution domain prepared for traffic service company. Currently we are preparing new par suite with CANARI.

Jozef Vivoda works on new B-spline based finite element vertical operators. 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

$$\# \text{ knots} = \text{model\_levels} + \# \text{ BCs} + \text{order\_of\_splines}.$$

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.

During his stay in Prague, Ján Mašek focused on the 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).

The verification of text forecasts provides helpful feedback to forecasters and thereby helps to improve their work. On call of SHMI forecasting office a new, more detailed tool of text forecast verification has been developed by Milan Káčer. It is a package of several object-oriented JAVA classes that is going to replace the old FORTRAN version. In comparison to the latter one, it covers more forecasted elements, deals with more observation data and allows local regional forecasts. The present version of the package enables interactive forecast formulation inputs, database reading/writing as well as statistics of verifications for all forecasts (also 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> day) globally or categorized by author, day, month...

As the demand for bigger ALADIN-LAEF domain arose, Martin Belluš is setting up a new domain and retuning the blending ratio accordingly. Demand for bigger ALADIN-LAEF domain with better topography representation arose mostly out of two reasons. One of them is inclusion of the whole Black sea (requested by Romania) and coverage of Turkey (as a new ALADIN partner) in the computational ALADIN-LAEF domain. The second reason is the request for the cooperation with GLAMEPS (Grand Limited Area Model Ensemble Prediction System). The main restriction on the other hand is the SBU limitation Austria has at ECMWF's HPC.

New blending ratio according to the higher target resolution and the whole operational breeding-blending cycle for the new ALADIN-LAEF domain is currently under testing procedure.

Additional research will be done to answer the question, whether more profit would be gained from such high resolution ensemble ( $\Delta x=10-12\text{km}$ ) or rather from increased number of ensemble members at the new domain but necessarily with coarser horizontal resolution (currently the "old" operational setup reads 16 members at  $\Delta x = 18\text{km}$ ).

Another activity of our group (Richard Habrovský and Ján Kaňák) is application of GII method to calculations of DTHETA2 index with use of EUMETSAT and ALADIN model data, in the framework of retrieval algorithm (Kalman filter). This index was compared with original GII indices (K-index, Lifted index and total precipitable water content). This DTHETA2 index was used in detail study of severe windstorm over Slovakia and Hungary on 25 June 2008 (to be published).