LIMITED AREA MODELLING ACTIVITIES AT THE HUNGARIAN METEOROLOGICAL SERVICE (2002/2003)

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INTRODUCTION

The numerical weather prediction (NWP) group of the Hungarian Meteorological Service (HMS) belongs to the Department of Research and Development. The further enlargement of the NWP team was continued: altogether having 10 persons working on NWP leading to around 6 man-year of work on limited area modelling. Certainly the main activities are concentrated around the ALADIN model: more precisely and importantly on the exploitation and regular evaluation of the operational model, on the research and development of the three-dimensional variational data assimilation scheme (3d-var), and the design of a working plan for short-range ensemble prediction system.

ALADIN EXPLOITATION: ALADIN/HU

There were some significant changes in the operational exploitation of the ALADIN model (due to decentralisation of the LACE project): only one model version is executed (introduced on the 5th of November, 2002), which is similar to the previously used LACE version on domain size and to the former Hungarian version in its resolution. The main characteristics of this new model version are as follows:

- domain over continental Europe
- optimal interpolation scheme (CANARI) is running every hour for nowcasting purposes for a domain over the Carpathian Basin
- dynamical adaptation mode (no independent data assimilation cycle; 3d-var data assimilation scheme is under continuous parallel testing suite)
- lateral boundary conditions applied from the ARPEGE French global model every 3 hours (transmission via Internet and/or satellite dissemination system)
- 6,5 km horizontal (432 * 384 points) and 37 levels vertical resolution
- 270 s timestep (two-time level semi-Lagrangian advection scheme)
- 48 hours, integration twice a day
- hourly post-processing in the first 36 hours and 3 hourly afterwards
- further dynamical adaptation of the wind field (every 6 hours) over Hungary (to 2,5 km resolution)

The ALADIN model is executed on our IBM Regatta p690 server, which has the following main characteristics:

- The computer is the same than one element of the ECMWF IBM cluster
- CPU: 32 processors (1,3 GHz)
- Peak performance: 5.2 Gflops/processor
- 64 Gbyte internal memory
- 360 Gbyte disk space
- Loadleveler job scheduler is installed and used for the safe exploitation and scheduling of the operational model and research jobs.

RESEARCH AND DEVELOPMENT ACTIVITIES: GENERAL MODEL PERFORMANCE

The general performance of the operational version of the ALADIN model is continuously monitored and some basic verification scores (bias and root mean square error) are regularly put on the homepage of our institute (http://omsz.met.hu/english/kfo/neo_en.html).

The model was intensively criticised during the winter season: for a long period the 2m temperature forecast of the model was extremely bad (the other forecasted values were rather correct, moreover the tendencies of the near surface temperature were also correct, but the actual values not) having an extreme overestimation of its values. This event was examined with some details: a more complex radiation scheme was tried, the application of the 3d-var scheme was checked, “artificial” snow cover was put into the initial conditions of the model. The main preliminary outcome of the examinations led to the conclusion that the lack of snow analysis in the ALADIN model is probably the reason of the bad forecast cases. The investigation of this case will be continued in the future.

RESEARCH AND DEVELOPMENT ACTIVITIES: 3D-VAR

The main research and development topic for the Hungarian Meteorological Service in the ALADIN project is the further development of the three-dimensional variational (3d-var) data assimilation scheme. The basic characteristics of the 3d-var scheme tested in Budapest are as follows:

- 6 hour data assimilation cycle (first guess: 6h forecast of the ALADIN/HU model)
- Applied observations: SYNOP and TEMP data (in ODB data base)
- Background error statistics gained by the standard NMC method
- The cycling forecasts (the 6h forecasts) are governed by ARPEGE analysis (all the boundary information are analysis)
- Digital filter initialisation is used in cycling and production

The performance of this basic version of the scheme was verified by computing classical verification scores together its comparison to those of the operational model version. The general comparison showed a very neutral impact, which is probably due to the fact that on the one hand the 4d-var scheme at Météo France is very efficient providing excellent initial conditions to the ARPEGE model and on the other hand just some surface observations are

used additionally to those observations already used at ARPEGE 4d-var. Beside that some case studies were also conducted, when the operational model was rather successful and also when on the contrary the operational scheme provided a rather poor forecast. For instance some improvements were spotted in a summer case, when the surface-triggered convection had an important role in the precipitation formation, therefore the local surface observations had a significant impact on the forecast. Based on these general results we have decided to keep the 3d-var run in double suite and simultaneously to continue the developments towards the inclusion of new data sources into the assimilation system.
Regarding new type of observational data significant efforts were devoted to the local application of ATOVS data from NOAA-15 and NOAA-16 satellites (the processing of this data was carried out by the AAPP program package.

The following experiments were performed in order to test the impact of ATOVS data in the forecasts of the ALADIN model:

- Dynamical adaptation version (operational reference version, no assimilation)
- Assimilation of TEMP and SYNOP data, multivariate formulation
- Assimilation of TEMP and SYNOP data, univariate formulation for humidity
- Assimilation of TEMP, SYNOP and AMSU-A data, thinning on 80 km resolution, multivariate scheme
- Assimilation of TEMP, SYNOP and AMSU-A data, thinning on 120 km resolution, multivariate scheme
- Assimilation of TEMP, SYNOP and AMSU-A data, thinning on 80 km resolution, univariate scheme for humidity
- Assimilation of TEMP, SYNOP and AMSU-A data, thinning on 120 km resolution, univariate scheme for humidity

Based on these experiments the following main conclusions were drawn:

- The impact of ATOVS data in the data assimilation system is rather neutral.
- The humidity data should be assimilated in a univariate form.
- The 80 km thinning distance is slightly better for use.

Work was also carried out on the potential applicability of aircraft data in the ALADIN data assimilation system. First the spatial and temporal distribution of the available data was checked, then the impact studies were done. The preliminary results of the impact studies showed also neutral impact on the forecasts, however the work is going to be continued paying attention especially to the thinning strategy of the available data.

RESEARCH AND DEVELOPMENT ACTIVITIES: LAM EPS PROJECT

At the end of 2002 it was decided to initiate in the future significant work on short range ensemble forecasting. Our Service was also volunteering to be a lead centre for the LAMEPS topic in the framework of the SRNWP project (this was finally not accepted). Nevertheless the main outline for our LAM EPS project was formulated and intensively discussed with our French colleagues. Based on these plans the main foreseen development areas are as follow:

- Investigation of the impact of target domain and time window of the global singular vector computation to ALADIN EPS.
- The direct application of ARPEGE global EPS outputs as initial and boundary conditions for the ALADIN/HU EPS system.
- Possible clustering of ARPEGE ensemble members (similarly as it is done in Italy).
- Computation of native singular vectors over a regional domain.
- Breeding modes and/or perturbations of observations will be considered in a later stage depending on the previously obtained results.
- Simultaneous development of research tools as classical EPS performance and verification tools.

RESEARCH AND DEVELOPMENT ACTIVITIES: NETWORKING

Finally it is mentioned that we do consider important to actively take part in the networking activities of the ALADIN project, some of the main elements of it are listed below:

- Initiation and organisation of the first ALADIN maintenance and phasing workshop, 25-29 November, 2002
- Gergely Bölöni became the working group leader of data assimilation for the LACE project (since January, 2003)
- Providing training (by Sándor Kertész) on the installation and application of ODB database for the ALADIN model, Budapest, 14-18, April, 2003
- ALATNET seminar on scientific results, Királyrét, 15-17 October, 2003
- ALADIN/LACE mini-workshop on data assimilation, Budapest, 20-22 October, 2003
- Research stays of Steluta Alexandru (ALATNET fellow) working on the ALADIN 3d-var scheme (June-November, 2003)
- Research stay of Raluca Radu (ALATNET fellow) working on the boundary problem for the ALADIN model (October-November, 2003)
- Guest researcher from Croatia working on the ALADIN 3d-var (study of vertical analysis increments) scheme (Kristian Horvath, 11 August – 11 September, 2003)

SUMMARY AND OUTLOOK

In the past few years the Hungarian Meteorological Service invested more and more energy (manpower, computer resources, etc.) into numerical weather prediction. This effort led to the enlargement of the NWP team and also for significant contribution to the success of the ALADIN project (especially on the development of the 3d-var data assimilation scheme). We hope and plan to pursue these efforts together with the development activities on the short range limited area ensemble prediction system.