The quasi-operational LAMEPS system of the Hungarian Meteorological Service (HMS)

Edit Hágel

Hungarian Meteorological Service

Division for Numerical Modelling and Climate Dynamics

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Characteristics of the system

The quasi-operational short-range limited area ensemble prediction system of HMS is running on an IBM (p655) cluster server. The server has 4 nodes, each node has 8 processors (32 processors in total).

The system is based on the **ALADIN** limited area model and has **11 members**. At the time being we perform a **simple downscaling, no local perturbations** are generated. The initial and lateral boundary conditions are provided by the global **PEARP** ensemble system (LBCs every 6 hours). The LAMEPS is running once a day, starting from the 18 UTC analysis, up to 60 hours. The **horizontal resolution is 12 km**, the number of vertical levels is 46 (hybrid coordinates). The forecast process starts every day from cron at 23:00 UTC and finishes around 04:00 UTC.

IBM (p655) cluster server

Integration domain of the LAMEPS

Schemata of the system. Ensemble members are organized into 4 groups, each group running on one node of the IBM cluster independently from the other groups until the preparation of the NetCDF files, which is done in one go for all members.

Visualization

Boundary conditions

Verification results

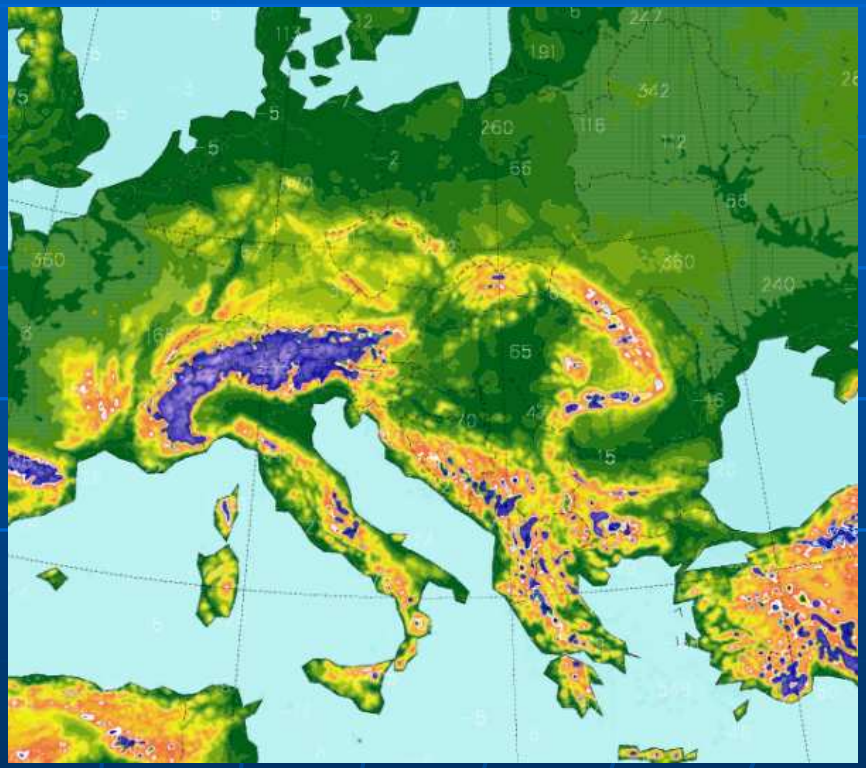
Characteristics of the system

- 10+1 ensemble members
- Based on the ALADIN model

- ICs and LBCs from PEARP
- Downscaling, no local perturbations yet

- One run per day at 18 UTC
- Integration up to 60 hours
- 12 km horizontal resolution
- 46 vertical levels

- In quasi-operational mode since February 2008



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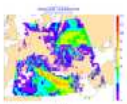
Visualization

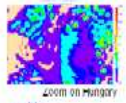
Visualization of the LAMEPS forecasts is done in two ways at the moment: using Metview and a web interface, and using HAWK.

Visualization using **Metview** and a **web based interface**:

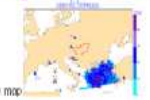
The web interface



Total precipitation forecast for one ensemble member

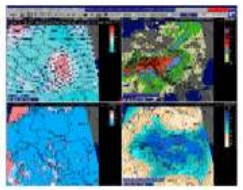


Zoom on Hungary



Probability map

Visualization using **HAWK** (Hungarian Advanced Workstation), a visualization software developed locally at HMS, used in the daily work of the forecasters.



Visualization of the ensemble forecasts in HAWK: 2PVU mean and spread (top left), total precipitation ensemble mean (top right), probability map for windgust (bottom left), 700 hPa relative humidity ensemble mean (bottom right)

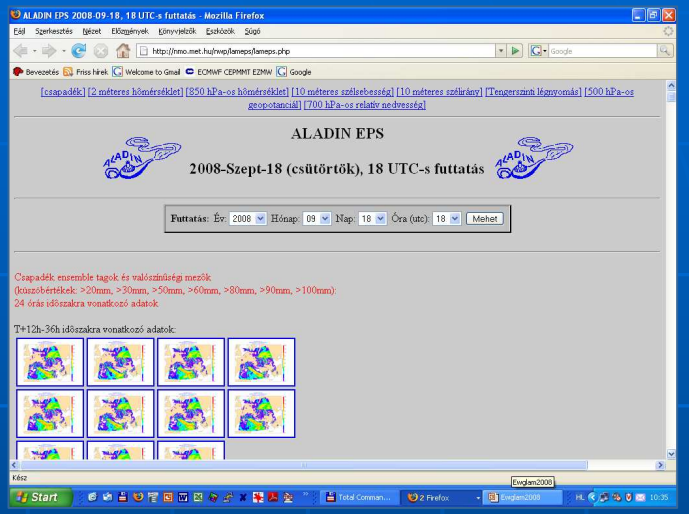
Boundary conditions

Verification results

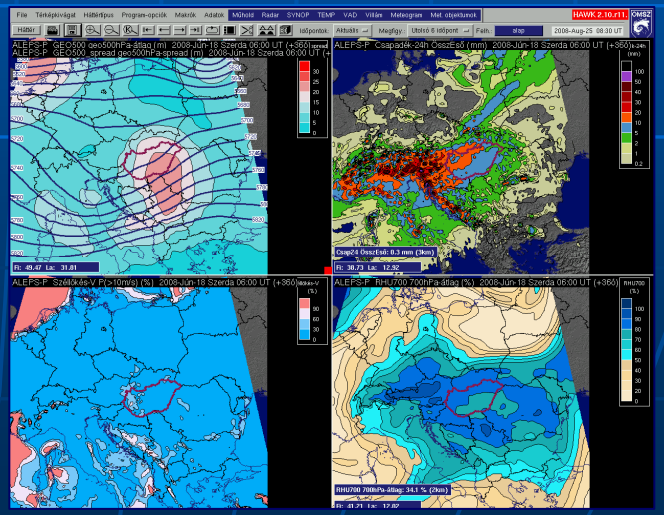
Visualization

Visualization in two ways:

- Using Metview and a web interface



- Using HAWK



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IBM (p655) cluster server

Integration domain of the LAMEPS

Schemata of the system. Ensemble members are organized into 4 groups, each group running on one node of the IBM cluster independently from the other groups and the preparation of the NetCDF files, which is done in one go for all members.

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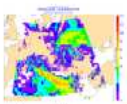

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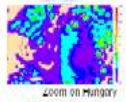

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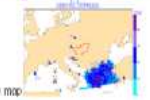

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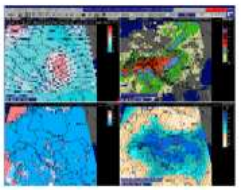


Visualization of the ensemble forecasts in HAWK: T850 mean and spread (top left), total precipitation ensemble mean (top right), probability map for windgust (bottom left), 700 hPa relative humidity ensemble mean (bottom right)

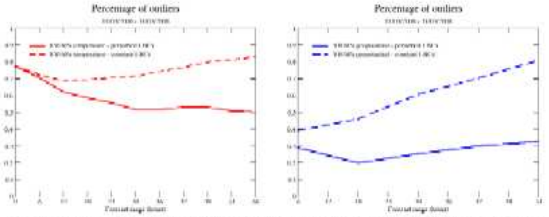
Perturbed lateral boundary conditions

Running a limited area model means that we need not only initial, but lateral boundary conditions as well for the integration. Moreover, it is very important to **use different boundary conditions for each ensemble member.**

WHY? It can be shown that during the initial part of the forecast the effect of the initial conditions is dominant, while in the later part the effect of the lateral boundary conditions takes over the dominance. Without using different lateral boundary conditions, after an initial time (depending e.g. on the size of the domain) the members would become very similar due to the influence of the lateral boundary conditions.

An experiment was performed using the same lateral boundary conditions for each member. Only the initial conditions were different. In the control experiment all the members had different initial and lateral boundary conditions.

The figures show percentage of outliers diagrams for T850 and Z500 for both runs (with unperturbed and perturbed LBCs).

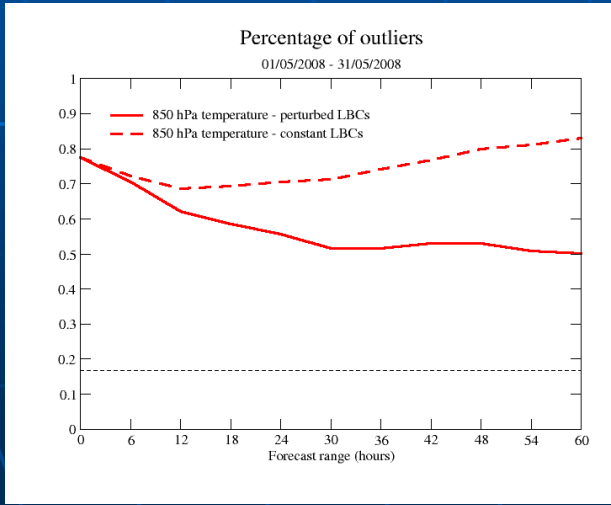


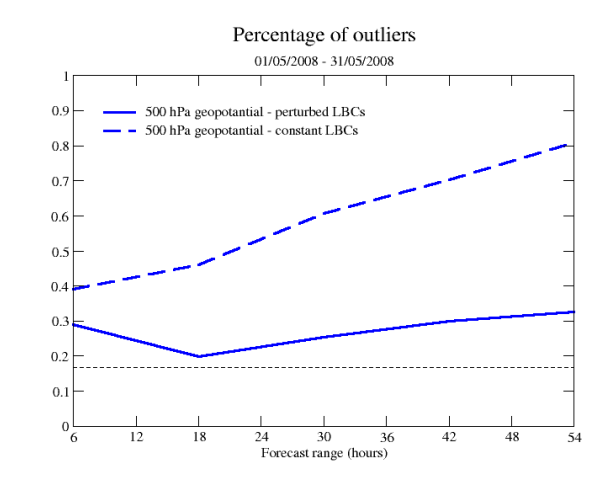
Percentage of outliers diagrams for 850 hPa temperature (left) and 500 hPa geopotential (right). Solid curve is the control experiment (with different LBCs for each ensemble member), dashed curve is the run with the same LBC for all members. The thin horizontal line is the expected value. One can see that in case of the experiment with constant LBC the percentage of outliers is not decreasing but increasing during the forecast which means less and less spread in the ensemble. This can be explained with the dominance of the LBCs. (Verification period was 01/09/2008 – 31/09/2008.)

Verification results

Boundary conditions

- Is it important to use different boundary conditions for each ensemble member?





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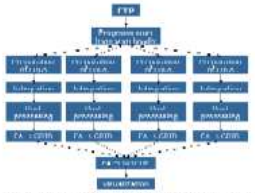

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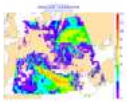

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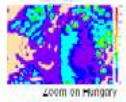

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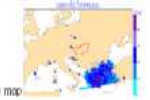

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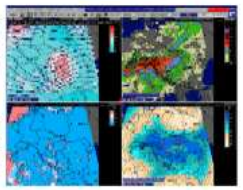

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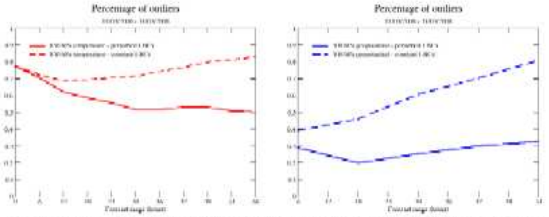

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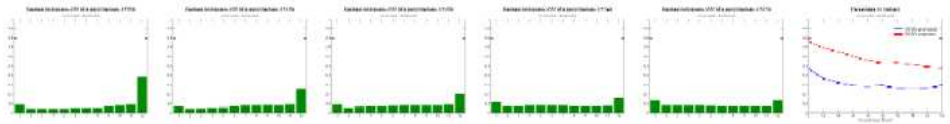
Verification results

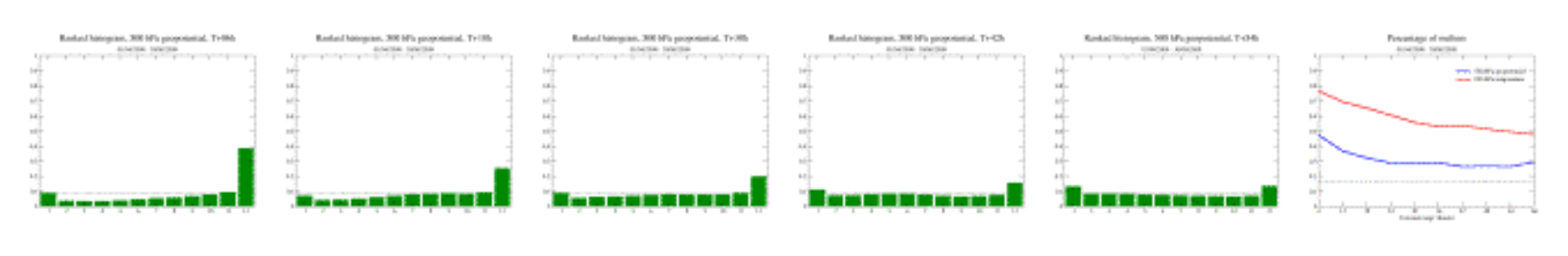
Verification is being performed for a longer period. First results are shown here for April, May and June from 2008. From previous verification results it is known that the system has better scores for upper air parameters and worse for surface parameters (especially for 2 meter temperature). This might be the result of the fact that in PEARP mainly upper air parameters are perturbed, from the surface only pressure. Results also show that the spread of the system is not sufficient for some parameters. Therefore in the **future** we plan to generate initial perturbations locally using **singular vectors computed with the ALADIN model.**



First five panels: ranked histograms for 500 hPa geopotential for T+06h, T+18h, T+30h, T42h and T+54h for the period April-June 2008. Initially the diagrams have a „U" shape which indicates underdispersion. In the second part of the forecast range the diagrams are close to being flat, the spread is much better. Last panel: percentage of outliers diagrams for 500 hPa geopotential and 850 hPa temperature. Results are better for Z500 (blue curve). For T850 (red curve) the system doesn't have enough spread.

Verification results

- Verification of a longer period is going on at present
- First results are on the poster



In case of any question don't hesitate to ask me!