Miklós Balogh
Gergely Bölöni
Gabriella Csima
Edit Hágel
András Horányi
István Ihász
Sándor Kertész
László Kullmann
Andrea Lőrincz
Gábor Radnóti
Roger Randriamampianina
László Szabó
Gabriella Szépszó
Balázs Szintai
Helga Tóth
Miklós Vörös

Recent development and changes in the operational ALADIN/HU 3D-Var system

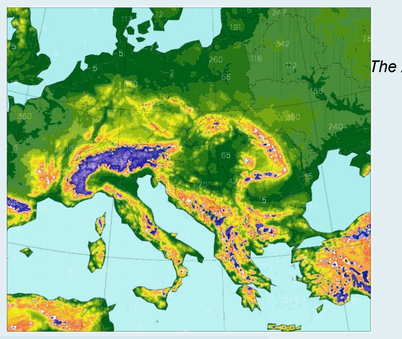
boloni.g@:met.hu; kullmann.l@met.hu

Hungarian Meteorological Service

Operational configuration

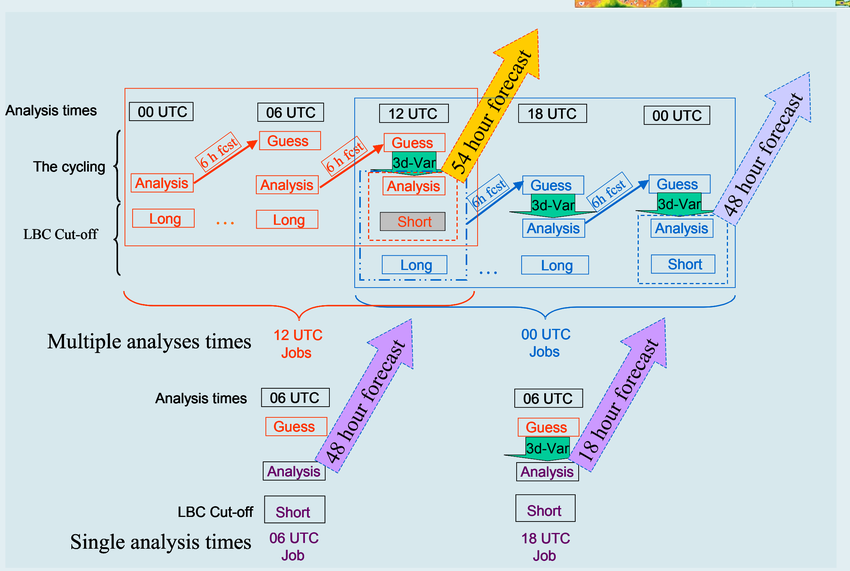
Main features of the operational ALADIN/HU model

- Model version: AL28T3 (AL30T1 since 2nd of October, 2006)
- Initial conditions: 3D-VAR assimilation
- New schedule since 2nd of October, 2006 on the Altix machine
- Four times productions a day: 00 UTC (54h); 06 UTC (48h)
  12 UTC (48h); 18 UTC (18h)
- Boundary conditions from the ARPEGE French global model



The ALADIN/HU model domain and orography

Different observations (SYNOP, TEMP, AMDAR, AMSU-A, AMSU-B) used in the operational data assimilation system



The schematic illustration of the data assimilation cycle

Model geometry

- 8 km horizontal resolution (349*309 points)
- 49 vertical model levels
- Linear spectral truncation
- Lambert projection

Assimilation settings

- 6 hour assimilation cycle
- Short cut-off analyses for the production runs
- Ensemble background error covariances
- Digital filter initialisation
- LBC coupling at every 3 hours

Observation usage

- SYNOP (geopotential)
- SHIP (geopotential)
- TEMP (T, u, v, q)
- ATOVS/AMSU-A (radiances from NOAA 15 and 16) with 80 km thinning distance
- ATOVS/AMSU-B (radiances from NOAA 16, 17 and 18) with 80 km thinning distance
- AMDAR (T, u, v) with 25 km thinning distance and 2 hour time-window, together with a special filter (that allows only one profile in one thinning-box)
- Windprofilers (u,v)
- Web-based observation monitoring system (see below)

Forecast settings

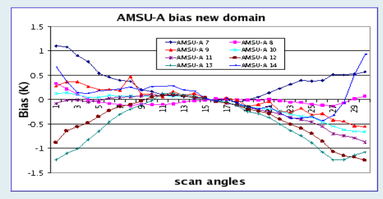
- CY30T1
- Digital filter initialisation
- 300 s time-step (two-time level SISL advection scheme)
- LBC coupling at every 3 hours
- Hourly post-processing in the first 36 hours and 3 hourly afterwards

Operational suite / technical aspects

- Transfer ARPEGE LBC files from Météo France (Toulouse) via Internet and ECMWF re-routing as backup
- Model integration on 24 processors (32 processors on Altix)
- 3D-VAR on 24 processors (32 processors on Altix)
- Post-processing
- Continuous monitoring supported by a web based system

The computer system

- SGI Altix 3700
- CPU: 96 processors (1,5 Ghz)
- 192 Gbyte internal memory
- IBM TotalStorage 3584 Tape Library (capacity: ~ 30 Tbyte)
- Job scheduler: PBSpro on Altix



Bias correction coefficients for the ATOVS data are computed locally. Here, one can see the scan-angle bias computed over the ALADIN/HU domain.

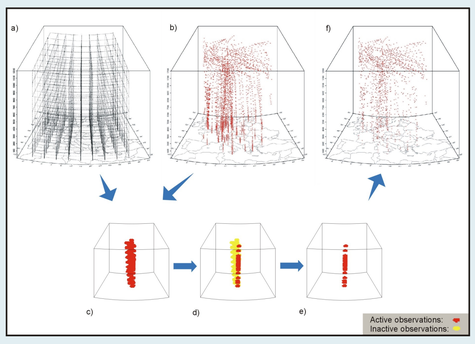


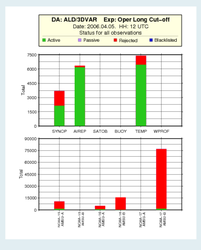
Illustration of the aircraft data thinning algorithm

Description of the aircraft data time filtering algorithm

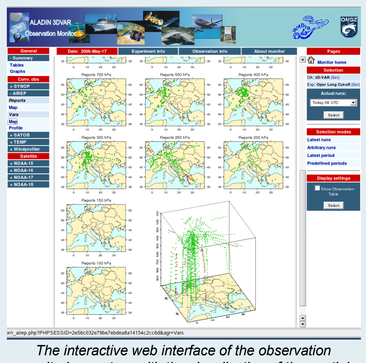
The SGI Altix 3700 supercomputer (bottom left) and the IBM TotalStorage 3584 Tape Library (bottom right)at HMS. The Altix machine is operationally used for the exploitation of the ALADIN model from 2nd of October, 2006.

Observation monitoring system

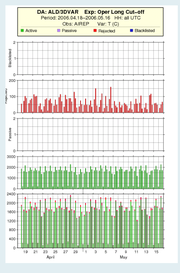
A prototype of an observation monitoring system has been developed to support the maintenance and evaluation of the ALADIN 3D-VAR data assimilation systems, concerning both the operational suites and the experimental runs. The work has been carried out within the RC-LACE Data Manager activity.The system is dealing with all kinds of observations that are available in the recent 3D-VAR system in Budapest. It can handle analysis dates and periods of analyses, as well. The system can monitor the number and status flag of observations and compute statistics for the the observation and background, and the observation and analysis departures. Advanced visualization on maps, vertical profiles, time-series and time-height diagrams is provided. The system can be used both in batch mode and interactive mode, the latter is based on a web interface with on-the fly graphics generation.



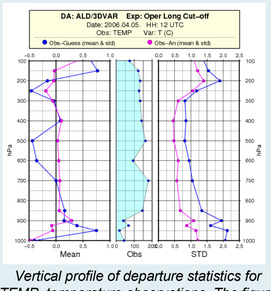
Sum of observation status flags per observation types



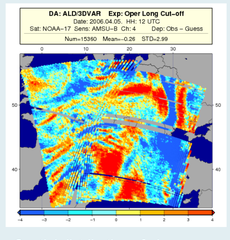
The interactive web interface of the observation monitoring system with the visualization of the spatial distribution of the status of AIREP reports



Time-series of the status of AIREP temperature observations for a one-month period



Vertical profile of departure statistics for TEMP temperature observations. The figure in the middle shows the number of active observations



Spatial distribution of obs-guess departures for a selected NOAA-17 AMSU-A channel

Technical background

The recent version of the system is using an ASCII dump of the ODB observational database. The system was written in C++ and the graphics is based on the GMT package.

Future plans

The ongoing work is the modification of the system to use ODB directly. It will make possible the advanced usage of the wide range of information stored in ODB. New statistics (Jo-table, residuals), graphical types (histograms, time distribution graphs) and automatic report generation is also under development. The new system will be capable of performing local blacklisting of SYNOP and TEMP observations.

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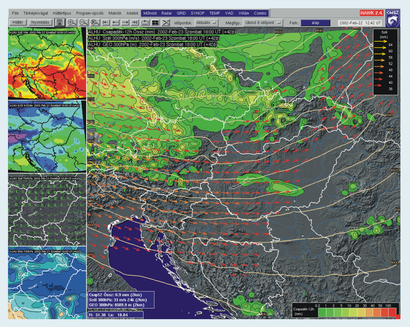
Data users

Visualization

HAWK-2 (Hungarian Advanced WorKstation) is the operational meteorological visualization system of HMS. It is a UNIX-based C++ software that allows the quick and effective visualization and printing of all kinds of meteorological data (NWP products, radar and satellite images, VAD, lightning, synop, temp, air parcel trajectory, etc.).



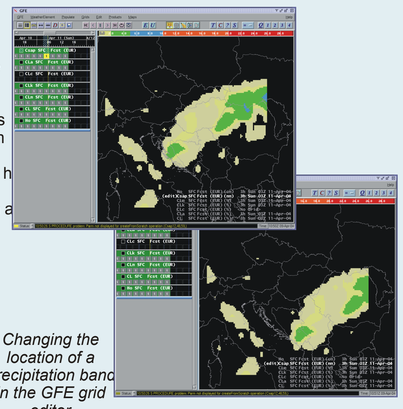
Visualization of ALADIN forecasts in HAWK

Forecasters can achieve the ALADIN products in HAWK in many different formats:

- Map-based visualization (isolines, isoline-shading, wind barb, wind arrow)
- Pseudo-temps (emagram)
- Pseudo-satellite images
- Meteograms
- Cross-sections (spatial and temporal)
- 3D visualization

Automatic forecasts

HMS has developed a uniform forecast database (stored in ORACLE) that contains the required NWP fields on a common grid with a temporal resolution of 1 hour. Most of the forecast products at HMS will be soon generated automatically from this database. At present, the first part of the database is based on ALADIN forecasts up to 48 h while the second part is based on ECMWF forecasts. The two model forecast are joined with a simple temporal relaxation. Forecasters are permitted to edit the database via a graphical grid editor tool called Graphical Forecast Editor (developed at Forecast Systems Laboratory, Boulder). At present, GFE is used in a quasi-operational mode at HMS.



Changing the location of a precipitation band in the GFE grid editor

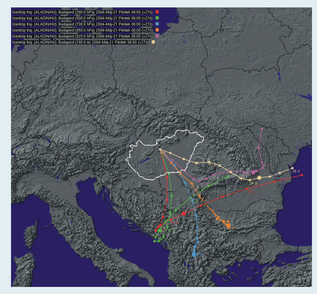
Environmental and other applications

ALADIN provides the input of different environmental models:

- FLEXTRA trajectory model - run at HMS on the same computer as ALADIN; forecasters can launch the computations interactively
- MEDIA dispersion model - run at HMS
- RODOS emergency management system - run at the Nat. Emergency Management Centre
- SINAC nuclear emergency management system - run at the Nuclear Power Plant of Paks

Other environmental and industrial data services:

- Data for the road management
- Data for the water management: accumulated precipitation for water sheds
- Data for the electric management: cloud cover and radiation data
- Low level wind forecast for powerplants (15 min. freq.)



Isentropic trajectories computed with FLEXTRA - based on ALADIN forecasts

The monitoring system of the operational and parallel suites

At HMS the operational and the test versions of the ALADIN model are running twice a day (00 and 12 UTC). Continuous (24 h) monitoring of these suites is needed. This is done by a group of nine people from the NWP group. To make this work easier it was decided to develop a monitoring system based on PHP scripts. This web-based system has three main components:

- Monitoring of the operational and the parallel suites
- Diary of errors
- Statistics about the runs of the operational suite

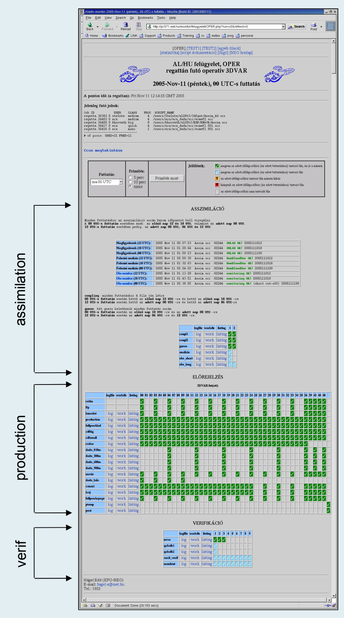
Monitoring of different model runs:

The basic idea of the system is to check the existence and size of different files (however, some applications are checked through logfiles). The possible statuses (which are indicated with different colours) of the files/applications are the following:

GREEN:	File exists, its size is good and it is belonging to the given model run
ORANGE:	File exists, it is belonging to the given model run, but its size is wrong
RED:	File is not there (or it is not belonging to the given model run)
BLUE:	File is there, it is belonging to the given model run, but nothing can be said about its size
GREY:	No file is required for the given time step

Each suite (at the moment we have an operational and two parallel suites) has its own page. On every page it is possible to choose among different model runs (such as yesterday 00 UTC, yesterday 12 UTC, today 00 UTC, today 12 UTC). It is also possible to set a value for automatic refreshing of the webpage (no refresh, refresh in every 5 minutes and refresh in every 10 minutes are the possible values).

Each page is organized into tables. There are three big tables: for assimilation, for production and for verification. Through these tables information is obtained not only about the name of the machine and the directory where the system looks for the files, but also about the name and size of the files and the date of creation.



The system provides access to different files and directories:

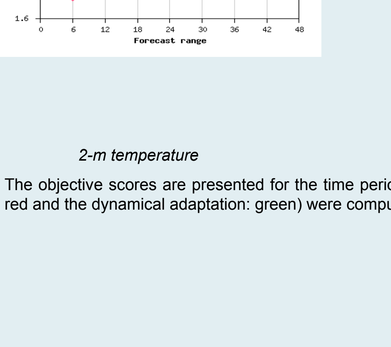
- Cronfiles
- Logfiles, listing files
- Working directories (with err and out files)

Diary of errors

In case of an error in the run of the operational or the parallel suites, one might feel important to:

- Share the problem with the others
- Make a note about it

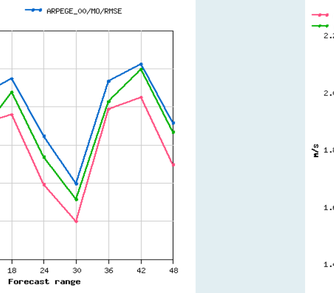
Therefore it became important to implement this feature in the monitoring system. Through a web page detailed description of the errors can be sent. These are stored and also sent automatically via email to the other members of the NWP group.



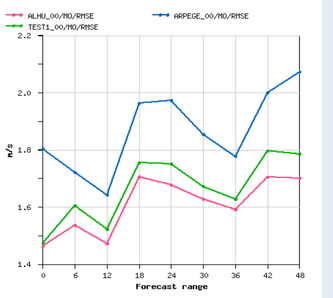
Web page for the diary of errors.

Statistics about the operational suite

Statistics are available through the system in different forms: diagrams and tables for a given model run or for a longer period.



Example of statistics for a longer period in a box plot form. The different applications of the operational run are on the x axis, while the time when they finished is on the y axis.



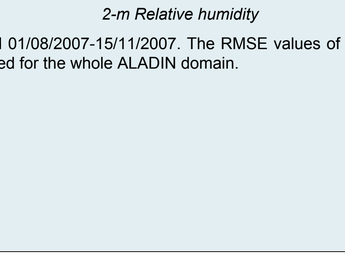
The web page of the operational suite. The green colour indicates that all files are ready and the operational run finished successfully. (The pages for the parallel suites are nearly the same.)

Verification

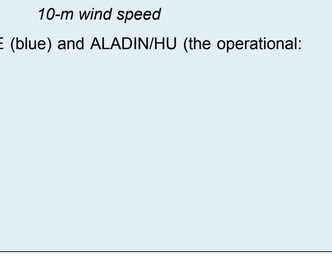
Objective verification

An interactive web-based verification system (called OVISYS: Objective Verification System) has been developed. It provides the verification of NWP forecasts used at HMS against surface (SYNOP) and radiosonde (TEMP) observations, including: scatterplots, contingency tables, maps and temporal evolution diagrams (ME, MSE, MAE, BIAS, RMSE), probability distributions and wind-direction pie charts.

2-m temperature



2-m Relative humidity



10-m wind speed

The objective scores are presented for the time period 01/08/2007-15/11/2007. The RMSE values of the ARPEGE (blue) and ALADIN/HU (the operational: red and the dynamical adaptation: green) were computed for the whole ALADIN domain.