WWW TECHNICAL PROGRESS REPORT ON THE GLOBAL DATA-PROCESSING AND FORECASTING SYSTEM (GDPFS), AND THE ANNUAL NUMERICAL WEATHER PREDICTION (NWP) PROGRESS REPORT FOR THE YEAR 2005

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1. SUMMARY OF HIGHLIGHTS

In 2005 there were basically no changes in the computer systems of the Hungarian Meteorological Service: the mainframe computers are the IBM Regatta (p690) and p655 servers and the SGI Origin 2000 computer. The ALADIN mesoscale limited area model is running on the IBM machine and the nowcasting programme package is on the SGI platform. As far as operational changes are concerned first, the ALADIN model's vertical resolution had been increased and then the three-dimensional variational data assimilation system (3d-var) of the ALADIN model was put into operations.

2. EQUIPMENTS IN USE AT THE CENTRE

IBM p655 cluster server with 32 processors (1,7 GHz processors), IBM Regatta p690 server with 32 processors (1,3 GHz processors), SGI Origin 2000 machine with 16 processors (500 MHz processors), HP L3000 cluster server with 8 CPU, different workstations (HP, DEC, SUN), EMC Clariion CX700 disk storage system (7,2 Tbyte native capacity), several LINUX computers (used for: Message Switching System, FTP, mail server, and other special meteorological purposes), CISCO routers and switches.

3. DATA AND PRODUCTS FROM GTS IN USE

The daily statistics of raw information:

SYNOP:	00/06/12/18 UTC	1877
TEMP:	00/12 UTC	619
	06/18 UTC	78

The daily statistics of products:

GRID (EGRR):	00/12 UTC	1196
(EDZW):	00/12 UTC	145
GRIB (EDZW):	00/12 UTC	1514
FAX (EDZW):	00/12 UTC	179
	06 UTC	4
	18 UTC	37

4. DATA INPUT SYSTEM

Automated

5. QUALITY CONTROL SYSTEM

Horizontal consistency check (for SYNOP messages) and hydrostatic vertical quality control (TEMP messages) for verification. Screening of observations included in the variational data assimilation system.

6. MONITORING OF THE OBSERVING SYSTEM

Surface and upper-air observations are monitored on the national level. Data assimilation monitoring system is developed and used (for all the observations operationally used in the 3d-var data assimilation process: SYNOP, TEMP, AMDAR, ATOVS/AMSU-A).

7. FORECASTING SYSTEM

The heart of the forecasting system is the ALADIN limited area model (ALADIN/HU), which is operationally launched twice a day providing 48 hours forecasts.

7.1 SYSTEM RUN SCHEDULE

The ALADIN short range forecasting model is launched on the IBM p690 Regatta machine, the data processing and visualisation are made on HP servers and workstations and also on linux PC-s.

7.2 MEDIUM-RANGE FORECASTING SYSTEM (4-10 DAYS)

There isn't any own medium range forecasting model (the products of ECMWF are used in the operational practise)

7.2.1 DATA ASSIMILATION OBJECTIVE ANALYSIS AND INITIALIZATION

None (see ECMWF)

7.2.2 MODEL

None (see ECMWF)

7.2.3 NUMERICAL WEATHER PREDICTION PRODUCTS

None (products are received through ECMWF dissemination channels).

7.2.4 OPERATIONAL TECHNIQUES FOR APPLICATION OF NWP PRODUCTS

10 days forecasts of deterministic model and ensemble prediction system of ECMWF are operationally used. Meteorological fields are displayed on workstations by the HAWK (Hungarian Advanced WorKstation) visualisation software. Automatic forecast generation is carried out based on the outputs of the ECMWF models until 10 days. The Kalman filter procedure is operational for the 2m temperature and relative humidity and 10m wind forecasts of the ECMWF model (see also ALADIN/HU model). The products of the ensemble prediction system is clustered with a clustering algorithm targeted to the Carpathian Basin.

7.2.5 ENSEMBLE PREDICTION SYSTEM

None (research studies are ongoing about the dynamical downscaling of ECMWF ensemble system with the help of the ALADIN model).

7.3 SHORT-RANGE FORECASTING SYSTEM (0-72 HRS)

The ALADIN mesoscale limited area model is applied for forecasts up to 48 hours.

7.3.1 DATA ASSIMILATION, OBJECTIVE ANALYSIS AND INITIALIZATION

The operational numerical weather prediction model ALADIN/HU is applied using three-dimensional variational data assimilation (3d-var) algorithm for the computation of initial fields for the numerical model. The main characteristics of the data assimilation system is as follows:

- Observations: SYNOP surface measurements (surface pressure), TEMP upper air soundings (temperature, wind, geopotential, specific humidity), AMDAR aircraft reports (temperature, wind), ATOVS satellite observations (AMSU-A radiances).
- Assimilation cycle: 6 hours
- Analyses method: three-dimensional variational data assimilation
- Analysed variables: temperature, humidity, wind components, surface pressure
- First guess: ALADIN 6h forecasts
- Coverage: Continental Europe
- Horizontal resolution: 8 km
- Vertical resolution: 49 levels
- Initialisation: digital filter initialisation

7.3.2 MODEL

The operational ALADIN/HU limited area NWP model is a version of the ALADIN model for the region over Europe. The main characteristics of the ALADIN model are as follows:

- Hydrostatic primitive equations;
- The equations are solved using the spectral method having elliptical truncation of bi-Fourier series;
- Hybrid vertical co-ordinates;
- Two-time level semi-lagrangian advection scheme;
- Semi-implicit time-stepping;
- 4^{th} order horizontal diffusion,
- Davies-Kallberg coupling (relaxation) scheme;
- The physical parametrization package (simple radiation scheme, Bougeault deep convection scheme etc.) is rather the same than it is for the ARPEGE French global model.

The main characteristics of the ALADIN/HU application are the following:

- Domain covering continental Europe;
- Integration twice a day (at 00 and 12 UTC) for 48 hours;
- 360*320 points in horizontal and 49 vertical model levels,
- Approximately 8 km of horizontal resolution;

- Coupling by the ARPEGE global model every 3 hours;
- Post-processed products every hour for the first 36 hours and 3 hourly afterwards on 32 pressure and 9 height levels.

7.3.3 NUMERICAL WEATHER PREDICTION PRODUCTS

Two-dimensional fields: mean sea level pressure, surface temperature, convective and frontal precipitation (including snow), total cloudiness (including low, medium and high level clouds), surface pressure, snow thickness, 10m wind, 2m temperature and relative humidity, 2m minimum and maximum temperature, pressure and temperature of the ICAO jet, surface pressure tendency, total precipitable water, short wave radiation arriving to the surface.

Three-dimensional fields: These fields are obtained on 9 height levels (on 20, 100, 300, 500, 600, 750, 900, 1250, 1500 metres) in the planetary boundary layer and on 32 pressure levels (on 1000, 990, 980, 970, 960, 950, 940, 925, 900, 880, 860, 850, 840, 820, 800, 780, 760, 740, 720, 700, 650, 600, 550, 500, 450, 400, 350, 300, 250, 200, 150, 100 hPa). The variables are as follows: geopotential (only on pressure levels), pressure (only on height levels), temperature, wind field, relative humidity, pseudo-potential temperature, vertical velocity (only on pressure levels), divergence (only on pressure levels), potential temperature (only on pressure levels), potential vorticity (only on pressure levels) and absolute vorticity (only on pressure levels).

7.3.4 OPERATIONAL TECHNIQUES FOR APPLICATION OF NWP PRODUCTS

Automated forecast generation based on the outputs of the ALADIN models giving 48 hors forecasts. Kalman filter statistical adaptation algorithm is operationally running for improving the 2m temperature, 10 wind and 2m relative humidity forecasts of the ALADIN/HU model.

7.3.5 ENSEMBLE PREDICTION SYSTEM

Intensive research and development work is ongoing about limited area ensemble systems based on the ALADIN model (sensitivity of global singular vectors is assessed with respect to its target domain and time).

7.4 SPECIALISED NUMERICAL PREDICTIONS

The outputs of the numerical weather prediction models used at the Hungarian Meteorological Service are intensively used for wide-range of applications like trajectory and dispersion modelling and hydrological modelling.

7.5. EXTENDED RANGE FORECASTS

The products received from ECMWF are used in the operational regime.

7.6 LONG RANGE FORECASTS

The products received from ECMWF are used in the operational regime.

8. VERIFICATIONS OF PROGNOSTIC PRODUCTS

ECMWF and ALADIN/HU products are verified and compared operationally computing simple statistical measures (bias and RMSE) using all the SYNOP and TEMP observations inside the domain of the ALADIN/HU domain. The verification is performed along the EWGLAM (European Working Group for Limited Area Modelling) standards. The automatically generated forecasts are also verified and compared to the forecasts issued by the forecasters. A new and comprehensive verification system (OVISYS: Objective VerIfication SYStem) is going to b introduced in the very near future.

9. PLANS FOR THE FUTURE

9.1 Development of GDPFS

New computers are going to be delivered at the Hungarian Meteorological Service: data archiving server (with approximately 30 Tbyte capacity) and a new Altix 3700 Bx2 server with 144 Itanium 2 processors.

9.2 Research activities in NWP

- Further enhancement of the three-dimensional variational (3D-VAR) data assimilation scheme for the ALADIN model: new observations (MSG SEVIRI data, ATOVS: AMSU-B data), improvements in the background error modelling.

- Development of a limited area ensemble prediction system based on the ALADIN model: computation of mesoscale local perturbations for the model based on breeding and singular vector approach.

- Development and first validation of the next generation ALADIN model (called AROME).

10. REFERENCES

Horányi, A., I. Ihász, and G. Radnóti, 1996: ARPEGE/ALADIN: A numerical weather predicition model for Central-Europe with the participation of the Hungarian Meteorological Service. Időjárás, 100., 277-300.