TECHNICAL PROGRESS REPORT ON THE GLOBAL DATA PROCESSING SYSTEM

National Contribution

Country – **Poland** Centre – **Institute of Meteorology and Water Management**

1. Summary of highlights

The modelling suite at IMWM consists of the non-hydrostatic limited-area "Lokal-Modell" COSMO-LM (resolution ~ 14 km, mesh size - 193 x 161 gridpoints / 35 layers) and of hydrostatic version of ALADIN model (resolution - 13.5 km, mesh size - 169 x 169 gridpoints / 31 layers).
Operational configuration of the system is shown in the Fig. 1 below.

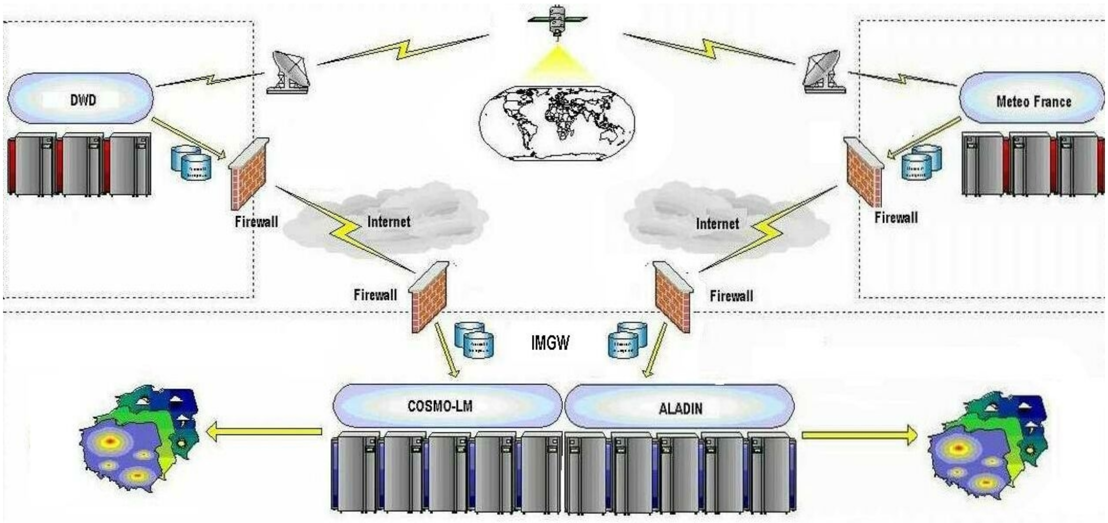

Fig. 1 Operational configuration of meteorological models at IMWM in Warsaw.

2. Equipment in use at the Centre

SGI Origin 3800, 100CPUs peak performance 100GFlops + test machine SGI 3200 4 CPUs

3. Data and products from GTS in use

For NWP – boundary and initial conditions (GRIB format) from global model(s) of DWD and MeteoFrance (see below)
For Forecast Offices - Almost all observational data from the GTS are used (SYNOP, SHIP, TEMP, METAR, PILOT, AIREP, AMDAR, SATEM, SATOB, GRIB, BUFR)

4. Data input system.

Fully automated.

5. Quality control system

There is no quality control system in use regarding outgoing data to the GTS except for formal structure.

6. Monitoring and observing system

Surface observations and upper air observations are monitored on the national level.

7. Forecasting system

7.1 System run schedule and forecast ranges

Run schedule consists of twice-a-day model(s) run. Forecast runs of LM with a data cut-off of approx. 3h after the main synoptic hours 00 and 12 UTC consists of 78-h forecasts for LM.

7.2 Medium range forecasting (4-10 days)

Medium- and extended range forecasts up to now are prepared basing on external sources (mainly, available results of global models). They consist of decade (10-day) forecast prepared every ten days. In special situation it is required to prepare a long-term forecast (for one or three months). This is mainly done using available global models combined with climatological resources.

7.3 Short range forecasting (0-72 hrs)

7.3.1 **Data assimilation, objective analysis and initialization** – n/a

7.3.2 Model

a) COSMO-LM

- Domain: Central Europe, 2700 x 2200 km, initial data time: 00 and 12 UTC, forecast range: 78 h;
- Prognostic variables: p, T, u, v, w, q_v, q_c, TKE, vertical co-ordinate: generalised terrain-following, 35 layers, horizontal- and vertical discretization: finite-difference, second order, time integration: three-time-level, leapfrog, split explicit scheme, time step 80 s, horizontal diffusion: linear, fourth order;
- Horizontal grid: 193 x 161 points on a rotated latitude/longitude grid, mesh size 14 km; Arakawa-C grid, orography: grid-scale average based on a 1-km data set.
- Parameterisations: surface fluxes based on local roughness length and stability, free-atmosphere turbulent fluxes based on a level-2.5 scheme with prognostic TKE, full cloud-radiation feedback based on predicted clouds, mass flux convection scheme, grid-scale precipitation scheme with parameterised cloud, microphysics, two-layer soil model including simple vegetation and snow cover.

b) ALADIN

ALADIN is a limited area model being developed in a frame of ALADIN Consortium and exploited at IMWM since 1998. Initial and lateral boundary conditions are taken from ARPEGE.

- Domain — Central Europe (2270x2270km)
- Basic equations — primitive equation system
- Independent variables — horizontal wind, temperature, specific humidity and surface pressure
- Numerical technique — spectral, semi-implicit semi-lagrangian scheme, DFI initialization
- Resolution, time step — 169x169 grid points, 31 levels, time step 600s, forecast range 48 hours

7.3.3 Numerical weather prediction products

- u- and v- component of wind and vertical velocity at levels[1] and at 10m agl.
- temperature at levels and at 2m agl.,
- specific humidity, specific cloud water content at levels
- pressure at levels
- snow temperature
- soil temperature at 0 and at 9cm down.
- water equivalent of accumulated snow depth

[1] "Levels" should be understood as model levels and (in some cases) as standard pressure levels or constant height levels.

- soil moisture content at 0-10 and at 10-100 cm down
- water content of interception store
- surface precipitation amount, rain, grid scale and convective
- large scale and convective snow
- dew-point temperature at 2m agl.
- minimum and maximum temperature at 2m agl.
- maximum wind velocity at 10m agl.
- drag coefficient
- transfer coefficient (sensible heat)
- total, high, medium and low cloud cover,
- albedo
- net short-wave radiation (surface and top of atmosphere)
- net long-wave radiation (surface and top of atmosphere)
- downward photosynthetic active radiant flux density
- total precipitation
- surface roughness
- momentum flux, u and v component
- sensible and latent heat flux
- convection base and top index
- top of dry convection (above MSL)
- water run-off
- pressure reduced to MSL
- cloud cover, grid scale + convective at levels

7.3.4 Operational techniques for application of NWP products

Short-range forecasts from Main Forecast Office are based on direct model output (DMO) of the LM.

7.4 Specialised forecasts

Model results are used for a range of applications. Examples:

DMO is used for the production of any weather situation with the aid of LEADS (Leading Environmental Analysis and Display System) to produce single images or image sequences for Forecast Offices. Short-range forecasts of weather, wind, temperature, pressure and sensible temperature in pictorial form are automatically produced for online presentation on the Intranet and on the Internet. The state of road surfaces and – in general – on-road conditions are on-line predicted by a road weather forecast system using data based on LM results and the energy balance model (SHAWrt) of the road surface, together with visibility and type of precipitation (FOGMOD_PL). Data from LM runs are available for National Atomic Agency in case of nuclear emergencies and/or accidents (RODOS system – Real Time On-line Decision and Support System). The possible influence of weather on human health ("bio-meteorology") is forecasted using LM results. Also, system for dispersion of pollutants is working in an operational way at IMWM, based on LM results processed for needs of dispersion modelling.

7.5 **Extended range forecasts (10 days to 30 days) (Models, Meteorology and Products)** – see 7.2

7.6 **Long-range forecasts (30 days up to two years) (Models, Meteorology and Products) –** see 7.2

8. Verification of prognostic products

Products are verified against both surface and upper air observations. Verification has become operational in 2004. List of verified products includes cloud cover, wind speed, temperature, dew point and ground pressure (for surface observations) and wind speed, temperature, pressure and relative humidity (for upper air soundings).

9. Plans for future

- introduction of nudging scheme
- introduction of nowcasting (up to 12 hours, high resolution grid) with radar-observations based wind retrieval and use of satellite data
- introduction of EPS based on multiple-model results and/or "lagged-EPS" approach

9.1 Research activities in NWP

- active participation in COSMO research efforts (research projects of high priority, mainly on data assimilation, verification and physical processes)
- active participation in ALADIN research efforts (as above)
- involvement in national/regional researches and studies

10. References

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