

## The 2010 upgrades of the Météo-France NWP system

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### 1. Progress report

A major upgrade of the global and regional prediction systems at Météo-France was implemented on 6 April 2010. The AROME-2.5km regional prediction system over mainland France has been modified as follows:

- increase of the number of vertical levels from 41 to 60 levels, the corresponding enhancement of vertical resolution is mainly located in the lower troposphere
- activation of an absorbing upper boundary condition with relaxation of the large-scales to the NWP boundary condition model
- change of the boundary condition model from the regional ALADIN-France to the global ARPEGE system, with hourly updated lateral and upper boundary conditions
- update of the background error covariance model used by the AROME 3DVar data assimilation
- use of flow-dependent background error variances provided by the ARPEGE ensemble assimilation system
- assimilation of AIRS, IASI and SSM/I radiances; implementation of a variational bias correction scheme for the assimilation of SEVIRI radiances; radiances are used with an increased density
- assimilation of radar reflectivities through Bayesian retrievals of vertical humidity profiles (*described elsewhere in this volume*)
- upgrades to the EDKF shallow convection scheme
- implementation of fog sedimentation
- improvement of the gust diagnostic computation.

The ARPEGE global prediction system has been modified as follows:

- increase of the model horizontal resolution from T538 to T798 stretched spectral truncation i.e. from 15 to 10.5km resolution over Western Europe (and to 60km over the South Pacific)
- increase of the model vertical resolution from 60 to 70 levels, most of the enhancement is located in the lower troposphere
- increase of the 4DVar assimilation increment resolution from T224 to T323 i.e. from 90 to 60km
- increase of the density of assimilated satellite radiances to 125km
- activation of extra radiance data in the 4DVar data assimilation: AMSU-B channel 5 over land (*see contribution by F. Karbou et al elsewhere in this volume*), IASI water vapour channels, and the NOAA19 satellite.
- assimilation of MODIS clear-sky water vapour winds
- increased dependency of the ARPEGE 4DVar assimilation on the ensemble assimilation system, which provides flow-dependent background error variances for all mass and wind control variables.
- improvement of the turbulent kinetic energy scheme and of the 4DVar simplified physics
- improvement of the gust diagnostic computation

The ALADIN regional systems has inherited from the ARPEGE modifications, the ALADIN horizontal resolution is now 7.5km over France and 8km over the SW Indian Ocean.

The ARPEGE ensemble prediction system (PEARP) has been upgraded in December 2009:

- increase of the number of members from 11 to 35
- increase of the vertical resolution from 55 to 65 levels
- initial perturbations are derived from the ARPEGE ensemble assimilation, on top of the previously used singular vectors.
- model error is represented in the forecasts using varying physical parametrization setups.
- more frequent ensemble forecasts (from the 06 and 18UTC analyses; previously, PEARP was only run from the 18UTC analysis)

The ARPEGE ensemble assimilation system, which now runs 6 members at T399 uniform resolution (i.e. 50km) has been upgraded to use 4DVar (3DVar was previously used) with 190-km increments. (*described elsewhere in this volume*)

The combined impact of the above changes is beneficial in terms of most forecast scores at large and regional scale. They have received favourable subjective evaluations both in routine forecasts and in severe weather events such as the Xynthia storm that hit Southwestern Europe on 27/28 February 2010. The corresponding software developments have been included into the IFS/ARPEGE software that is used by ECMWF and the ALADIN and HIRLAM consortia.

## **2. Plans for 2010**

Operational upgrades of the above systems in 2010 will at least include:

- a substantial increase in geographical extent of the AROME-France model, which will encompass the cities of Madrid, Rome, Prague, Hamburg, Shannon.
- the implementation of a high-resolution surface data assimilation for AROME.
- an upgrade of the PEARP global ensemble prediction system, which will reach 15km resolution over Western Europe.
- enhancements to the use of satellite radiances, including cloud-affected IR radiances, higher-resolution IASI radiances

Various model components will be upgraded for future operational applications, including improvements to the ARPEGE convection scheme and the representation of convection and fog in AROME. New configurations are being developed, including an enhanced ALADIN system for operational high-resolution NWP over tropical regions (West Indies, Guyana, Polynesia, Southwestern Pacific), a convective-scale ensemble prediction system, a 500m-resolution version of AROME, and a rapid refresh version of AROME for nowcasting and air traffic management applications.