

# The 2015 upgrades of the Météo-France NWP system

CNRM, Météo-France and CNRS

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The global and regional prediction systems have undergone significant changes in April and in December 2015.

## 1) Global NWP systems based on ARPEGE model

The horizontal resolution of the global deterministic system is improved, from 10 to 7.5 km over Western Europe and from 60 to 36 km over Southern Pacific (spectral resolution T<sub>1198</sub> linear grid with a stretching factor 2.2). The 4DVar minimizations resolutions are now T<sub>149</sub> and T<sub>1399</sub>. The vertical resolution is increased from 70 to 105 levels, with a lowest model level at 10m and a highest one at 0.1 hPa.

Background error covariances used in the 4D-Var analysis are better sampled thanks to the implementation of a new version of the ensemble data assimilation (EDA), based on 25 members at uniform resolution T<sub>479</sub> L105, with a temporal average of correlations that is reduced to one day and a half (instead of 4 days), and an update of correlations every 6 hours (instead of 24 hours). The figure 1 illustrates that a more frequent update of correlations enables to account for the geographical variations of horizontal correlations length scales, estimated 15 November 2013 at 06UTC and at 12UTC respectively. One can observe in particular that these length scales evolve significantly over 6 hours in this area, which is linked, among other things, to the displacement of low pressure systems.

The horizontal resolution of the 35 members of the global ensemble prediction system (EPS) is improved, from 15 to 10 km over Western Europe (spectral resolution T<sub>1798</sub> linear grid with a stretching factor 2.4). The vertical resolution is finer: 90 levels instead of 65.

Others modifications are:

- Calibration in EDA and background error variances filtering
- Version 11 of RTTOV. Vertical interpolations done in RTTOV using new coefficients
- 30' time-slots in Arpege 4D-Var (instead of 1h), “Jc\_dfi” term revision in 4D-Var
- Assimilation of new observations: 6 SSMI/S sounding channels of DMSP-F17 and F18, edge swath ATMS data, 6 sounding channels of SAPHIR on Megha-Tropiques, new GPS-RO data, new CrIS tropospheric channels (+27 over sea, +8 over land), EARS ASCAT Metop-B, Clear Sky Radiances of Meteosat-7, new GPS ground observation, radiosoundings in BUFR format, AMV and CSR data from Himawari 8, surface winds from RapidSCAT
- New observation errors for GPS-RO, AMSU-B, MHS. Algorithmic improvements for SSMI/S assimilation. Higher radiances density (factor 2) as input data in screening
- Radiation computations done every hour (instead of 3h)
- EPS adaptation to new EDA (from 6 to 25 members) + vertical modulation of inflation ahead EDA for initialization procedure
- New set of 10 physical packages (including a new prognostic convection scheme “PCMT”) in EPS
- Use of OSI-SAF sea ice fraction

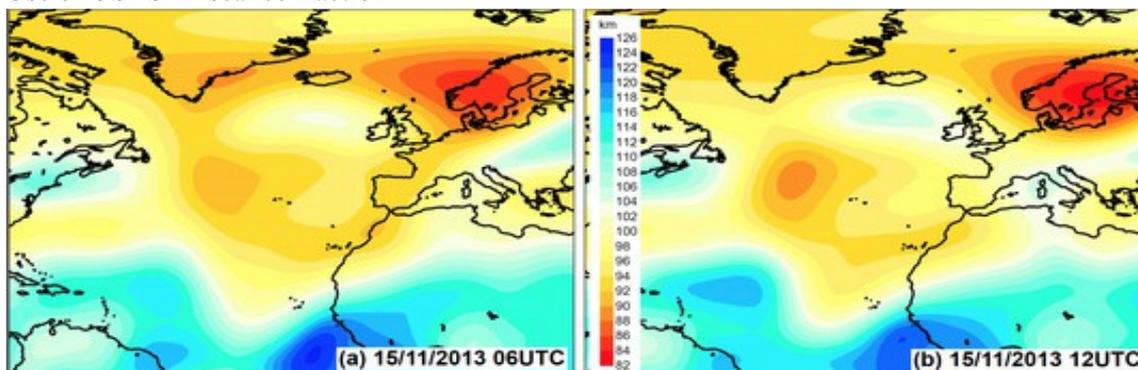


Figure1: Horizontal length scales of forecast error correlations of wind near 500 hPa (5.6 km height, color shading, in km), estimated 15 November 2013 at 06UTC (a) and at 12UTC (b). The length scale of a local correlation function is a measure of its spatial extension.

## 2) Regional NWP systems based on non-hydrostatic AROME model

The convective-permitting scale AROME-France system is now running with a horizontal resolution of 1.3 km, namely a halving relative to the previous version. Vertical resolution has also been increased, with a change from 60 to 90 levels with a lowest model level at 5m. Two of the most significant changes are a move towards a more continuous data assimilation process and a change in the spatial density (from 16 km to 8 km) of radar data (reflectivities and radial winds) used in the assimilation. The AROME variational data assimilation cycle remains 3D-Var, but the frequency of the analyses steps has been increased from 8 to 24 per day, thus potentially trebling the number of data used.

Two new systems have been introduced in the operational NWP suite for: i) nowcasting (called AROME-PI) including hourly analysis with 10' cut-off plus 6h short-range forecast with the same 1.3 km configuration than AROME-France, ii) weather forecasting for overseas territorial collectivities (called AROME-Overseas) with configurations at 2.5 km running four times par day up to 42h range over five tropical areas (figure 3).

Others modifications are:

- Same changes for observations as in ARPEGE system
- New selection of IASI channels used for cloud detection
- Update of the long range forecast initialized à HH with the analysis performed at HH+1 during the model integration
- Predictor-corrector temporal scheme with one iteration
- Modified semi-lagrangian advection scheme taking into account the flow deformation
- Numerical diffusion tunings (spectral and grid-point)
- New orographic database (GMTED 2010 at 250m resolution)
- Changes in the physics: autoconversion, orographic surface drag, orography slopes and shadowing effects on surface radiation fluxes

Scores and case studies confirm a significant improvement of AROME-France precipitation forecasts, including, as illustrated in figure 2, a reduction of the positive bias, which was particularly pronounced between 12 and 18 TU (occurrence of the maximum of convective precipitation).

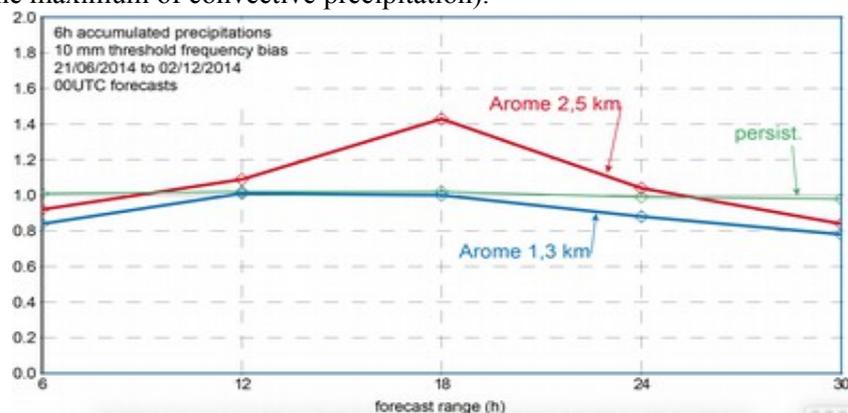


Figure 2: Frequency biases of 6 hourly accumulated precipitation forecasts above given thresholds, 10 mm/6h in this case, against forecast range between 21 June and 2 December 2014. Forecasts are started from 00UTC. Red curve: old operational Arome (2.5 km resolution); blue curve: new operational Arome (1.3 km resolution); green curve: persistence forecast.



Figure 3: Five AROME-Overseas operational domains