

## 2.2. FRANCE

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The ARPEGE e-suite, tested from autumn 2009 to spring 2010, corresponds to an increase of the horizontal resolution which is equal to 10 km over France and 60 km over New-Zealand and of the vertical resolution (70 levels) mainly in the troposphere. The time step is reduced to 10 min. The uniform resolution of the analysis is 60 km and corresponds to the lowest resolution of the simulation. New weights of the observations and the first guess are used in the 4DVAR assimilation scheme, the covariances of the assimilations come from an ensemble of data assimilation and a new linearized microphysical scheme is used during the assimilation process. The density of the assimilated satellite brightness temperatures is multiplied by 3, 10 supplementary IASI channels and the AMSU-A and HIRS soundings of the satellite NOAA19 are used in ARPEGE. The TKE advection is taken into account in the temporal evolution of TKE. The diagnostic wind gustiness is deduced from 10m wind and TKE.

The objective verification of this e-suite shows an improvement in the troposphere of the scores over Europe and the extra tropical domains when the reference is given either by the radio soundings or by the ECMWF analysis. For the geopotential heights, the improvement reaches 0.5m at 500 hPa at a lead time of 48 hours et more than 1m one day after. These results are statistically significant only for the large extra tropical domains (Figure 1). The stratospheric worsening is due to the variational bias correction for the increased number of satellite observations of the e-suite.

This worsening is seen as an improvement if the reference is the analysis of the ECMWF.

The temperature improvement in the troposphere is of the order of 0.1 K in the low troposphere and the jets errors are also reduced of 0.4m/s. The comparison with the surface observations do not provide any important and significant change.

The subjective verification of forecasters leads to the same conclusions: the forecasts are improved for lead times larger than 2 days. The most important storms of 2009 and 2010 are predicted with a quality equivalent to the operational model but the successive runs are more stable.

The ALADIN-FRANCE model also uses the new satellite data and with the same higher resolution. Its vertical resolution is the same as ARPEGE and the horizontal resolution is increased to 7.5 km over the western Europe. The same improvement as for ARPEGE is recovered for the ALADIN-FRANCE model.

The AROME model is now directly coupled to the ARPEGE model every hours, a damping toward the ARPEGE fields is applied in the levels such that  $Pressure < 110hPa$ . The vertical resolution (60 levels) is stronger than the ARPEGE resolution in the troposphere but weaker in the stratosphere. AROME assimilates the same satellite data as ARPEGE and ALADIN. It also assimilate the reflectivities observed by the French radar network. Only the turbulent fluxes of conservative variables are computed in the turbulence scheme and the shallow convection scheme of the up drafts is changed. A slow sedimentation speed is included in the microphysical scheme for the fog. These modifications lead to neutral scores for the AROME forecasts. The QPF are of the same quality but the convection was not active during the e-suite validation period mainly in winter.

**GEOPOTENTIEL:PA.r 00/TP-PAD.r 00/TP**  
 (1. m) Chaîne 2009\_03: Hautes Resolutions: Obs + Modeles  
 127 simulations de 96 h du 20091123 au 20100405

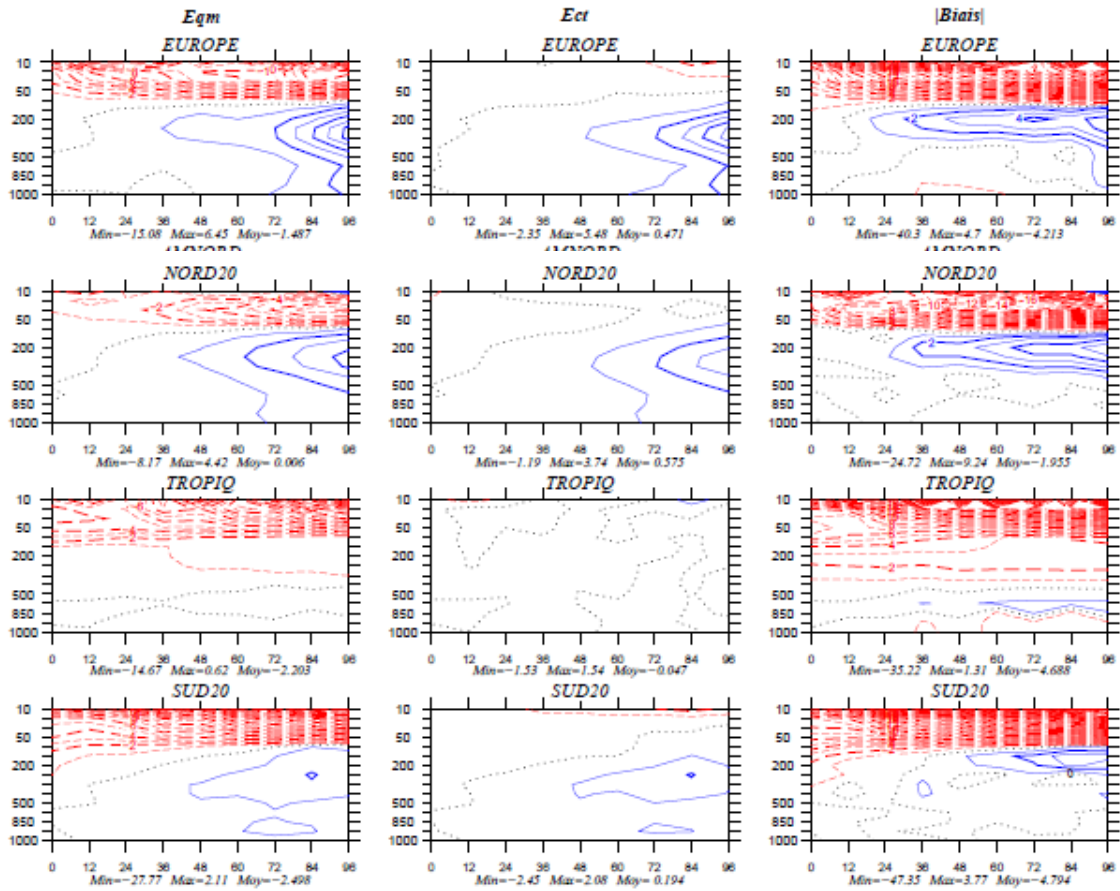
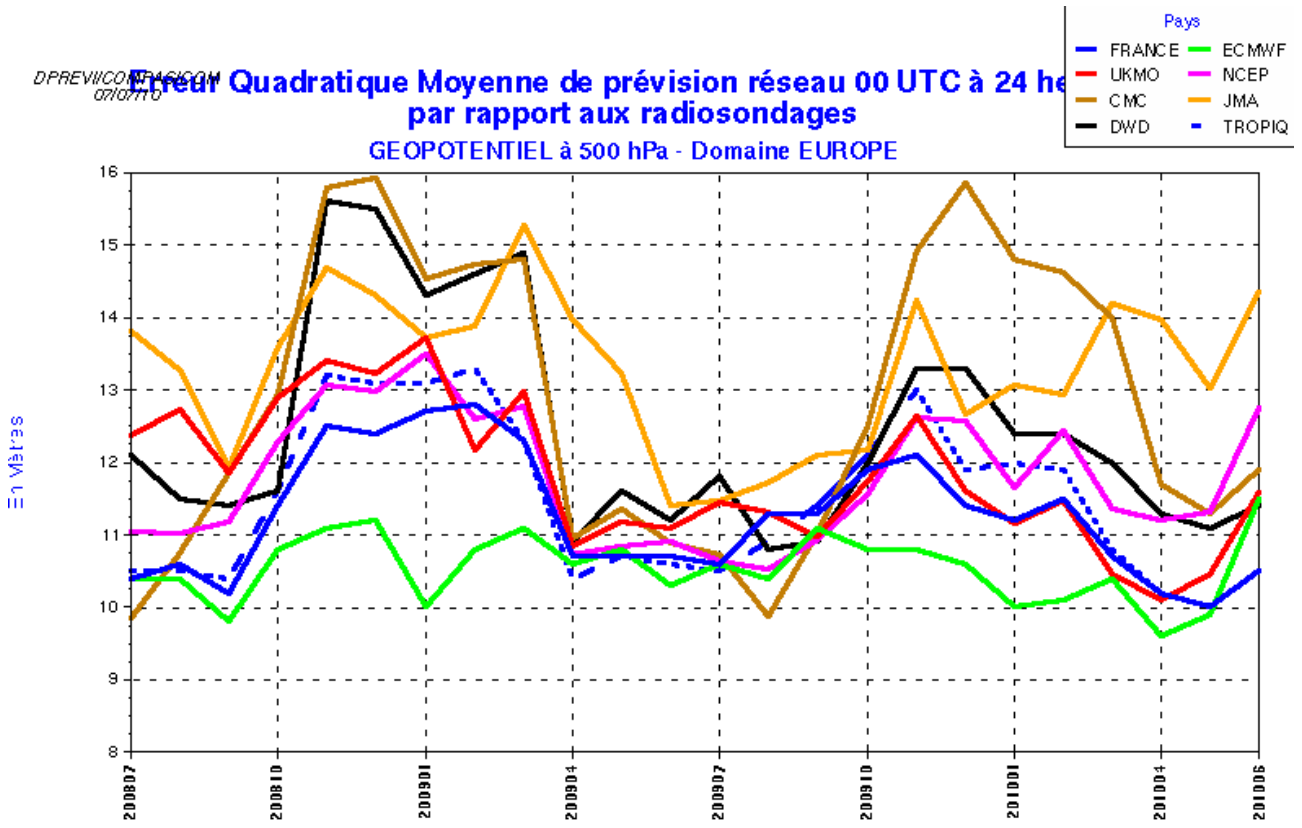


Figure 1: Difference of the scores realized by the operational version of ARPEGE and its e-suite. The reference is provided by the radio soundings measurements. The scores are computed for the geopotential heights: Bias (right), standard deviation (centre) and root mean squared error (left) for different domains: from top to bottom Europe, North 20, Tropical area, South 20. The isolines are plotted every meter and the blue ones correspond to an improvement and the red ones to a worsening.



ARPEGE tropospheric scores (Z500 at 24 h) over Europe North 20.