A few improvements brought to the French global and fine-scale models

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A major upgrade of the NWP system in April 2010 has already been described in the 2010 Blue Book. Additional improvements were made at the end of 2010, a few of which are described here.

The representation of stratiform clouds, shallow convective clouds and associated precipitations is based in Arpege and Aladin models on the prognostic evolution of specific humidity for four classes of hydrometeors: cloud liquid water, cloud solid water, rain and snow. Microphysical processes related to precipitation are described explicitly. Sedimentation is computed with a statistical algorithm suitable for "long" time steps (between 9 and 30 minutes).This parameterization of microphysical processes has been improved to correct some deficiencies identified by forecasters. Non zero sedimentation speed, about several centimeters per second, is now taken into account for the liquid and solid cloud water. This modification decreases the cirrus cloud cover in a realistic way and the high sensitivity of the parameterization to the autoconversion threshold for the solid water phase. This change allows a revision of the snow fall speed (0.6 m/s to 1.5 m/s) and of the autoconversion thresholds with a slightly positive impact on the simulation of stratocumulus clouds.

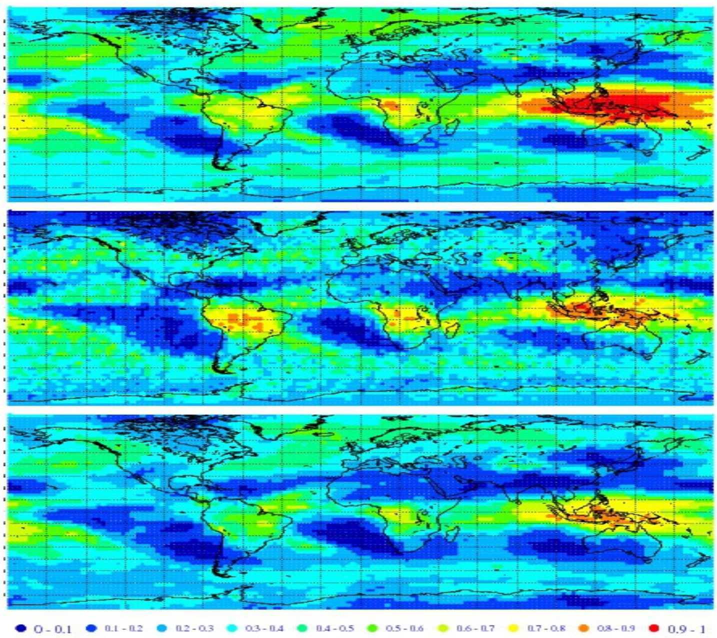

Figure 1: high cloud cover simulated by the ARPEGE model averaged over December-January-February 2007/2008 with the old (top panel) and then new (lower panel) version of microphysics compared to the high cloud cover derived from CALIPSO lidar observations (middle panel).

The numerical weather prediction model AROME has a dedicated 3D-Var data assimilation system providing analyses every 3 hours. This year, it has been possible to assimilate radar reflectivity data, via a 1D+3D approach (Caumont el al, 2010). As can be seen in figure 2, the assimilation of reflectivities improves precipitation detection scores for short range forecasts while, at the same time, retaining a good level of false alarm rate.

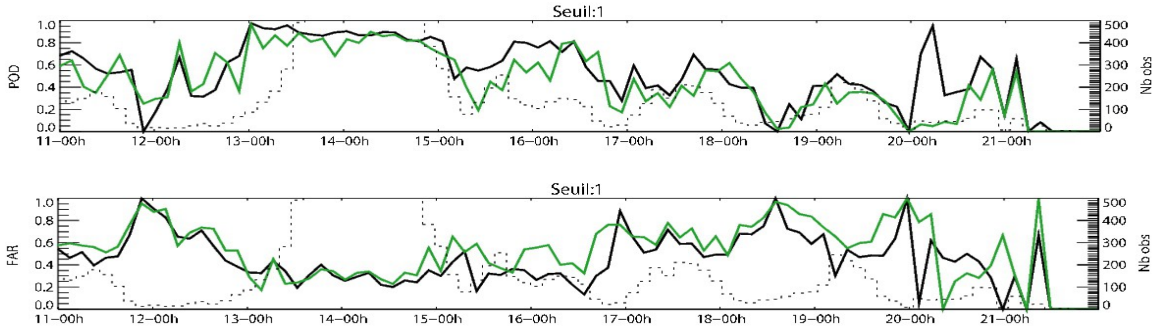

Figure 2: comparison of forecast time-series to rain-gauges On top, probability of detection (POD); bottom, false alarm rate (FAR) for short range cumulated precipitation forecasts between 00h and 03h. Scores show the 1mm/h precipitation threshold for the experiment with the assimilation of radar reflectivities (solid black line), and without the assimilation of radar reflectivities (solid green line), between the 11th and the 21st of December 2008 inclusive. The dashed black line corresponds to the number of observations below the threshold of 1mm/h.

The quality of fine scale forecasts also depends upon the land surface state since it has a strong influence on water and energy exchanges with the atmosphere. In its first operational configuration, the prognostic soil variables of AROME were interpolated from surface analyses produced by the global model ARPEGE. In order for AROME to have its own surface analysis system, a methodology based on the one currently used in the operational models ARPEGE and ALADIN has been set-up. Soil temperature and moisture contents are corrected using screen-level short-range forecasts errors of temperature and relative humidity (Giard and Bazile, 2000). Figure 3 shows that most dry and wet regions are rather consistent over the domain between the two maps. However, the interest of correcting AROME forecasts clearly shows up since small scale features are better resolved particularly over mountainous regions. Quantitative Precipitation Forecasts are systematically improved with the experimental AROME suite.

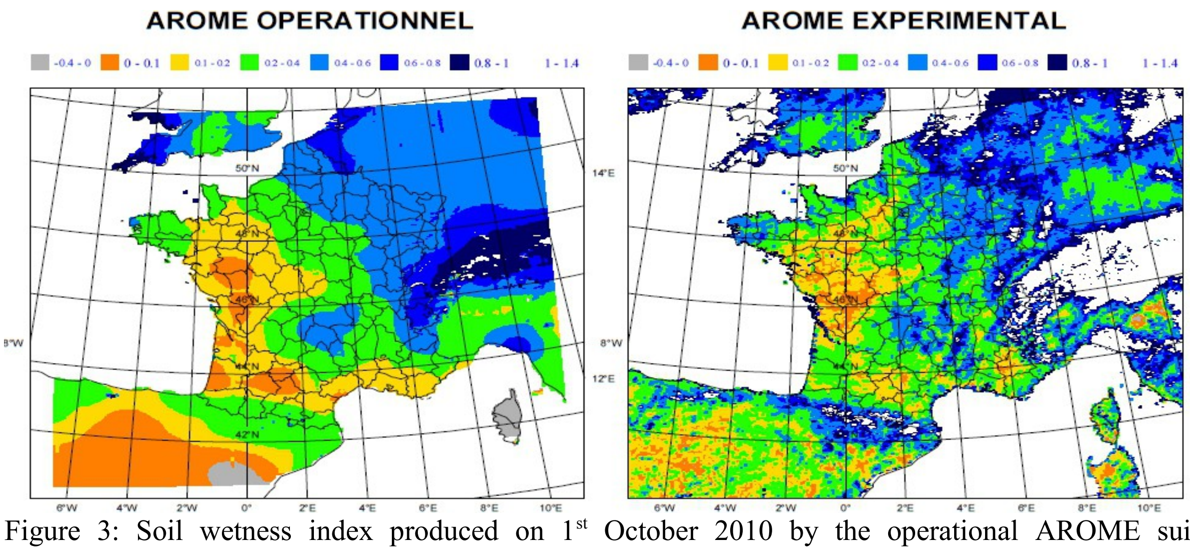

Figure 3: Soil wetness index produced on 1st October 2010 by the operational AROME suite (interpolation from the ARPEGE model) and by an experimental AROME suite (having its own surface analysis)

References:

Caumont O., V. Ducrocq, E. Wattrelot, G. Jaubert, S. Pradier-Vabre, 2010: 1D+3DVar assimilation of radar reflectivity data: a proof of concept. *Tellus A*, **62A** (2), 173-187, doi: 10.1111/j.1600-0870.2009.00430.x.

Giard, D., and E. Bazile, 2000: Implementation of a new assimilation scheme for soil and surface variables in a global NWP model. Mon. Weather Rev., 128, 997-1015