THE ALADIN-FRANCE ASSIMILATION AND FORECAST SYSTEM

Claude Fischer, Bernard Chapnik, Pierre Brousseau and Ludovic Auger
Météo-France

ALADIN FRANCE : some general features

About ALADIN-FRANCE

The French domain can be seen in Figure 1. The centre of the domain is located at 46.47°N; 2.58°E. Computations are performed in spectral bi-Fourier space with elliptic truncation at wave number 149. The equivalent grid has 9.51 Km gridmesh. The vertical dimension is discretized in 46 levels (+ a surface)

During a forecast ALADIN-FRANCE is coupled to its coupling model (ARPEGE) every 3 hours. The timestep is 415.385 s

Operationally, 4 runs are performed each day at 00, 06 12 ant 18 UTC. Forecasts terms are 54H for the 00H forecast, 48H at 06H, at 42H at 12 and 36H at 18H.

The operational Data assimilation

The assimilation scheme is 3D-Var with a 6H window. A continuous "long cut-off" cycle provides the guess for a "Short cut-off" production which provides the operationally used analysis.

Assimilated observations are
- –Surface pressure and SHIP winds
- –2m temperature and RH
- –Aircraft data
- –SATOB motion winds
- –Drifting buoys
- –Soundings (TEMP, PILOT)
- –Satellite radiances: AMSU-A, AMSU-B, HIRS, Meteosat-8 SEVIRI
- –QuikSCAT winds
- –Ground-based GPS zenithal delays

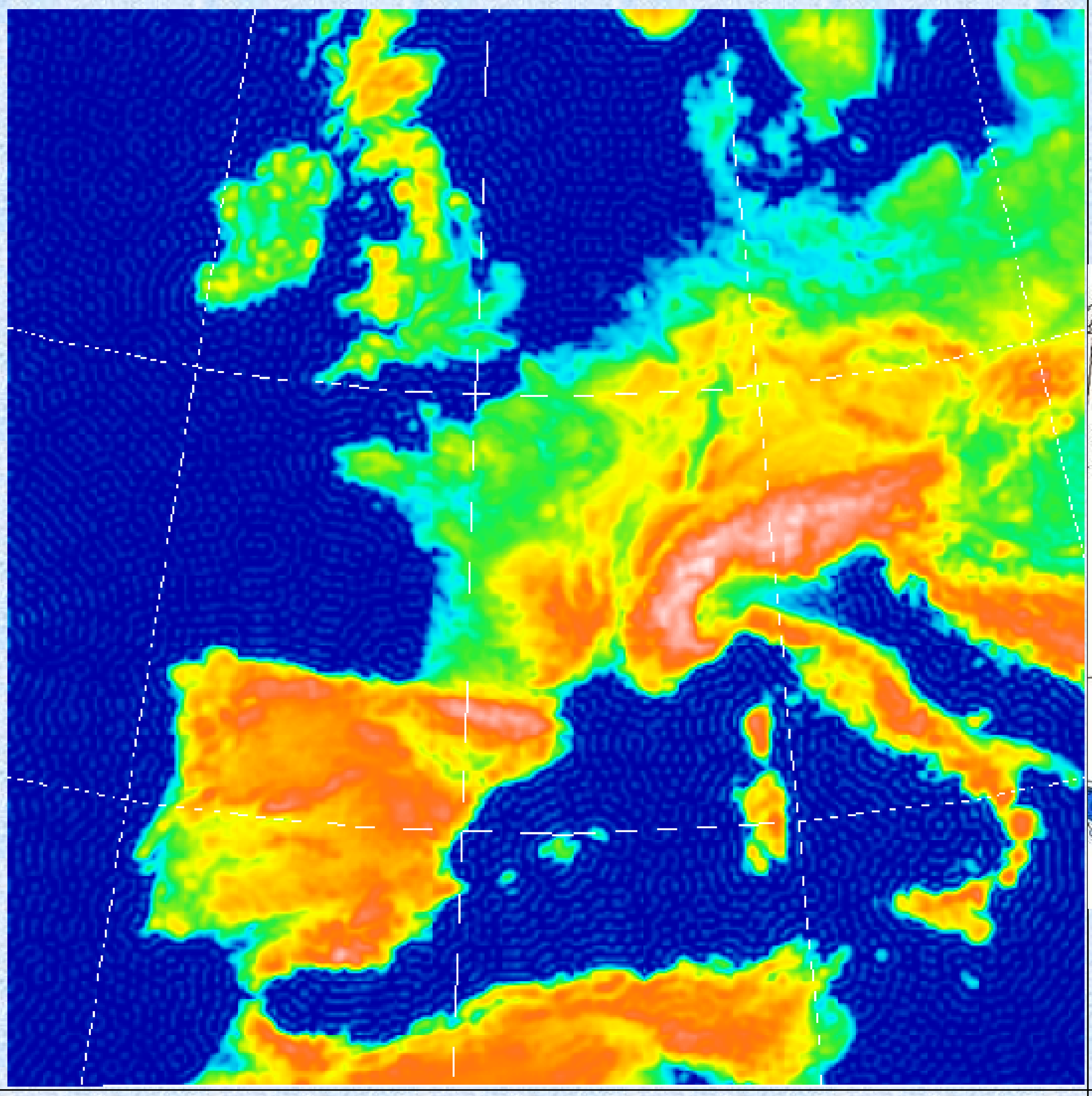


Fig.1. The ALADIN-France domain, with the orography.

The most likely next E-suite

What would be in the E-suite ?

The most remarkable items :

-Observations: independent extractions for Aladin; de-biasing of MSLP;

-Assimilation methods: Sigma_b maps of the day; Ω and NL balance in Aladin Jb

-Physics: enveloppe orography halfed; 6 bands in the SW Morcrette radiation; and in the APCS:

*statistical sedimentation

*autoconversion in the microphysical adjustment

*abandon the second microphysical adjustment after turbulence

-Semi-Lagrangian Horizontal Diffusion and associated reformulated spectral diffusion

-CY31T1

Impact from the onset of a prognostic microphysics scheme ("APCS") : the likelihood of precipitations

Figure 4 compares 6H accumulated precipitations for ALADIN with the former Kessler scheme (right panel) and with the new Advanced Prognostic Cloud Scheme (left) on the 1st of April 2006 at 00UTC. It can easily be seen how the jagged intense precipitation spots, to a large amount determined by orography, have been replaced by smoother larger scale structures. This is a consequence of the new water variables which have been introduced in the treatment of resolved precipitations (rain, snow, cloud liquid and ice contents).

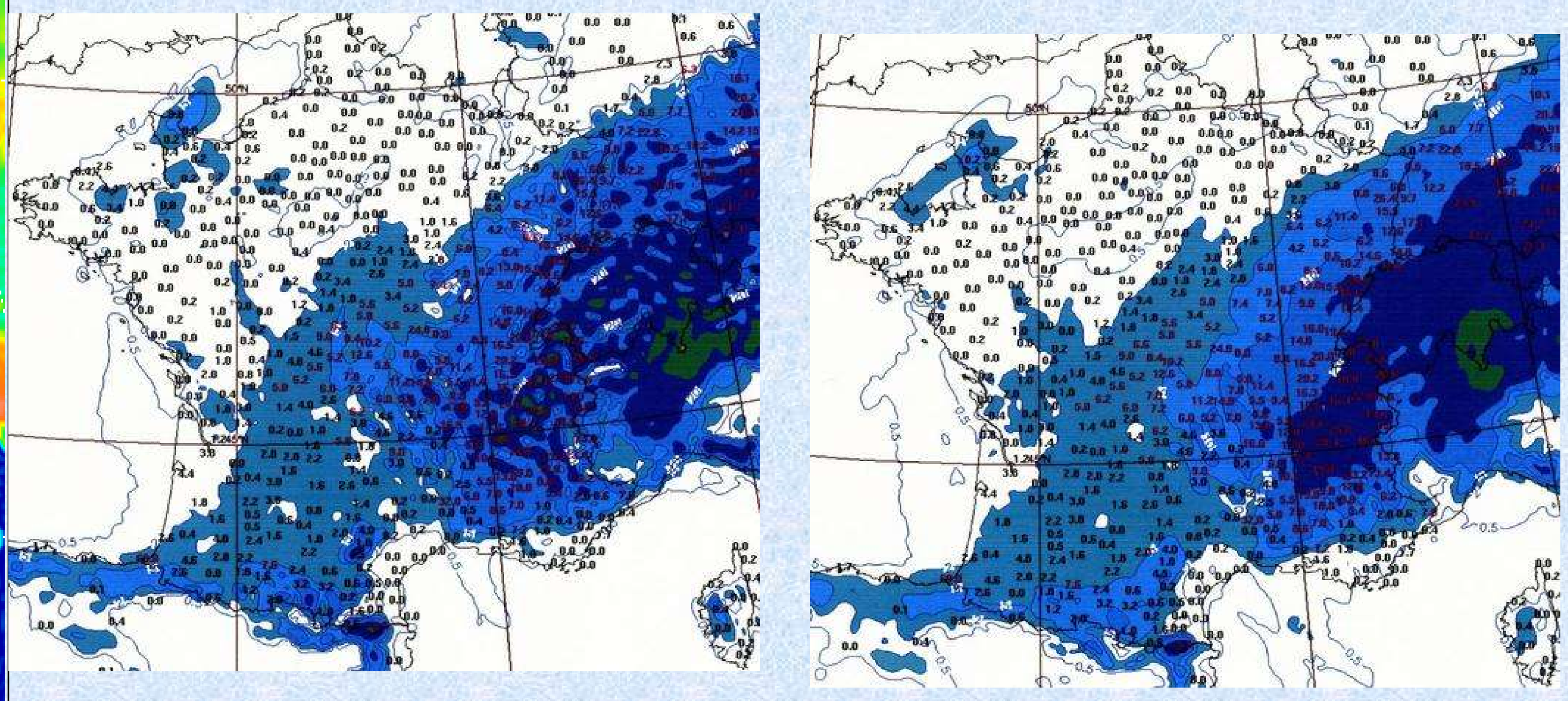


Fig. 4 compares the six hour accumulated precipititation forecast seen by the former Kessler-scheme model (left) and the APCS version (right) on April the 1st at 00H

Current developments

A refinement of the analysis scheme: The Jk term

The variational scheme used by ALADIN 3D-Var allows for the introduction of supplementary penalisation terms in the cost function.

In order to keep advantage from the ARPEGE analysis of large atmospheric scales, a new term is introduced: the Jk term. It penalises departures of the ALADIN analysis from ARPEGE for wave numbers ranging from 1 to 12.

The idea is close to the « blending » procedure, which has been shown to improve the structure of precipitation fields.

Figure 2. Shows the improvements in term of forecast error for temperature brought by this new term. An effect can clearly be located in the upper stratosphere, showing that this analysis takes profit of ARPEGE's better representation of this region of the atmosphere.

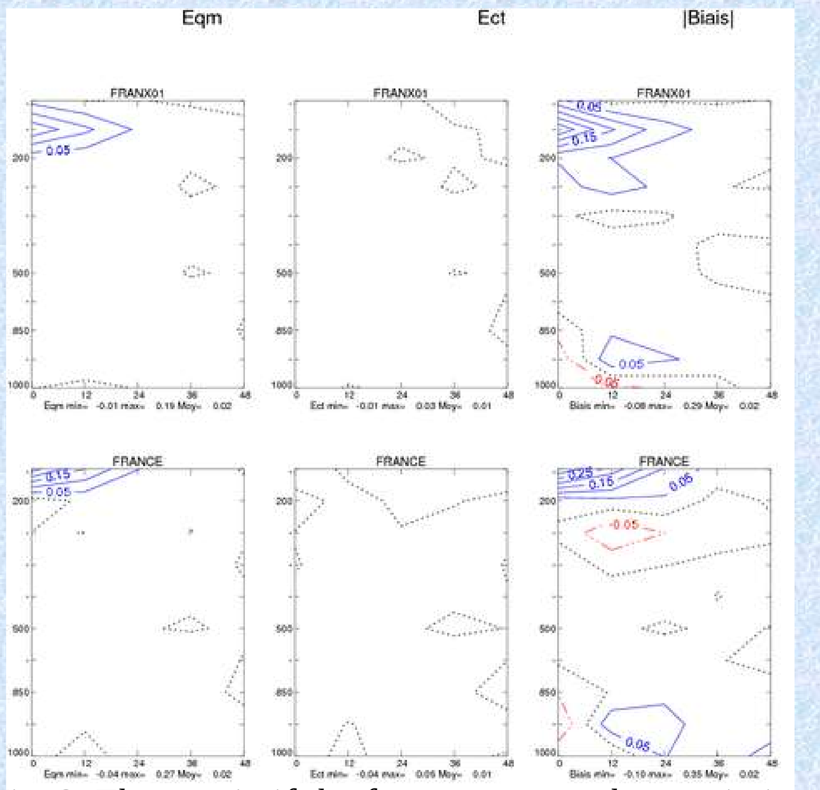


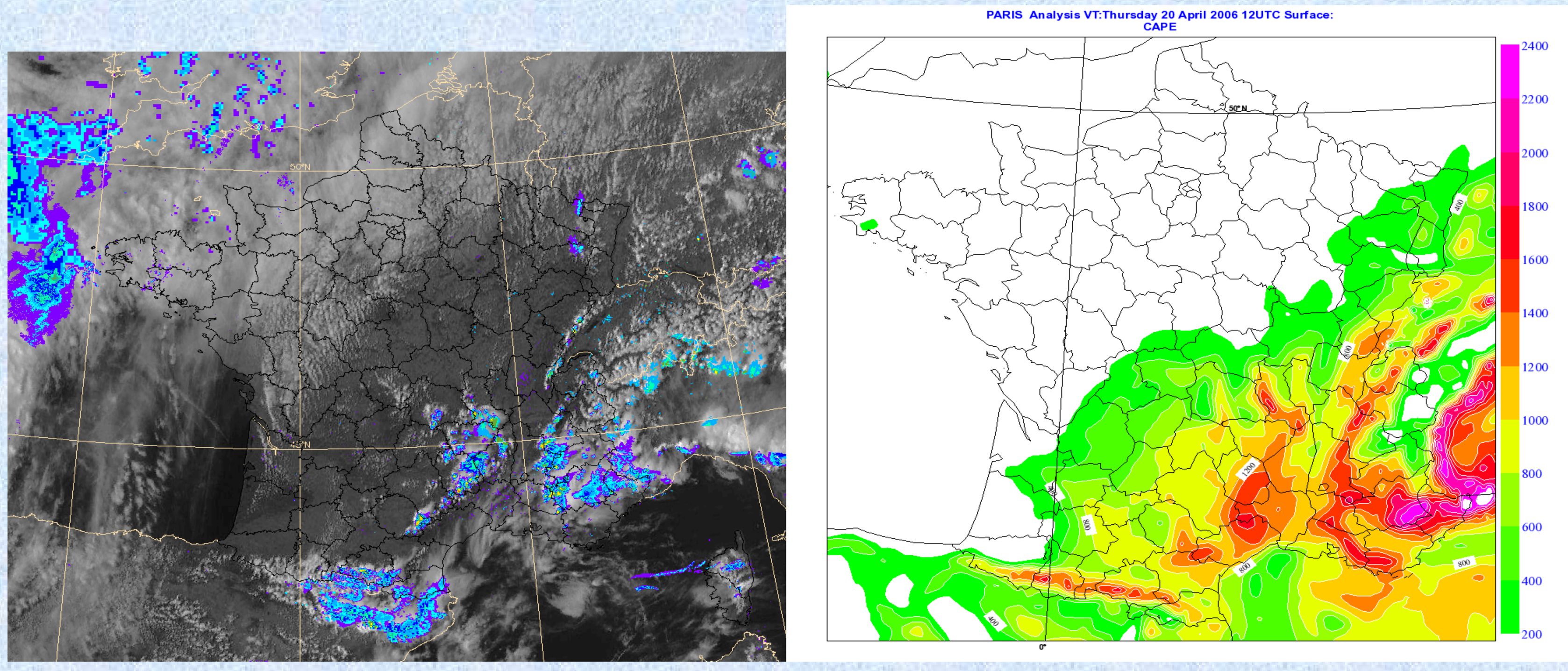
Fig. 2. The x axix if the forecast term , the y axix is the pressure level. Blue isolines correspond to reductions of forecast error for temperature (0.05K per line) while red lines corespond to an increase of the error.

An ALADIN based nowcasting tool : VARPACK

Varpack diagnostic analysis is a diagnostic tool that provides to forecasters every hour an analysis of atmospheric fields as precise as possible for immediate forecasting purposes.
Most currently used output fields are 2m humidity and temperature, 10m winds, CAPE and MOCON (Moisture Convergence). Two more levels are used close to the ground: 10m and 2m levels in order to have an analysis independent of surface fields.
A new B matrix was designed to fit the new geometry, statistics for the two new levels are deduced from statistics of the last level from the usual B matrices.

All the observations available for ALADIN-3dvar plus 10m wind observations are currently used. Figure 3 shows the Varpack CAPE field at 12H00 for the 20th of April and the radar echoes and clouds at 16H00. For that situation the CAPE diagnostic works quite well since the high CAPE values are localized at the position of the rain events two hours later

Fig. 3. Comparison between an infrared image with colocalized radar observations (left panel) at 14H00 UTC and the CAPE field produced by VARPACK (right panel), for the same date at 12H00 UTC on April 20th 2006.



Future developments

Data Assimilation

3D-Fgat

The 3D Fgat (First Guess at Appropriate Time) scheme allowing for a low-cost taking into account of the temporal distribution of observations is currently being developed in collaboration with the Hungarian service.

Ensemble Jb

The current B already uses the information from an ensemble of ALADIN forecasts issued from an ARPEGE analyses ensemble. Future statistics will be produced from an ensemble of cycled ALADIN analyses. Longer term works will aim to include more flow dependency into it.

Future observations

A noticeable effort is being made to include among analysed observations the METEOSAT 9 imager instruments. Future developments will, in a longer term, also include AMSU-B and HIRS land observations, as well as radial winds from Doppler radars.

Towards AROME, A first try of a Rapid Update Cycle (RUC)

The future AROME system will become operational for the meso-γ scale in 2008. Its data assimilation part will greatly be inspired by the ALADIN data assimilation. The system will need to exploit all the numerous, high density, time distributed observations to provide a useful mesoscale analysis A possible way to ahieve this is the RUC scheme, which performs successive analyses with a short time window. The figure below compares Radar reflectivities with an ALADIN analysis of precipitations on a six hour window and a RUC with two three hour windows. While the conventional analysis of precipitations is not even correctly localized, it can be seen that the RUC analysis is more accurate and that its structures are closer to those seen by the reflectivities.

Fig. 5 compare observed precipitation (reflectivitiess) in the left pannel, precipitations analysed by the current 3D-Var, in the middle pannel and precipitations analysed by the RUC in the right pannel.