THE REGIONAL NWP SYSTEMS AT METEO-FRANCE

with contributions from the CNRM/GMAP staff

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 60 levels (+ a surface)

During a forecast, ALADIN-FRANCE is coupled with ARPEGE every 3 hours. The timestep is 450 s to have an even number of iterations for 1h

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

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. Coefficients for variational bias correction (applied to satellite observations) are computed by Arpege.

Assimilated observations are

- Surface pressure and SHIP winds
- 2m temperature and RH, 10m winds
- Aircraft data
- SATOB motion winds (AMV)
- Drifting buoys surface pressure
- Soundings (TEMP, PILOT)
- European wind profilers
- Satellite radiances: AMSU-A, AMSU-B, HIRS (NOAA and METOP), Meteosat-9 SEVIRI (5 channels)
- QuikSCAT winds
- Ground-based GPS zenithal delays
- New AQUA/AIRS channels (~54)
- MSG/SEVIRI Clear Sky Radiances (the 2 so-called "water vapor channel")
- Clear-sky microwave radiances over land

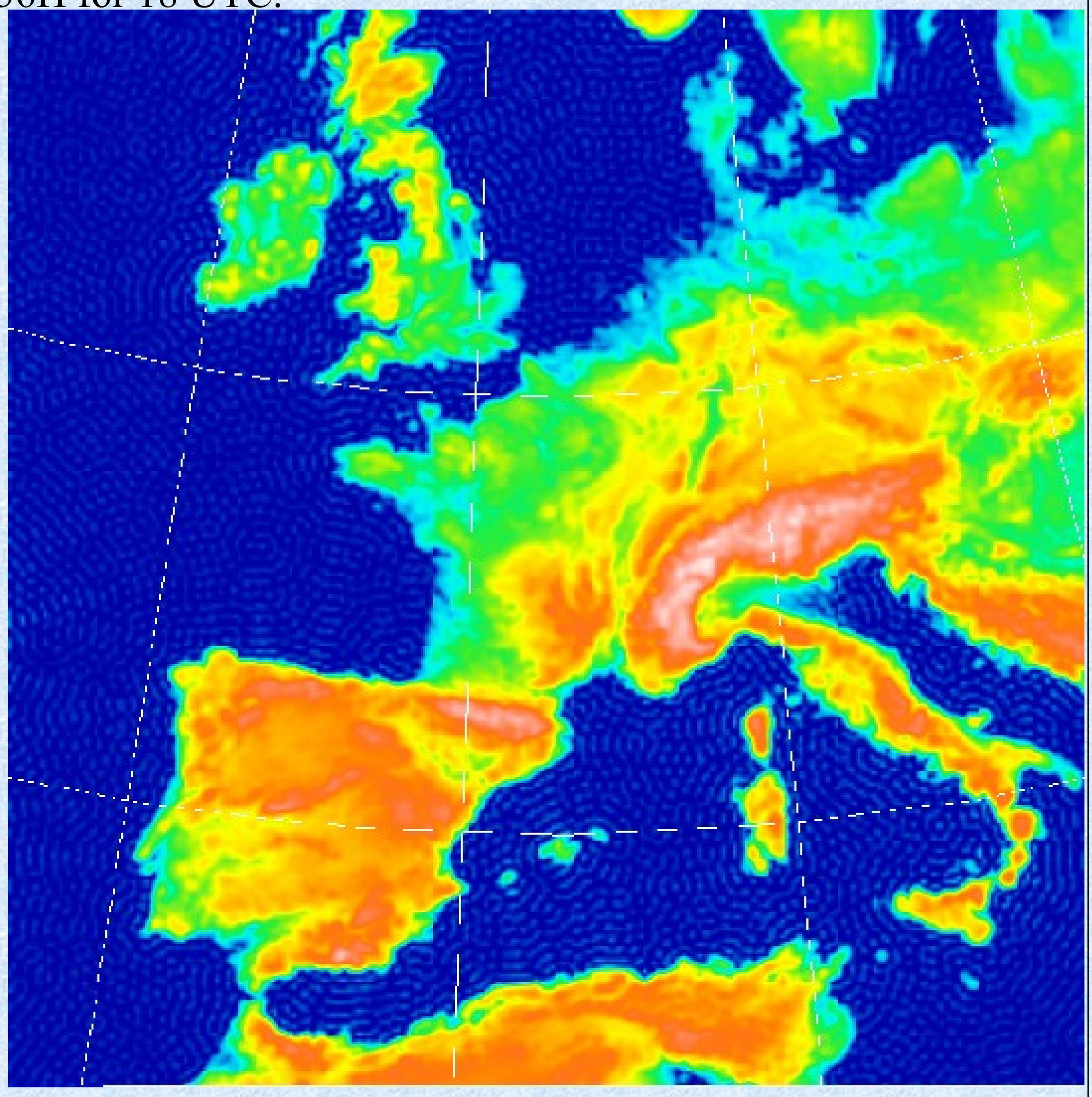


Fig.1. The ALADIN-France domain, with the orography.

-Cloudy AIRS
-IASI (sea/land/seaice)

The operational suite

The cycle for the operational suite is CY33T1, this suite contains important changes in the physical parametrizations used in Arpege and Aladin. It has been running since februar 2009.

➢ **ARPEGE and ALADIN-France:**

✓Physics:

- identical horizontal diffusion of vorticity, divergence and temperature
- vertical turbulent diffusion scheme with prognostic tubulent kinetic energy (CBR)
- shallow convection scheme form Bechthold et al. (2001)
- use of sea surface turbulent fluxes scheme ECUME (Weil et al. 2003)
- improved entrainment at the top of boundary layer

➢ **ALADIN-France**

•Same changes than in Arpège plus introduction of surface assimilation scheme CANARI adapted from Arpège.

ARPEGE and ALADIN next E-suite (autumn 2009)

- Change of resolution of ARPEGE: T800C2.4L70, (~ T400L70 for the analysis increment with, 3 outer loops in 4D-VAR)

- Doubling of the density of about all radiances types (change the scale of data use from one spot every 250 km to one every 125 km)

- Increase of resolution for ALADIN-France L70 to about 7,8/8 km

-cy35t2

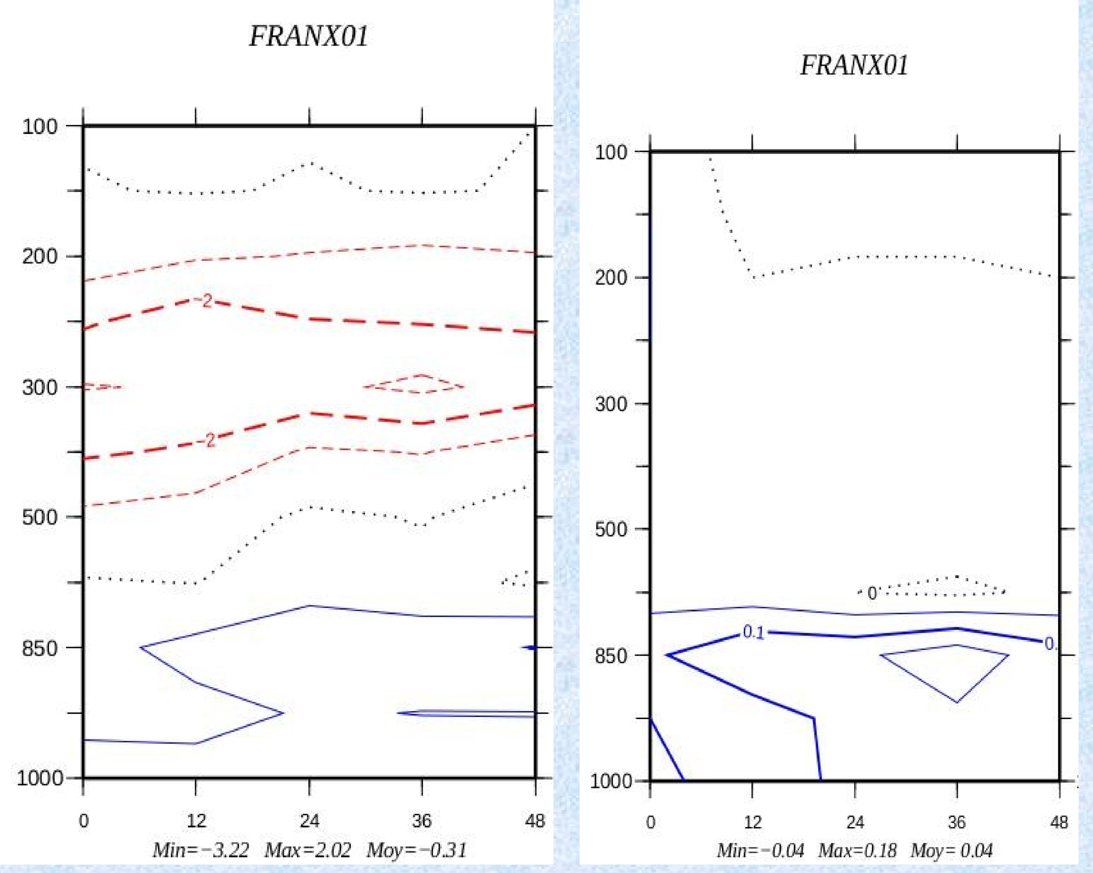


Fig. 3. Differences of RMSE (in comparison with TEMP measurements) between 48h forecasts with the actual operational suite and the old operational suite for moisture (left) and temperature (right). Blue (red) contours means better (worse) agreement with observations.

Assimilation of radar data in Arome

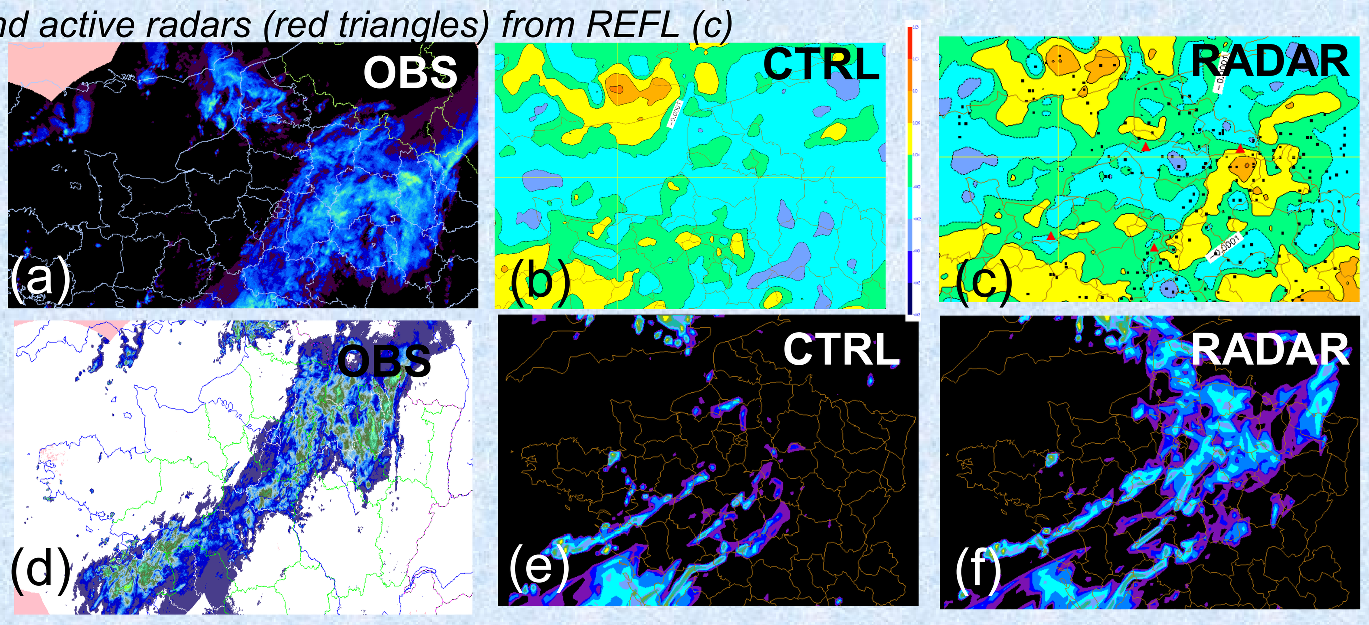
•Assimilation of radar reflectivities

To assimilate reflectivities, an observation operator that allows to convert the model control variables (surface pressure, temperature, wind and moisture) into a model equivalent radar measurement at the observed location has been developed. The moist processes involved in the definition of this observation operator are nonlinear. So, instead of using a variational approach whose minimization of the cost function could fail, an original "1D+3DVar method" has been introduced by Caumont et al. (2006). At present, this method has been implemented and is tested in the available AROME pre-operational assimilation.

Case of 20 November 2007

Top panels: composite reflectivity product for the 21h UTC analysis time of November the 19th (a), horizontal cross section at 850 hPa of the specific humidity increments field from CTRL (b), with superimposed active pseudo-profiles of reflectivities (black spots) and active radars (red triangles) from REFL (c)

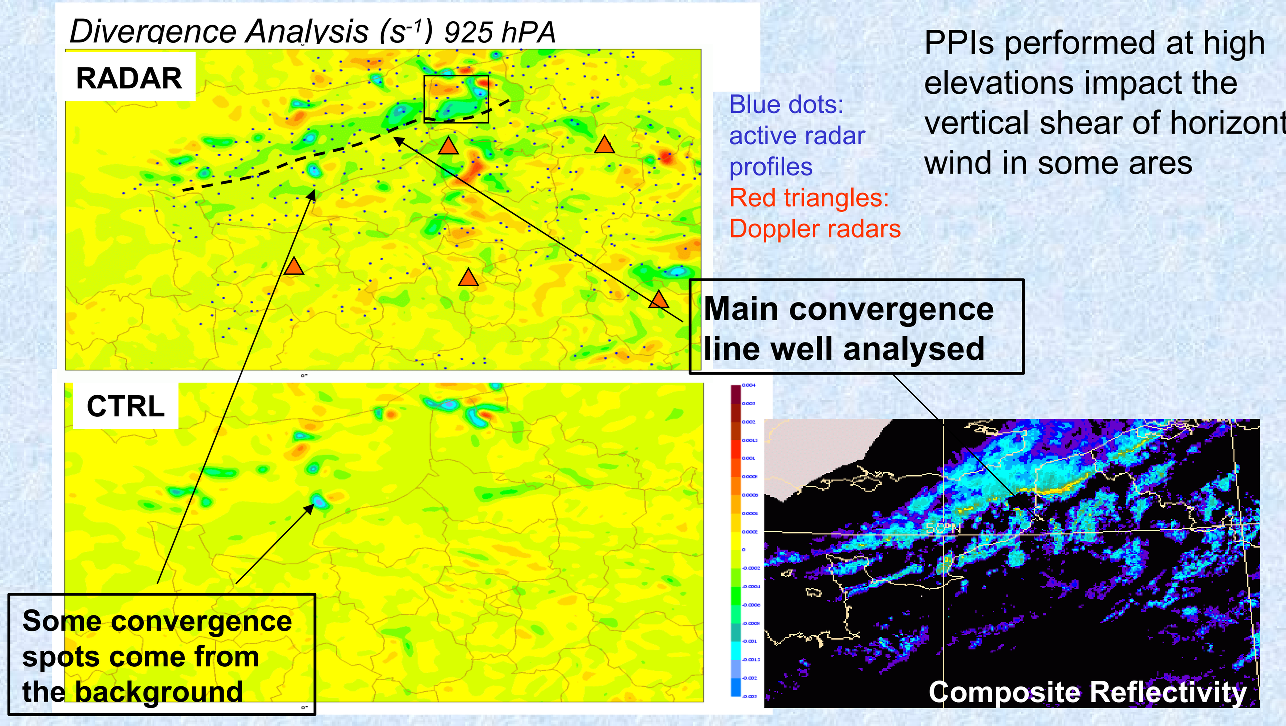
Bottom panels: composite reflectivity product at 22h UTC on the 19th of November 2007 (d), horizontal cross section at 2500m of the simulated reflectivities (1 hour forecast) from CTRL (e), from REFL (f)



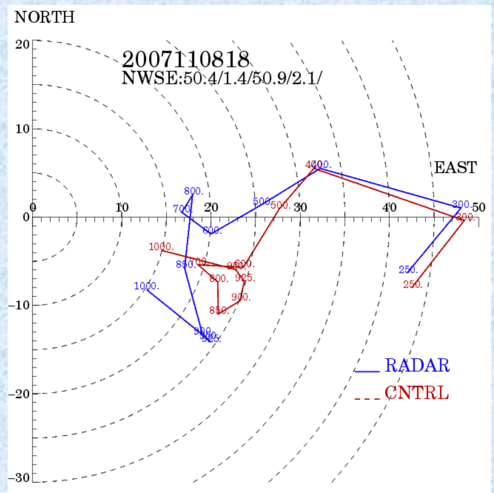
•Assimilation of Doppler wind

Pre-operational assimilation of radial velocities from Doppler radars of the french ARAMIS network in the non-hydrostatic model AROME is performed. For this purpose, several data pre-processing procedures are applied to avoid as much as possible erroneous measurements, due for instance to dealiasing failures, to enter the minimization process. An observation operator, allowing to simulate radial winds from the model's variables has been include in a 3DVar assimilation system.

Case study: frontal rain band (08/11/2007)



PPIs performed at high elevations impact the vertical shear of horizontal wind in some ares



Holograph of the wind averaged within the boxes displayed in left panels

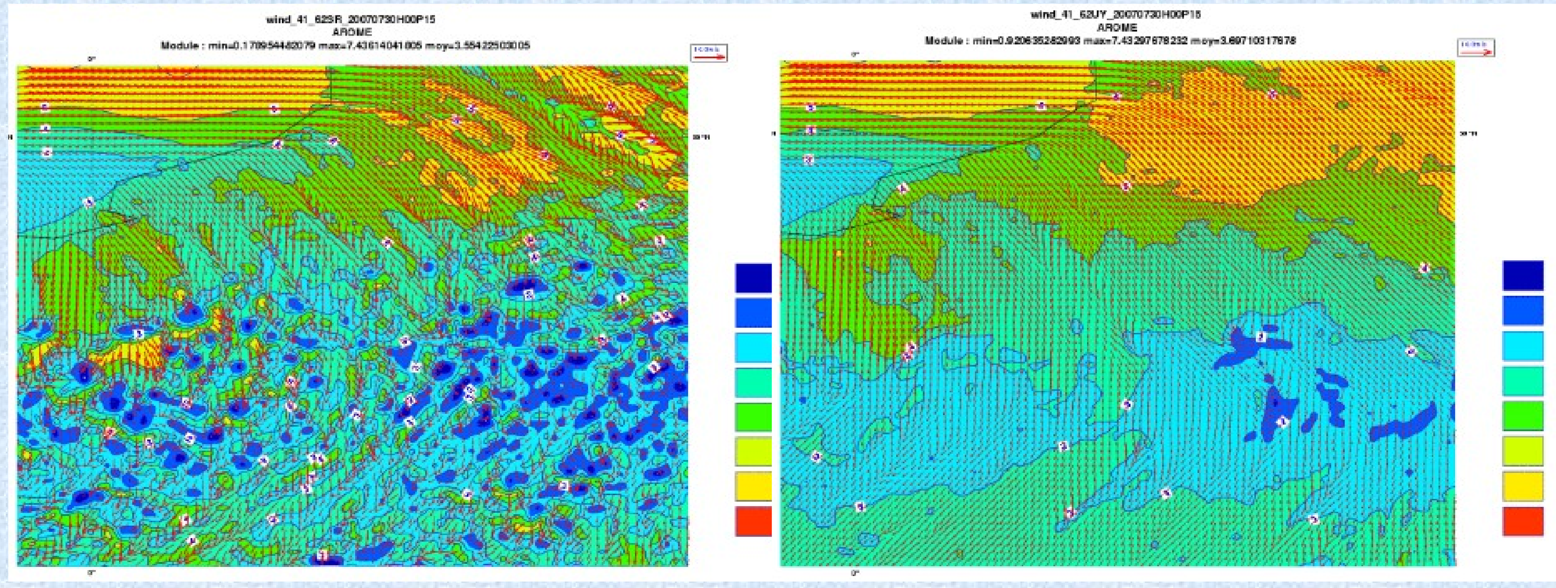
The resulting short range forecast of precipitation presents more realistic features with doppler winds

Montmerle, T and C. Faccani, 2008: Mesoscale assimilation of radial velocities from Doppler radar in a pre-operational framework. Mon. Wea. Rev, in press

AROME now operational at Météo-France

Forecast model: French domain and cost issues

AROME operational domain is 600x512 points, with 2.5km horizontal gridmesh. Time step of the model is 60s. On 64 processors of the NEC SX8R, 24 h forecasts can be produced in 20' elapse. The figures show 24h cumulative rainfall on August 23rd 2007 with a good agreement between model and radar picture.



Without EDKF **With EDKF**

Fig. 4: Impact of EDKF on wind structures in Arome (Wind moduel is plotted in shaded countours).

Rapid Update Cycle

The first operational AROME version should run on 4 daily production runs, for a 30 h range. Its assimilation should be with 3 hourly RUC including radar wind data. Further work will concern the spin-up and the initialization of forecasts.

Scores

Temperature scores (Fig 7) display improvement of forecasts with Arome compared to Aladin when forecast range is smaller than 24h. Regarding rainfall forecast, Arome (using shallow convection scheme EDKF operational since early Sept.) improves forecasts of low and strong precipitating events in comparison with Aladin.

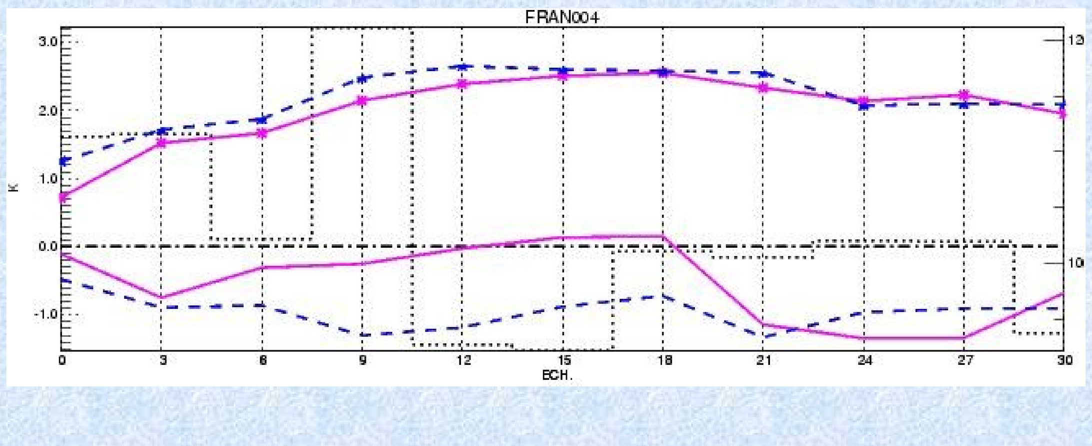


Fig. 5. Bias (bottom) and RMSE (top curves) of Arome (magenta) and Aladin (blue) forecasts in regards to SYNOP measurements for temperature. Abscissa is forecast range (hours).

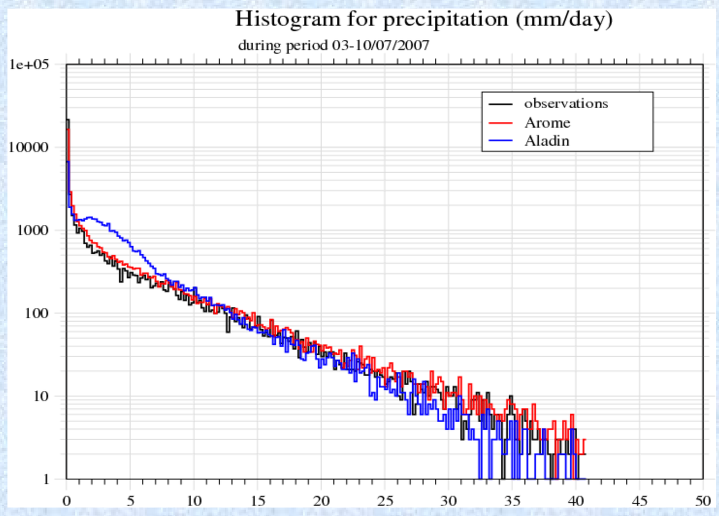


Fig. 6. Histogram for precipitation (mm/day) for Arome with EDKF (red), Aladin (blue), and observations (black). Frequency of low and strong precipitation are improved in respect with observations.