The NWP systems at Météo-France

25th ALADIN Wk & HIRLAM ASM 2015, Elsinore, 13-16 April 2015

Future AROME Overseas

Characteristics :

• Domains spread all along the tropical belt (fig. 1) and more focused, compared to current ALADIN domains, on the point of interests (2.5 millions inhabitants, 115 000 km2),

• 2.5km resolution (all the more important for small and rugged islands : fig. 2)

• total number of grid-points multiplied by 3 for a cost 30 times higher (with 60s time step).

• Explicit deep-convection

• ICE3 micro-physics

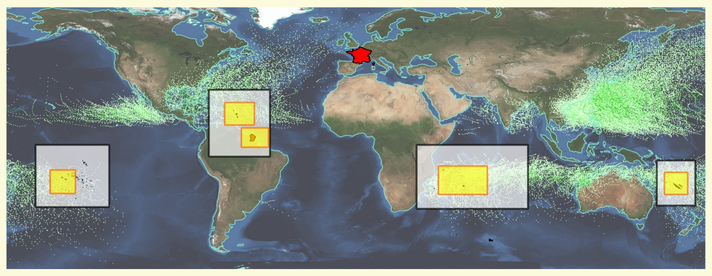
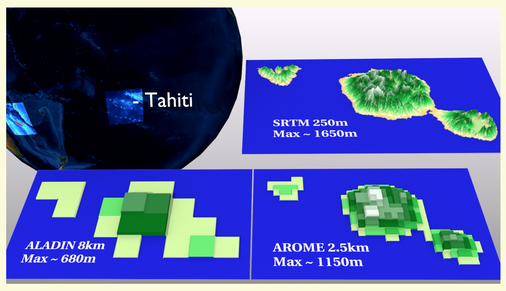


Figure 1 : Future AROME overseas domains (in yellow) and current operational ALADIN domains (in white)

Figure 2 : Tahiti orography (in ALADIN and in AROME)



Specificities :

• Ocean is preponderant

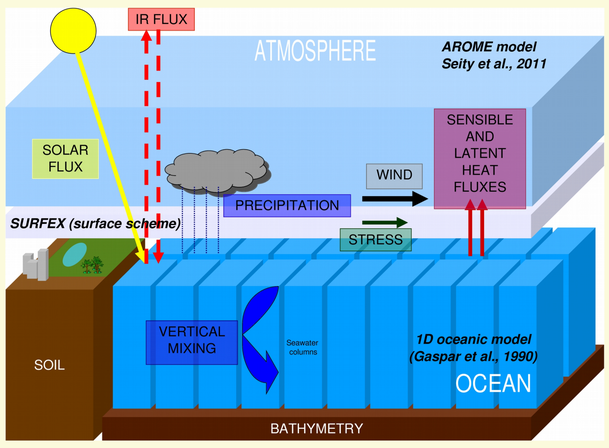
• Many tropical cyclones

=> need for an ocean coupling

• First tests with 1D Ocean Model (fig. 3)

=> promising results on Bejisa case (fig. 4)

Figure 3 : Coupling between AROME and 1D oceanic model



Added value of AROME for heavy rain events and accurate local effects (not shown here)

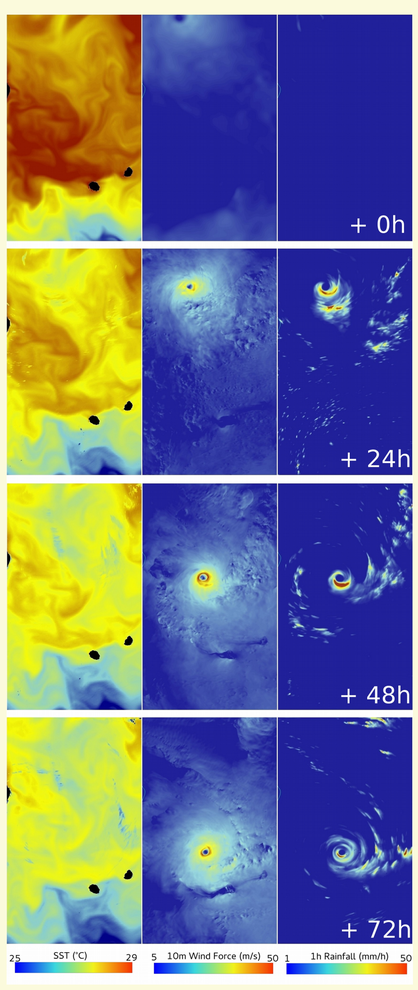


Figure 4 :AROME over Indian Ocean, Tropical Cyclone Bejisa, AROME +72h forecast based on 12.31.2013 0h run Initial ocean fields : Mercator-Ocean PSY4 model, 1/12°

ARPEGE-ALADIN-AROME experimental suite

CY40-op1 High Resolution ARPEGE-AROME configurations (switch to oper expected in spring 2015)

ARPEGE : T1198 with a stretching factor of 2.2 and 105 levels. First level at 10m (17m in present operational configuration). This gives a resolution of 7.5km over France. The proposed time step is 360s.

The 4DVAR experimental suite will use 2 outer loops. The first one is 40 iterations at T149 C=1 with a time step of 1350s, the second one 40 iterations at T399 C=1 with a time step of 900s.

	Standard Height (km)	Arp70	**Arp105**	Ifs137
Surface boundary layer	0 - 0.15	3	**6**	6
Planetary boundary layer	0.15 - 1.5	11	**18**	18
Free troposphere	1.5 – 8.0	19	**26**	26
Tropopause	8.0 – 15.0	15	**24**	24
Stratosphere	15.0 – 50.0	19	**27**	51
Mesophere	50.0 – 80.0+	3	**4**	12

Figure 5 : Vertical resolutions of ARPEGE oper, new and IFS

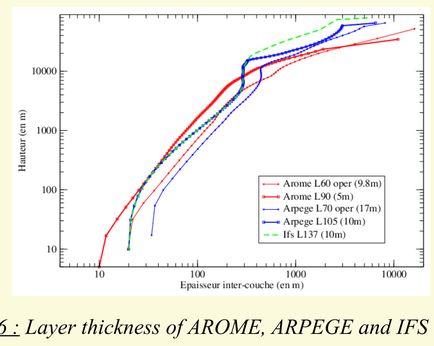


Figure 6 : Layer thickness of AROME, ARPEGE and IFS

A new version of **AEARP** is also in test with 25 members, a resolution of T479 C=1 and a time step of 720s :

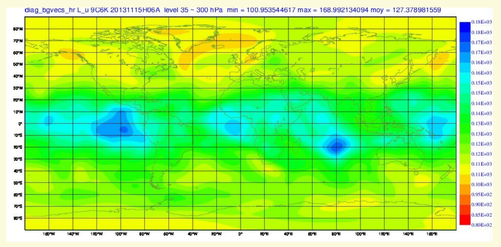


Figure 7 : Wavelet B, 6 members, 4 day average, updated every 24h (operational)

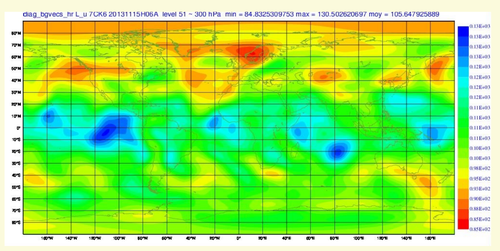


Figure 8 : Wavelet B, 25 members, 1.5 day average, updated every 6h (experimental)

- **AROME** :1,3km L90 (1440x1536x90 grid), with dt=50s (PC iterative scheme used)
- Dynamics and physics modified choices (SLHD_new, COMAD, SBL scheme off)
- Data assimilation part (B calculation, 1 h cycle with Incremental Analyses Update)
- 274 BULL nodes (4 for I/O server)
- Forecast length increased up to +42h (r0 and r12)
- New post processing domain and new fields (max reflectivity for inst.)
- Surfex files changes (compacting, filtering the number of fields)
- Improvements on convective cells realism (number, size, life-time, intensity).
- positive convective rainfall bias significantly reduced.

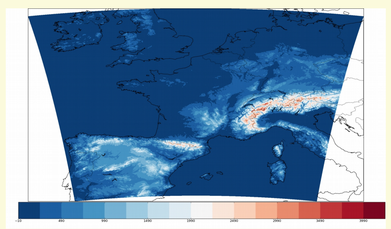


Figure 9 : AROME 1,3km orography from GMTED 250m

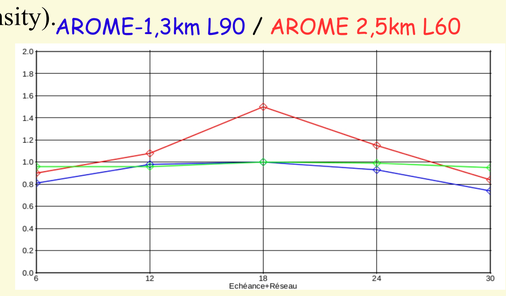


Figure 10: Relative bias of AROME r0 6h cumulative rainfalls (summer+autumn 2014)

AROME Ensemble Prediction system

The configuration : A high-resolution ensemble prediction system is being prepared for operational use (production will start in 2016).The model is the same as in the deterministic L90 AROME-France suite, except for the horizontal resolution (2.5km in the ensemble, 1.3km in AROME-France). There will be 12 members at up to 48-h range. **Ensemble perturbations** come from: clustered boundary conditions from the PEARP global ensemble, centered PEARP initial perturbations, SPPT stochastic model perturbations, comprehensive surface perturbations. **Applications** being developed include: choice of best model by human forecasters, decision aid for severe weather events (e.g. heavy precipitation, convection, gusts, winter conditions), probabilistic weather forecasts, forcing of flood models, air traffic management.

Recent research results:

Extensive validation using HyMeX SOP1 data (Sept-Nov 2012) shows that it not important to have consistent initial and lateral boundary perturbations. This makes it attractive to use ensemble data assimilation (EDA) for initial perturbations. A cheaper alternative to EDA is to add small-scale random noise to the initial conditions: it improves over the simple downscaling of initial perturbations from a larger-scale ensemble.

Surface perturbations improve the ensemble performance; most of this improvement comes from perturbing soil moisture, soil temperature, and SST. Explicit surface perturbations are necessary, even if an EDA is used to perturb the atmospheric analyses, because EDA lacks surface dispersion.

The **spatial correlations** of ensemble forecasts are highly sensitive to the correlations of surface perturbations, at low levels. The correlation sensitivity to SPPT correlation structures, or to correlations in the initial perturbations, seems to be negligible after a few hours.

The introduction of a **tolerance in space and time** when computing the precipitation probabilities, can be proven to improve the forecast scores, by filtering small-scale noise and increasing the apparent ensemble size.

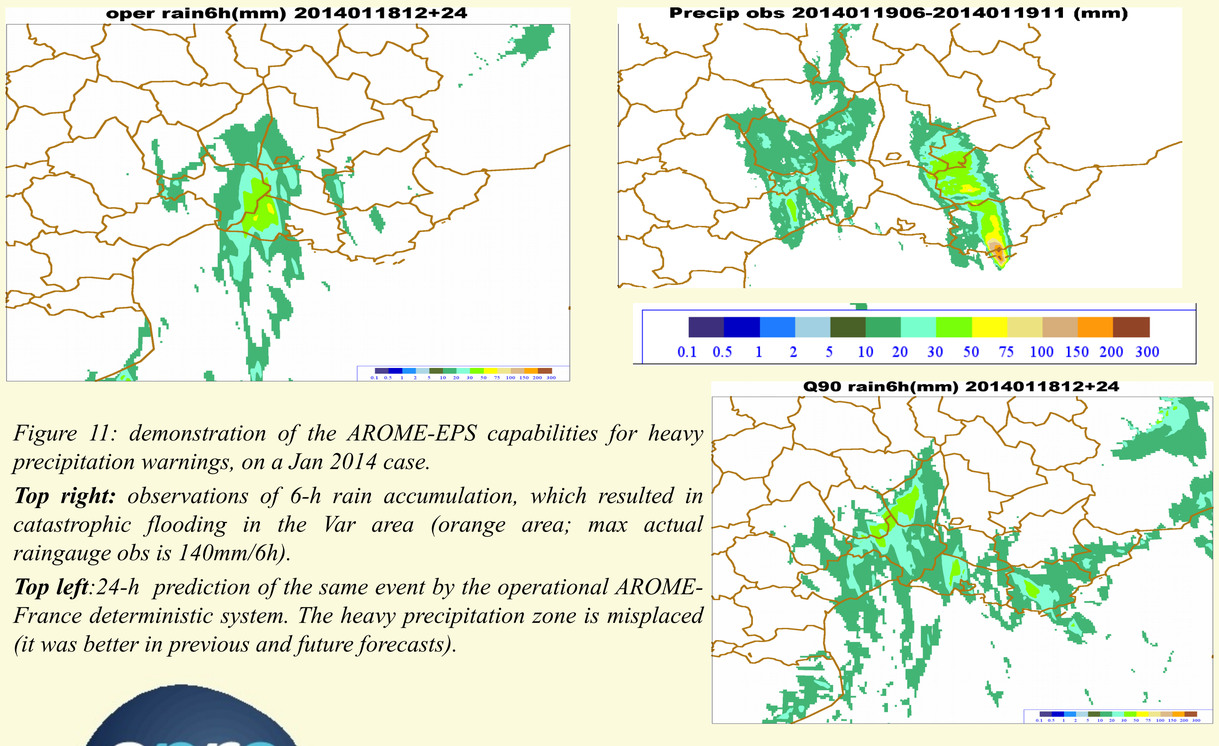


Figure 11: demonstration of the AROME-EPS capabilities for heavy precipitation warnings, on a Jan 2014 case.

Top right: *observations of 6-h rain accumulation, which resulted in catastrophic flooding in the Var area (orange area; max actual raingauge obs is 140mm/6h).*

Top left*:24-h prediction of the same event by the operational AROME-France deterministic system. The heavy precipitation zone is misplaced (it was better in previous and future forecasts).*

Bottom right: *24-h AROME-EPS prediction of the 90% quantile of the rain PDF. Although the intensity is underestimated, the risk of severe precipitation over Var is much better indicated than in AROME-France. Besides, the AROME-EPS forecasts are more consistent in time, which may have helped the real-time forecasting decision process.*

Nowcasting activities at Météo-France

AROME-NWC :

A new nowcasting configuration based on the meso-scale model AROME-FRANCE has been set up. The goal is to cover the nowcasting short time ranges 0-6 hour with an analysis using the most recent observations followed by a forecast. In spite of the short cut-off time (10 minutes) a majority of observations relevant for nowcasting are available, the radiosondings and gps observations are completely missing, but the impact on the overall system performance is small. The hourly forecasts are not cycled (fig. 12), that ensures less spin-up and a better resilience of the overall system. The system performs better compared to AROME-FRANCE mostly because the use of more recent observations (see fig. 13 for rain scores).

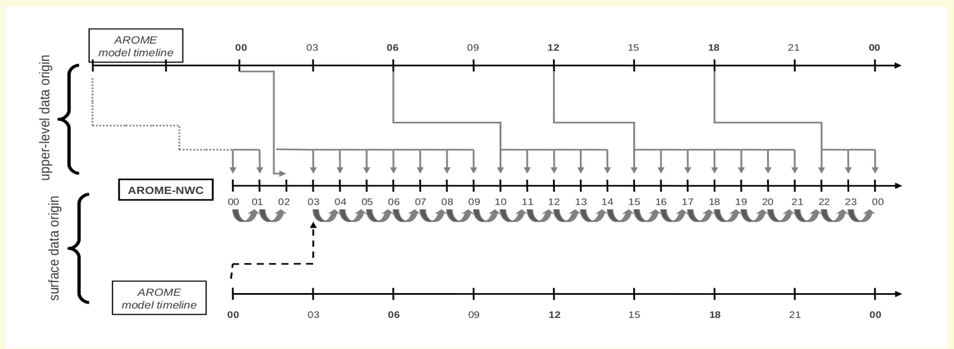


Figure 12 : Operational AROME-NWC system architecture

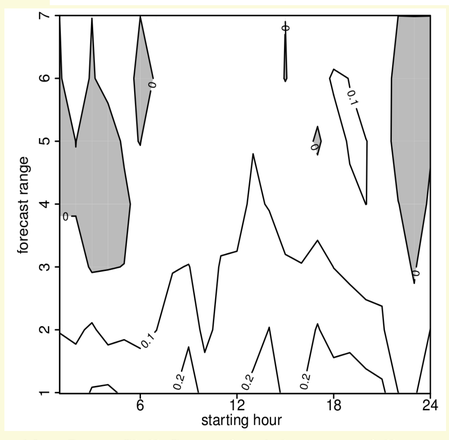


Figure 13 : Brier Skill Score for 1 hour rainfall accumulation, the difference between the AROME forecast and the AROME-NWC forecast as a function of the analysis time of the AROME-NWC forecasts (X-axis) and of the forecast range (Y-axis) is shown.

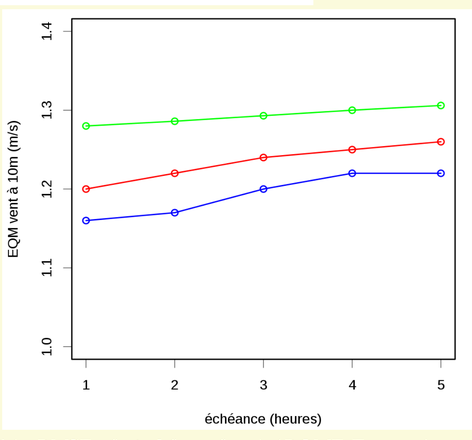


Figure 14 : RMSE of wind force for a) AROME-France (green) b) AROME-airport on the large domain at 2.5 km (red) and c) AROME-airport at 500m resolution. X-axis is the forecast range in hours.

AROME-airport configuration :

A new configuration, AROME-airport has been set up. It is a 500m dynamical adaptation of AROME-NWC on strategic areas such as airports. If needed some dedicated observations can be included in the preceeding AROME-NWC analysis. The usefulness of such forecasts has been assessed during an observation campaign during which additional wind profilers were proven to have some impact (fig. 14).

Recent features :.We are currently working on the data assimilation of mode-S data. Those provide wind and temperature data similarly to AMDAR observations, but are much more numerous. Due to the high number of data a careful thining is required to gain some forecast skill. Our goal is to find out whether mode-S data are more useful in a nowcasting context.

cnrs dépasser les frontières

METEO FRANCE