# NUMERICAL SIMULATIONS OF MAP IOP2B WITH AROME

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**Abstract**: The goal of this study is to use the large amount of measurements collected during the MAP IOP2B, to validate a new Numerical Weather Prediction system : AROME. We also evaluate AROME by comparison with ALADIN and Meso-NH simulations of this IOP. The AROME 2.5 km results are sensitive to the choice of the coupling model. AROME 2.5 km coupled with AROME 10 km is able in pseudo-operational conditions (long time step and coupled with forecasts) to reproduce the main features of the IOP2B. In this configuration it produces results closest to the Meso-NH reseach model ones.

***Keywords -*** *MAP, IOP2B, AROME*

## 1. INTRODUCTION

The AROME (Application de la Recherche à l'Opérationnel à Méso Echelle) project aims at developing a new Numerical Weather Prediction system in order to improve the forecast of mesoscale phenomena and extreme weather events. AROME is planned to be used operationally by 2008 over mainland France. This system, which will run at 2.5 km horizontal resolution, is designed for short range forecasts. A prototype of AROME has been developed in 2004. It gathers research outcomes and operational progress : it uses a physical package from the Meso-NH research model which is plugged into a Non-Hydrostactic version of the ALADIN software (Bubnova et al. 1995 ; Benard 2004). AROME will also have its own mesoscale data assimilation system that will enable to take benefits from mesoscale data such as radar data. This part is still under developments.

The amount of data collected during the MAP campaign and the phenomena observed are well adapted to validate our prototype. We chose as a first case the IOP2B (19-20 September, 1999), already simulated with a lot of NWP systems, and producing large amounts of rainfalls.

## 2. NUMERICAL SET-UP

The Meso-NH physics used in AROME includes a complete microphysical scheme with five species of condensed water (Pinty and Jabouille 1998), a 1D turbulence parameterization (Cuxart et al., 2000) with Bougeault Lacarrère mixing lengths (Bougeault and Lacarrere 1998), a detailed surface scheme (Noilhan and Planton 1989, Masson 2000), and the operational ECMWF radiation code. For the 10-km version of AROME, the Meso-NH convection scheme is also added (Bechtold et al. 2001).

We performed 48 hours forecasts with AROME, starting from 19-09-1999 at 00 TU. We ran with a time step of 60s over a domain of 240×240 points (Figure 1) corresponding with the 2.5 km domain chosen for the Meso-NH simulation of this IOP described in Asencio et al. (2003). The radiation scheme is called every 15 minutes. In order to catch the synoptic features over the alps, we used a 10-km model forecasts as initial and lateral boundary conditions. We tried different 10-km models: ALADIN Austria (coupled with ARPEGE forecasts) and AROME 10km coupled with ARPEGE forecasts. The ALADIN simulations were performed by E. bazile and Y. Wang (2002). As AROME will be an operational model, our goal was to check if our prototype would have been able to do good forecasts in operational conditions. That is the reason why we chose to couple with model forecasts instead of model analysis.

## 3. RESULTS

The synoptic situation of this MAP IOP2B has already been described in a lot of papers such as Asencio et al. (2003). As shown in Figure 2, AROME is able to simulate the three stages of activity observed during this IOP: pre-frontal activity over the Alps, frontal passage, and post-frontal activity.

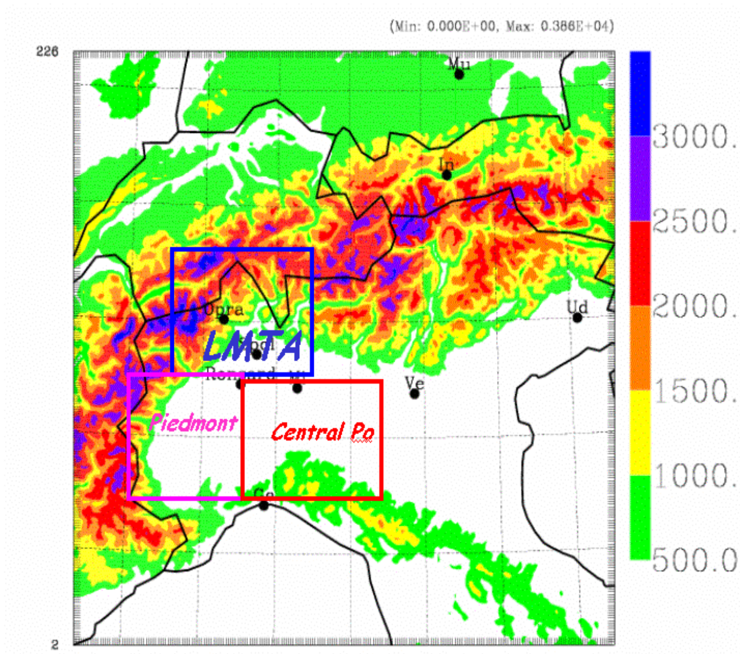


**Figure 1.** Orography of the 2.5 km AROME domain

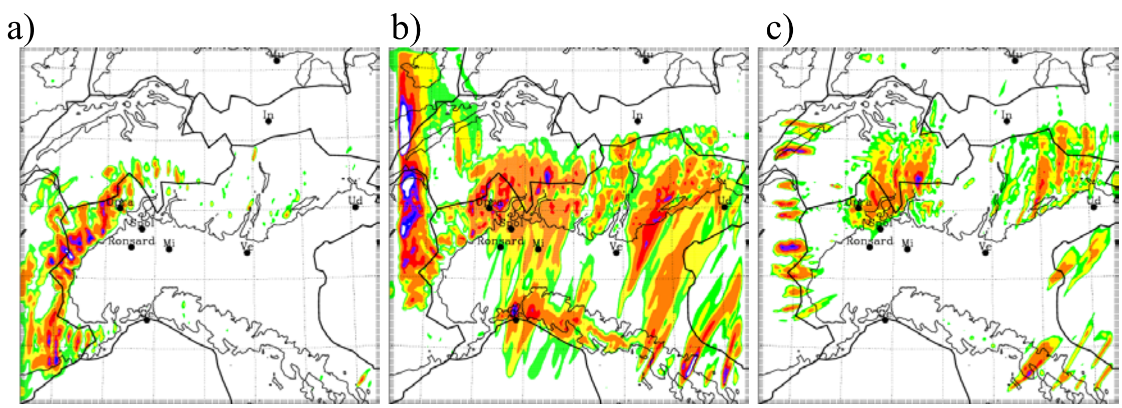


**Figure 2.** AROME 2.5 coupled with AROME 10 km simulation : 6h cumulative rainfalls during a) pre-frontal period (between 18-24 TU on 19-09) b) the frontal passage (06-12 TU on 20-09) and c) post-frontal period (18-24 TU on 20-09). 500m topographic contours are also plotted.

We computed the time evolution of averaged hourly rainfalls over the three small areas shown in Figure 1: Lago Magiore, Piedmont, and Central_Po. The Meso-NH experimental framework is described in Asencio et al (2003). On Figure 3, we can sea that model results are close to the observation over the LMTA area concerning the timing, with an over-estimation of the maxima. In the Central Po area, no model is able to reproduce a good timing. In the Piedmont area, most simulations over-estimate the rainfalls, except the Meso-NH one and the AROME 2.5 coupled with AROME-10 one. The AROME-10 simulation is closer to the observation than the ALADIN one. On the three areas, we can also see that the AROME 2.5 simulation coupled with ALADIN produce about the same amount of rainfalls than the ALADIN one, with a temporal shift of about 3 hours. Comparing AROME-10 with AROME-2.5 simulation coupled with AROME-10, we can see that results are about similar, sometimes closer to the observations and to the Meso-NH results in the 2.5 simulation (between +24 and +30 hours over Piedmont Area for exemple).

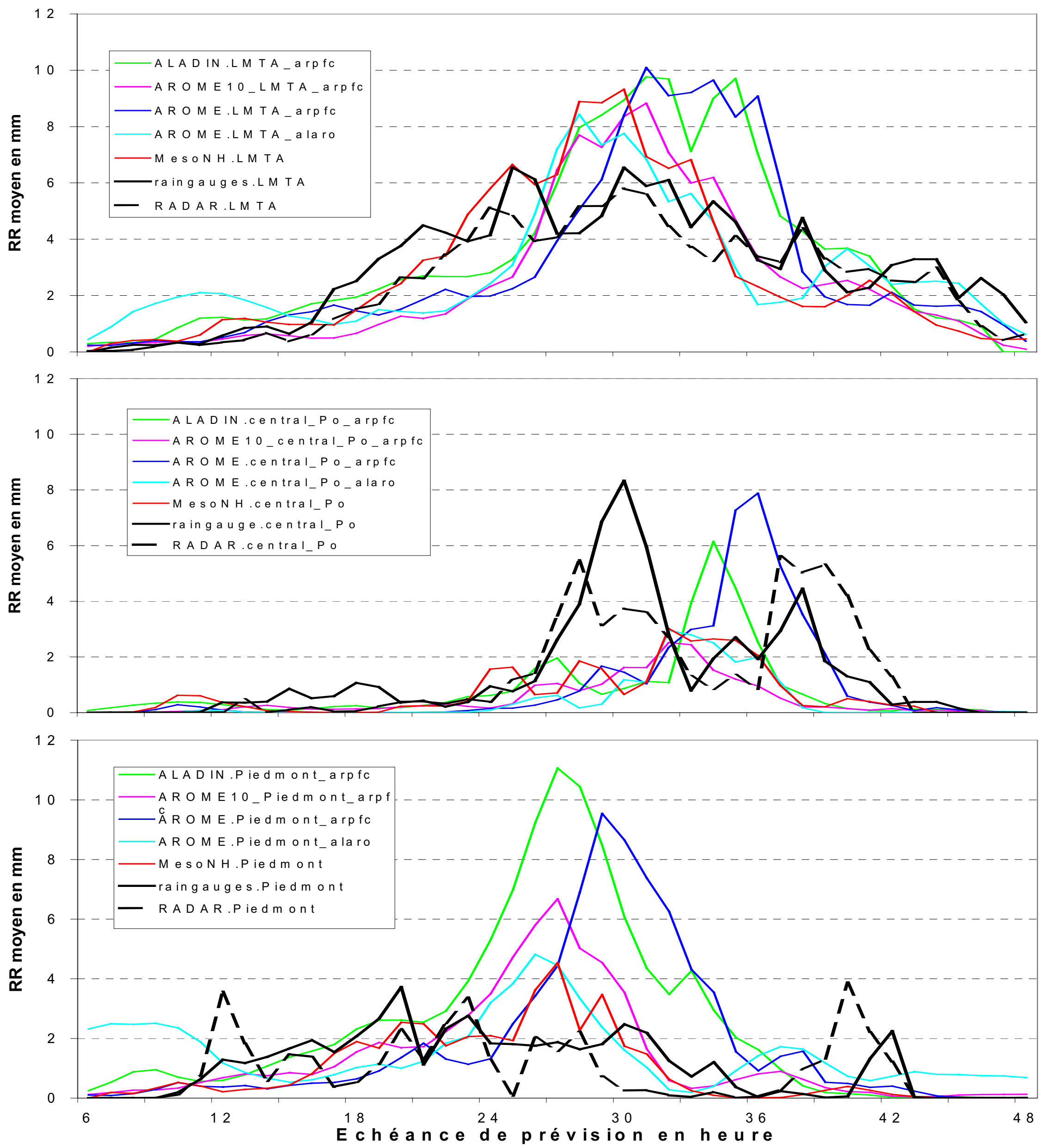


**Figure 3.** Time evolution of hourly cumulated rainfalls over the areas shown in Figure 1. Black lines correspond to raingauges estimations for the solid line, and radar estimation for the dashed one. Color lines correspond to numerical simulations: Aladin Austria in green, AROME 10 km in pink, AROME 2.5 km coupled with ALADIN in blue, AROME 2.5 km coupled with AROME 10 km in cyan, and Meso-NH in red.

## 4. CONCLUSION

The simulation of IOP2B performed with AROME has shown the ability of our model to perform good simulations in pseudo-operational conditions (long time step and coupling with forecasts). We also pointed out the sensitivity of the 2.5 km results to the choice of the coupling model. In this IOP, most of the features are driven by large scales conditions and the 2.5 km resolution does not seem to improve the 10-km forecasts a lot. The IOP2a with its squall line formation, would probably have been better adapted to show the improvement allowed by the 2.5 km resolution. It will be a next AROME simulation.

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