SET UP OF AN AROME BUCHAREST CONFIGURATION

Météo-France stay report : 18.05-30.05 2008

Doina Banciu
National Meteorological Administration – Romania

Supervisor: Yann Seity

1. Introduction

The main aim of this stay was to set-up an Arome configuration for the air pollution applications for an area around Bucharest and to have a reference integration for further implementation at home.

In fact two domains were generated one covering the entire country at 2.5 km resolution and another covering Bucharest and its surroundings at a resolution of 1.5 km as described in section 2. The Arome integration was performed (the set – up is presented as well in section 2) for both domains for an abundant precipitation case when severe convective storms developed over Bulgaria, Romania and Ukraine (see also the site of the convection working group - now casting with satellite http://convection.satreponline.org/cases/april08/index.php). Few results of this integrations are shown in section 3 in comparison with observation data.

As well the stay was a good opportunity for a lot of discussion regarding the proper way to improve the representation of surface characteristics by using the local data and the possibility to further increase of the model resolution necessary for urban area air quality modelling.

2. Domains and configurations set-up

The two chosen domains orography, without envelope (covering Romania- AR01 and covering Bucharest –AB01) is presented in figure 1.

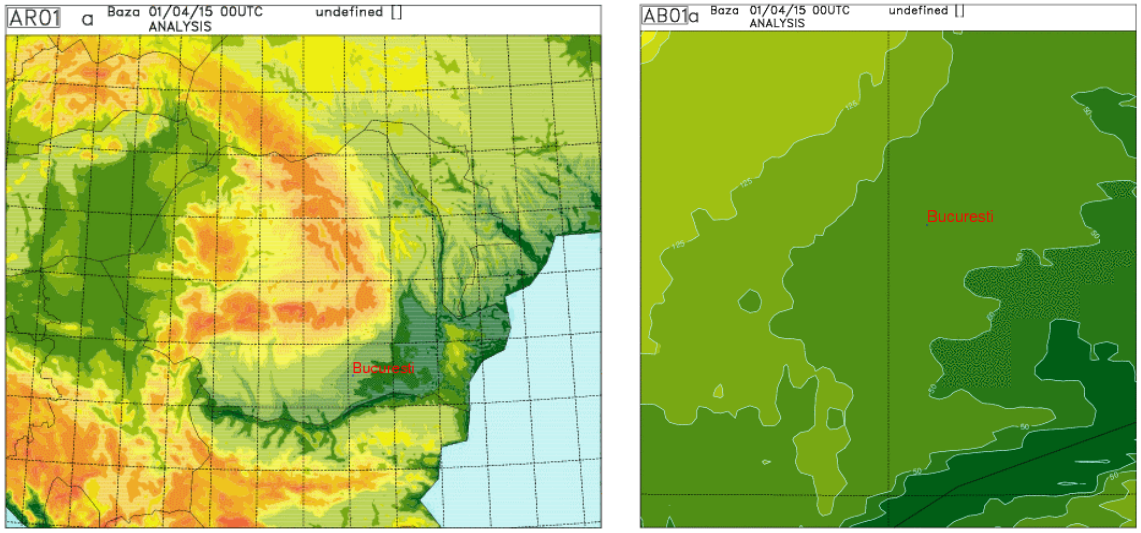


Fig.1 Arome orography : AR01 domain (left) and B01 domain (right)

The two domains have a linear grid and the geometry in Lambert projection is the following:

- **AR01:** Δx=2. 5 km, 421 x 349 grid points (without the extension zone), 41 vertical levels
- **AB01**: Δx=1. 5 km, 69 x 69 grid points (without the extension zone), 41 vertical levels

The initial and boundary conditions (1 hour frequency) were provided by the Aladin model integrated on the Romanian operational domain (see the figure 2).

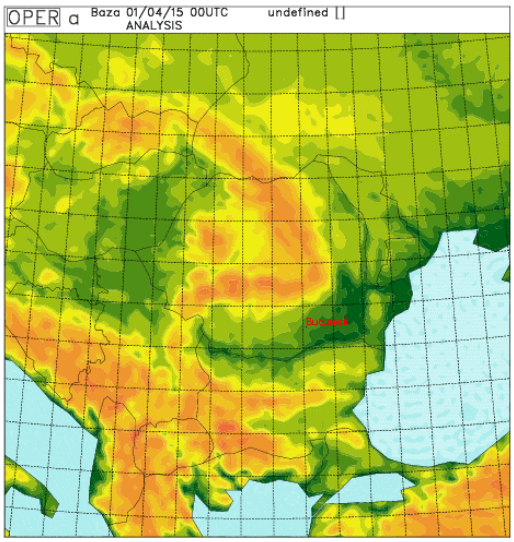


Fig. 2 Aladin orography : Romanian operational domain (Δx=10 km, 133x 133 grid points)

Unlike for the Romanian operational configuration, the Aladin (hydrostatic version) model was integrated by using 60 vertical levels and the namelist of the operational ALADIN model in May 2008.

As well, the AROME configuration was the France pre-operational AROME, corresponding to cy33t1.

For the generation of the climatic files (in model grid and in geographical grid), the coupling files and model integration and post-processing there were used scripts instead of OLIVE facilities, in order to allow an easier implementation in Romania. All this scripts could be found on torri-machine, in the directory: ~mrpe705/AROME.

3. Results for a case of abundant precipitation (April 22, 2008)

On April 22, 2008 the south-eastern Europe was dominated by a large perturbation (see figure 3). The frontal system associated to this perturbation cross Romania. Almost the entire part of the country was affected by precipitation, their intensity being higher in the northeast Romania, where they reached 75 l/m^2 (fig.4).

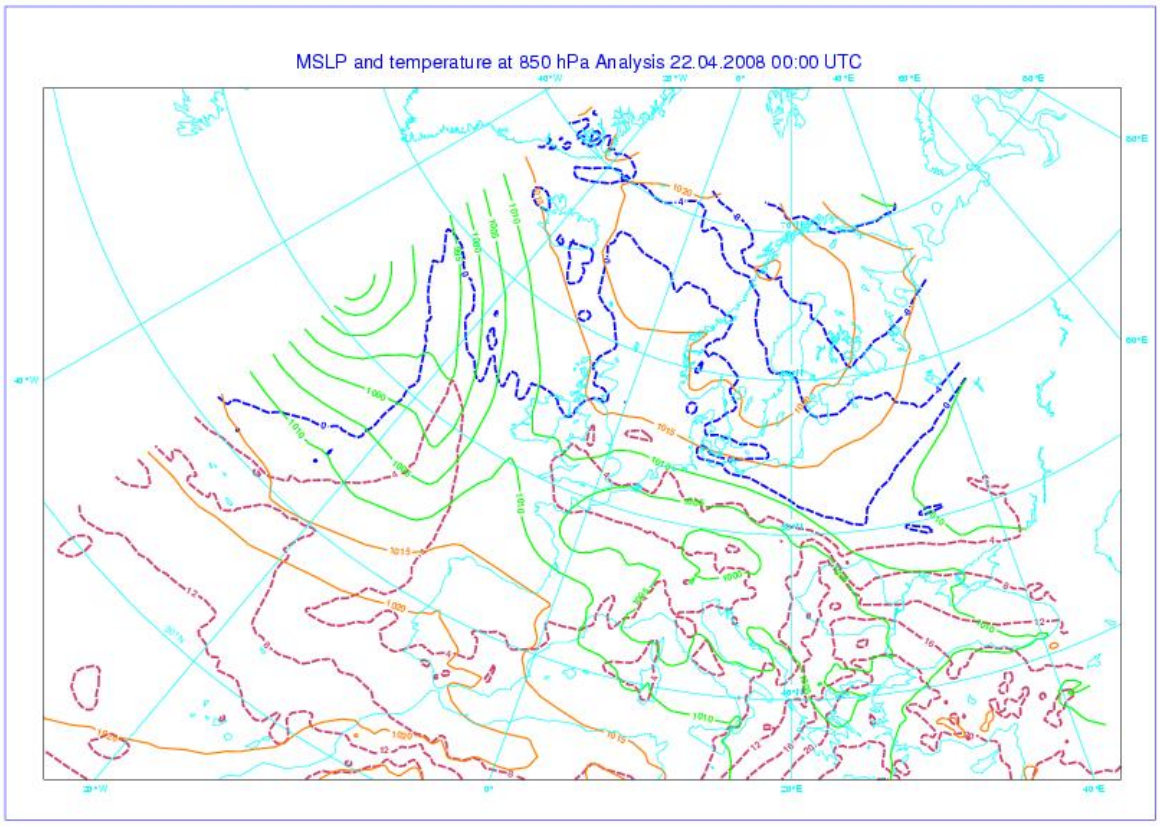


Fig. 3 ECMWF analysis**,** valid on 22.042008, 12 UTC: mean sea level pressure and 850hPa temperature (green full line – pressure equal or lower than 1000 hPa, blue dash lines – negative temperatures, violet dash lines – positive ones)

In the warm sector of the perturbation, several intense convective storms developed. One of them affected the south-eastern part of Romania, in the afternoon of April 22. Despite of the fact that the storm did not lead to exceptionally amount of precipitation, its signature in wind, satellite and radar data was very pronounced.

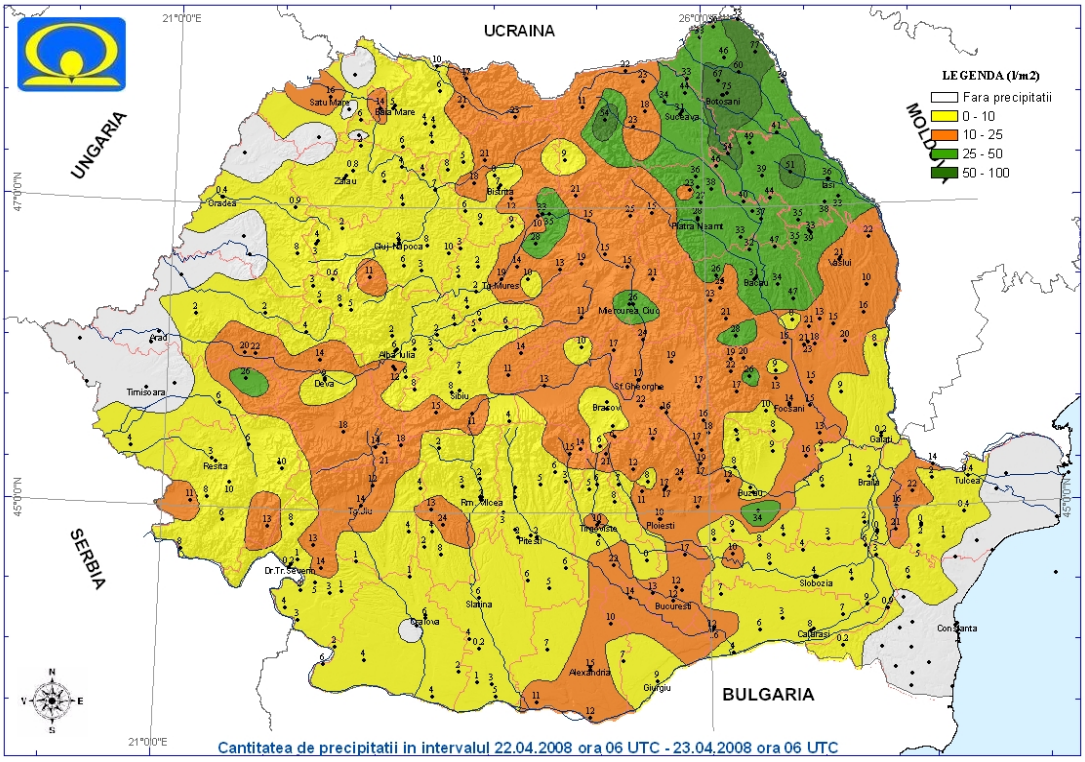


Fig. 4 Observed cumulated precipitation : 22.04.2008 06 UTC – 23.04.2006 06 UTC

The AROME model simulated quite well the precipitation field, even it has the tendency to overestimate the amount of high precipitation. In fact the same tendency was noticed to the ALADIN model with out AROME was coupled.

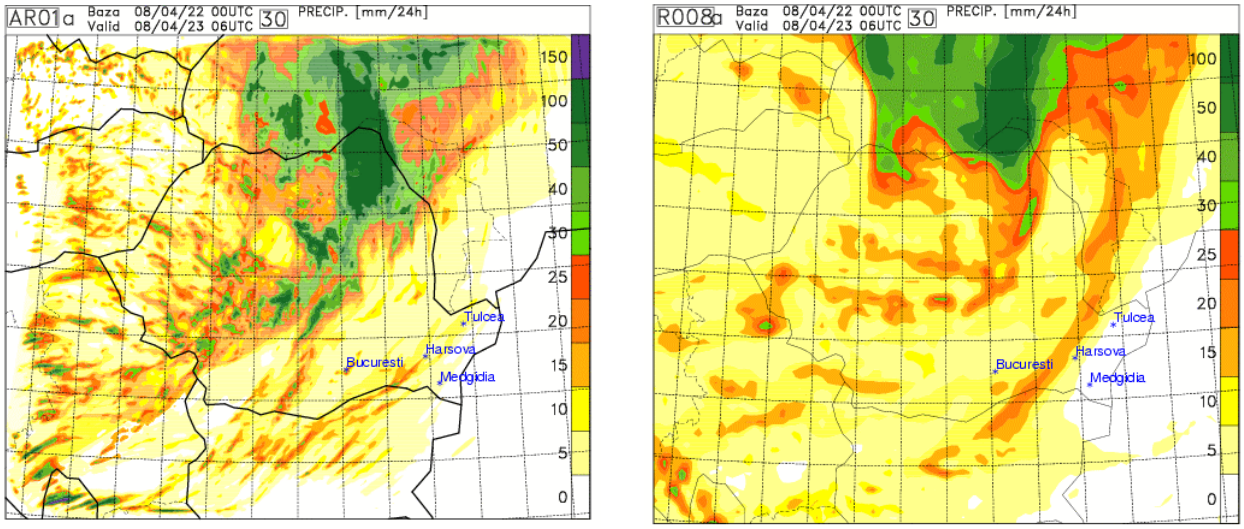
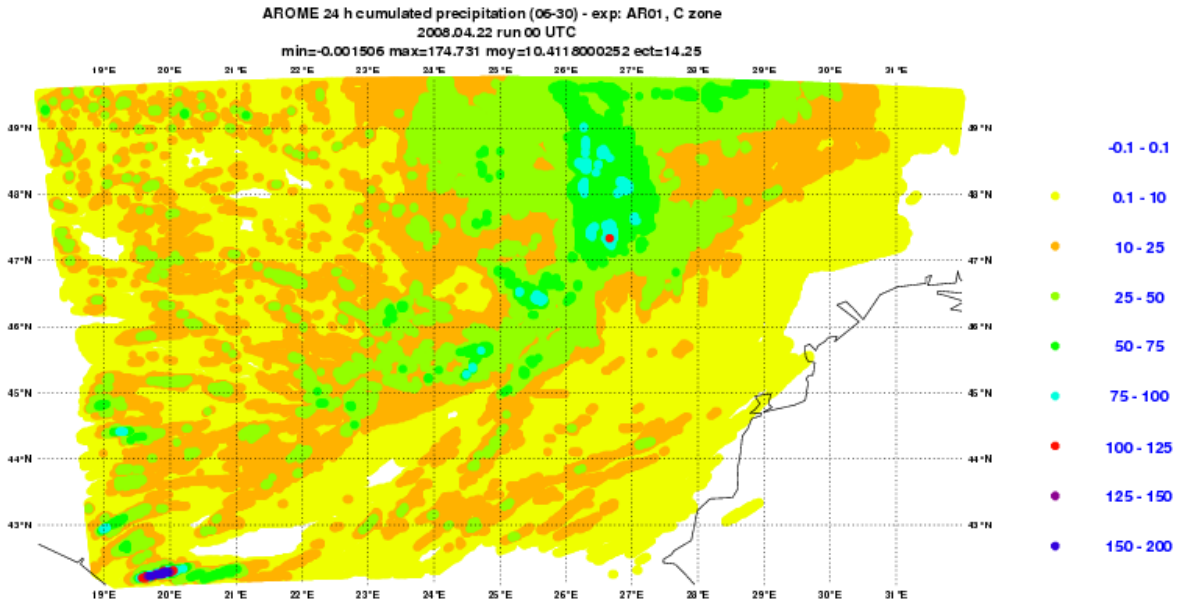


Fig. 5 Forecast cumulated precipitation : 22.04.2008 06 UTC – 23.04.2006 06 UTC by AROME at 2.5km (left) and ALADIN (right) models

As well some high precipitation were noticed, around the coupling zone. To cure this problem, the method of orography relaxation in the coupling zone developed by Karam Essaouini was applied. The general pattern of precipitation is not changed but part of the storms points are removed (see figure 6).



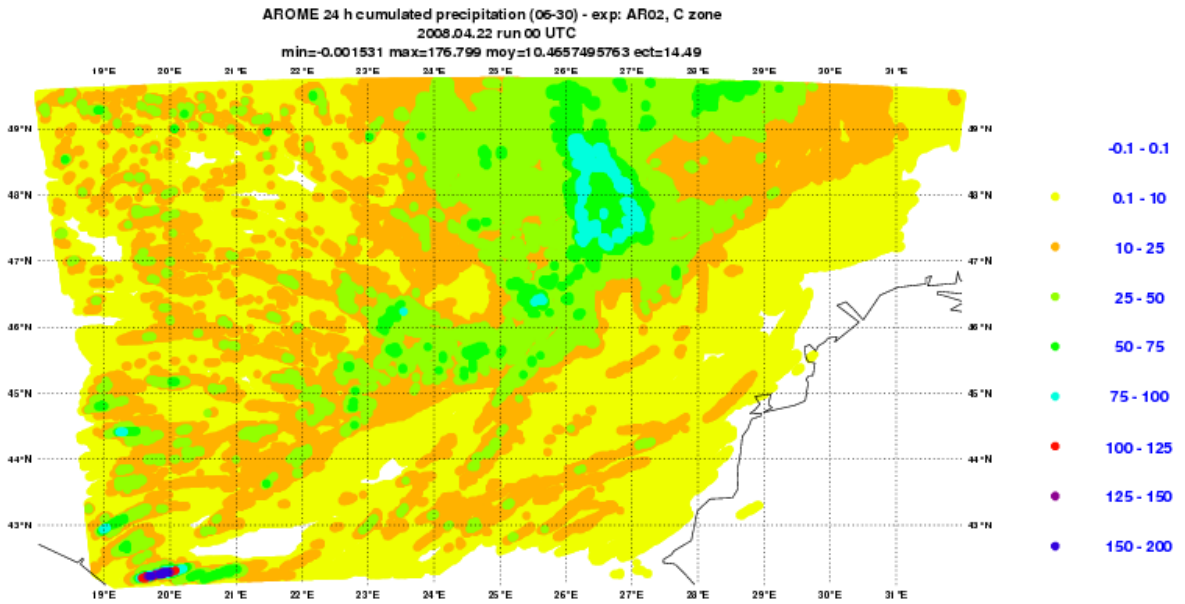


Fig. 6 Forecast cumulated precipitation : 22.04.2008 06 UTC – 23.04.2006 06 UTC by AROME at 2.5 km : Reference configuration (top), with orography relaxation (bottom)

The Arome behaviour at 1.5 km was also satisfactory. The precipitation field, presented in figure 7, shows the traces of the intense convective cells organised in a "V" shape (figure 8).

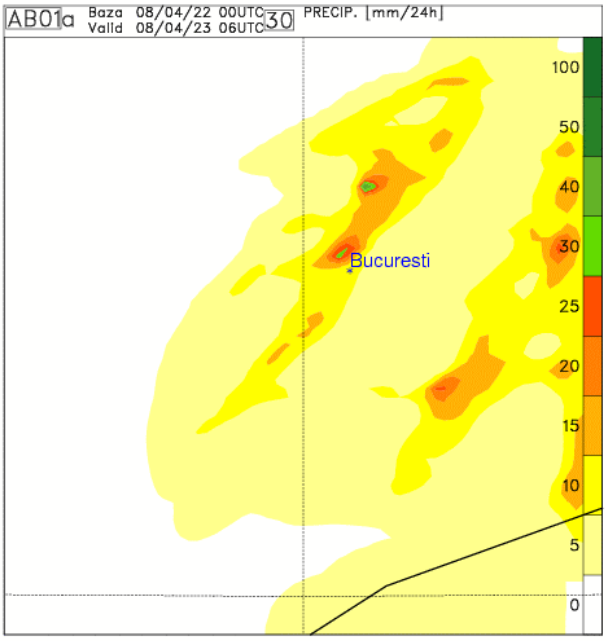


Fig. 6 Forecast cumulated precipitation : 22.04.2008 06 UTC – 23.04.2006 06 UTC by AROME at 1.5 km

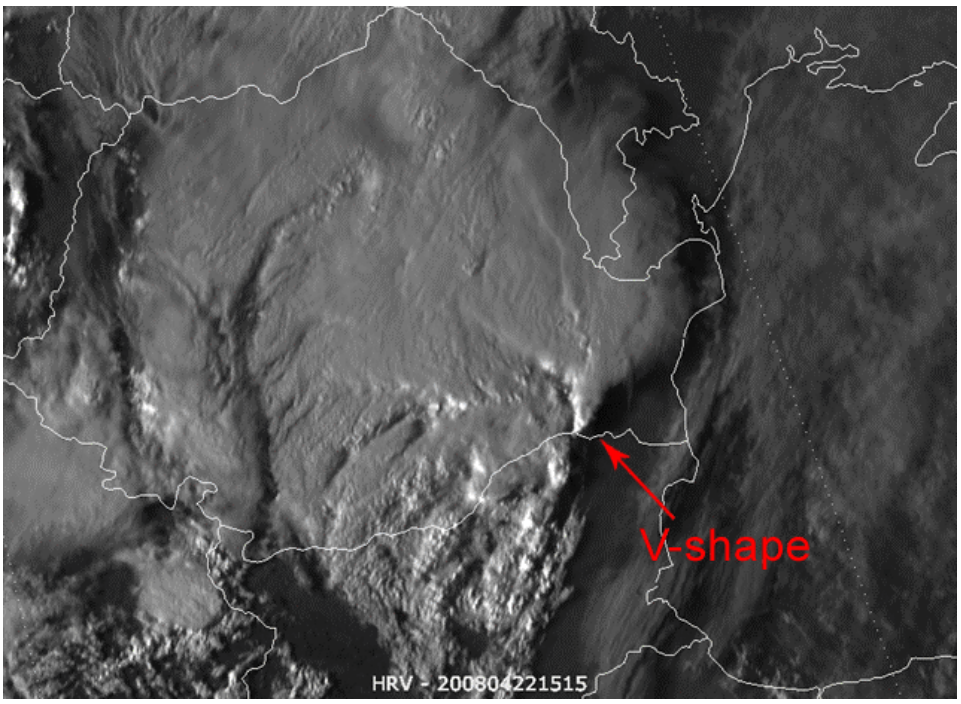
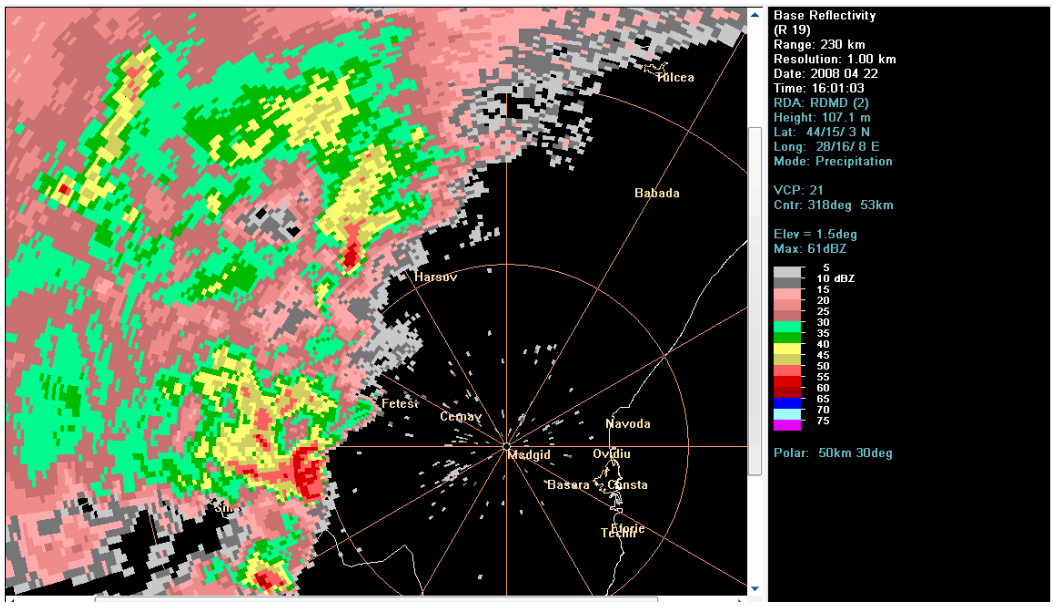


Fig. 7 High resolution satellite image (visible) at 22.04.2008 15:15 UTC

Even at 2.5 km the Arome models succeeded to simulate the storm effects in its displacement towards noth-east. The model was able to simulate the specific pair of meso-cyclone/ meso-high in the region where a very intense cell (70-75 dBz at its maximum) generated strong winds and the high displacement speed, as one can see comparing the radar data with model forecast (fig.6-8).



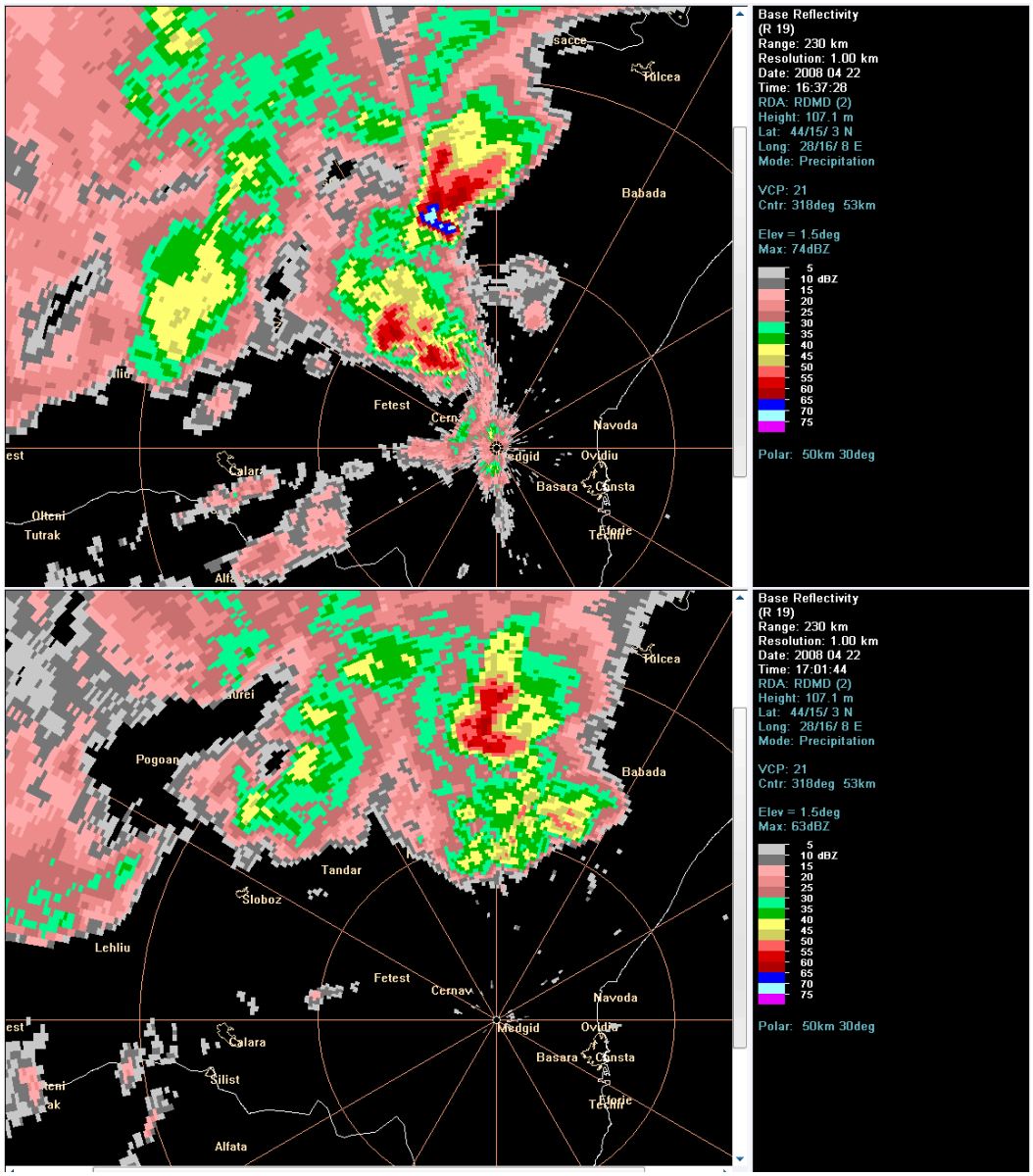


Fig. 8 Radar image valid at 22.04.2008 16:01 UTC (top), 16:37 UTC (center), 17:01 UTC (bottom)

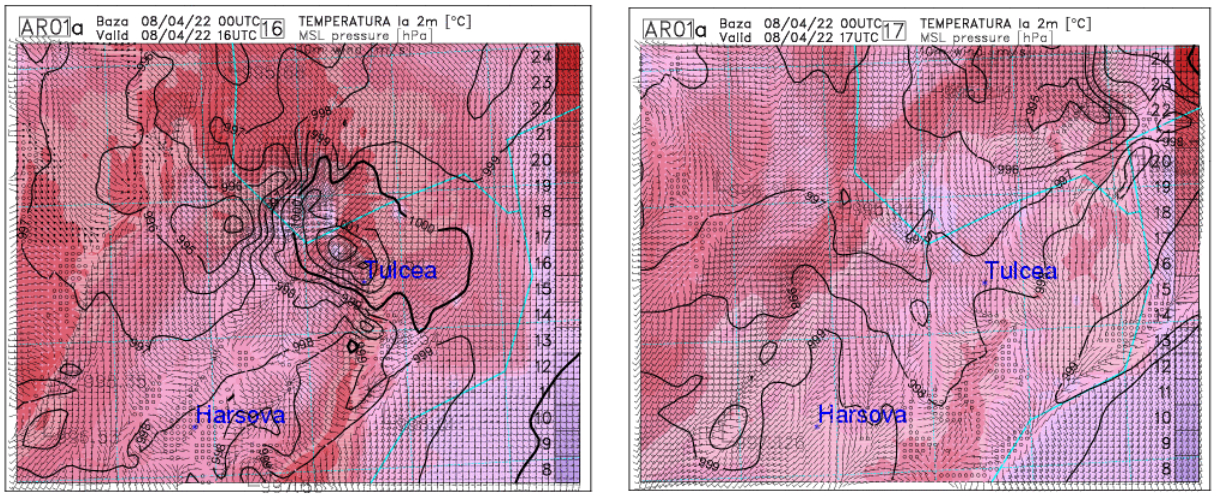


Fig. 9 Arome 2.5 km MSLP and 850 hPa temperature valid at 22.04.2008 16 UTC (left) and 17 UTC (right)

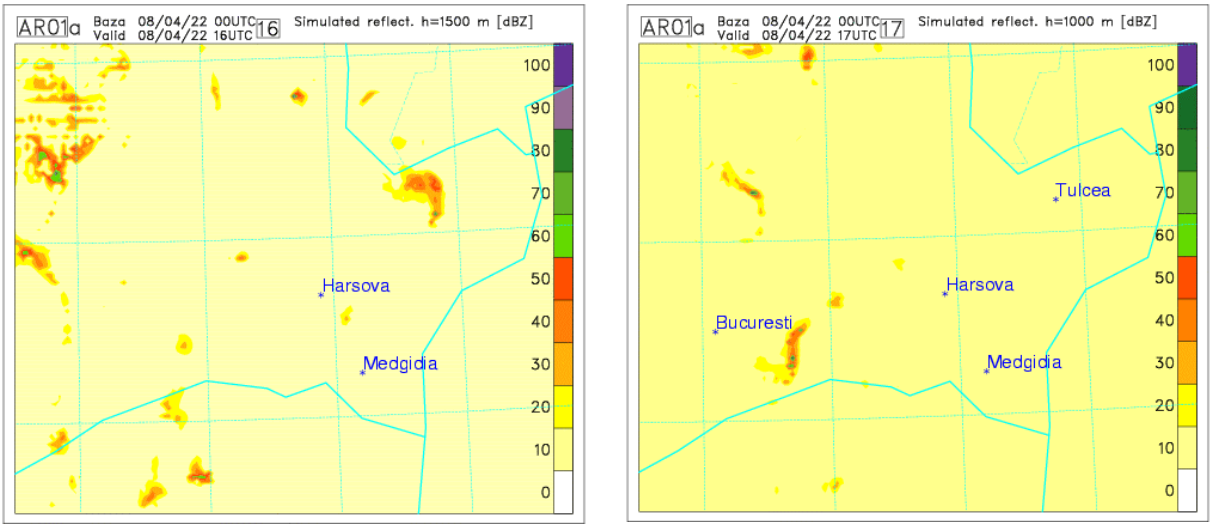


Fig. 9 Arome 2.5 km simulated reflective at 1500 m hight
valid at 22.04.2008 16 UTC (left) and 17 UTC (right)

Outlook

Two AROME domains together with their reference configuration and simulations for Romania are now available and the practical knowledge on the involved procedures was achieved. In the near future it will be possible to integrate the AROME model in Romania, at least on the small domain around Bucharest, providing the necessary information for air quality modelling.

Acknowledgements

I am grateful to my supervisor Yann Seity who guided my in with patience in the AROME practical world. I would like to thank to Gwenaelle Hello, Sylvie Malardel, Patrick Le Moigne and Francois Bouyssel for very fruitful discussion. Discussions about data processing with Yves Bouteloup and Eric Bazile were as well very useful for me; I would like to thank them too. Special thanks go towards Karam Essaouini who helped to use the orography relaxation method. As well many thanks to my colleague Aurora Stan Sion for providing me radar data and now casting analysis about the simulated case.