

Operations – Portugal (second half of 2010)

In the second half of 2010, important changes happened in the operational procedures, the main event being the operationalization of AROME for Madeira archipelago and the Portuguese mainland.

a. ALADIN: In September, ALADIN forecasts were extended to 72 hours, with all the main characteristics kept constant (see Newsletter 35). In December, ALADIN operational model was upgraded to cycle 36t1. A performance test of configuration 001, for a random day, showed an increase of 7.3% in the time needed to finish the integration between cy35t1 and cy36t1. With this new cycle, major improvements in relative humidity at 2 meters were verified while other boundary layers parameters showed approximately the same scores as the previous operational cycle 35t1. Next are shown some selected results of the validation of cycle 36t1 over the mainland territory, with the statistics and scores calculated for a total of 48 stations homogeneously distributed over Portugal. These stations were selected carefully, having removed stations with strong local characteristics that are not well perceived by models.

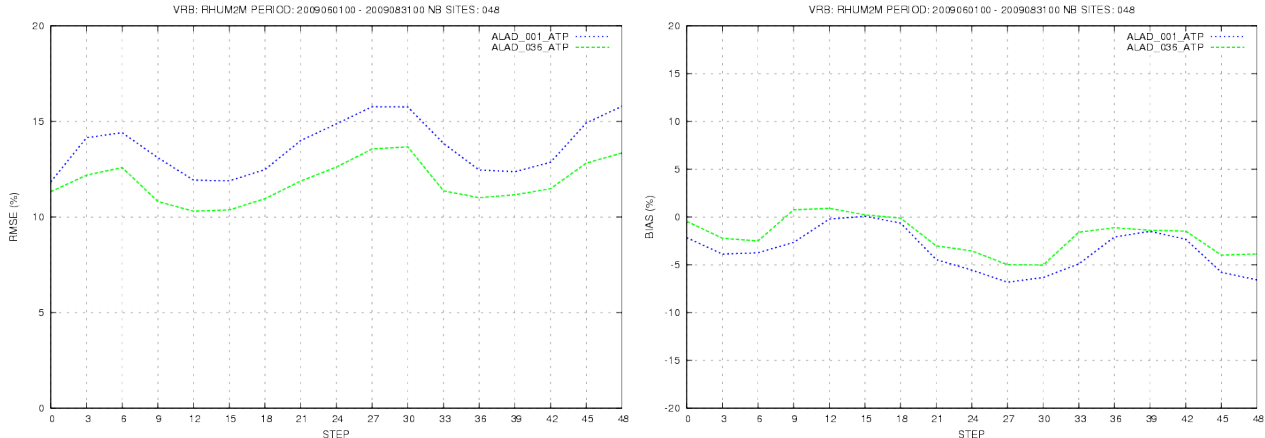


Figure 1 – RMSE (left) and BIAS (right) of 2-meter relative humidity for ALADIN CY35T1 (blue) and ALADIN CY36T1 (green), in summer 2009.

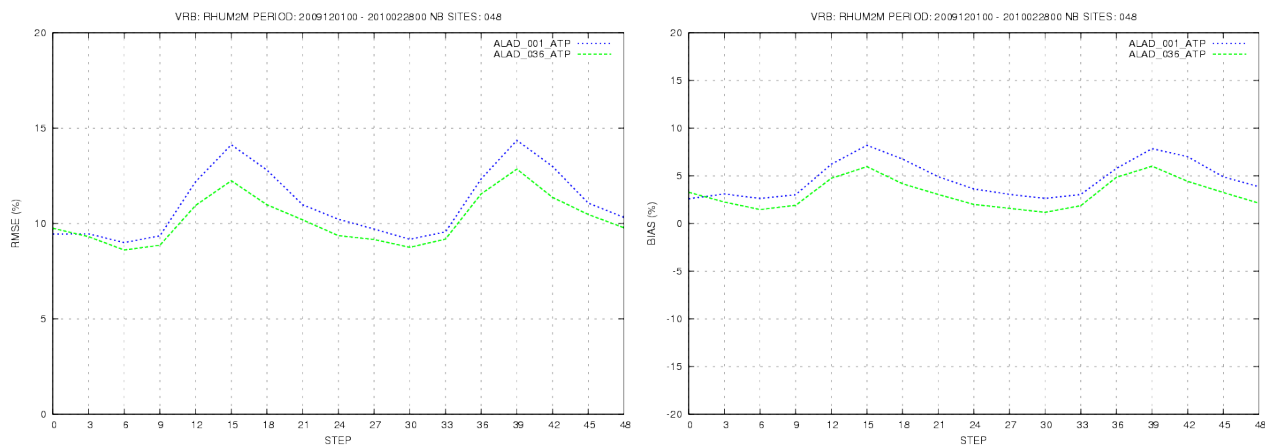


Figure 2 – RMSE (left) and BIAS (right) of 2-meter relative humidity for ALADIN CY35T1 (blue) and ALADIN CY36T1 (green), in winter 2009/2010.

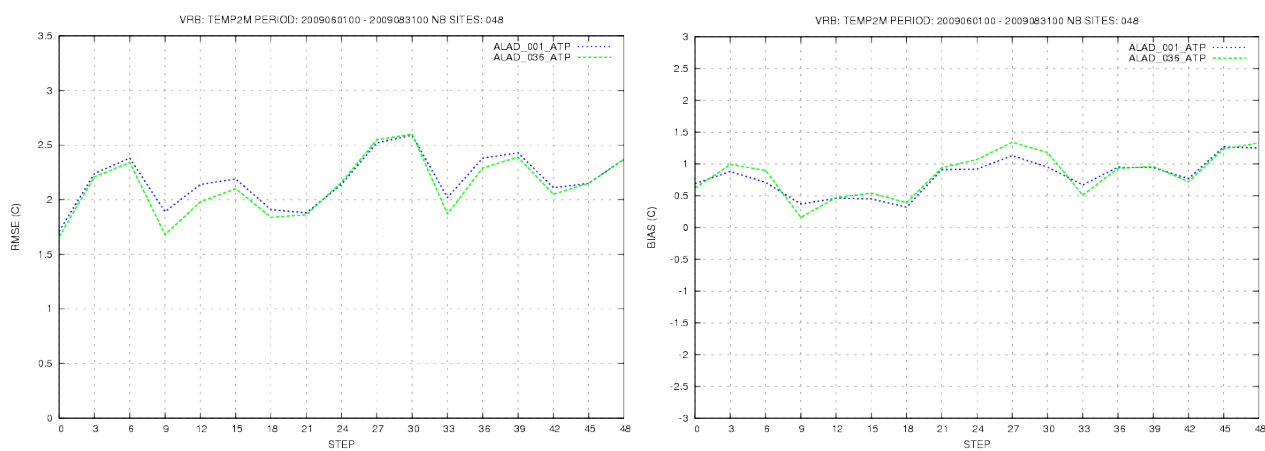


Figure 3 – RMSE (left) and BIAS (right) of 2-meter temperature for ALADIN CY35T1 (blue) and ALADIN CY36T1 (green), in summer 2009.

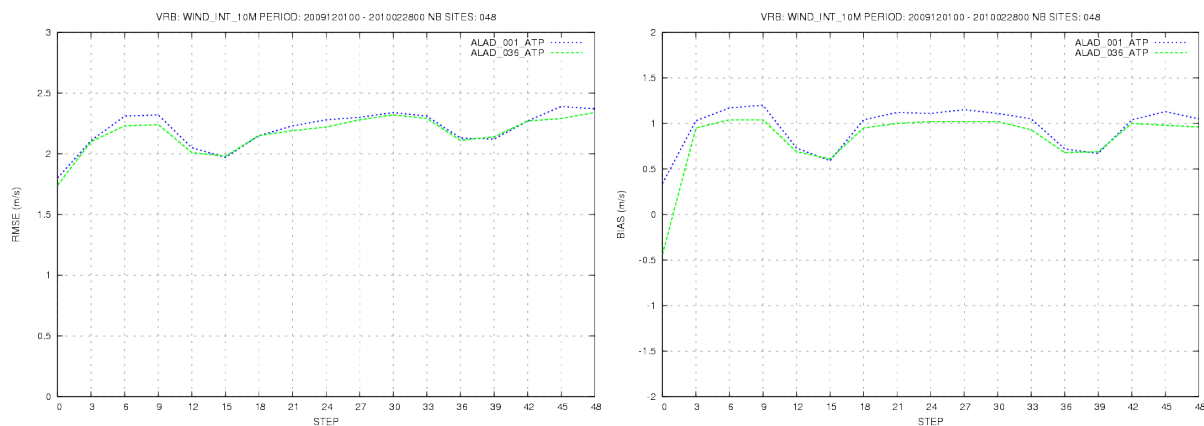


Figure 4 – RMSE (left) and BIAS (right) of 10-meter wind speed for ALADIN CY35T1 (blue) and ALADIN CY36T1 (green), in winter 2009/2010.

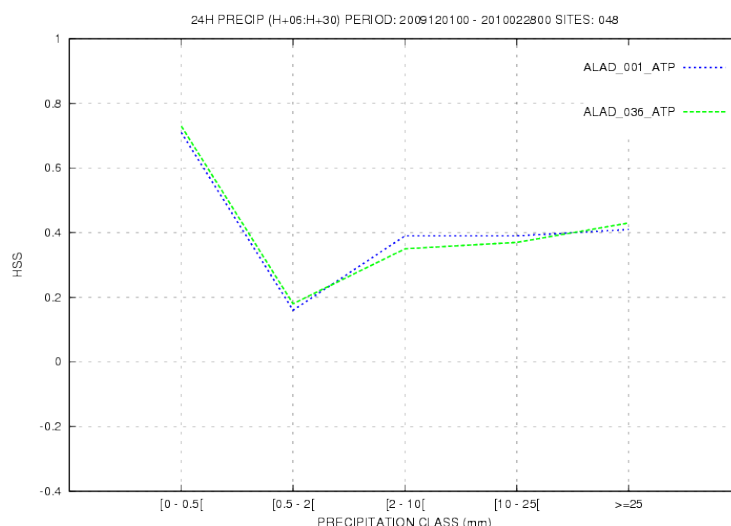


Figure 5 – Heidke Skill Score (HSS) of 24-hour accumulated precipitation for ALADIN CY35T1 (blue) and ALADIN CY36T1 (green), in winter 2009/2010.

Table 1 – HSS of 24-hour accumulated precipitation for one year data.

Cycle / Season	Summer 2009	Autumn 2009	Winter 2009/10	Spring 2010
35t1	0.37	0.44	0.46	0.40
36t1	0.42	0.49	0.47	0.47

b. AROME: Since August AROME model has been run in operational mode (cy35t1) on an IBM p5-575 machine, for two different domains, one called AROME-PTG that covers the mainland territory and another called AROME-MAD that encompasses the Madeira archipelago. Both domains share the following characteristics:

- 2,5 km horizontal resolution
- 60 seconds time step
- 46 vertical levels
- 2 runs (00UTC and 12 UTC) with 48 hours integration range
- 3 hour coupling frequency from ALADIN

AROME-PTG domain (C+I) has 239x349 points and AROME-MAD domain (C+I) has 181x189. In configuration 001 and for the PTG domain are used a total of 5 nodes, 40 dual-core processors, 80 tasks with SMT activated with a typical execution time between 1h45 and 1h50. For the MAD domain, configuration 001 is run with the total of 3 nodes, 24 dual-core processors, 48 tasks with SMT activated and a typical execution time between 1h15 and 1h20. In both cases, Open MP can't

be used because it randomly crashes during the execution of configuration 001. Examples of post-processed fields of AROME are shown bellow.

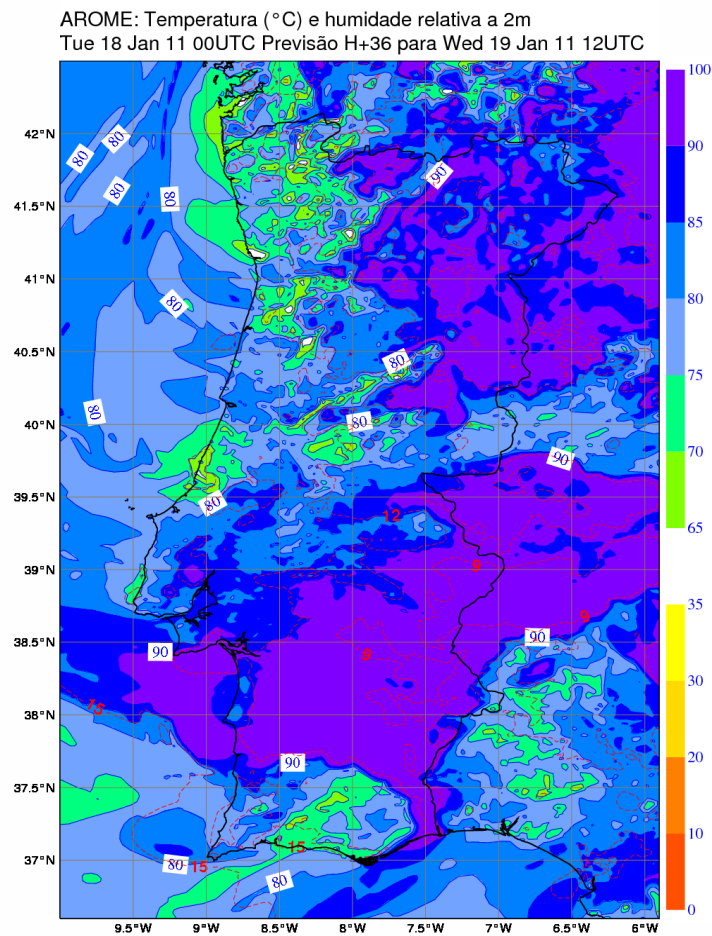


Figure 6 – Forecast of 2-meter temperature and relative humidity, with AROME-PTG cy35t1.

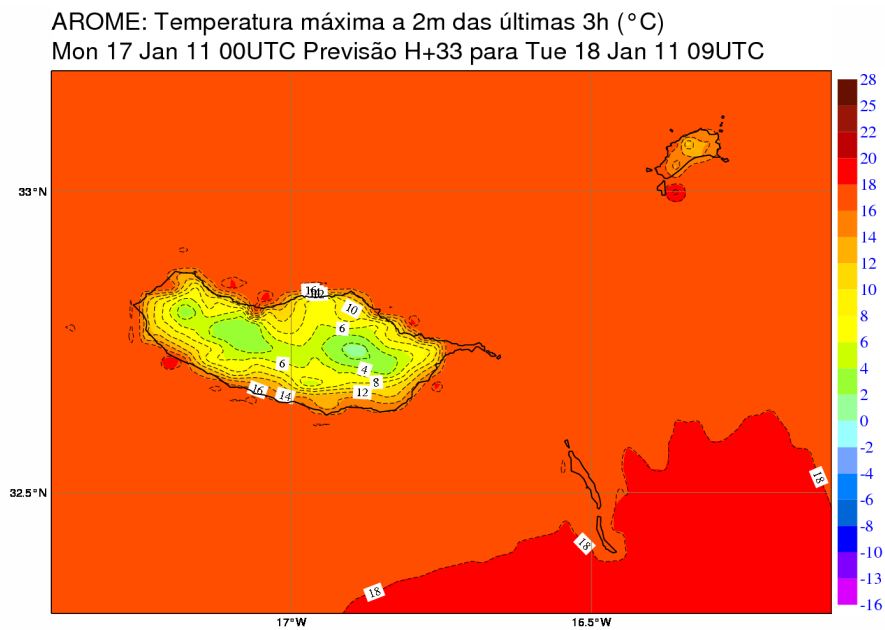


Figure 7 – Forecast of 2-meter maximum temperature in the last 3 hours, with AROME-MAD cy35t1.

Next are shown some results of the objective verification of the model's performance, for the two different AROME domains. Shown are also the results obtained with ALARO cy36t1 at 5km resolution and ALADIN cy36t1 at 9 km resolution. Due to some constraints with AROME's time series, statistics have only been calculated to a forecast range of 30 hours.

Figures 8 and 9 show the RMSE and the BIAS, respectively, for winter 2009/10 and summer 2010, computed for a sample of 48 weather stations in Mainland. Figure 10 shows the Heidke Skill Score of 3 hour precipitation for ALADIN, ALARO, AROME and HIRLAM at a resolution of around 5 km.

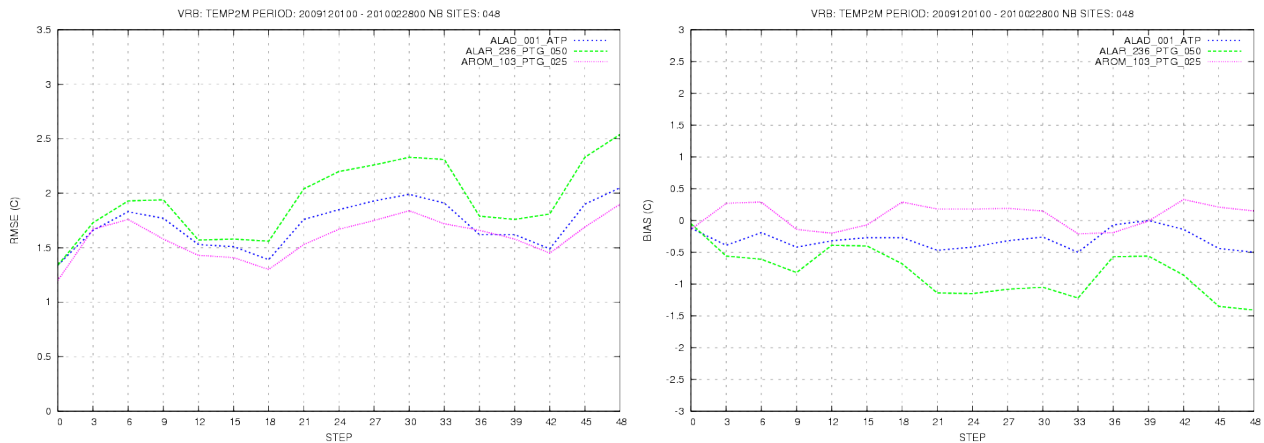


Figure 8 – RMSE (left) and BIAS (right) of 2-meter temperature during winter 2009/10 for ALADIN (blue), ALARO (236) and AROME-PTG (pink).

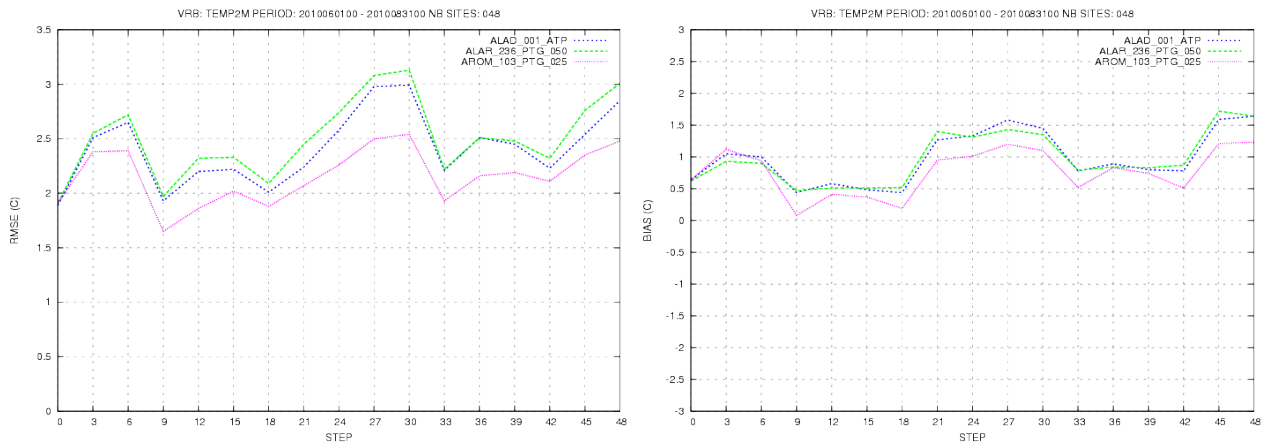


Figure 9 – RMSE (left) and BIAS (right) of 2-meter temperature during summer 2010 for ALADIN (blue), ALARO (green) and AROME-PTG (pink).

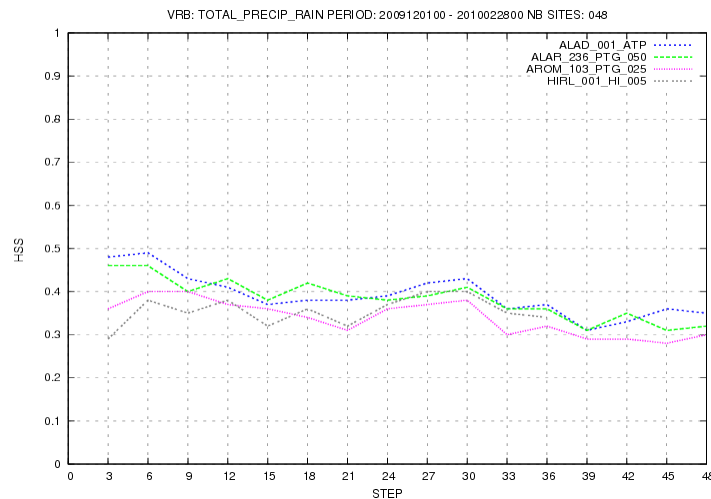


Figure 10 – HSS of 3-hour precipitation in winter 2009/2010 for ALADIN (blue), ALARO (green), AROME-PTG(pink) and HIRLAM (grey).

Overall, AROME is the model that has the lowest BIAS and RMSE for the 2-meter temperature and 2-meter relative humidity. For the other variables (cloudiness, wind speed and direction) scores are similar to ALADIN and ALARO. In winter, precipitation scores for AROME are similar to the ones computed for other models, as shown in figure 10. In summer, the HSS of AROME is usually one of the highest.

In the case of Madeira domain, verification showed that for 2-meter temperature AROME gives the lowest RMSE and a constant and near zero bias, for 2-meter relative humidity the best result is again from AROME, followed by ALARO and finally ALADIN, with errors below 15% during the majority of the year, except in summer where they increase to values above 15% and below 20%. For mean sea level pressure the 3 models have similar performances as well as for the direction of wind at 10 meters. For the 10-meter wind speed, AROME and ALARO take the lead, each one topping the best performance in different seasons or different forecast steps. For precipitation, ALARO gave the best forecasts in autumn, winter and spring, while AROME was the best at summer, although the small sample available for this season makes the results inconclusive. Finally for cloudiness, ALADIN showed much better performance than ALARO and AROME. The results for wind speed and cloudiness are given below.

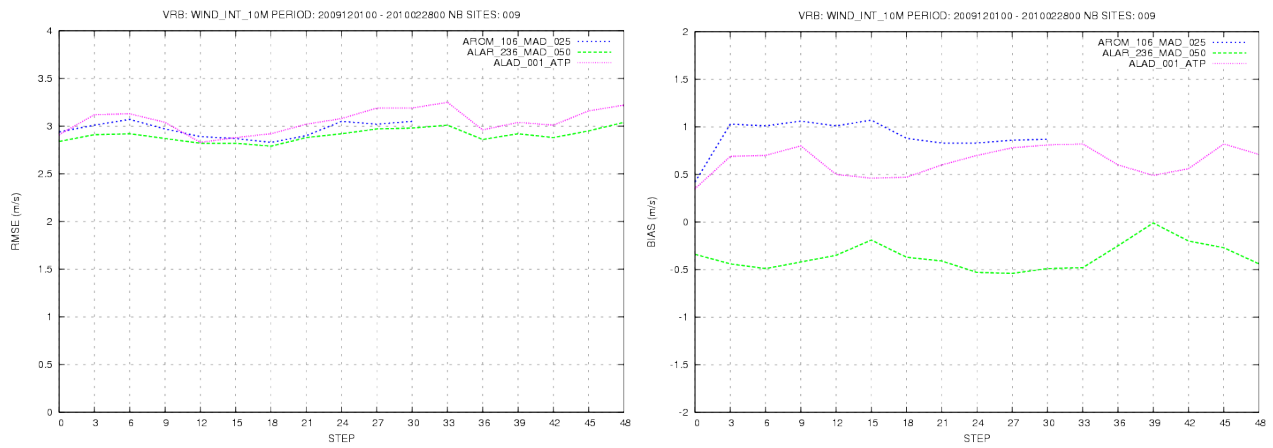


Figure 11 – RMSE (left) and bias (right) of 10-meter wind during winter 2009/2010 for AROME-MAD (blue), ALARO (green) and ALADIN (pink).

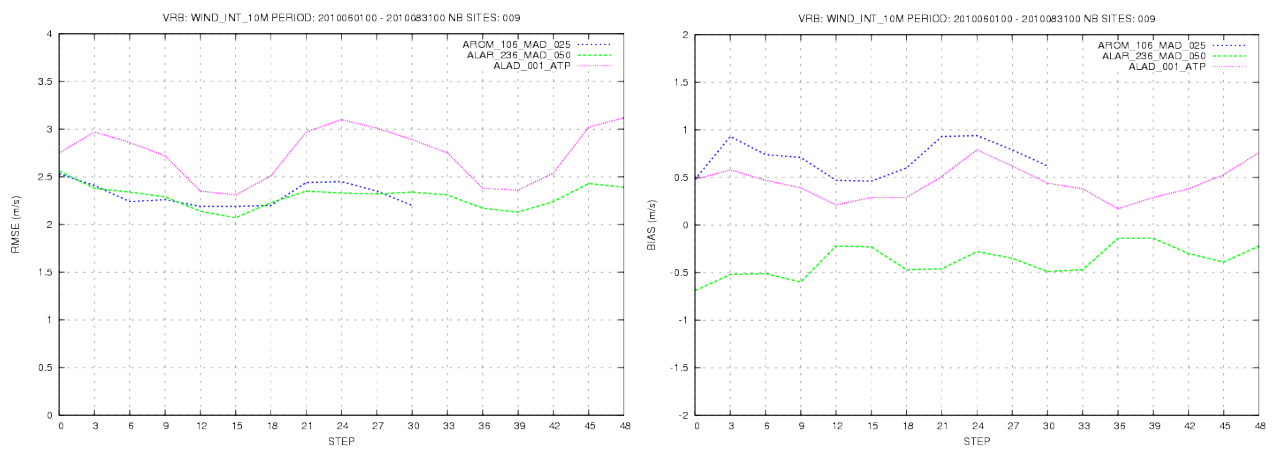


Figure 12 – RMSE (left) and bias (right) of 10-meter wind during summer 2010 for AROME-MAD (blue), ALARO (green) and ALADIN (pink).

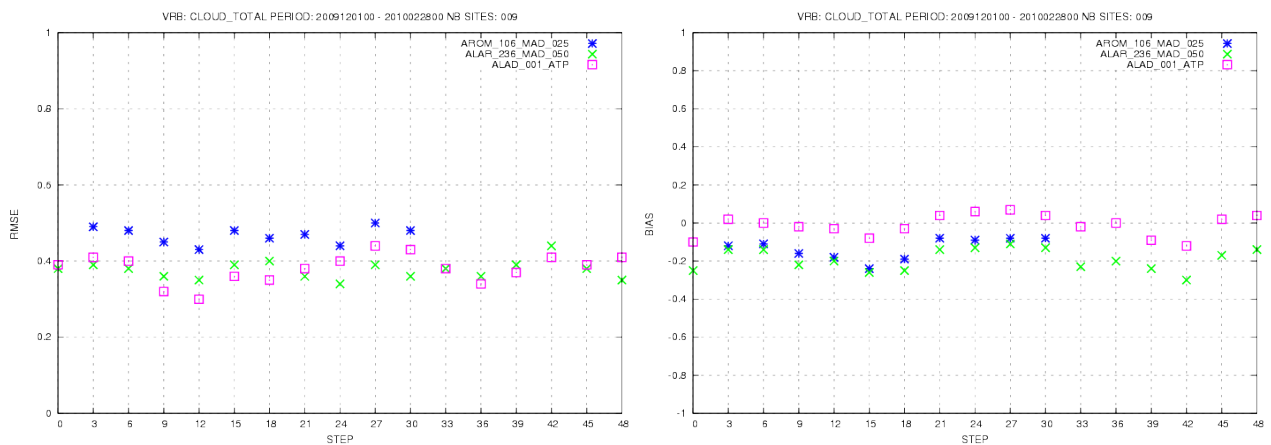


Figure 13 – RMSE (left) and bias (right) of cloud cover during winter 2009/10 for AROME-MAD (blue), ALARO (green) and ALADIN (pink).

c. **Tephigrams:** Tephigrams with ALADIN forecasts started to be produced for 41 selected locations in Portugal.

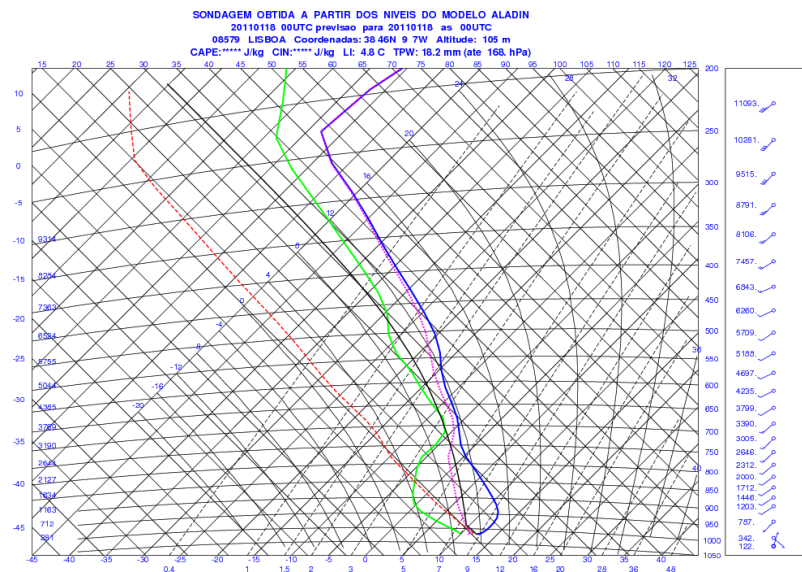


Figure 10 – ALADIN tephigram for Lisbon.

d. **Meteograms:** Meteograms based in ALADIN and AROME forecasts were also made available, in a total of 288 locations for ALADIN and of 282 locations for AROME.

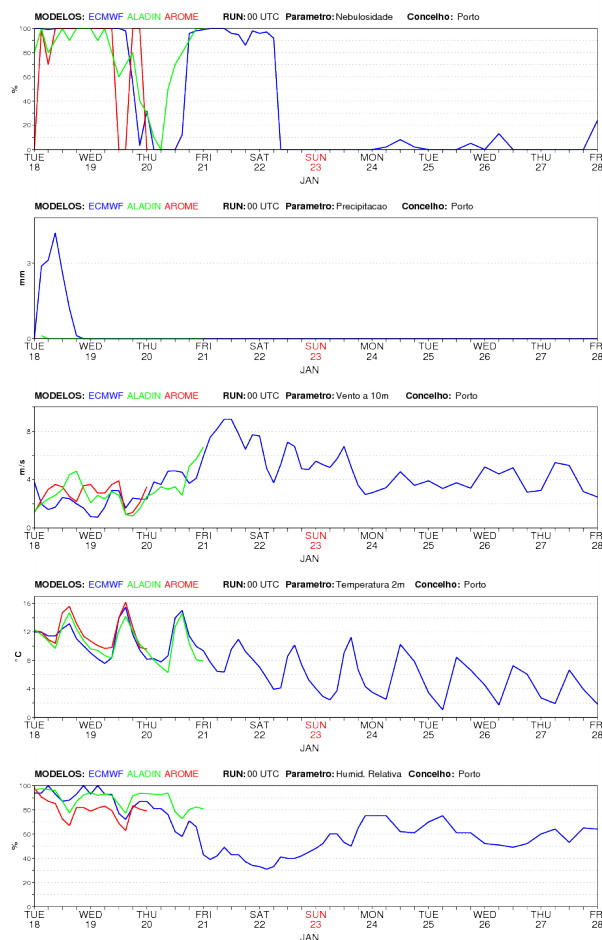


Figure 11 – Meteogram for Oporto.