

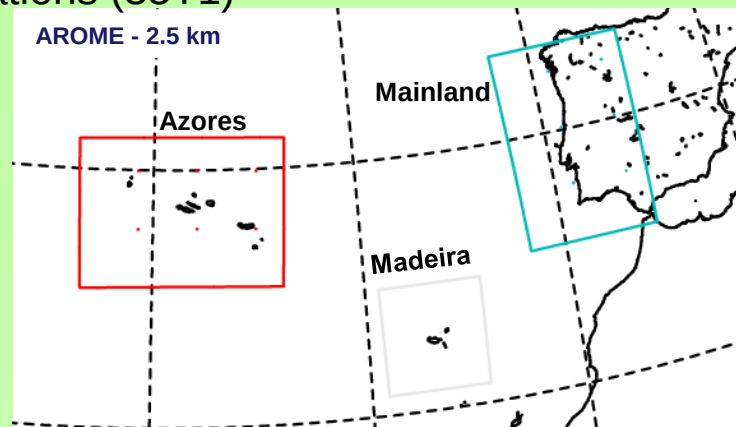
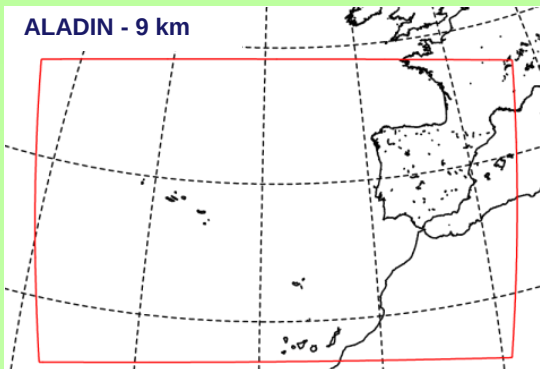
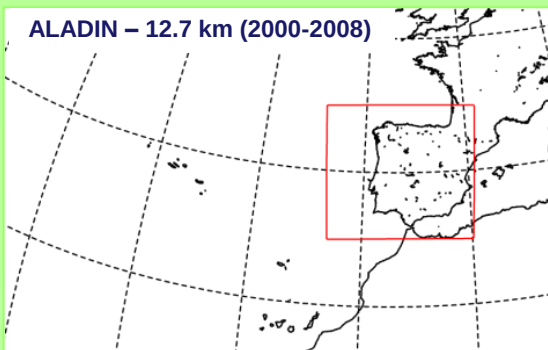
Summary of main activities

Since the full upgrade of the Portuguese NWP operational system by the end of 2008, to a HPC platform and a DELL cluster, an ALADIN new geographical domain and resolution and job's scripts under SMS/XCdp, the main focus has been targeted towards high resolution models. Pre-operational runs with AROME model at 2.5 km resolution for two domains, Portugal mainland and Madeira archipelago, started in 2009 and in 2010 both models became operational. An AROME domain for Azores archipelago is being run in validation mode, with cycle 36T1. ALADIN and the two operational AROME domains have also been upgraded this year to cycle 36T1. Model output statistics and Kalman filter have been applied to extreme daily temperatures forecasts of ALADIN, AROME and ECMWF models. Regarding NWP model verification system, daily and monthly scores of all models available at IM are being calculated operationally. A testing 3D-Var ALADIN-Portugal data assimilation suite is being built for a geographical domain of 288x288 gridpoints. Operational analysis fields from CANARI system are merged with upper-air 6h ALADIN-Portugal forecasts to build the background.

ALADIN and AROME operational versions

Timeline of changes

Apr 2000 Cycle 09
Jun 2000 Cycle 11T2 (CYCORA included)
Jul 2001 Cycle 12_bf02 (CYCORA_bis included)
Apr 2002 Time step change (540s to 600s)
Jun 2006 Cycle 28T3 (new geographical area and climatologies)
Jun 2007 Wind dynamical adaptation for 3 domains
Apr 2008 CANARI surface analysis fields (temp. & rel. humidity)
Dec 2008 Cycle 32T3 (new domain and resolution)
Out 2009 Cycle 35T1
Jan 2010 AROME-Mainland & AROME-Madeira in operations (35T1)
Dec 2010 Cycle 36T1 in ALADIN
Jun 2011 Cycle 36T1 in AROME-Madeira
Out 2011 Cycle 36T1 in AROME-Mainland



Under validation

- AROME for Azores archipelago

Foreseen activities

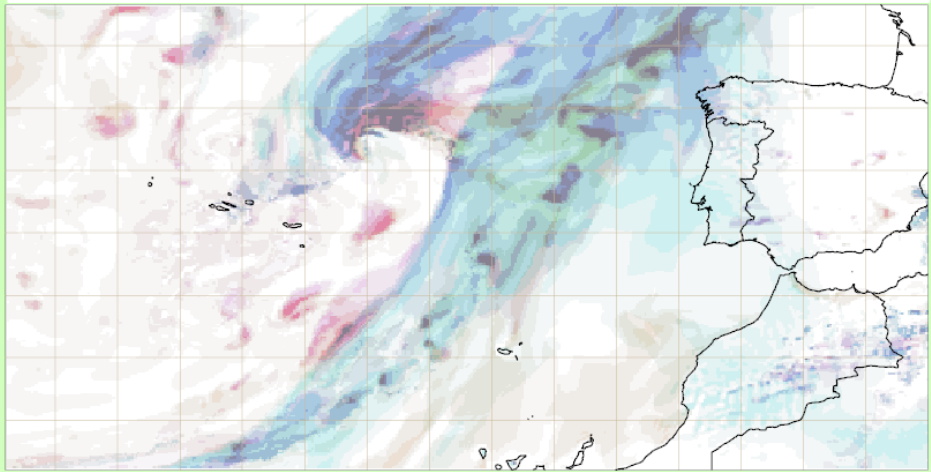
- Calculation of a climatological B matrix by the ensemble method for the 3D-Var ALADIN-Portugal data assimilation system
- Increase of vertical levels in the ALADIN-AROME system

Models characteristics

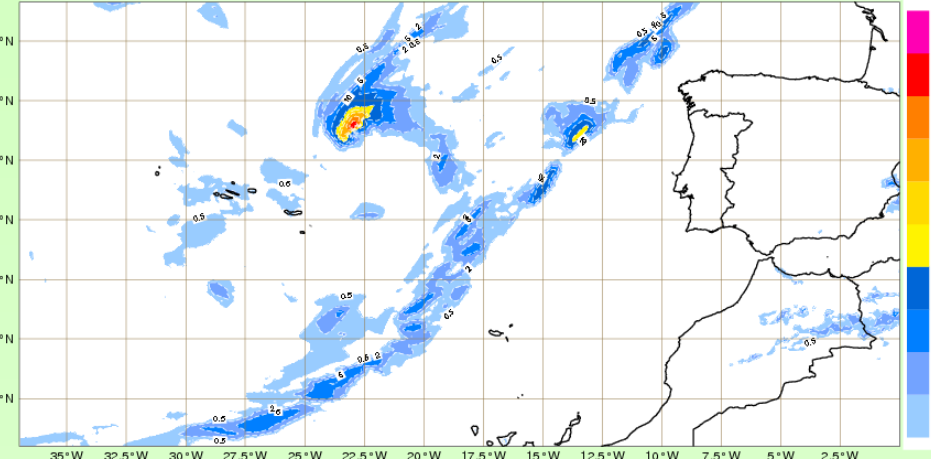
ALADIN-Portugal

- Spectral hydrostatic model
- Hybrid vertical coordinates
- Digital filter initialisation
- Semi-lagrangian advection scheme
- Two-time-level semi-implicit time scheme
- ISBA surface parameterisation scheme
- Initial and LBC from ARPEGE
- 3 hour coupling frequency
- Geometry:
 - Size (lon x lat): 439 x 277 points
 - Horizontal resolution: 9 km
 - Number of vertical levels: 46
 - Time step: 360 s
- Integration frequency: twice a day
- Forecast range: 72 hours
- Output frequency: 1 hour
- Cycle 36T1

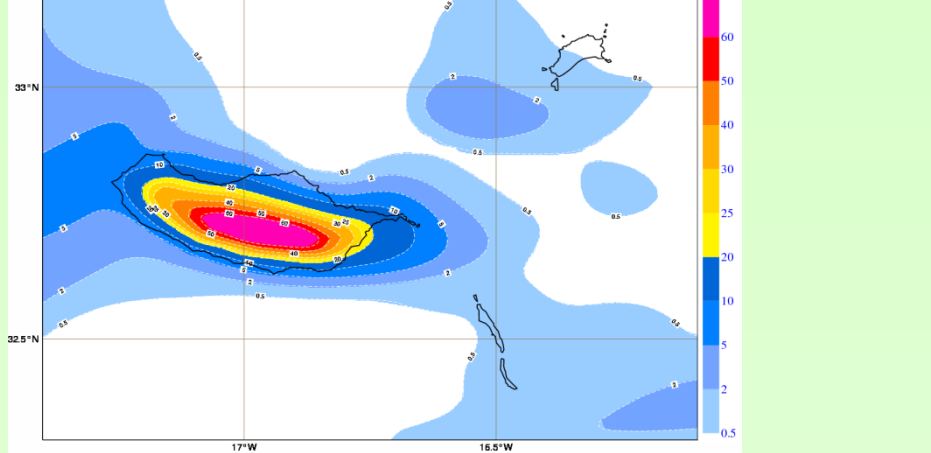
ALADIN: Nuvens Baixas B+M Medias M+A Altas A+B A+M+B
29-09-11 00 UTC Previsão H+42 para 30-09-11 18 UTC



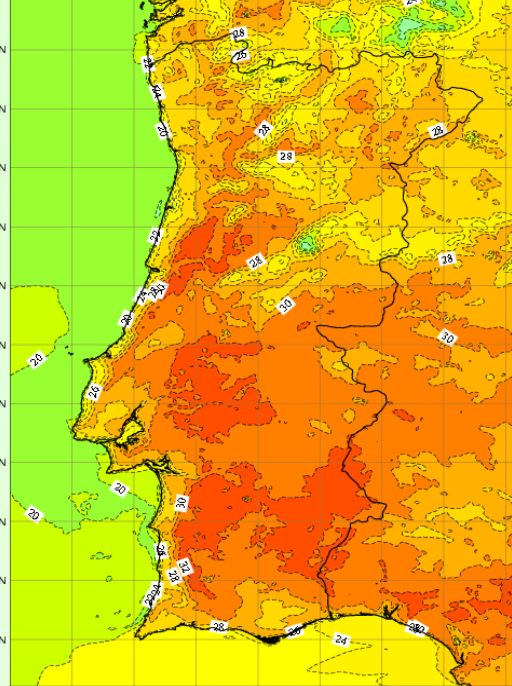
ALADIN: Precipitação total (mm) acumulada em 3 horas
Thu 29 Sep 11 00UTC Previsão H+(42-39) para Fri 30 Sep 11 18UTC



AROME: Precipitação total (mm) acumulada em 3 horas
Fri 19 Feb 10 12UTC Previsão H+(24-21) para Sat 20 Feb 10 12UTC



AROME: Temperatura a 2m (°C)
Thu 29 Sep 11 00UTC Previsão H+39 para Fri 30 Sep 11 15UTC



AROME

- Spectral non-hydrostatic model
- Semi-lagrangian advection scheme
- Two-time-level semi-implicit time scheme
- Initial and LBC from ALADIN-Portugal
- 3 hour coupling frequency
- Geometry:

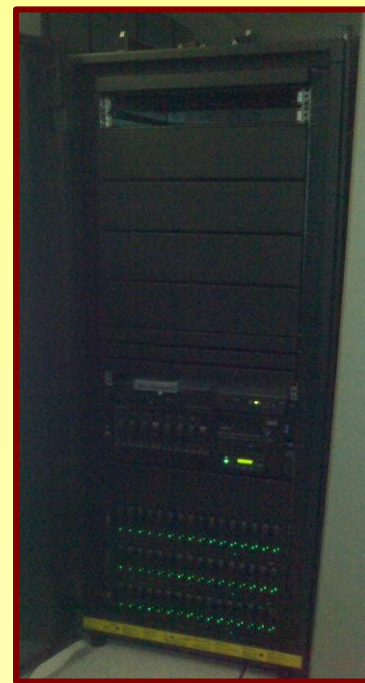
Domain	Mesh size (lon x lat)	Horizontal Resolution (km)	Vertical levels	Time step
Mainland	360 x 250	2.5	46	60
Madeira	200 x 192			
Azores	270 x 360			

- Integration frequency: twice a day
- Forecast range: 48 hours
- Output frequency: 1 hour
- Cycle 36T1

Computing resources

HPC system IBM p5-575

- 10 nodes
- Each node with 8 Power 5+ dual-core processors @ 1.9 GHz
- 32 GB RAM of memory per node
- 2 TB total disk space
- AIX 5.3 operating system
- Open Multi-Processing and Simultaneous Multi-Threading
- General Parallel File System
- LoadLeveler
- Fortran (xlf) and C/C++ (xlc) IBM compilers

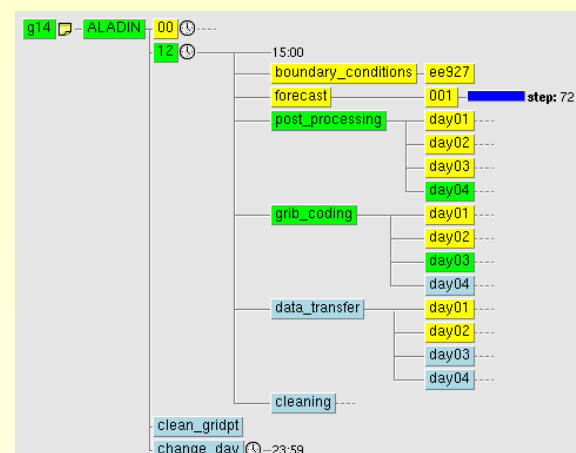


DELL PowerEdge 2950

- 10 nodes
- 2 Intel Xeon X5355 Quad-core processors @ 2.66 GHz
- 4 x 2GB RAM
- 8 TB per node
- Linux PAIPIX-IM operating system with:
 - Fortran and C/C++ compilers
 - Metview/Magics (ECMWF) graphical software
 - SMS/Xcdp (ECMWF) job scheduler
 - Local database (Temporal Instrumental Data Base – TIDB/IM)



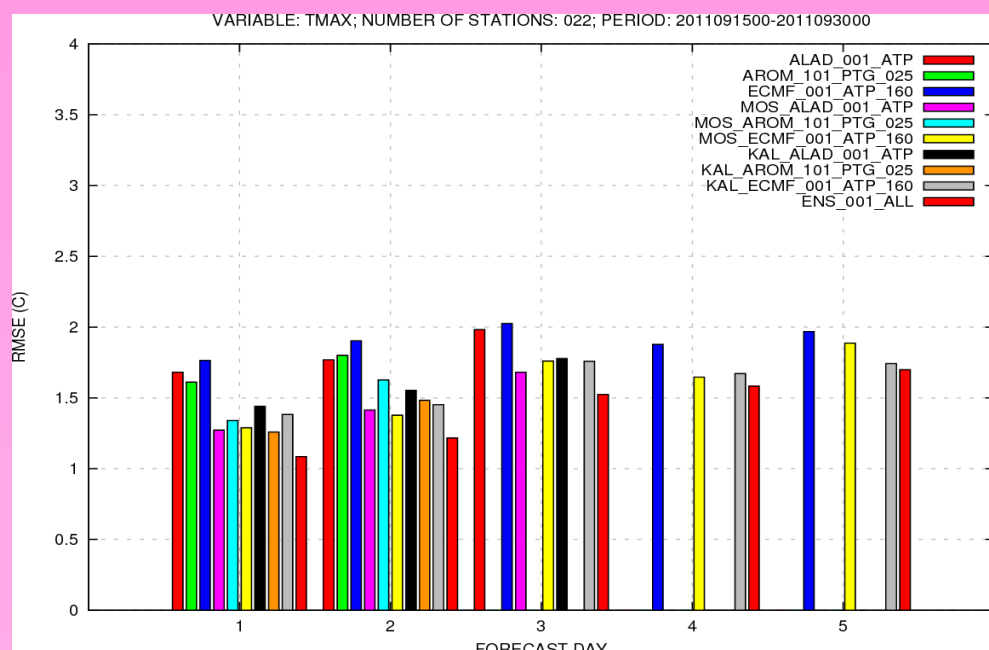
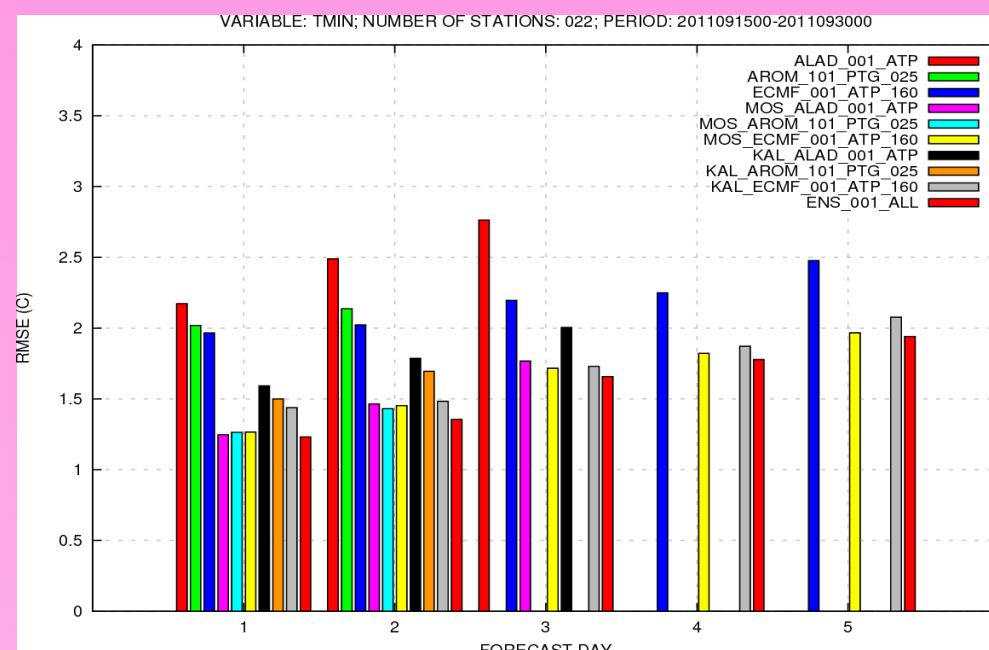
DELL system is the front-end device of IBM and SMS software is used for batch job scheduling from a DELL machine to the HPC cluster. DELL machines are used for data processing, visualization and archiving. The NWP operational system is run under SMS suites.



Models verification

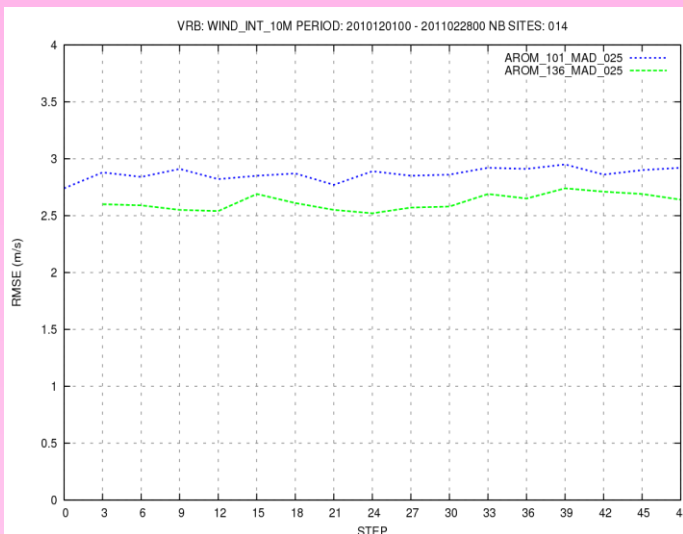
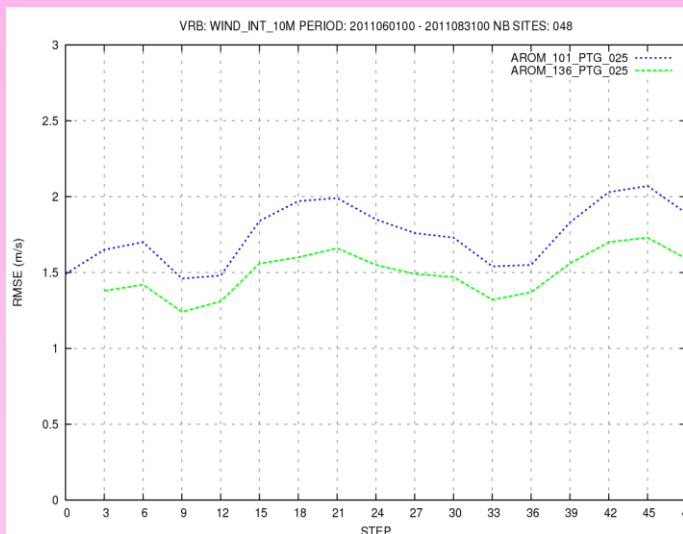
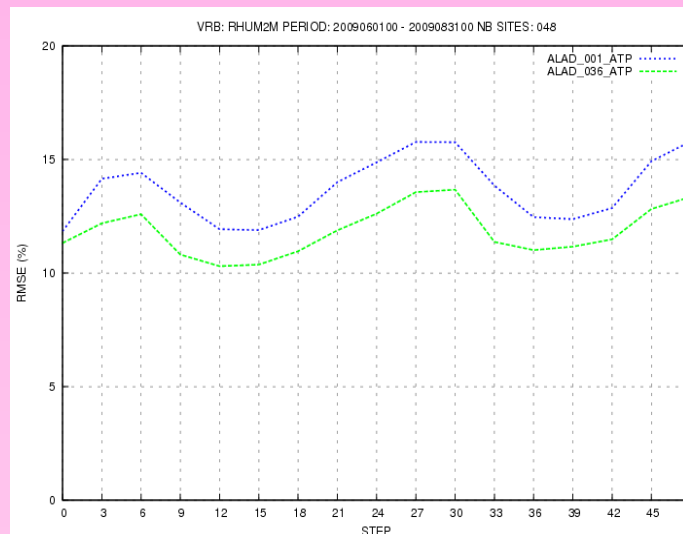
(joao.rio@meteo.pt, nuno.lopes@meteo.pt, manuel.lopes@meteo.pt)

Statistical models



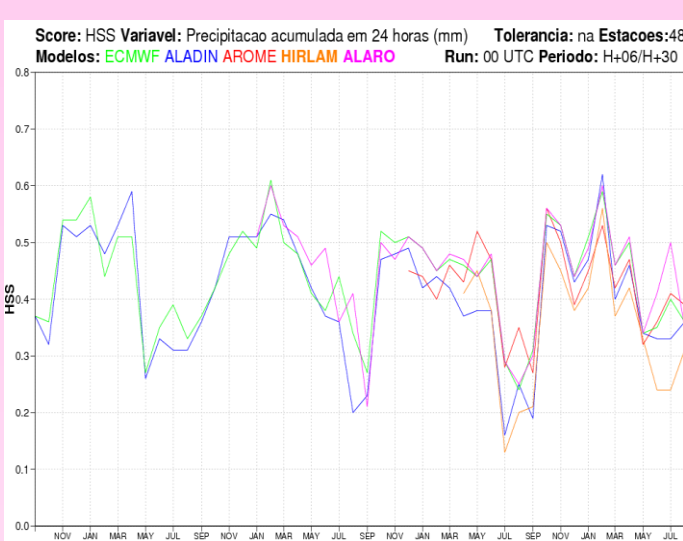
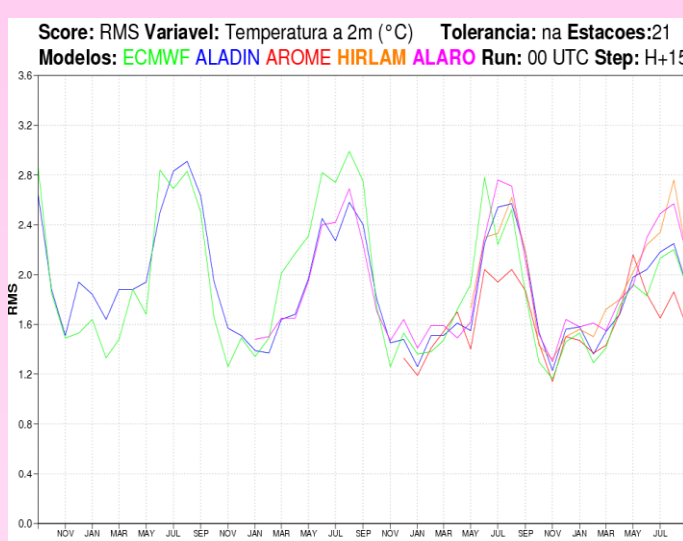
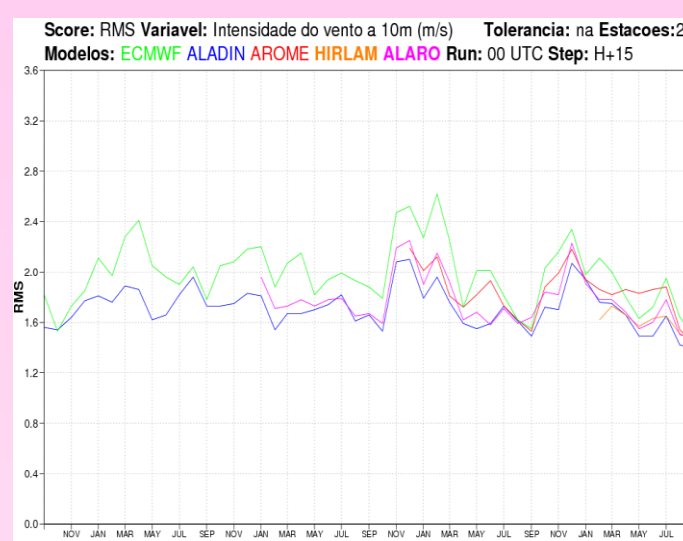
RMSE of tmin and tmax of direct models output (ALADIN, AROME and ECMWF), MOS and Kalman filter and an “ensemble” (average of the statistical models). Results have shown the advantage of using the “ensemble” product to forecast extreme daily temperatures.

Cycle 36T1 versus cycle 35T1



ALADIN and AROME's validations of cycle 36T1 compared to cycle 35T1 have shown a clear improvement in the forecast skill of 2 metres relative humidity for ALADIN (left) and a small improvement in the forecast skill of 10 metres wind speed of AROME- Mainland (middle) and AROME- MAD (right).

Monthly scores time series



RMSE time series of 10m wind speed (left) and 2m temperature (middle) for step H+15, and Heidke Skill Score time series for 24h precipitation.