Limited Area Modelling Activities in Portugal

35th EWGLAM and 20th SRNWP meeting, 30/09-3/10/2013, Antalya (Turkey)

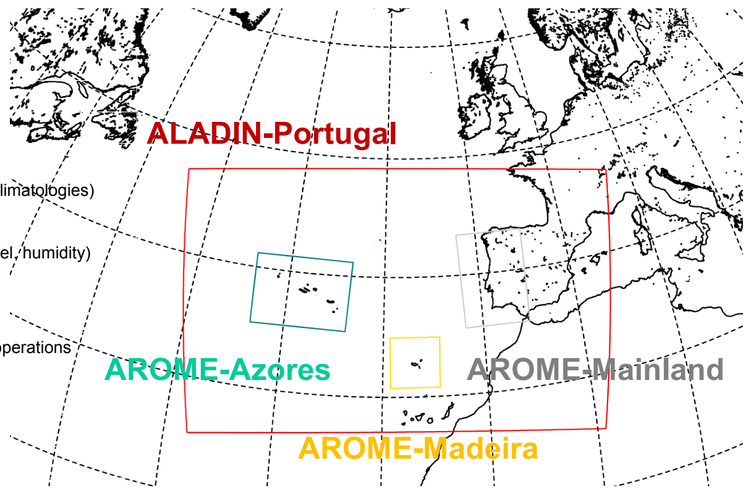
Summary of main activities

The Portuguese NWP operational system is based on a set of SMS/XCdp scripts which are submitted from a front-end DELL cluster to an IBM p575 platform. ALADIN-Portugal runs over a domain which covers the Portuguese mainland and the adjacent Atlantic Ocean including the Portuguese Islands, at 9km of horizontal resolution and 46 vertical levels. The ALADIN model provides initial and boundary conditions to the highest resolution model AROME. Operational runs with AROME model at 2.5 km resolution started in 2009, 2010 and 2011 respectively for three domains of Portuguese mainland, Madeira archipelago and Azores archipelago. Cycle 36T1 is being used in operations since December 2010. A backup system has been also implemented at ECMWF to run ALADIN-Portugal as a Time Critical Application. Meanwhile, future scenarios of computing requirements have been drawn to prepare the acquisition of a new local HPC infrastructure and an IBM blade system is being used to test a new environment for pre- and post-processing. At the same time, case-studies are frequently conducted to assess the models' performance in severe weather conditions (in comparison with ECMWF's model), as well as the manufacture of new post-processed products for several purposes and clients. The effort onto the creation of a local data assimilation cycle is on going: a climatological B matrix is being diagnosed for an ALADIN/Portugal 3D-Var testing cycle and in addition, technical work for the ingestion of Portuguese radar data into an AROME/Portugal 3D-Var cycle is taking place, with the support of Hungary and Croatia.

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
Dez	2011	AROME-Azores in operations (36T1)



Foreseen activities

- Diagnosis of a climatological B matrix for the 3D-Var ALADIN/Portugal testing cycle
- Ingestion of Portuguese radar data into an AROME 3D-Var data assimilation cycle
- Full upgrade of the actual operational ALADIN/AROME system: new computing platform and new NWP system configuration, including: 4x/day production runs, increase of the forecast range, horizontal and vertical resolutions of the coupling files and increase of geographical domain for the AROME model.

Models characteristics

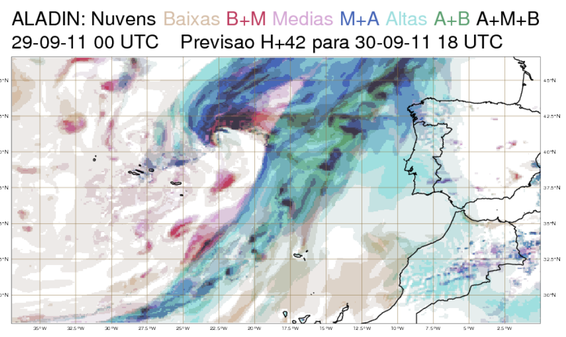
ALADIN-Portugal

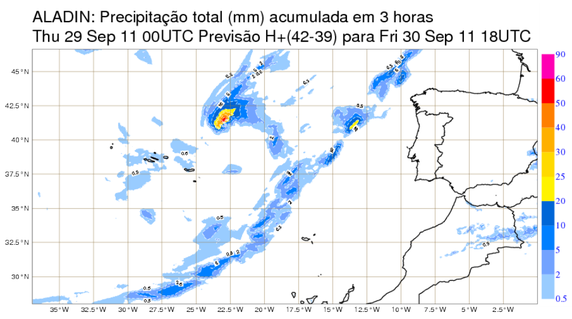
- Spectral hydrostatic model
- Hybrid vertical coordinates
- Digital filter initialisation
- Semi-lagrangian advection scheme
- Two-time-level semi-implicit time scheme
- ISBA surface parameterisation scheme
- Initial and LBC from ARPEGE
- 3 hour coupling frequency
- Geometry:
  - Size (lon x lat): 439 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

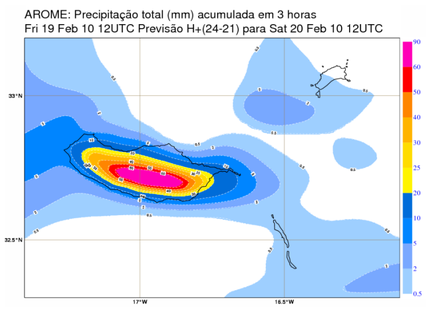
AROME

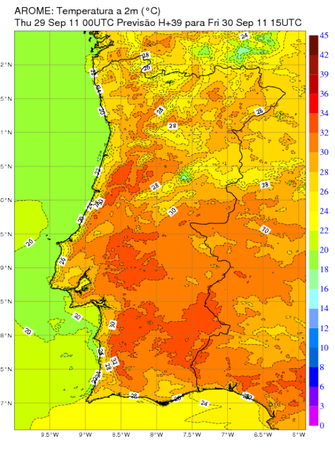
- Spectral non-hydrostatic model
- Initial and LBC from ALADIN-Portugal
- 3 hour coupling frequency
- Geometry:

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









Spatial Indicator of the Probability of Occurrence of Strong Events

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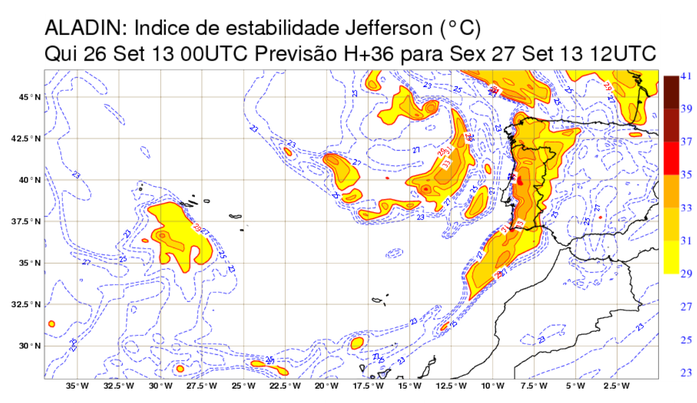

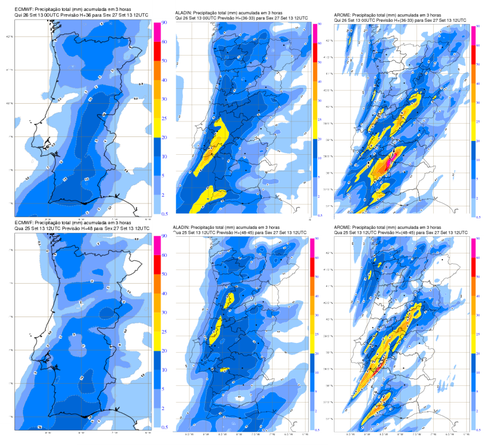

A multi-model lagged ensemble of 6 members from the ECMWF, ALADIN-Portugal and AROME-PTG models at the 00UTC and 12UTC runs and up to the range of 48 hours is considered to produce with a 3h step, a spatial indicator of the probability of occurrence of strong events, in particular of wind intensity, gust and precipitation at a chosen resolution of 0.25º for forecasting purposes.

As an illustration, the bottom panels show, for the range of 36h, the location of the averaged spatial probability of accumulated precipitation occurrence, above the thresholds: (a) 1mm/3h, (b) 10mm/3h and (c)20mm/3h. It tells how consistent is the forecast information, between the three models, when an active cold front is forecasted over Portugal mainland. The top left chart illustrates the synoptic situation, while the top right panels illustrate the available information from the 2 runs of the 3 models, ECMWF, ALADIN and AROME.

Case Study of a very localized Convective Cell

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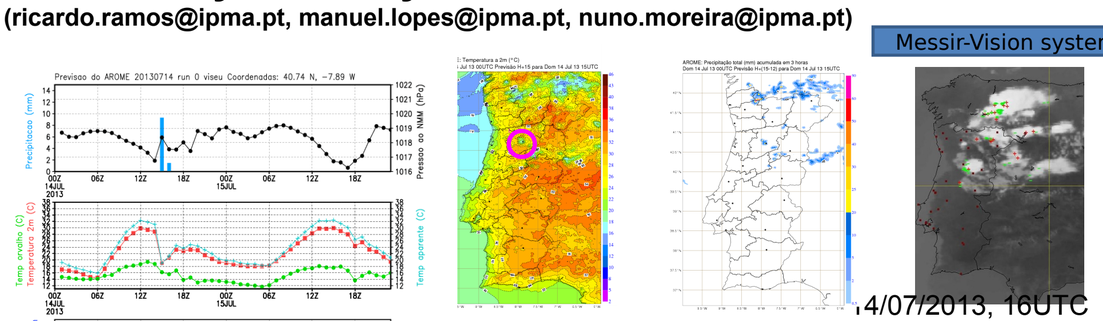
Messir-Vision system



14/07/2013, 16UTC

Locally hourly produced meteograms illustrate a convective cell captured by a 18h range AROME forecast, but not by ECMWF neither ALADIN-Portugal forecasts. CAPE, that is performed in operational mode, has shown that after the precipitation event AROME managed to locally step down its energy for values of 12 J/kg, while for the same place, ALADIN-Portugal kept the value of 2236 J/kg and ECMWF the value of 335 J/kg. This kind of exercise help the local forecasters to understand the limitations of each model.

Local Data Assimilation Activities

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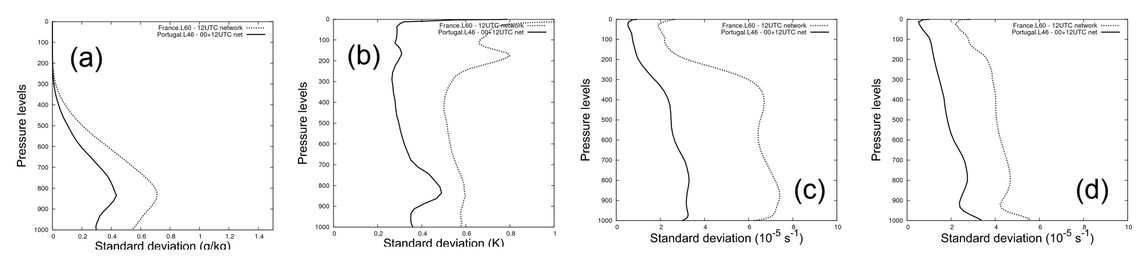
The acquisition of local data assimilation capacities has been an issue during the last year:

1. ALADIN-Portugal 6h forecast error statistics used to compute a first climatological B matrix to be included in the 3D-Var minimization algorithm are being diagnosed. The errors have been performed using an ensemble technique ensemble in dynamical adaptation mode with the OLIVE system during a stay in Météo-France (M-F). The panels in the illustration show the vertical profiles of horizontally averaged standard deviations of the 6h forecast errors, estimated for ALADIN-Portugal (solid line) and for ALADIN/France (dashed line) at two different periods, 20120401-20120430 and 20080213-20080313, respectively, for: (a) specific humidity, (b) temperature, (c) vorticity and (d) divergence.



2. AROME-PTG at ECMWF is being used under the HARMONIE system to prepare an experiment (ptg37h12) in order to evaluate the impact of Portuguese radar observation on its forecasts in a couple of case-studies. The application **aromebufr** from the Hungarian radar team has been adapted to convert Portuguese reflectivities in cartesian representation - PPIs, into M-F BUFR format. The Portuguese radar data has been sucessfully ingested when a reverted version of the BATOR application and according to M-F standards (cy37t1_bf.04) is used; it fails for the actual HARMONIE version. In a second attempt a CONRAD interface built in Croatia for IRIS radar system has been also used to produce the local BUFR data. The same version of HARMONIE has rejected it also.

3. *An impact study of updating background error covariances in the ALADIN-France data assimilation,* by Loïk Berre, Maria Monteiro and Carlos Pires, accepted for publication at the JGR - Atmospheres

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