Limited Area Modelling Activities in Portugal

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1 Summary

During 2017-2018 a few changes occurred on the local operational NWP system (Section 2): in July 2017, the number of levels was increased in all domains and the frequency of daily runs was increased just for the Iberian domain AROME-PT2; in December, SURFEX replaced ISBA as the surface scheme in the coupling model ARPEGE (CY42T_op02); and in September 2018 a hourly screen level parameters CANARI entered into operations using as guess the short-term AROME-PT2 forecasts initialized by a surface Data Assimilation cycling by the OI_MAIN formalism [1] (Section 4). At the same time Portugal assumed the coordination of the ALADIN core programme “DA basic KIT”. In parallel, under the framework of a cooperation with NWP SAF to assimilate ASCAT information at the coast of the Iberian Peninsula and starting somr common activities with AEMET, IPMA’s satellites group has locally implemented HARMONIE-AROME on a new IBM p8 platform. Derived products from AROME forecasts like the Automatic Forecasts Algorithm and the AROME meteograms supporting the forest fire combat are now into operations (Section 4). Further local team efforts have been put to support other research projects, like CLIMENA - CLimate change Impacts on the Marine Environment of the North Atlantic and FAST - development of new Forecast Skills for meteo-Tsunamis in the Iberian Shelf.

2 The Portuguese NWP system versions

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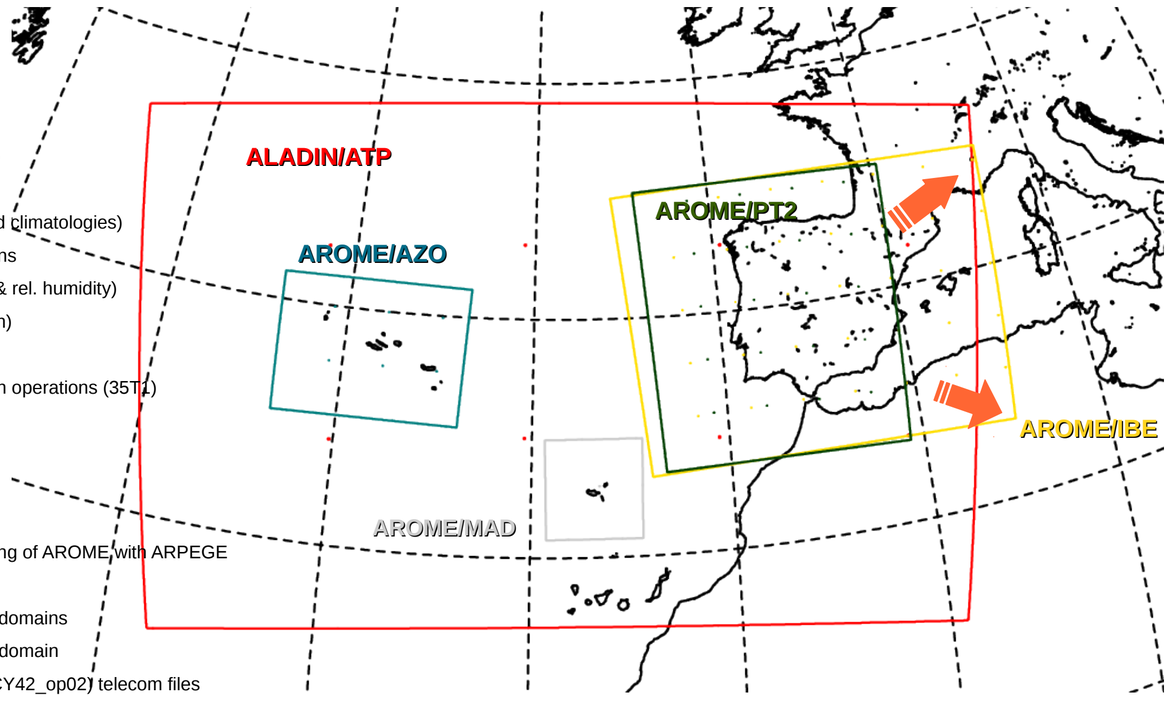
The Portuguese (SR)NWP system is based on a set of SMS/XCdp scripts submitted from a front-end cluster to an HPC IBM platform (see Table). ALADIN-Portugal runs over a domain which covers the Portuguese Mainland and the adjacent Atlantic Ocean including the Portuguese Islands, at 9km of horizontal resolution (ATP). The integration of the AROME forecasting model is done for three domains: Portuguese Mainland (PT2), Madeira (MAD) and Azores (AZO) Archipelagos. The latest model takes direct ARPEGE fields for its initialization.

OPER		DEVELOPMENT
IBM blade + IBM p7+	computing platform	IBM blade + IBM p7+
ALADIN-ATP domain (CY38T1 export)	model physics	To be locally discontinued
9.0km, 46 levels, DFI, ARPEGE 3-hour coupling, 00/12UTC runs up to 72 hours	local version aspects	
AROME (CY38T1 export)	model physics	AROME (CY40T1_bf07 export)
2,5km	horizontal resolution	2,5km
60	vertical levels	60
ARPEGE (10,0km)	coupling model	ARPEGE (10,0km)
No-DFI, no-DA	initialisation method	No-DFI, DA (3-hour OI_MAIN)
CY38T1 (PT2, MAD), CY35T2 (AZO), CY40 (ARP LBC)	climatologies	CY38T1 (PT2, with Alqueva lake physiography), CY40 (ARP LBC)
3h	coupling frequency	3h
00UTC, 06UTC, 12UTC, 18UTC	integration hours	12UTC
48, 30/48, 48, 30/48	forecast range	48
PT2, MAD, AZO	domains	PT2
CANARI (CY38T1)	standalone surface analysis	CANARI (CY38T1)
AROME-PT2	background	
Regional WMO BUFR SYNOP	observations	

Time Line

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)
Apr 2015 Cycle 38T1 in all domains; direct coupling of AROME with ARPEGE
Jun 2015 10km resolution in ARPEGE coupling
Jul 2017 Increase on the number of levels in all domains
Jul 2017 Increase on the run frequency for PT2 domain
Dec 2017 SURFEX replaced ISBA in ARPEGE (CY42_op02) telecom files
Sep 2018 Hourly screen-level OI analysis from a surface DA for AROME-PT2



3 AROME derived products

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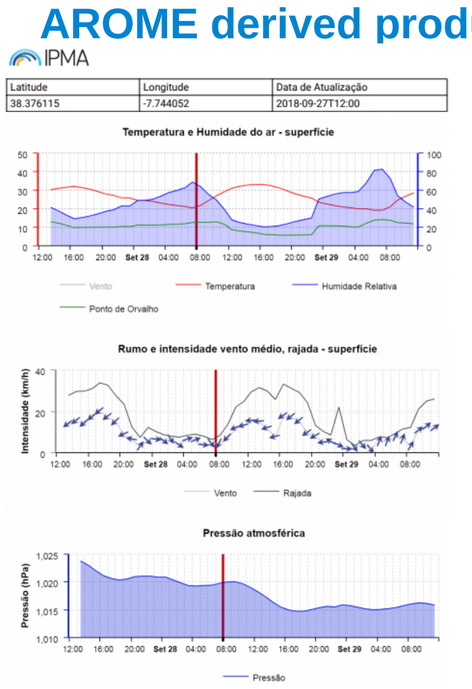
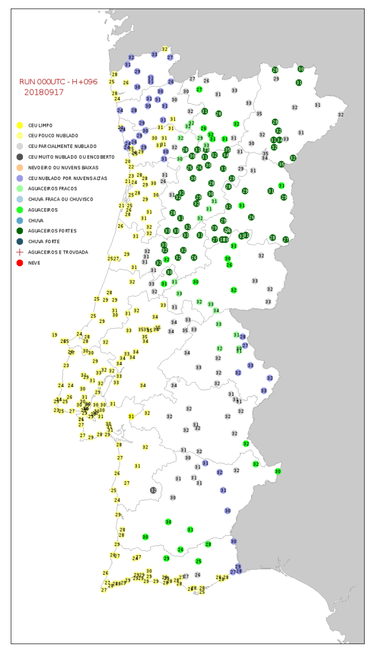


Since 2014, on-demand meteograms for AROME-PT2 are available for Civil Protection by a phone call request; during 2018 a new system based on a Web Map Service (see panel on the left) with model data has been set in pre-operations. Through this platform interactive metrograms for AROME over the 3 domains can be obtained. For 2019 both solutions will exist under a redundant way.

The latest version of the Automatic Forecasts Algorithm (see illustration on the right side panel) has been implemented during 2018. It uses Model Output Statistics (MOS, 40 days) and KALMAN filter (30 days) techniques applyed to AROME and ECMWF HRES forecasts to build the best guess to the meteorological station forecasts. 2-metre temperature and 1º-meter wind are automatic post-processed; 2-meter relative humidity is corrected using the temperature. The final forecast is the average of all available statistical post-processed values.



4 Data Assimilation activities

The new local DA system was implemented in AROME-PT2 and has been built as extensions of the actual local operational SMS/Xcdp scripting environment. On the local Data Assimilation system the CY38T1 has been used. Collaboration with RC-LACE [1] countries and AEMET was a key issue in these achievements. Further developments and validation is on-going. Foreesen steps will include the implementation of a full CANARI/OI_MAIN + 3D-Var assimilation scheme, taking advantage of recent develpments on upper-air pre-processing achievements [2,3] and on the ALADIN Core Programme for the establishement of a Data Assimilation basic KIT.

OI_MAIN Surface DA (Giard & Bazile, 2000) + OI hourly analysis (Taillefeur, 2000)

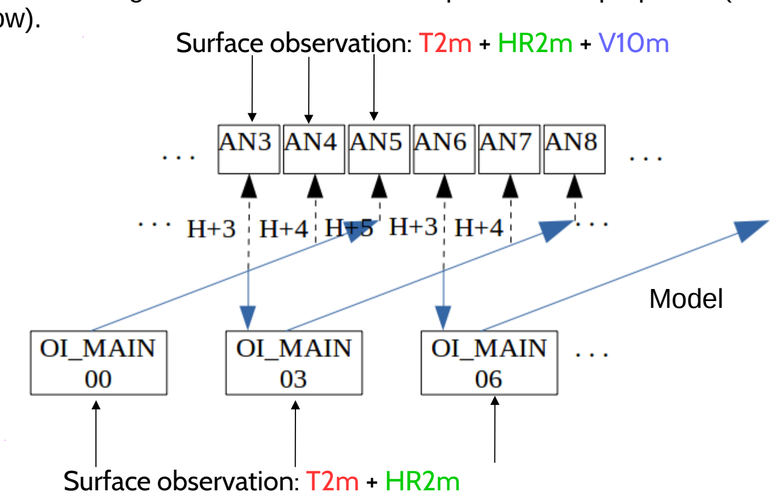
Along 2017, the local surface DA cycling suffered two important upgrades giving rise to a positive impact on the screen level parameters forecasts (see right side top panel): decrease of the cycling period, from 6- to 3-hour; 6-hour change of SST. The added value of OI_MAIN join with the cheap computational coast made its forecasts ideal as background to a standalone CANARI (OI) hourly analysis of screen level parameters which was validated with added value over the locally available products (see right side bottom panel)i. Therefore, the new analyses are being used for agricultural as well as fire prevenction purposes (see full scheme on the panel below).

> AROME-PT2 (CY38T1, 46Lev.)

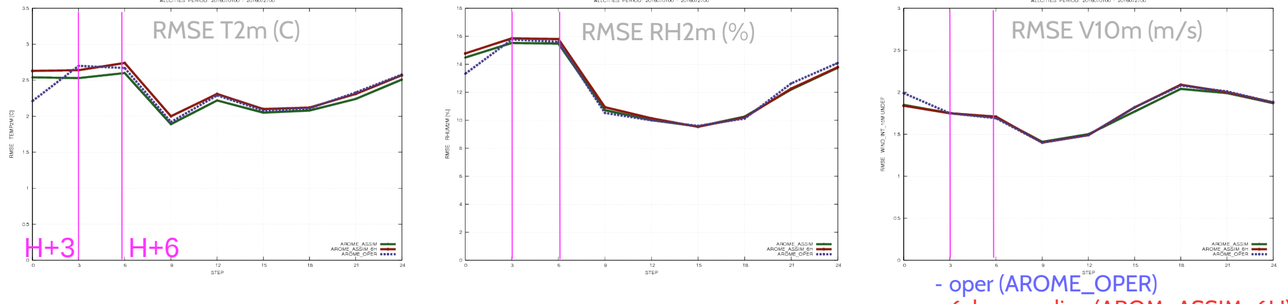
> 1-hour regional sharing WMO BUFR SYNOP

> home-made pre-processing (emoslib, ECMWF):
. retards & ammends,
. duplicates,
. choose WMO IDs overlaps between Portugal and Spain (922, 912, 927, 960 at least)
. Rem. obs records with ambiguos metadata.

> SST update each 6-hour cycle



24-hour forecast OI_MAIN validation for a Summer period: 20160701 – 20160727 (00UTC *network*)



Hourly CANARI-AROME validation (00UTC *network*): Summer (20170801 – 20170815) Winter (20170110 - 20170207)

Table - RMSE and BIAS of screen level parameters analysis over Mainland for Portugal CAN-ARO and CAN-ALA *vs*. ARO-OP initial fields

	T2M		H2M		V10M	
EXP	RMSE (C)	BIAS (C)	RMSE (%)	BIAS (%)	RMSE (m/s)	BIAS (m/s)
CAN-ARO(Summer)	1.52	0.18	8.86	-0.70	1.37	0.18
CAN-ARO(Winter)	1.63	-0.01	8.58	-1.36	1.35	0.03
CAN-ALA(Summer)	1.78	0.43	10.95	-0.76	2.18	0.92
CAN-ALA(Winter)	1.85	-0.09	10.66	-0.72	2.25	0.82
ARO-OP (Summer)	2.07	0.90	11.79	-4.69	2.50	1.63
ARO-OP (Winter)	2.06	0.27	12.69	-5.26	2.16	1.24

Conclusions: CAN-ARO is closer to observations than any other local product at 00UTC and 12UTC; daily analysis monitoring shows the results are consistent at any hour of the day.

[1] Giard, D., & Bazile, E. (2000): Implementation of a new assimilation scheme for soil and surface variables in a global NWP model. Monthly Weath Review, 128, 997-1015; **[2] Taillefer, F. (2002),** CANARI (based on ARPEGE cycle CY25T1 for ALADIN),GMAP/CNRM Technical Documentation, Mét France, Toulouse, France; **[3]Assunção, S., Monteiro, M., Salgado, R. (2017)**, Impact of the Introduction of Alqueva Dam in the AROME Forecasting Model, Proceedings 10th Simpósio de Meteorologia e Geofísica Proceedings 10º Simpósio de Meteorologia e Geofísica.
[4] Monteiro, M. (2016): Validation of a back-phased version of source code BATOR ,http://www.rclace.eu/?page=11
[5] Monteiro, M. (2017): Upgrade of the source code BATOR to WMO AMDAR template 311010v7,http://www.rclace.eu/?page=11
[6] Monteiro, M. (2018): CPDA1.3 - implementation and validation of BATOR: SHIP&BUOY

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