

1 Summary

During 2020-2021 no changes occurred on the local operational NWP systems (see Section 2): a local version of AROME is run over three different geographical domains (AROME-PT2, AROME-MAD and AROME-AZO) by dynamical adaptation of the global model ARPEGE, to provide 48-hour forecasts. Besides, a hourly high-resolution (2,5km) Optimal Interpolation (OI) analysis of screen-level parameters – CANARI (Taillefer, 2002) – having as background a short-term forecast from AROME-PT2, initialized by a surface Data Assimilation (DA) cycling (Giard and Bazile, 2000), is being kept unchanged in operations. A new HPC structure is being planned for 2022 and, in the meantime, the new developments which involve porting to a more recent cycle and the development of a DA solution to initialise the local models, are on-going at ECMWF HPC platforms. Two Canonical System Configurations are being tested and tuned in parallel, AROME (Section 3) and HARMONIE-AROME (Section 4), as described: i) the local AROME version initialised by the three configurations of dynamical adaptation (PT2, MAD and AZO domains, 2.5km, L60), AROME surface DA assimilation (PT2, MAD domains, 2.5km, L60) and AROME combined (OI_MAIN+3D-Var) DA (PT2, MAD domains, 2.5km, L60); and ii) HARMONIE-AROME-Iberia (cy40h1.1 with 65 vertical levels and a 2.5 km grid. Lateral boundary conditions are obtained from ECMWF operational boundary condition forecasts with 0-hour for cycles 00, 06, 12 and 18 UTC and 3-hour lag for cycles 03, 09, 15 and 21 UTC). Further local team efforts have been put to support other research projects, internal requests (post-processing) and also ALADIN/SRNWP activities.

2 The Portuguese NWP system versions (vanda.costa@ipma.pt, manuel.lopes@ipma.pt, maria.monteiro@ipma.pt, nuno.lopes@ipma.pt)

The actual Portuguese (SR)NWP system covers a wide geographical area over the North Atlantic region which includes the Iberian Peninsula and Adjacent Atlantic, and the Portuguese Archipelagos of Madeira and Azores (Figure 1). This system is described here according to its local application: for prognostic purposes - the integration of the AROME forecasting model, performed over the three different domains of Mainland (PT2), Madeira (MAD) and Azores (AZO), which take ARPEGE fields as initial and lateral boundary conditions; and, for diagnostic purposes - the hourly CANARI analysis for PT2 domain, having as first guess a short-term AROME forecast produced by a surface assimilation system. The system is based on a set of ecFlow scripts submitted from a front-end cluster to an HPC IBM platform (see Table 1).

Table 1 - Details on the Portuguese (SR)NWP system configurations.

	OPER	DEVELOPMENT
AROME (CY40T1_bf07_export)	Model physics	AROME (CY43T2_bf10_export)
2.5km	Horizontal resolution	2.5km
60	Vertical levels	60
ARPEGE (10km)	Coupling model	ARPEGE (10km)
no-DFI, no-DA	Initialisation method	no-DFI
CY38T1 (PT2, MAD), CY35T2 (AZO), CY40 (ARP LBC)	Climatologies	CY43T2 (PT2, MAD, AZO, ARP LBC)
3h	Coupling frequency	3h
00UTC, 06UTC, 12UTC, 18UTC	Integration hours	00UTC, 12UTC
48 hours	Forecast range	48 hours
PT2, MAD, AZO	Domains	PT2, MAD, AZO
local IBM p7+	Computing platform	ECMWF ecgate/ccs
CANARI (CY38T1)	Standalone surface analysis	
AROME (OI_MAIN, CY38T1)	Background	

Regionally shared WMO BUFR

SYNOP

Observations
Foreseen operational activities include: in the short-term, the validation of CY43T2, including the new climatologies from the same code version, for the MAD and AZO domains. In the medium-term, the acquisition of a new local HPC infrastructure; the implementation of a combined solution of surface + upper-air DA to initialise some of the model configurations; the westward extension of the geographical domain of PT2 in order to take advantage of the availability of satellite observations to enrich the assimilation schemes.

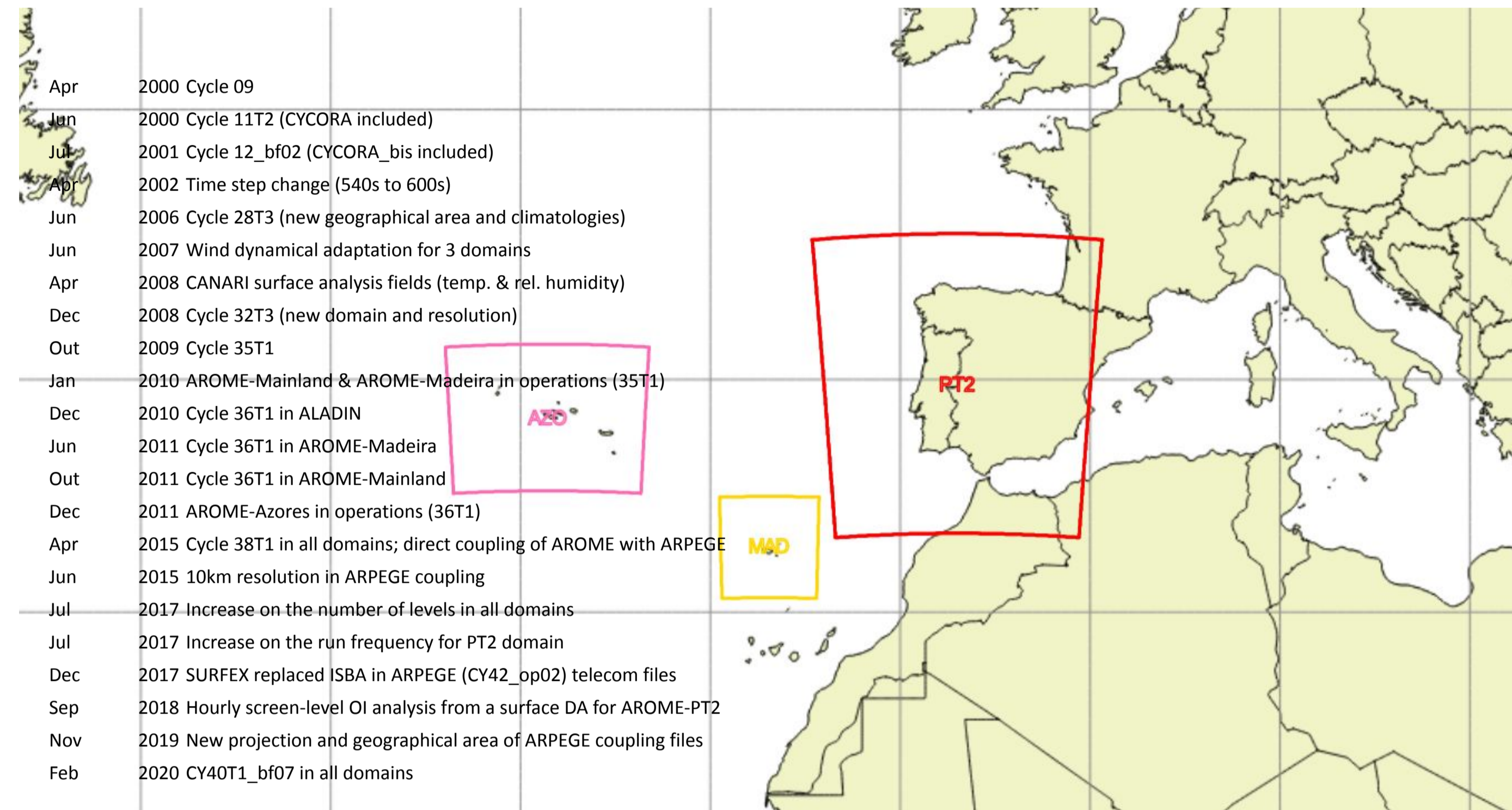


Figure 1 - Portuguese domains of AROME model and time line of main upgrades of local (SR)NWP system.

Framework of AROME (maria.monteiro@ipma.pt, joao.rio@ipma.pt, manuel.lopes@ipma.pt)

The local AROME developments have been migrated to ECMWF platforms due to the actual obsolescence of the local machine. Moreover, the actual numerical configurations have been ported to cycle CY43T2 and a combined solution of CANARI-OI_MAIN + 3D-Var DA is being tuned and validated for AROME/PT2 (using CY43T2 and ARPEGE as coupling model). In this section three different aspects of the on-going work are illustrated: Figure 2A. the validation of CY43T2_bf10 dynamical adaptation configuration porting, against surface observations for the 3 different domains. Basi scores for screen level parameters, shows a clear positive impact of the new cycle during Summer for the Iberian domain, while neutral impact for a Winter period. Although not so clear, the same kind of conclusions was obtained for Madeira domain. However, the same kind of conclusions were not obtained from Azores domain scores. Figure 2B. the preliminary validation diagnostics of CY43T2_bf10 combined DA cycling, where Iberian GTS BUFR SYNOP observations are assimilated along the Summer period.

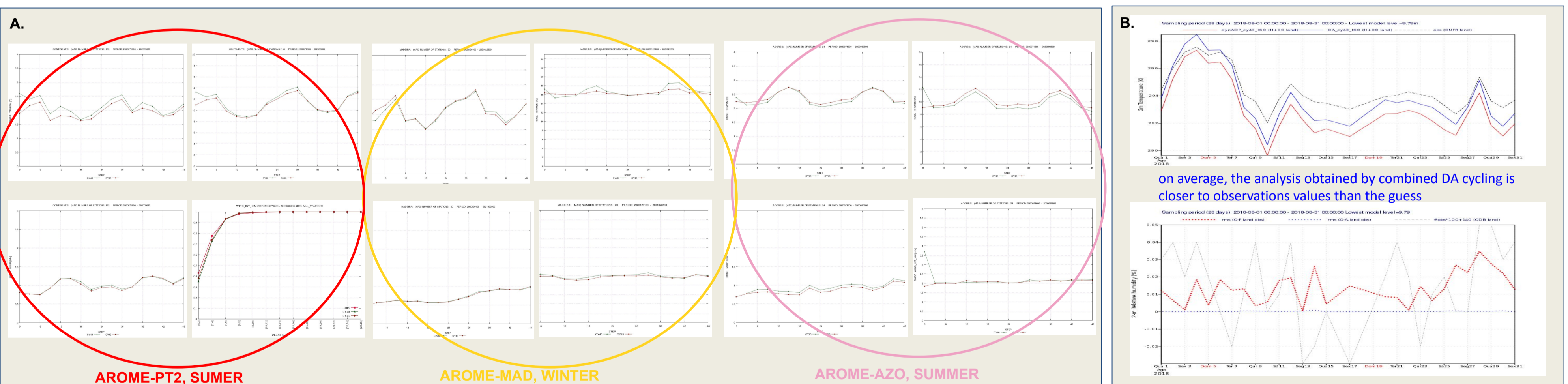


Figure 2 - Implementation diagnostics of CY43T2 on different AROME/PT2 configurations: A. dynamic; B. surface DA adaptation; C. combined DA.

Giard, J., & Bazile, E. (2000): Implementation of a new assimilation scheme for soil and surface variables in a global NWP model. Monthly Weather Review, 128, 997-1015; Taillefer, F. (2002), CANARI (based on ARPEGE cycle CY25T1 for ALADIN), GMAP/CNRM Technical Documentation, MétéoFrance.

Framework of HARMONIE-AROME (isabel.monteiro@ipma.pt, vanda.costa@ipma.pt)

HARMONIE-AROME activities started in 2018 have been twofold: targeting delivering daily short range weather forecasts for mainland Portugal and research in support to operations focusing on the optimal use of observations from satellite instruments. A real time HARMONIE-AROME suite (Figure 3) has been running since August 2020 at ECMWF/HPC infrastructure for a domain over the Iberia Peninsula (Figure 4).

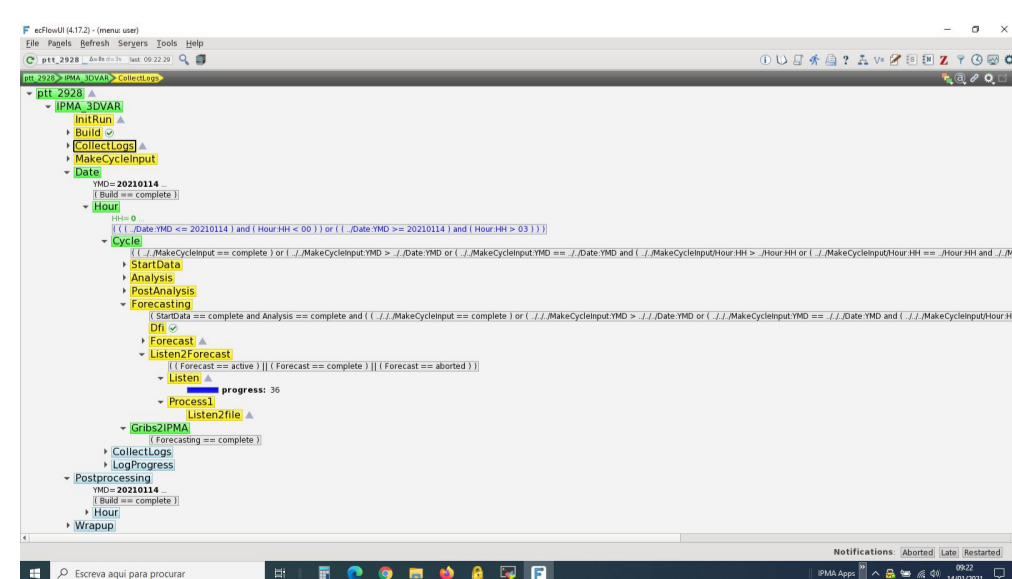


Figure 3 - Real time HARMONIE-AROME suite at ECMWF/HPC that produces forecasts locally displayed at IPMA.

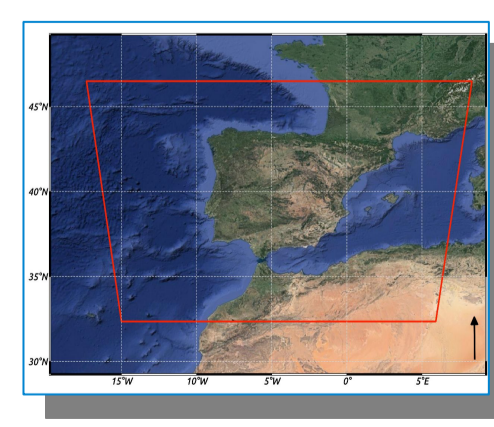


Figure 4 - IBERIAxxm_2.5 domain with 648x800 grid points, covering a 1620km x 2000km area.

It uses model cycle version cy40h1.1 with 65 vertical levels and a 2.5 km grid. Lateral boundary conditions are obtained from ECMWF operational boundary condition forecasts with 0-hour for cycles 00, 06, 12 and 18 UTC and 3-hour lag for cycles 03, 09, 15 and 21 UTC. It operates a 3D-VAR data assimilation system with a 3-hour cycling. Observations used include surface and upper air conventional observations as well as non-conventional observations from Metop polar-orbiting satellites. Conventional observations used in data assimilation are obtained from surface stations over land (SYNOP) and sea (SHIP, DRIBU); radiosondes (TEMP) and aircrafts (AMDAR and AIREP). Non-conventional observations include scatterometer winds obtained from ASCAT on the 3 METOP satellites - ASCAT-A, ASCAT-B, and ASCAT-C (Table 2). Throughout 2021, testing will be carried out on a suite based on cycle 43h2.1, focusing on tuning 3D-Var configuration and on model verification.

Table 2 - Observation types and assimilated parameters

Source	Observation type	Parameter
Conventional	SYNOP	Z
Conventional	SHIP	U10, Z
Conventional	DRIBU	U10, Z
Conventional	AMDAR	U, T
Conventional	TEMP	U, T, Q
Non-conventional	ASCAT	10U

Developments foreseen will provide the inclusion of microwave, AMSU-A, MHS, MWHS-2, radiances in HARMONIE-AROME DA system; and further developments on the use of scatterometer winds. Research activities have been devoted to the optimal use of observations in the context of HARMONIE-AROME 4D-VAR project and on the use of ocean winds from scatterometers in the model and are performed in the framework of EUMETSAT funded project MIDAS. (Poster Session: MONTEIRO Isabel, COSTA Vanda and SILVA Fabiola: Scatterometer winds assimilation in HARMONIE-AROME for a domain over the Iberian Peninsula).