

Summary

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During 2020-2021 a few changes occurred on the local operational (SR)NWP systems (see Section 2): the ALADIN-HIRLAM code version CY40T1_bf07 has entered into operations for all the geographical domains and the local ecFlow scripting system was upgraded accordingly. Although these changes, the 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), was kept unchanged in operations. Experiments for further progress are running now at ECMWF computing platforms since the local operational IBM p7+ was considered obsolete to cope with more recent ALADIN-HIRLAM cycle versions. The new developments encompass: i) validation of a T-version of the code at CY43 for the configurations (see Section 3): dynamical adaptation (the 3 Portuguese geographical domains); surface DA (OI_MAIN, over Iberian domain); and combined DA (OI_MAIN+ 3D-Var, over Iberian domain) of conventional plus weather radar observations; ii) validation of several configurations of HARMONIE-AROME at different cycles having an optimised assimilation of meteorological satellite observations. Further local team efforts have been devoted to support other research projects, internal requests (post-processing) and also ALADIN/SRNWP activities.

The Portuguese NWP system versions

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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/cca |
| CANARI (CY38T1) | Standalone surface analysis | |
| AROME (OI_MAIN, CY38T1) | Background | |

Regionally shared WMO BUFR

SYNOP

Foreseen operational activities include: in the short-term, the validation of CY43T2 and 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 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.

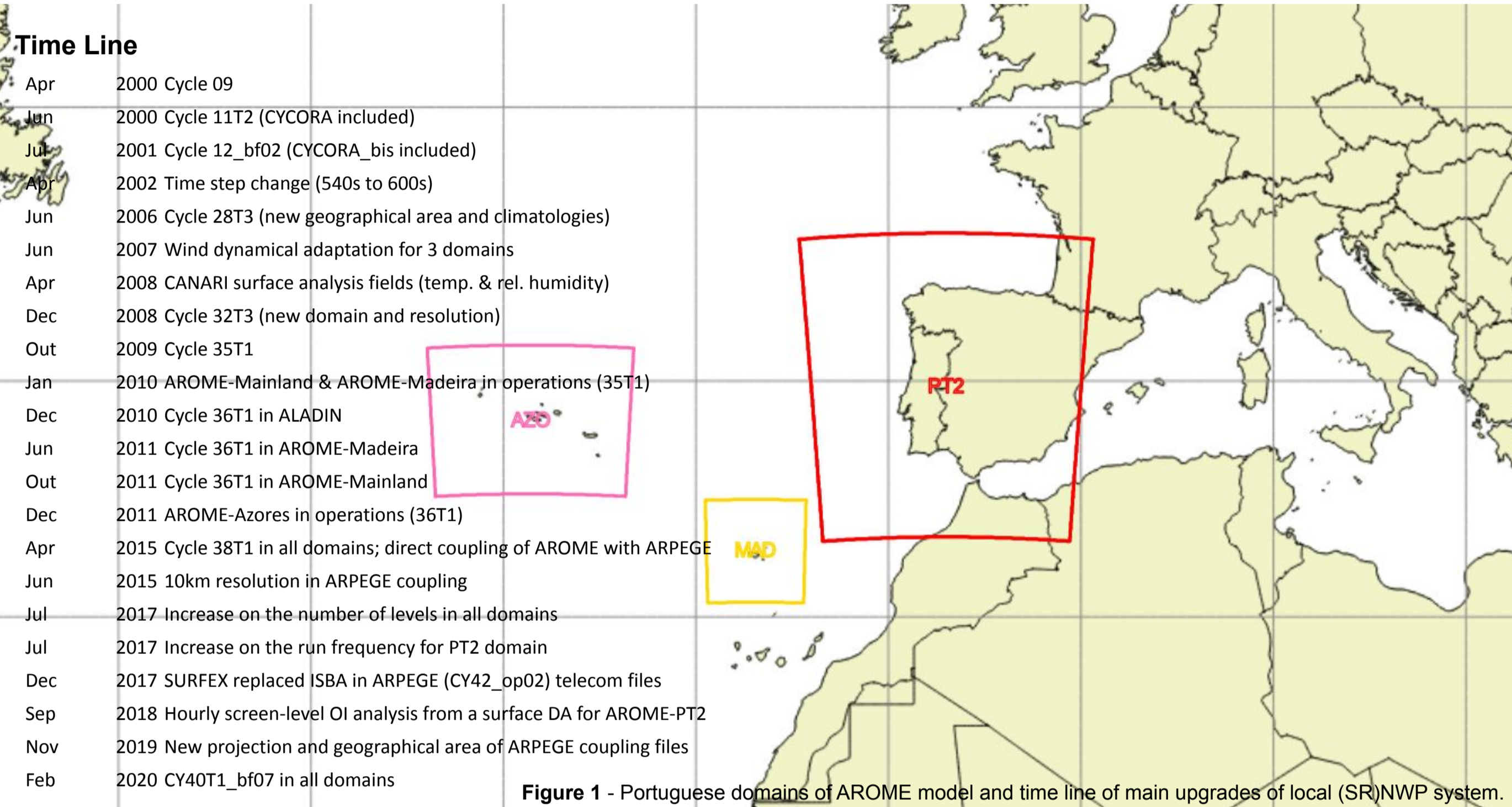


Figure 1 - Portuguese domains of AROME model and time line of main upgrades of local (SR)NWP system.

Data Assimilation activities

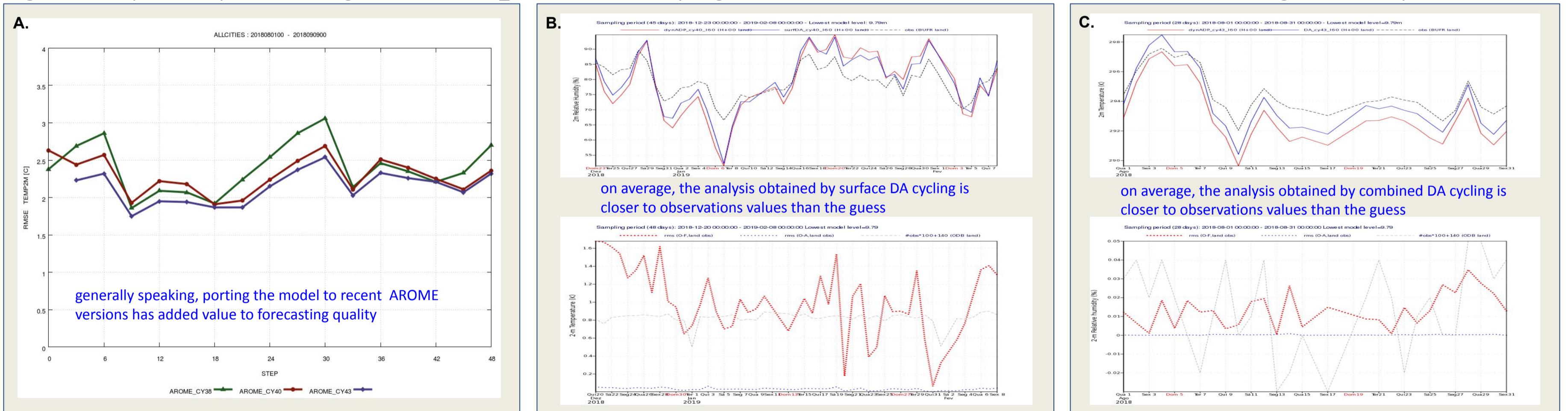
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Framework of AROME

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Towards a combined (CANARI-OI_MAIN + 3D-Var) DA solution for AROME/PT2 (CY43T2_bf10)

A combined solution of CANARI-OI_MAIN + 3D-Var DA is being tuned and validated on ECMWF computing platforms for AROME/PT2 (using CY43T2 and ARPEGE as coupling model). Two periods are under study: a Winter period, 10.Dec.2018-12.Feb.2019 and a Summer period, 22.Jun.2018-09.Sep.2018. This work has been performed under the framework of the DAsKIT programme (See presentation at the DA session). 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, in comparison with previous cycles; Figure 2B. the preliminary validation diagnostics of CY43T2_bf10 surface DA cycling, where Iberian GTS BUFR SYNOP observations are assimilated along the Winter period; Figure 2C. the preliminary validation diagnostics of CY43T2_bf10 combined DA cycling, where Iberian GTS SYNOP observations are assimilated along the Summer period.



Framework of HARMONIE-AROME

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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).

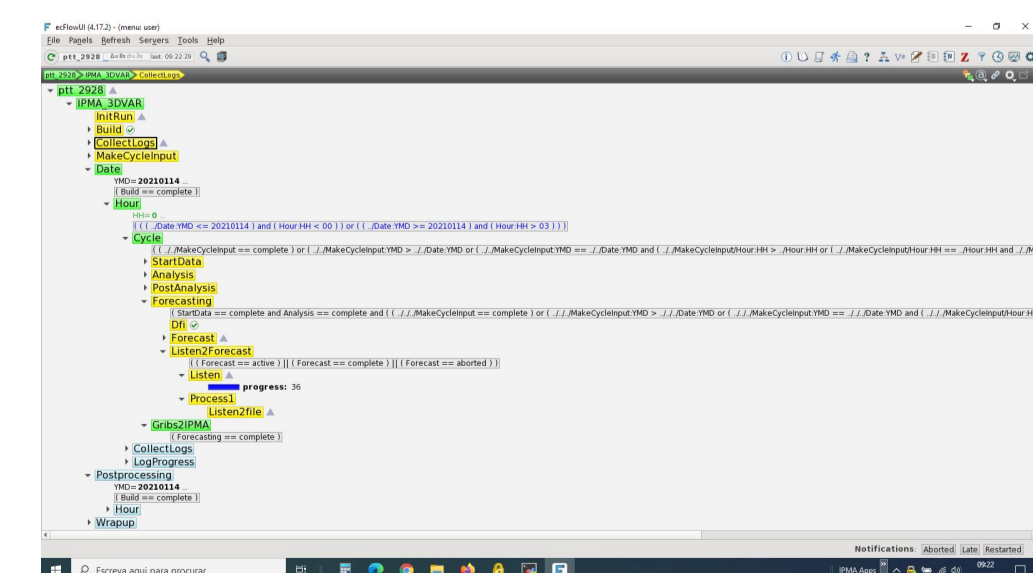


Figure 3 - Real time HARMONIE-AROME suite at ECMWF/HPC that produces forecasts locally displayed at IPMA.

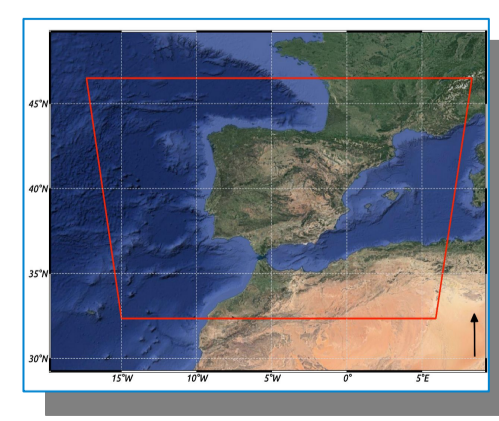


Figure 4 - IBERIAxxm_2.5 domain with 648x800 grid points, covering a 1620km x 2000km area.

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).