

## Summary

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During 2021-2022 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 30 or 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 in operations. The ITT to the acquisition of a new HPC structure and the re-design of the NWP system is being planned for 2022 (see Section 3). In the meantime, new developments (CY43) are expected to include a DA solution to initialise the local models, and these developments are taking place on ECMWF HPC platforms (cca). In particular, two Canonical System Configurations are being tested and tuned in parallel, AROME (Section 4) and HARMONIE-AROME (now shown), 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 and AZO domains, 2.5km, L60) and AROME combined (OI\_MAIN+3D-Var) DA (PT2, MAD domains, 2.5km, L60); and ii) HARMONIE-AROME-Iberia (cy43h2.1 with 65 vertical levels and a 2.5 km grid; lateral boundary conditions 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, not shown) . Further local team efforts have been put to support other research projects, internal requests (post-processing) and also ACCORD/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	2.5km
	60	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)
	Coupling frequency	3h
00UTC, 06UTC, 12UTC, 18UTC	Integration hours	00UTC, 12UTC
48, 30, 48, 30 hours	Forecast range	48 hours
PT2, MAD, AZO	Domains	PT2, MAD, AZO
local IBM p7+	Computing platform	ECMWF ecgace/cca
CANARI (CY38T1)	Standalone surface analysis	
AROME (OI_MAIN, CY38T1)	Background	
Regionally shared WMO BUFR SYNOP	Observations	

Foreseen operational activities encompass: in the short-term, i) the acquisition of a new local HPC infrastructure; and ii) the re-design of the actual operational SRNWP system. In particular, IPMA wishes to implement a combined DA solution of surface + upper-air to initialise some of the new model configurations; the south-westward extension of the geographical domain of PT2 in order to take advantage of the availability of satellite observations to enrich the assimilation schemes and cover Madeira region.

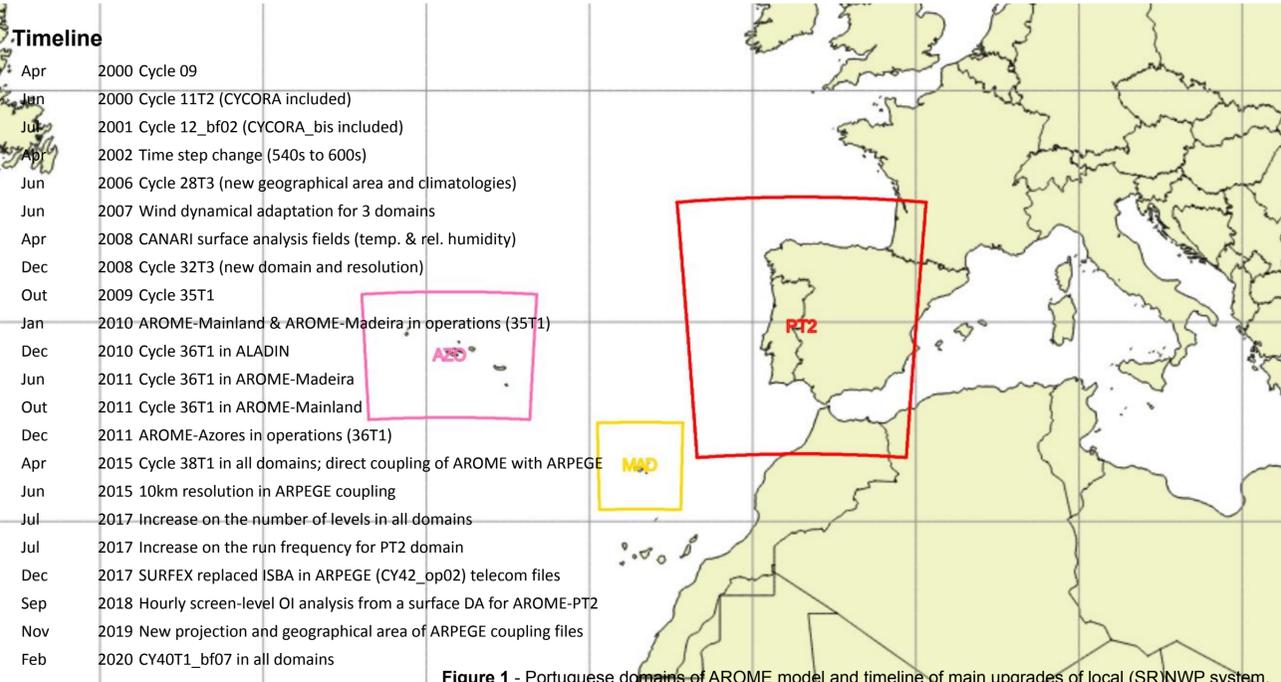


Figure 1 - Portuguese domains of AROME model and timeline of main upgrades of local (SR)NWP system.

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## Re-design of the Portuguese (SR)NWP system

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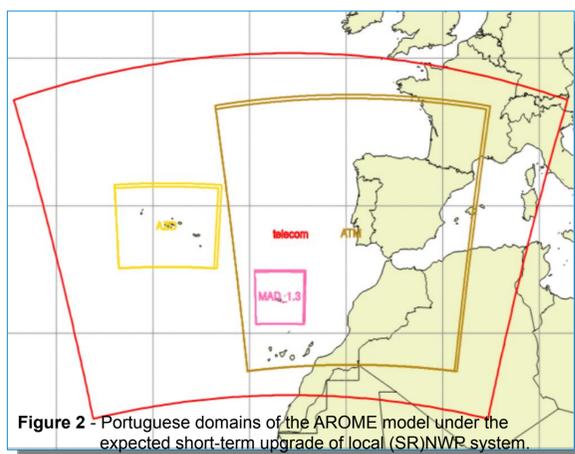


Figure 2 - Portuguese domains of the AROME model under the expected short-term upgrade of local (SR)NWP system.

The current operational Portuguese (SR) NWP system (Section 2) is expected to be fully upgraded in the short-term. This effort will encompass the following steps:

(i) the preparation of a benchmark with new geographical areas: the only domain which is expected to be unchanged is AZO; the domain of PT2 (over the Iberian Peninsula) is expected to be enlarged south-westward in order to take advantage of satellite observations over the Adjacent Atlantic region and to cover the Madeira Islands. This domain will be designated by ATM. The AROME model will be integrated over these two geographical areas with an horizontal resolution of 2.5km and vertical discretisation of 90 levels. In research/development mode, a domain over Madeira will be also considered, where the AROME model is expected to run with a 1.3km of horizontal resolution (90 vertical levels). The geographical area of the telecom files is expected to be kept unchanged.

(ii) an Invitation-To-Tender (ITT) , which is expected to be published this month.

(iii) the implementation of a DA scheme for the new ATM domain by a combined surface + upper-air algorithm, taking advantage of the experience legacy obtained under the framework provided by the former DASKIT programme (actual ACCORD ST8 WP; see Section 4).

## Data Assimilation activities

### Framework of AROME

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### Towards a combined (CANARI-OI\_MAIN + 3D-Var) DA solution for AROME in Portugal (CY43T2\_bf10)

A combined solution of CANARI-OI\_MAIN + 3D-Var DA is being tuned and validated on ECMWF computing platforms for AROME/PT2 and AROME/MAD (using CY43T2 and ARPEGE as coupling model), after initial diagnostics, which have shown that procedures were suitable for cycling. This work has been performed under the framework of the DASKIT programme. In this section, two different aspects of the on-going work are illustrated: Figure 3A., the preliminary validation of CY43T2\_bf10 forecasts for AROME/PT2 initialised by surface DA, against surface observations, in comparison to its dynamical adaptation configuration; Figure 3B., the preliminary validation of CY43T2\_bf10 forecasts for AROME/PT2 initialised by combined (surface+upper-air) DA, against surface observations in comparison to its dynamical adaptations configuration. In both systems, only regional GTS SYNOP data is assimilated (2-metre temperature and 2-metre relative humidity in both schemes).

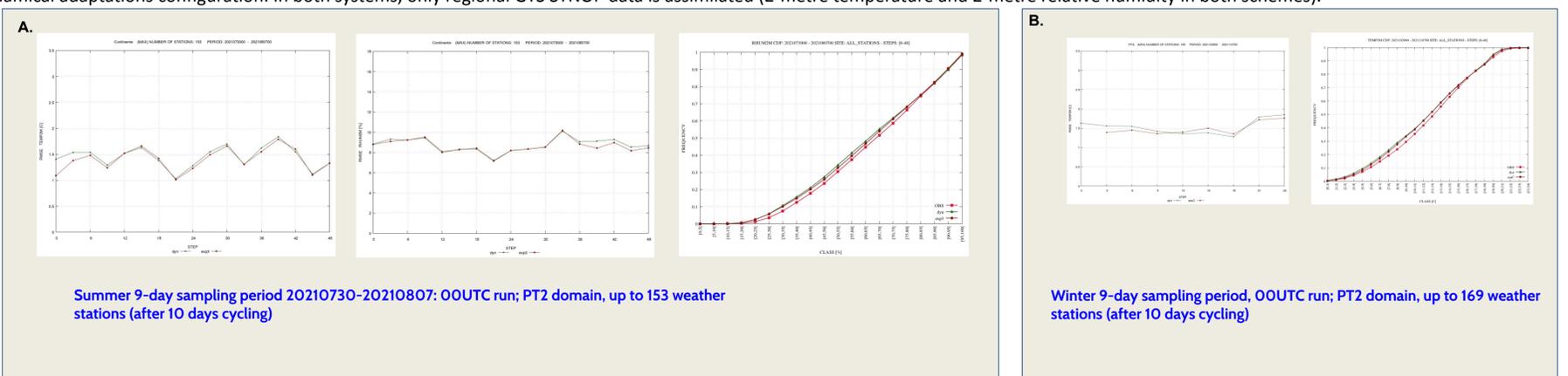


Figure 3 . RMSE and Cumulative Distribution Function (CDF) of screen-level parameters of AROME/PT2 forecasts when the model is initialised by different DA schemes: A. CANARI-OI\_MAIN; B. CANARI-OI\_MAIN + 3D-Var

Giard, D., & 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, Toulouse, France.