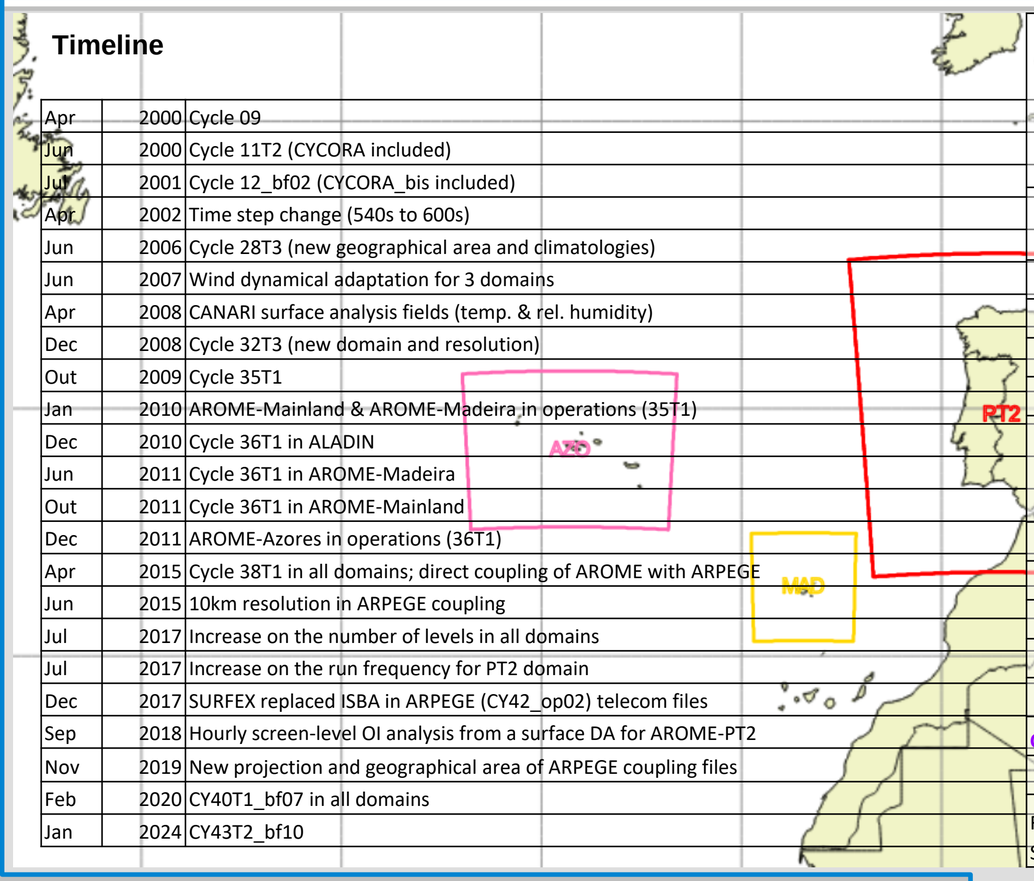
# NWP activities at IPMA

4th ACCORD All Staff Workshop, Norrköping, 15-19 April 2024

## Timeline

| | | |
|---|---|---|
| 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 |
| Dec | 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 |
| Nov | 2019 | New projection and geographical area of ARPEGE coupling files |
| Feb | 2020 | CY40T1_bf07 in all domains |
| Jan | 2024 | CY43T2_bf10 |




| | |
|---|---|
| AROME (CY40T1_bf07_export) | Model physics |
| 2.5km | Horizontal resolution |
| 60 | Vertical levels |
| ARPEGE (10km) | Coupling model |
| no-DFI, no-DA | Initialisation method |
| CY38T1 (PT2, MAD), CY35T2 (AZO), CY40 (ARP LBC) | Climatologies |
| 3h | Coupling frequency |
| 00UTC, 06UTC, 12UTC, 18UTC | Integration hours |
| 48, 30, 48, 30 hours | Forecast range |
| PT2, MAD, AZO | Domains |
| local IBM p7+ | Computing platform |
| CANARI (CY38T1) | Standalone surface analysis |
| AROME (OI_MAIN, CY38T1) | Background |
| Regionally shared WMO BUFR SYNOP | Observations |

## The Portuguese NWP system(s)

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The actual Portuguese (SR)NWP operational 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. The system is described according to its local application: a **prognostic** component - where the integration of the AROME forecasting model is performed over the three different geographical domains of Mainland (PT2), Madeira (MAD) and Azores (AZO) as the dynamical adaptation of the global model ARPEGE which, provides the initial and lateral boundary conditions; and, a **diagnostic** component - where an hourly CANARI analysis for the PT2 domain, having as first guess a short-term AROME forecast produced by a surface data assimilation (DA) system, is produced. The system is based on a set of ecFlow scripts submitted from a front-end cluster to an HPC IBM platform (see also left middle panel).

Geographical domains of AROME model (left background illustration); timeline of main upgrades (left side of the panel); and detailed information on the operational configurations of the Portuguese (SR)NWP system ( right side of the panel).

## Operational HPC system

ATOS Bull Sequana X400 series

Operational HPC system - ATOS HPC Bull Sequana X430 A5 with:

- 30 computing nodes, each with 2 AMD EPYC™7763 processors with 64 cores @ 2.45 GHz and 256 RAM, in a total of 3840 cores;
- 2 login nodes, each with 1 AMD EPYC™Milan 7313 processor with 16 cores @ 3.0GHz and 128 GB RAM;
- 2 management nodes, each with 1 AMD EPYC™processor with 24 cores @ 2.8GHz and 128 GB RAM ;
- Lustre file system;
- 160 TB raw Lustre storage.

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

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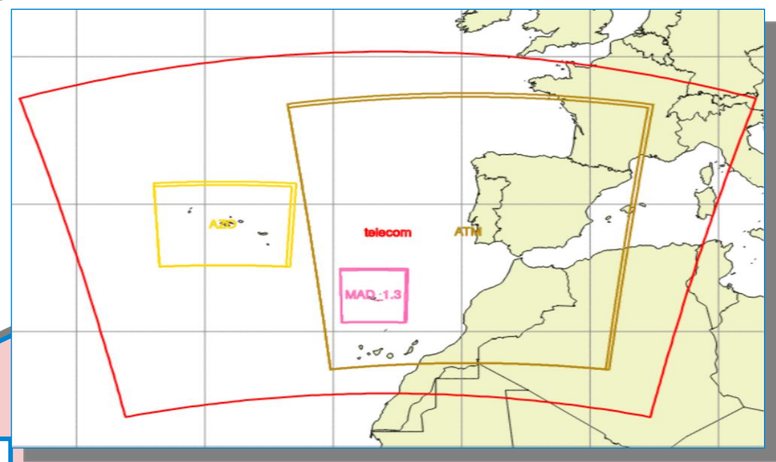
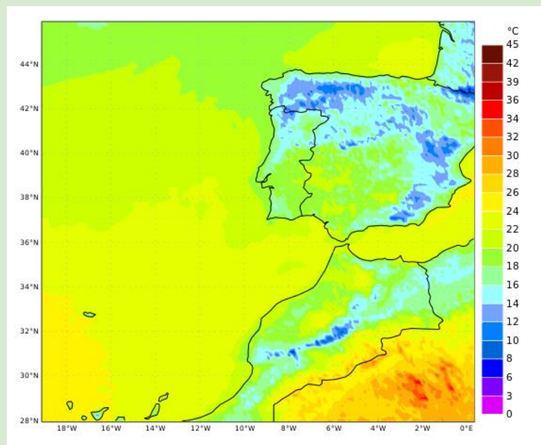
*Since 2023, the re-design of the NWP system is ongoing in a three-fold process: (1) migration (and porting to CY43T2_bf10) of the current operational system to the new HPC ATOS Bull Sequana (left panel) has finished and it is in pre-operational state; (2) the implementation of a new geographical configuration and model geometry on the Atlantic/Iberian domain (AROME ATM, 2.5km, 90L) (right panel) is finished, it will provide the initial and lateral boundary conditions to a higher resolution version of AROME-MAD (1.3km, 90L) over the Madeira archipelago (central panel below), expected for the end of the year; (3) implementation of a 3-hour cycling of the AROME combined (OI_MAIN+3D-Var) DA solution over ATM domain (central right panel).*




## New domain configuration for AROME 2.5km L90 in Portugal, under tests



First tests sucessfull

## Combined DA solution for AROME in Portugal

The combined solution of CANARI-OI_MAIN (Giard & Bazile, 2000) + 3D-Var DA tuned and validated on ECMWF computing platforms for AROME/PT2 (using CY43T2 and ARPEGE as coupling model) is in the process of migration for the local operational machine.

## Contribution to DE_330 (ECMWF) project

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## Impact models - Risk assessment of Wild Fires

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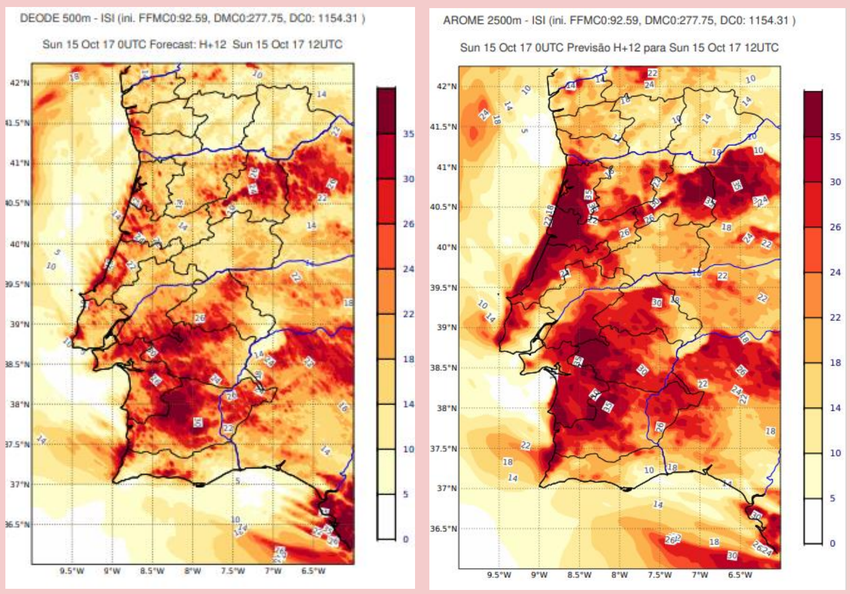
A risk assessment for a very severe case of forest fires over Portugal mainland, using Initial Spread Index, is shown. With limited resources for fire figthing, a better definition of the areas with higer risk can be key to a better answer from Civil Protection Authorities.




## DE - Prototype implementation

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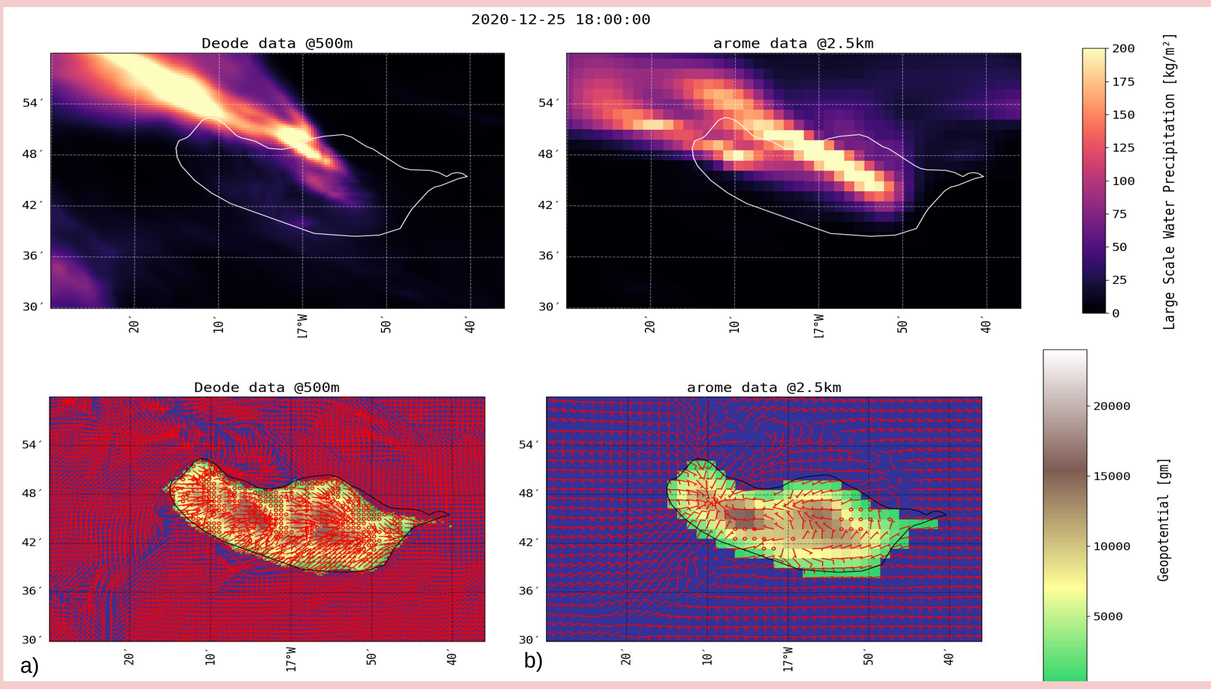
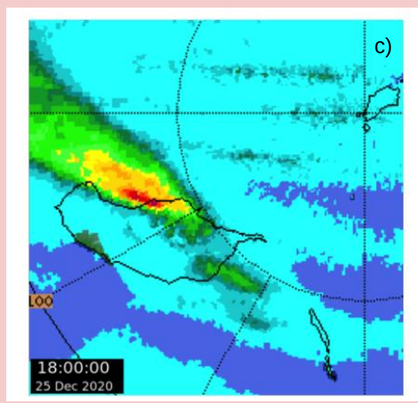
Three cases have been selected to demonstrate the implementation of the DE prototype workflow across Portuguese domains and to analyze the potential added value provided by hyper-resolution atmospheric simulation: (1) the wildfires in Mainland Portugal in October 2017; (2) the heavy and persistent precipitation in Madeira in December 2020; and (3) the wildfires in Mainland Portugal in August 2022. The case concerning Madeira is illustrated here. Conclusions suggest that the anchored flow, and consequently the precipitation patterns, are better represented in the DE prototype simulation compared to the local operational model, largely due to a more accurate depiction of orographic effects. However, results indicate also that precipitation amounts may be slightly underestimated in the DT model which is ongoing.

**Conducted experiments settings:** On-Demand DT prototype 0.4.0 run on ECMWF-ATOS (based on cy48t3), with AROME 500m/90L (1080x960), coupled to IFS HRES, no assimilation applied; **Reference:** pré-opoeracional AROME/MAD




(c) 18-hour accumulated precipitation observed by the radar of Porto Santo

(a) the effect on the 12-hour Eastern atmospheric flow wind, driven by localized orography and simulated by: DE (left panel) and AROME/MAD (right panel).
(b) the 18-hour accumulated precipitation, constrained by the quasi-static localized flow and simulated by: DE (left panel) and AROME/MAD (right panel).

**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.

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