HARMONIE-AROME nowcasting suite at AEMET

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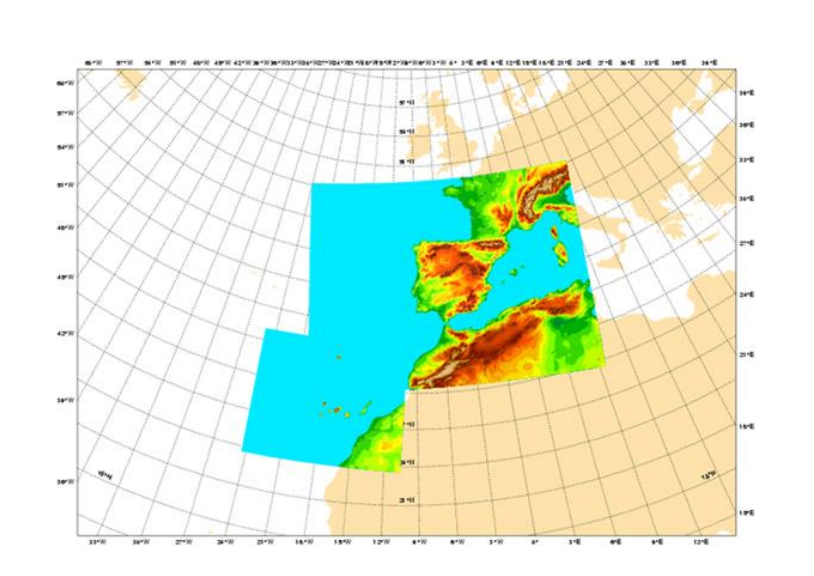
Outline

- Aemet operational suites.
- Main characteristic of Nowcasting suite.
- Objective verification and case study.
- Ongoing work.
- Summary and conclusions

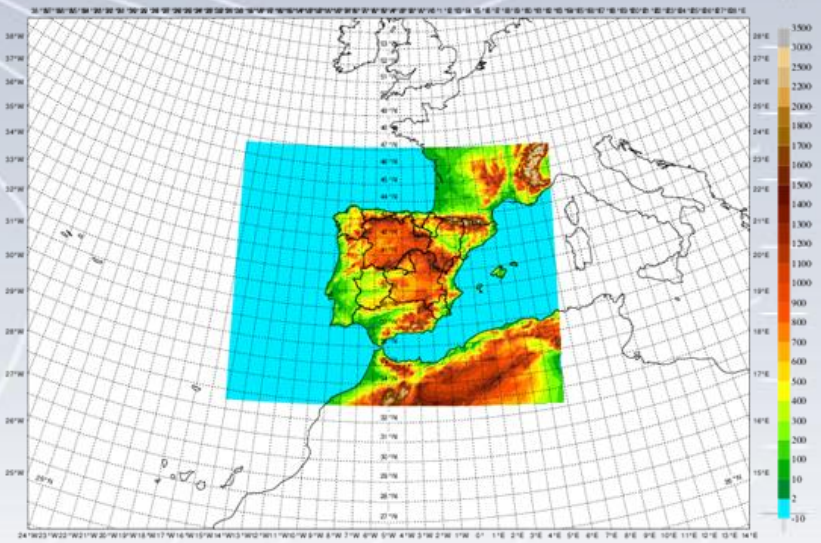
Operational suite. AIB

- Two domains that cover the Iberian Peninsula and the Balearic Islands and the Canary Islands.
- Harmonie-Arome cycle 43h2.1.1
- 3h cycle, with 72 hours of forecast length for 4 of the cycles.
- 2.5km of horizontal resolution & 65 levels in the vertical.
- SAPP has been operational like pre-processing software of observations since June of 2020.
- Assimilation approach.
  - Canari and 3D-VAR data assimilation:
    - Conventional observations: SYNOP (T2m& RH2m for 3D-VAR), SHIP, BOUY, E-AMDAR (q-sensor), RADIOSONDES.
    - Radar (reflectivity).
    - Satellite obs:
      - ATOVS (Metop-B, Metop-C, NOAA-18, NOAA-19)
      - IASI (Metop-B),
      - Scatterometers (Metop-B and Metop-C)
      - Global Navigation Satellite System (GNSS) Zenith Total Delay (ZTD) data
      - SEVIRI Water Vapour Channels. Operational since December 2022



Nowcasting suite. AIN

- One domain that covers the Iberian Peninsula and the Balearic Islands.
- Has been considered operational suite since the 20th of December of 2023.
- Harmonie-Arome cycle 43h2.1.1.
- 1.25km of horizontal resolution & 65 levels in the vertical.
- **1h** cycle, with **12 hours of forecast length** for all the cycles.
- Nested to the operational suite of Harmonie-Arome of 2.5km.
- Assimilation approach.
  - Canari and 3D-VAR data assimilation:
  - Cut-off time: **23 m**.
    - Conventional observations: SYNOP (T2m& RH2m for 3D-VAR), SHIP, BOUY, E-AMDAR (q-sensor), RADIOSONDES.
    - Radar (reflectivity).
    - MODE-S EHS.
    - Satellite obs:
      - Global Navigation Satellite System (GNSS) Zenith Total Delay (ZTD) data
      - SEVIRI Water Vapour Channels**.**



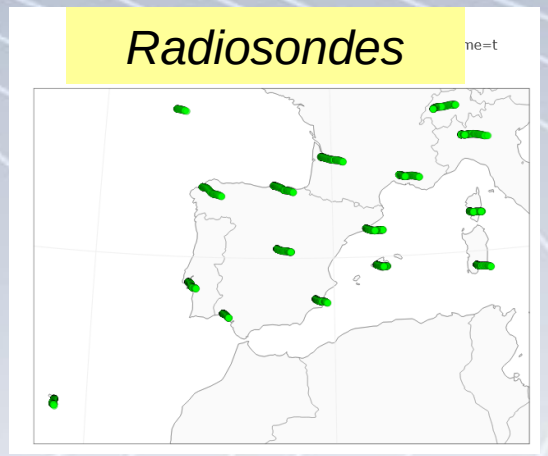
Nowcasting suite. Use of observations

- In spire of cut-off time has been reduced, the number of radiosondes is close to the operational
  - AIB cut-off: 70 minutes.
  - AIN cut-off. 23 minutes.

- The gnss observations have been pre-processed using with a fast procedure.
  - For the moment we are only using one processing centre.

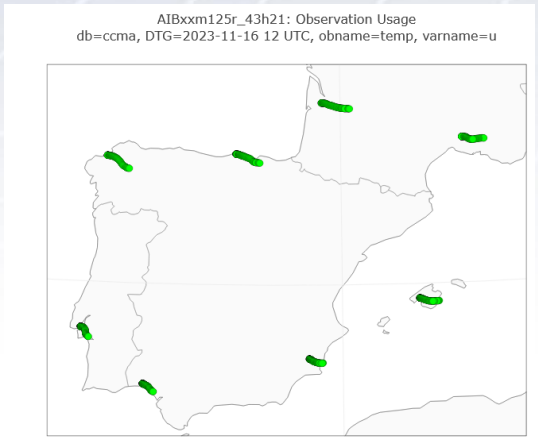
2.5 km ope

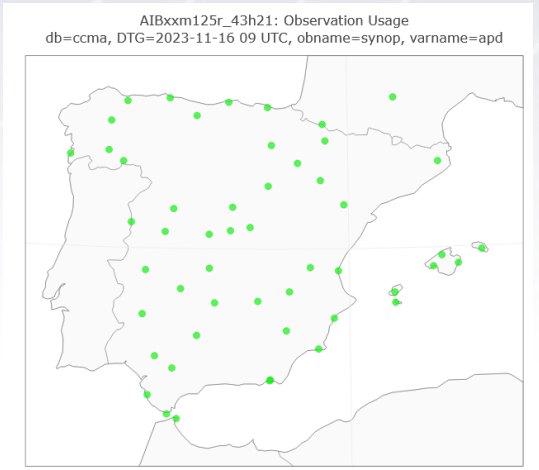
Radiosondes



gnss

1.25 km NWC





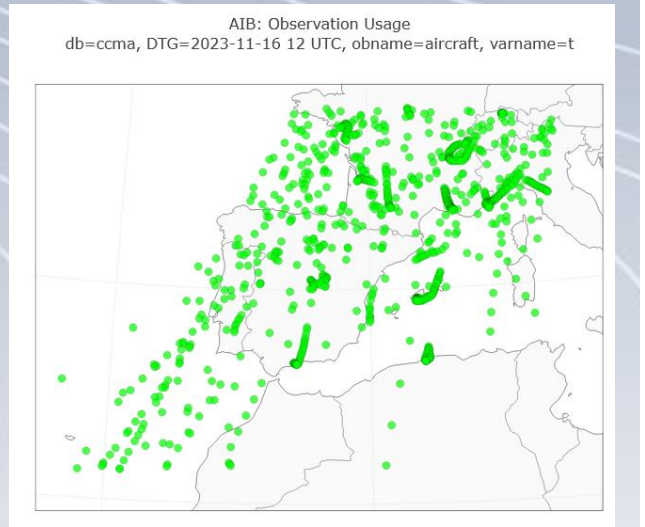
Nowcasting suite. Use of observations

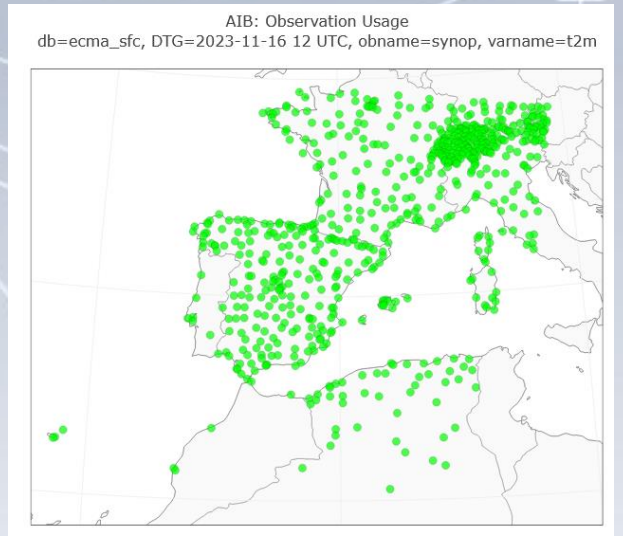
- Mode-S EHS observations (fast procedure v2.2) are assimilated in the nowcasting suite.
  - It is not ready yet for the AIB suite.
  - Mode-S data are provided by EMADDC.

AMDAR

SYNOP

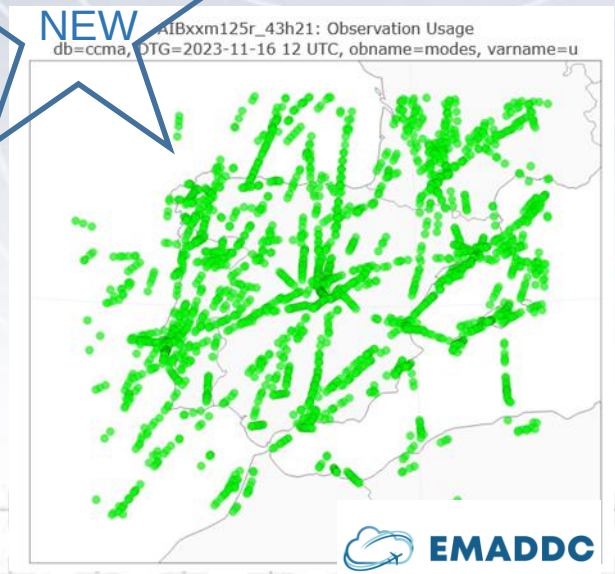
2.5 km ope

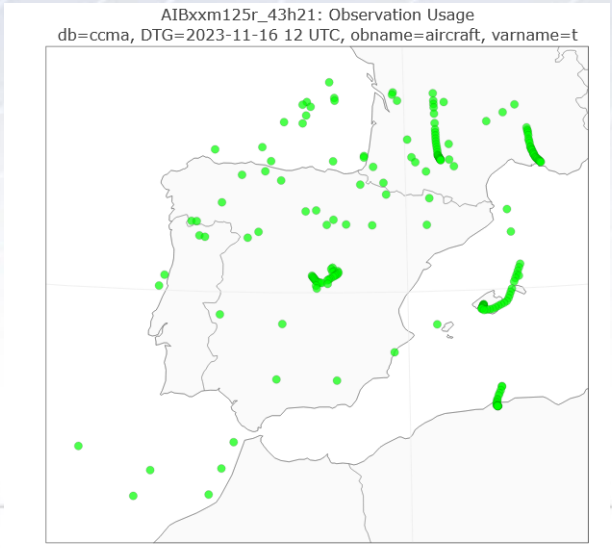


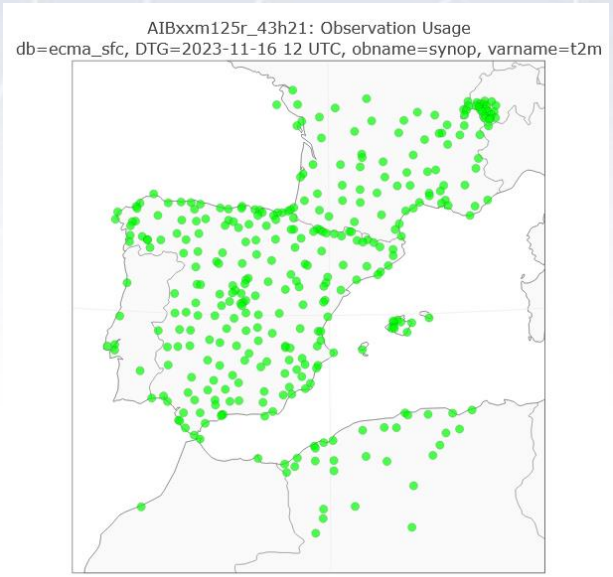


1.25 km NWC

NEW

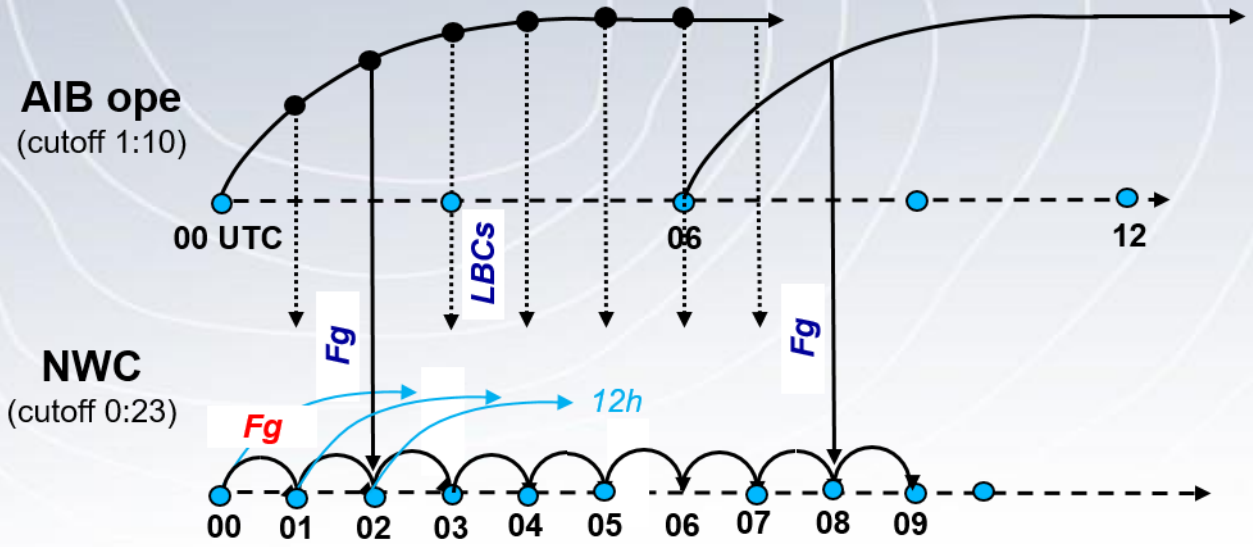






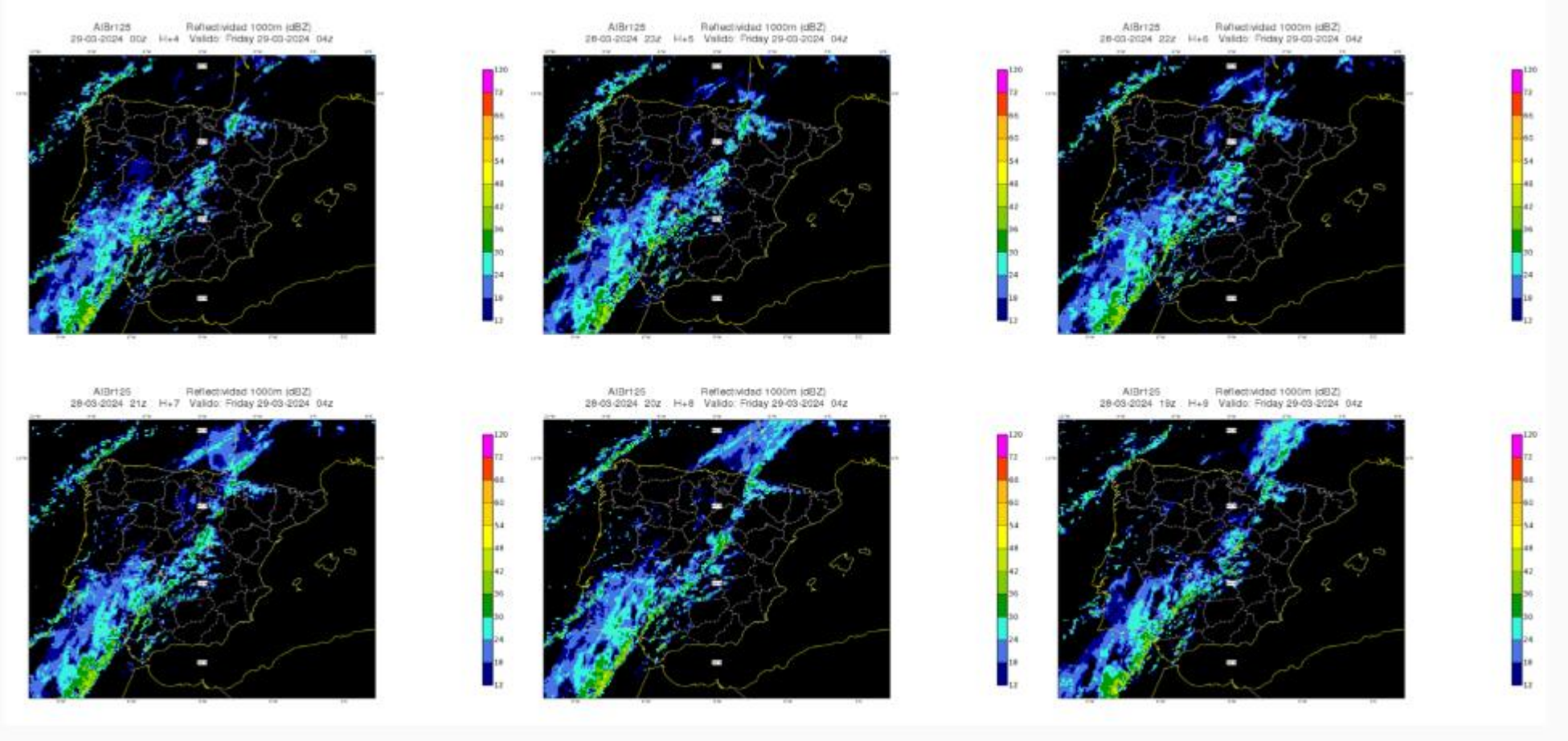
Nowcasting suite. Nesting

- The boundaries files come from the 2.5km suite of Harmonie-Arome.
- Surface Fg from own H+1.
- Upper air Fg from own cycling except at 02, 08, 14, 20 cycles.
  - Deterministic suite uses more types of obs



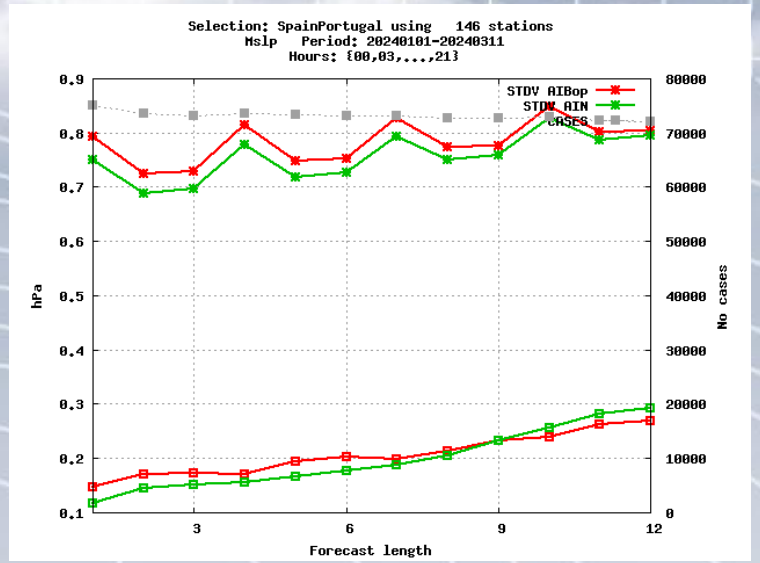
Nowcasting suite. Visualization.

- From contiguous cycles we van build a poor man ensemble

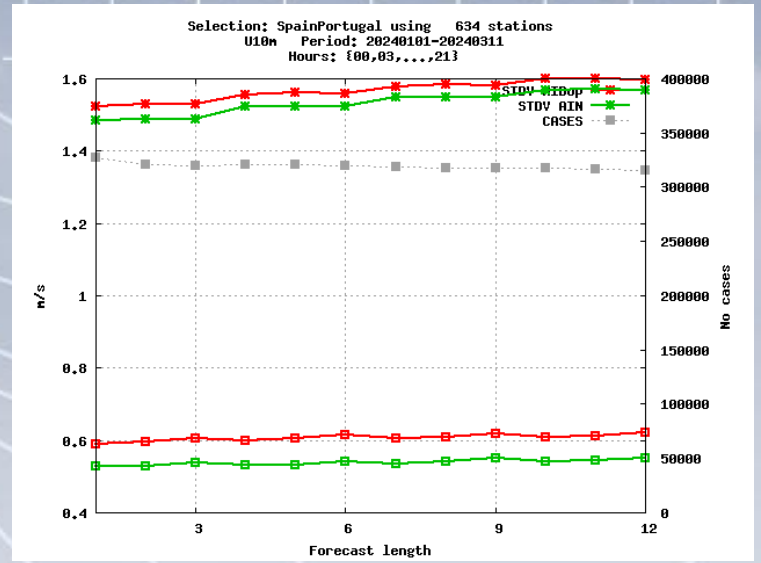


Objective Verification

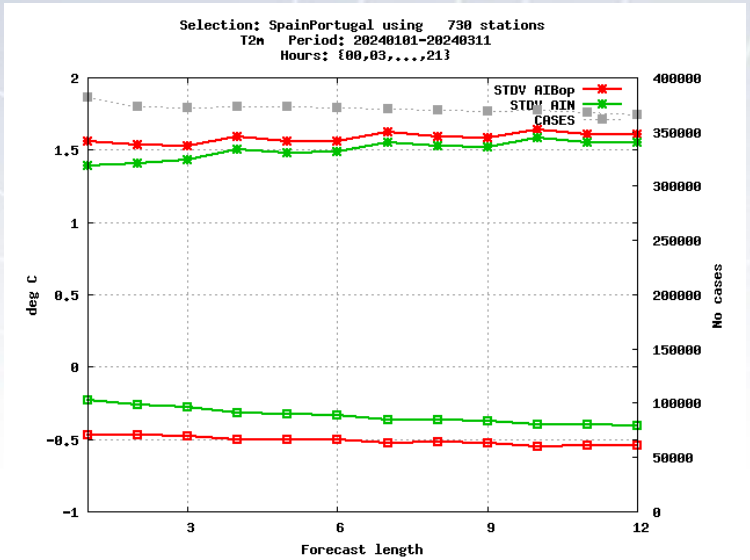
- The verifications had been done taking in account the availed times for both suites.
- There is not too much impact in upper air.
- Red 2.5km suite.
- Green Nowcasting suite.



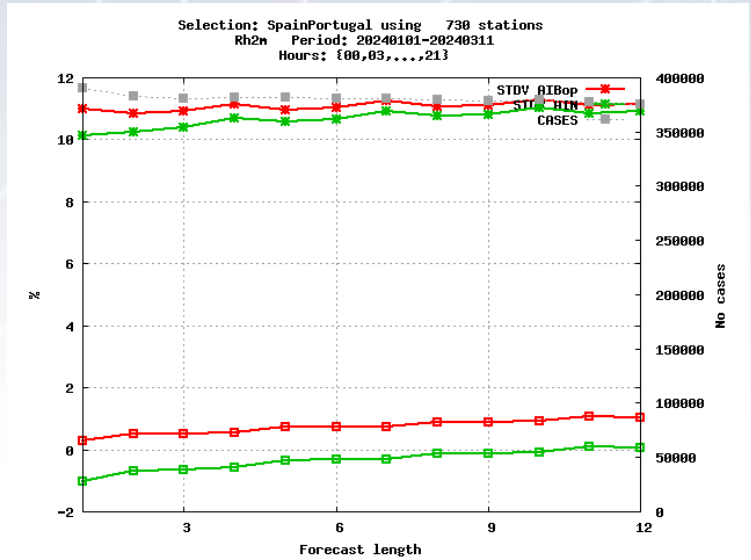
Mslp



U10m



T2m

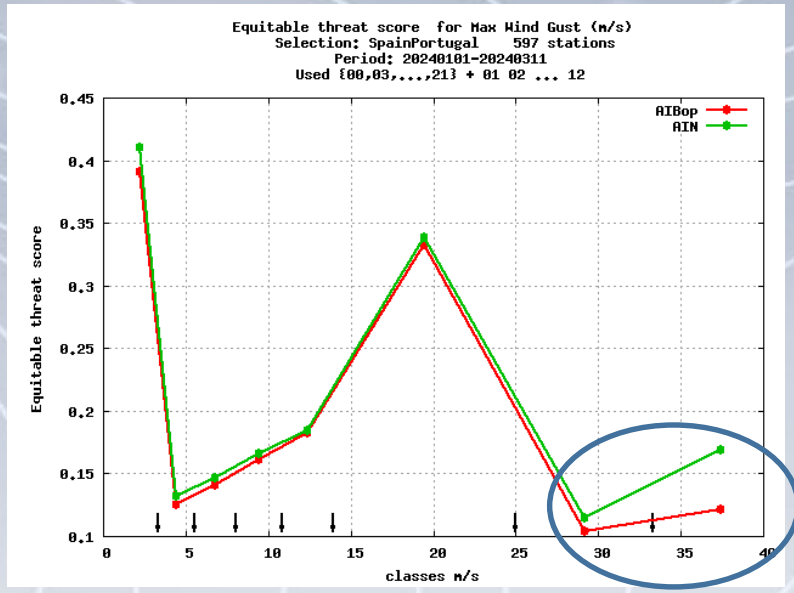


Rh2m

Objective Verification

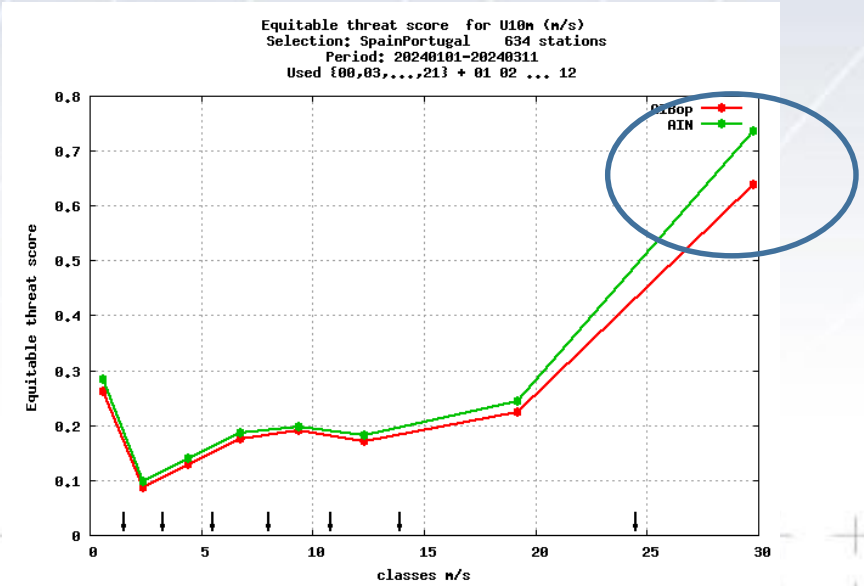
- Objective verification for wind.
- We also notice an improvement in Equitable Treat Score (ETS) for high ranges.

ETS Wind Gust



- Red 2.5km suite.
- Green Nowcasting suite.

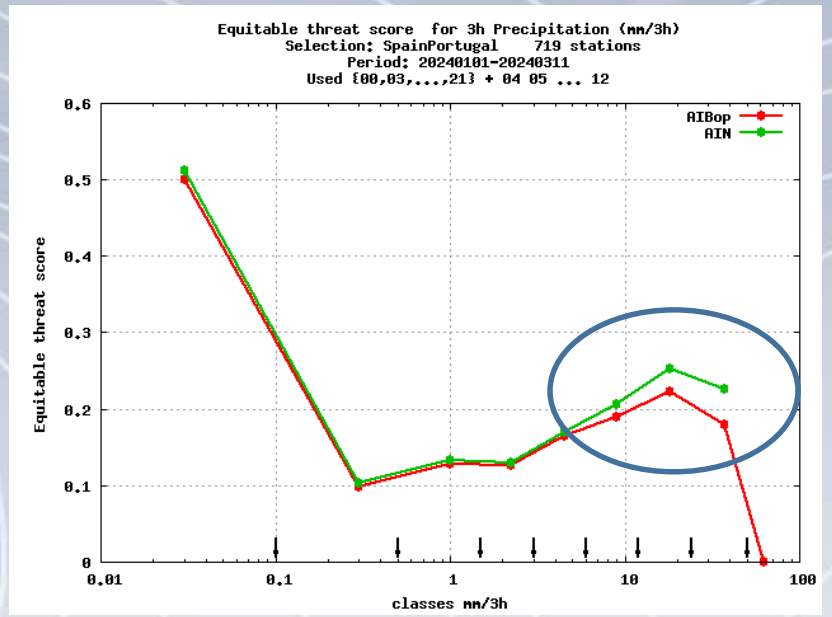
ETS 10 m Wind



Objective Verification

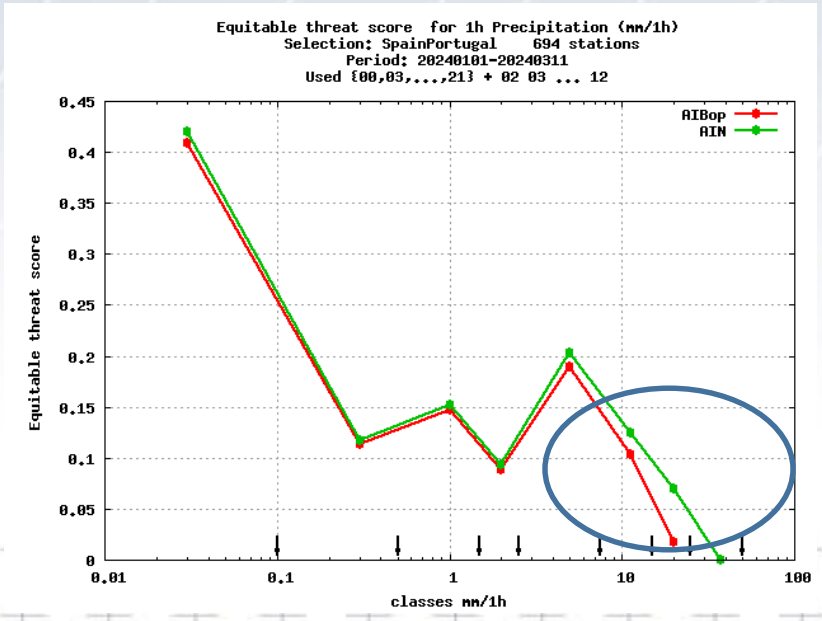
- Objective verification for precipitation.
- The Equitable Treat Score for precipitation shows better scores for the nowcasting suite.

ETS 3h prec



- Red 2.5km suite.
- Green Nowcasting suite.

ETS 1h prec



Objective Verification. Spin up issues.

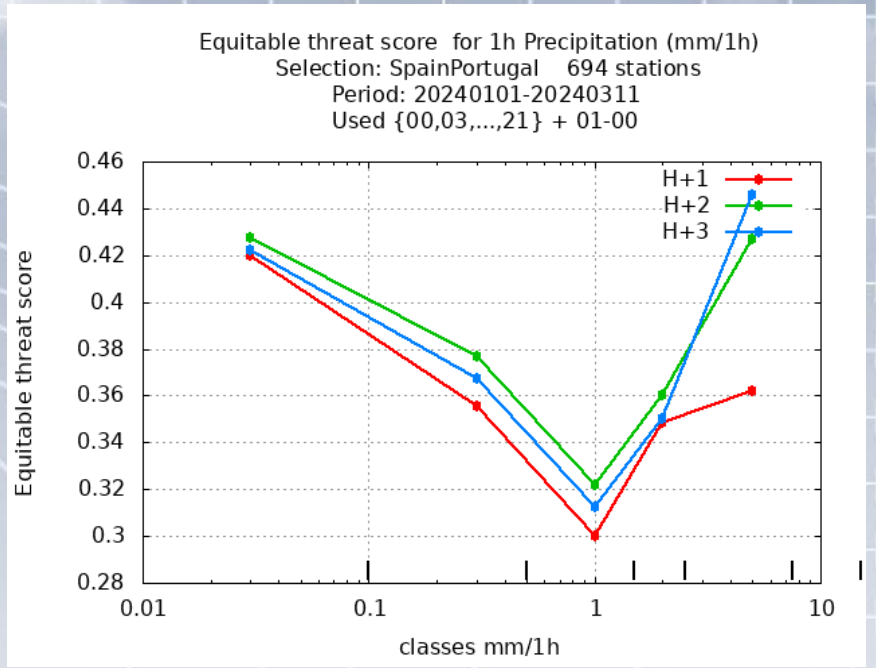
There is a spin-up problem.

The right can see the objective verification of 1h acc. precipitation.

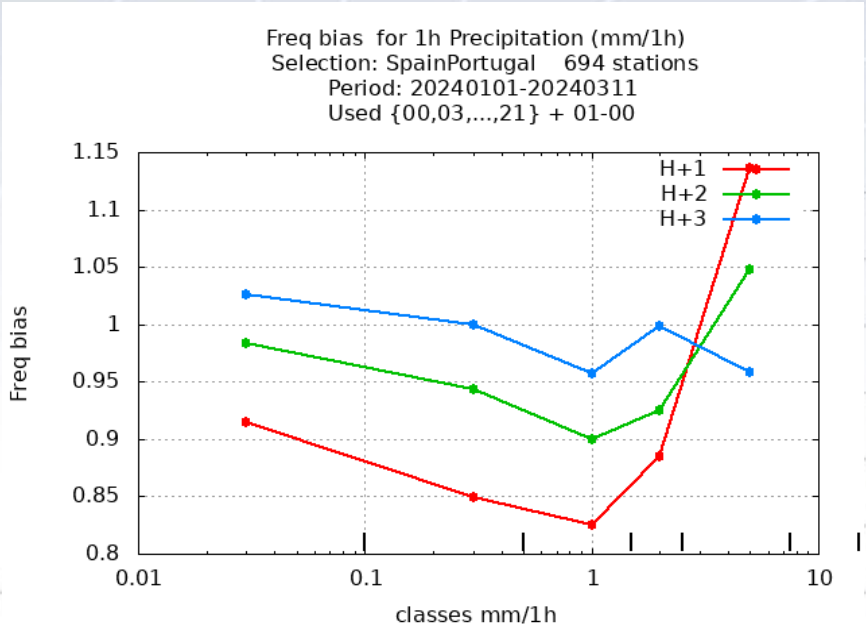
There is some spinup H+2 performs better than H+1 which underestimate.

- H+1.
- H+2.
- H+3

ETS 1h prec

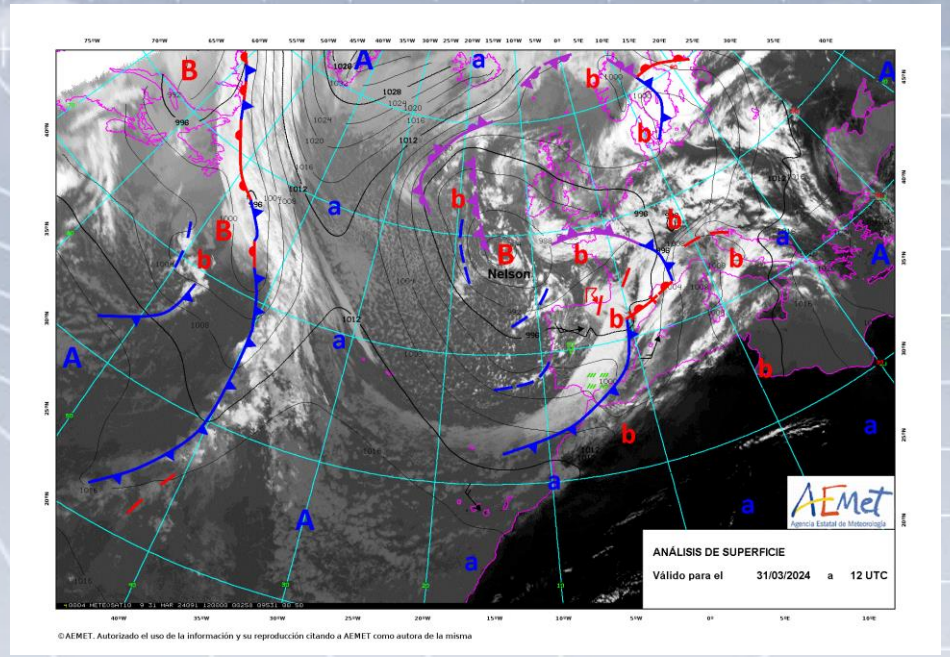


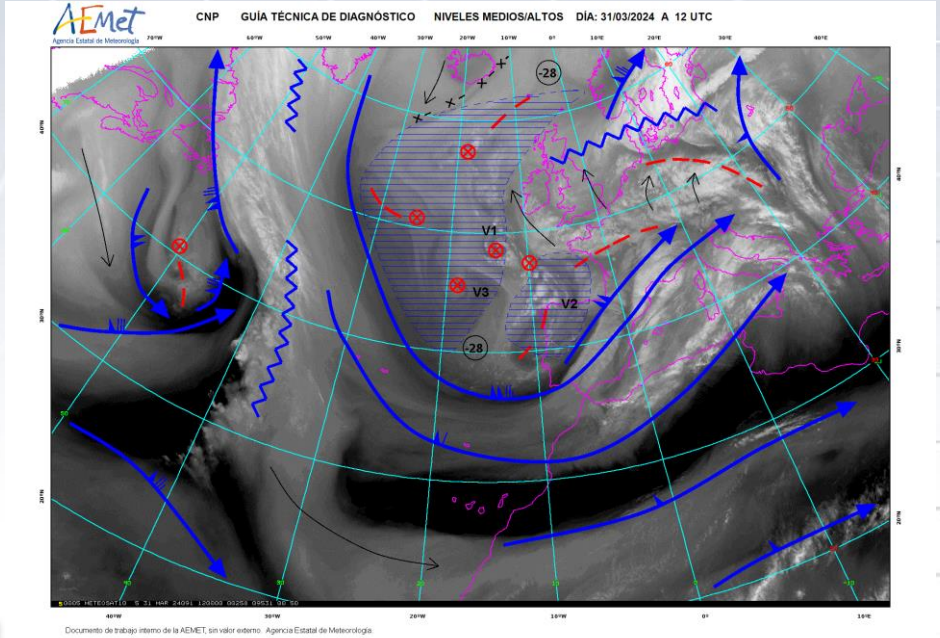
Frecuency Bias



Nelson storm. 31-3-2024 14 UTC

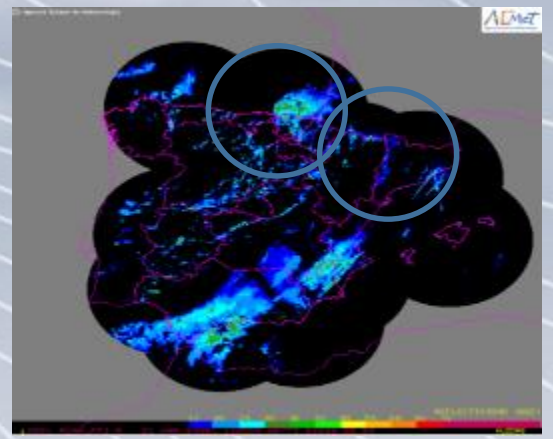
- There was a low pressure system in the North-West of the Iberian Peninsula with a cold front associated to it.
- The system develops several jets.
  - One of them is close to the Canary Islands.
- For that reason, there was strong winds, with low temperatures and strong precipitation over the Iberia Peninsula.
  - Over the Pyrenees and in the central plateau this precipitation was snow.
- Also a convection cell is created in the Vizcaya Golf.

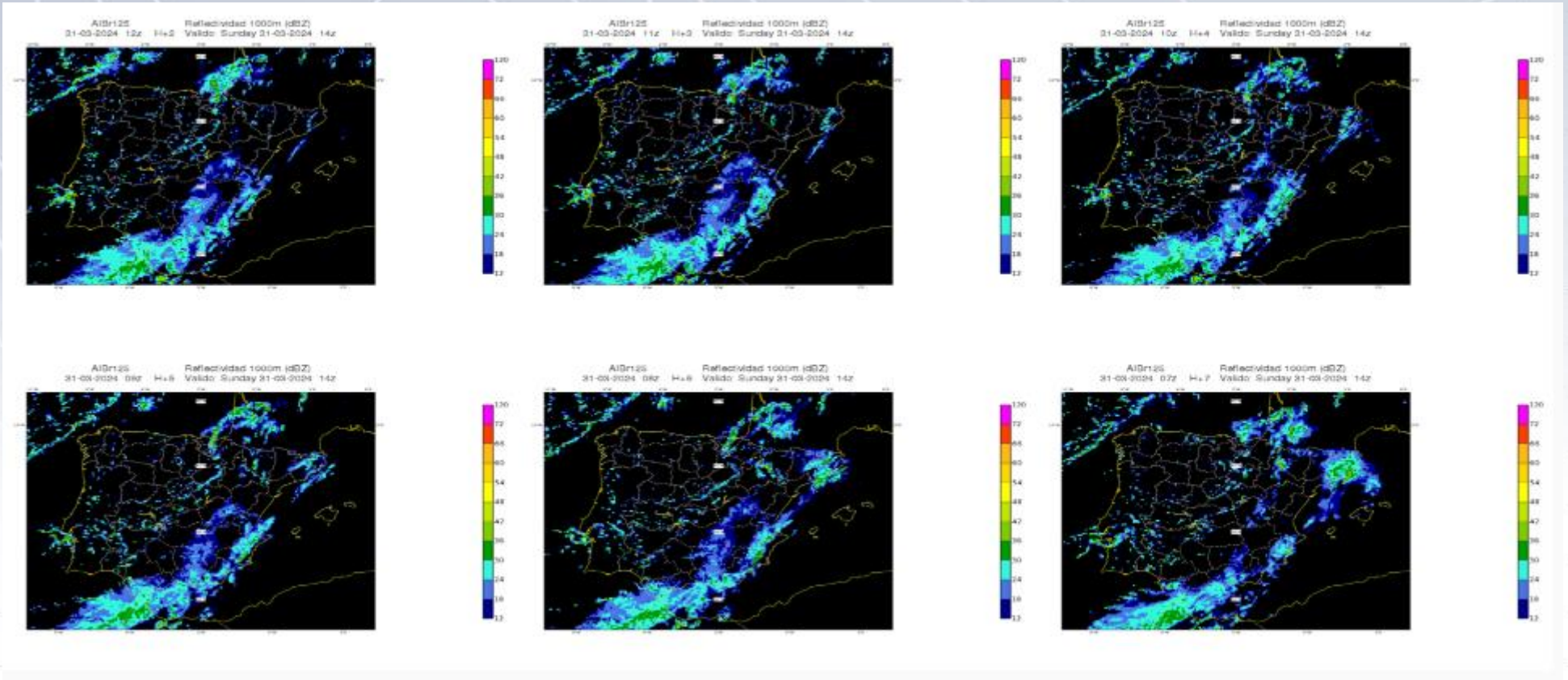




Nelson storm.
31-3-2024 14 UTC

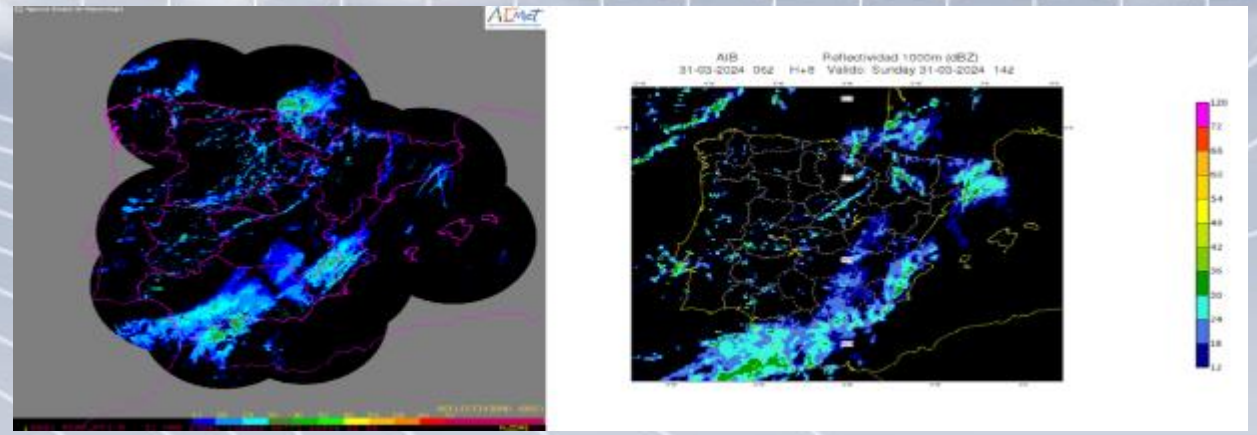
- In the deterministic suite (2,5 km) the convective cell over Catalonia was overestimated.
- And the Vizcaya Golf ones was underestimated.

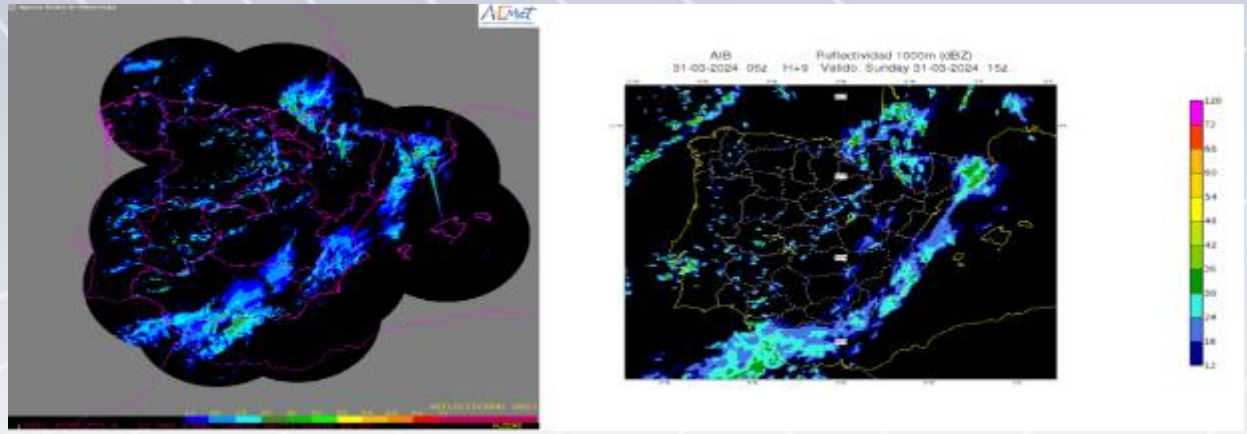


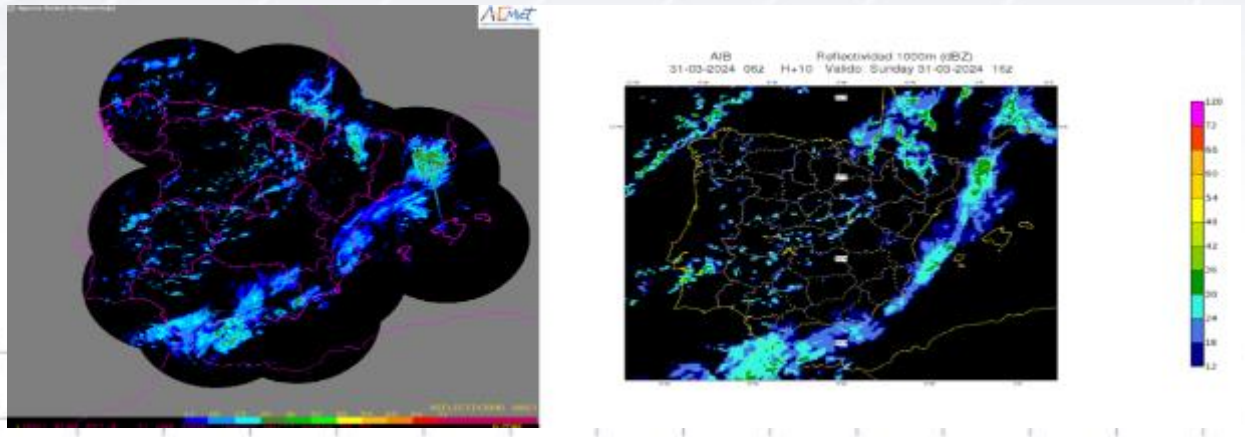


Nelson storm.
31-3-2024 14 UTC

- In fact the suite of 2.5km of resolution produced the precipitation over Catalonia before that the convection was developed.







Next steps.

- Nowcasting suite is operational at Aemet, but we have a lot of things to do for improving the suite:
  - Update the cycle. Now we are using Harmonie-Arome cycle43h2.1.1 and we are working for updating to cycle46.
  - Increase the number of vertical levels from 65 to 90.
  - Solve some problems of spin-up. Improve initialization.
  - Regarding the use of observations:
    - Tuning of radar reflectivity observation error.
    - Generate a new white list for gnss.
    - Improve the assimilation of SEVIRI WV's channels.
    - Add more observations sources like AMVs.
    - And in the future radar winds…
  - Improve visualization and add probabilistic products.

Main conclusions.

- Nowcasting suite is operational at Aemet.
  - 1.25 km of resolution in the vertical and 65 vertical levels.
  - Hourly cycling with12 hours for forecast length in order to make a “poor man” ensemble.
  - 3D-Var is using for Upper-Air assimilation:
    - Uses conventional observations + Radar Reflectivity + Modes-EHS wind’s + gnss + SEVIRI (WV’s)
  - Verification scores are better than the lower resolution Harmonie-Arome suite for surface variables, including precipitation.

Tack så mycket.

Thank you very much.

Muchas gracias.