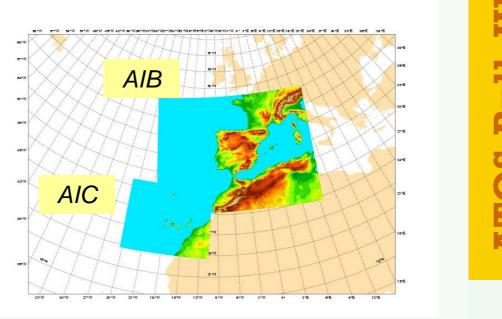


# **AEMET NWP Activities<sup>1</sup>**

## 44th EWGLAM - 29th SRNWP Meeting, Brussels, 26-29 Sep 2022

- Operational suite based on HARMONIE-AROME cycle 43h2.1.1 updated <sup>2</sup> on 7<sup>th</sup> September 2021 to a new HPC cirrus
- 2.5 km runs 4 times per day with a forecast length of 72 hours for 2 geographical domains (Iberian Peninsula and Canary Islands).
- **3DVar analysis** with **3hr cycle** incl. AMDAR humidity obs, radar reflectivities, ATOVS, GNSS ZTD, ASCAT wind , IASI and SEVIRI obs.
- IFS humidity in the blending process (LSMIX). Assimilation of T2m and rh2m in 3Dvar
- SAPP preprocessing for conventional observations
- Radar reflectivity using OPERA from BALRAD preprocessing including Spanish, Portuguese and French radars.
- Radar wind assimilated in passive mode.
- Retuned scales in CANARI
- 2 patches for Nature tile and disabling Surface Boundary layer Scheme
- Max Richardsson: XRISHIFT<sup>3</sup>
- Increase roughness boosting heterogeneity of open land patch (FAKETREES)
- Orographic roughness parametrization OROTUR <sup>4</sup> enabled (to alleviate a positive Wind bias which is still too large)



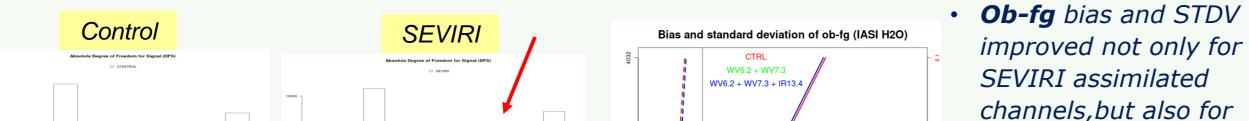
### ATOS-Bull High Performance Computer available from April 2021 (1<sup>st</sup> Phase) compose of two identical clusters each with

- 140 compute nodes mounted on Bull Sequana X440 A5 chasis. Each node with
- 2 AMD EPYC<sup>™</sup>7742 processors (64 cores)
- 256 GB DDR4-3200 memory
- It increases the computer capacity at least 8 times. The system will be enhanced in 2023 with 48 additional compute nodes



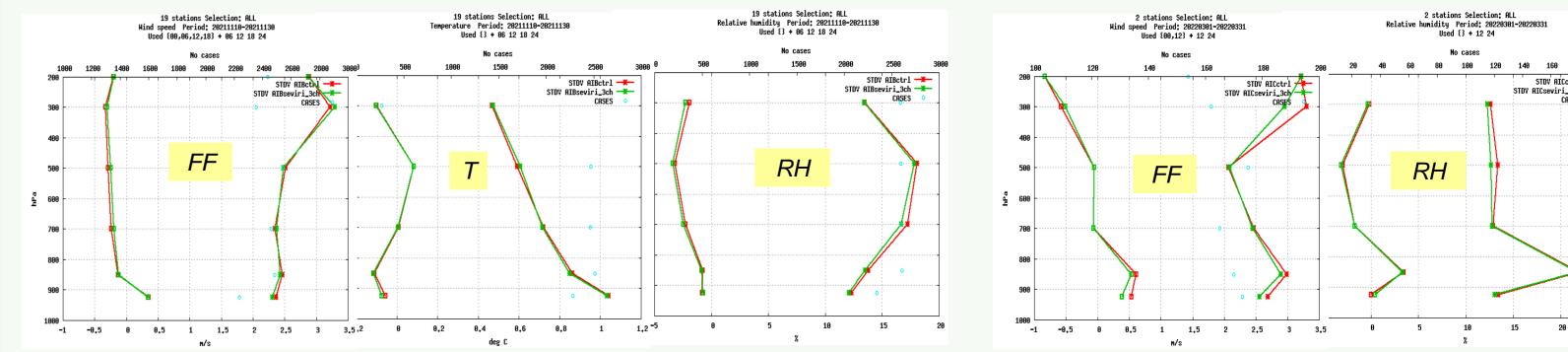
### Sensitivity studies to assess the impact of SEVIRI DA

- Tests based on Cy43.h.2.1.1 with 3hr cycling for the operational domains (AIB and AIC)
- Several periods with H+24 at 00, 06, 12 and 18 UTC
- SEVIRI radiances, WV6.2, WV7.3 and IR13.4, at all cycles over sea
- VARBC with 24hr cycling and 1 predictor (constant)

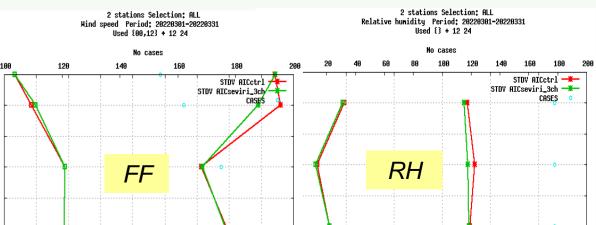


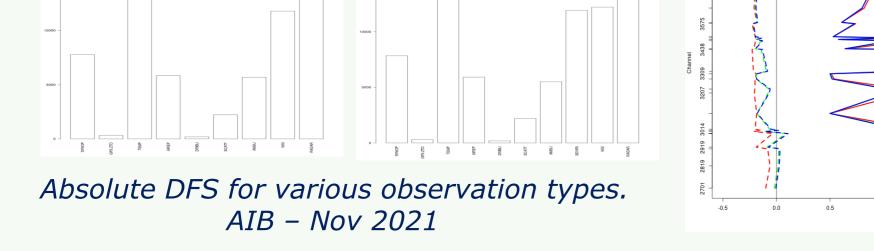
#### **SEVIRI Objective verification**

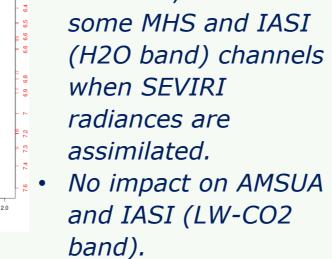
CTRL: Conventional + GNSS-ZTD + SCATT + Radar Reflec. + ATOVS + IASI \*seviri\_3ch: CTRL + Assimilation of SEVIRI WV6.2, WV7.3 and IR13.4 over sea



#### Canary Islands domain







Improvement in the humidity profiles and slight improvement on the wind. Very small impact on near surface variables with no clear signal on precipitation. The performance for WV6.2+WV7.3 and WV6.2+WV7.3+IR13.4 was very similar and for the time being only the WV channels will be assimilated operationally

RH and DOW from both sources

### Objective verification of radiation *Diurnal cycle of 1hr global SW: Obs-Forecasts for 1hr global SW* HARM and OBS . 1h Global radation [W/m<sup>2</sup>] Period: 202208 Jsed 00,06,12,18 + 01 02 ... 24 12 15

Routine verification of Global and Direct SW, and LW radiation is performed

• Not straightforward due to the diverse quality of the radiation observations: so far only the 5 more reliable stations are taken into account

• Slight uderestimation of global SW

• Modificantions on Monitor and Fldextr to account for the new variables

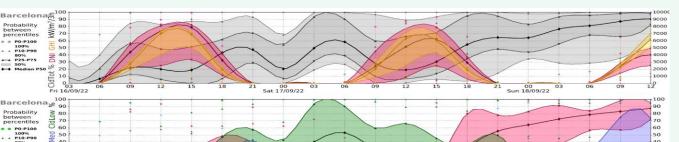
Preliminary results but HARM seems to have some underestimation of global SW radiation

### AEMET- $\gamma$ SREPS

• Multi-model (4 mesoscale NWP models) and multi-boundary conditions (from 5 Global NWP models) LAM-EPS at **2.5km** which runs operationally up to 48/60 hours on 3 domains: Iberian Peninsula, Canary Islands and Antarctica

OBS 1h Global radation

 $\gamma$ SREPS-Antarctica: currently participating into WMO YOPP-SH Winter TOP



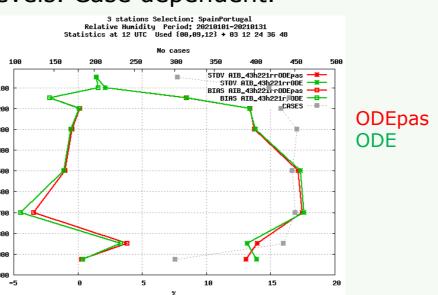
\* HARMONIE-AROME · Hirlam 

### 2022 novelties

New ECMWF HPCF ATOS (Bolonia)

New experiments assimilating reflectivity and Doppler winds from ODE (Baltrad) and OIFS (OPERA) Cy43h221 Parallel tests over Iberian Peninsula for 1 month : January 2021

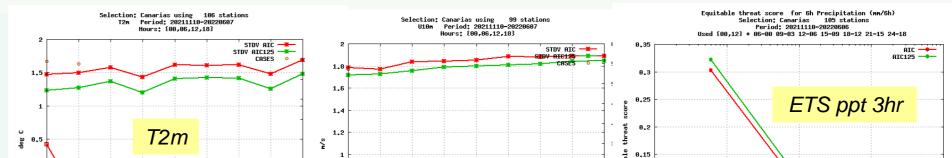
1) Impact of the assimilation of DOW from ODE: Neutral impact in general but slightly better in RH for certain levels. Case dependent.



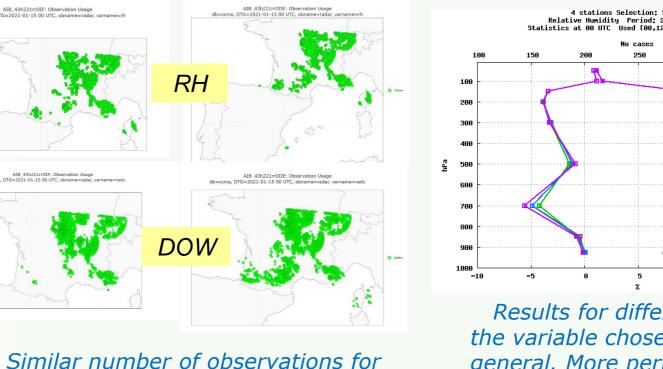
See presentation "Use of radar radial winds from the OPERA network"

### High Resolution Modelling

### 1) Canary Islands operational domain at 1.25 km (quadratic grid)



2) Impact of preprocessing: REFL and DOW from ODE or OIFS: Quite similar results using either source of data. But case dependent



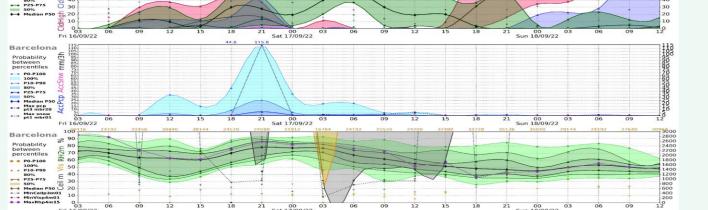
Results for different sources vary with the variable chosen but neutral in general. More periods and case studies needed.

efl+DOW ODE

Refl+DOW OIFS

Refl OIFS

- DA including operational obs with new structure functions
- Verification for 7 months: Operational linear 2.5km vs quadratic 1.25 km

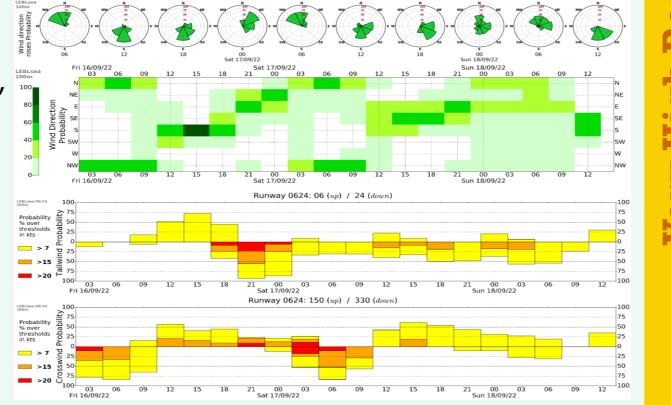


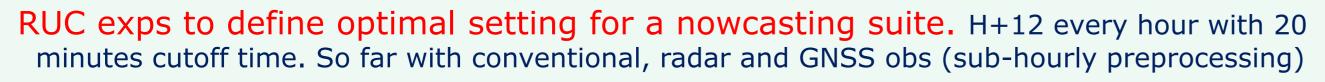
### 2023 challenges

- Probabilistic products:
  - EFI (Extreme Forecast Index) and SOT for rain, snow, wind gust and T2m max and min
  - Calibrated EPSgrams
  - Mountain forecast: Froude height
  - Warnings: thunderstorms and lightning
  - Aeronautic: icing and CAT
- Increase Iberia domain size by 2023
- Include 12UTC cycles in Canary I. / Antarctica
- Extend all simulations up to 72 hours from 48/60
- Introduction of Data Assimilation cycling

available:

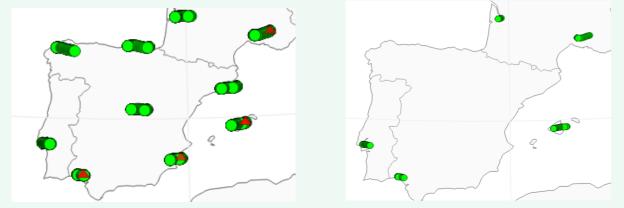
- *y*SREPS scripting update from **Python2** to 3 and migration from HPCF Cray (Reading).
- Operational EPSgrams available on forecasting offices for airports-runways (below) and province cities (left) in Spain.



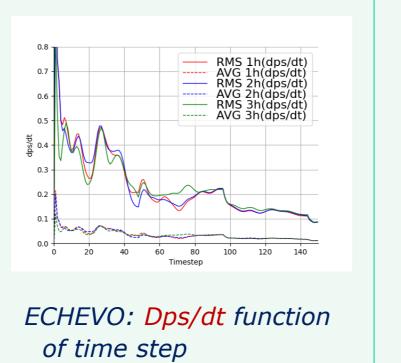


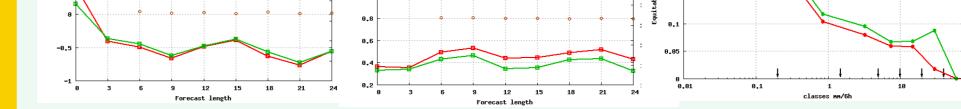
#### Testing:

- 2.5/1.25 km resolution (1.25 km better). New structure functions computed
- 1, 2 and 3hr cycling (better with 1 or 2 hr cycling)

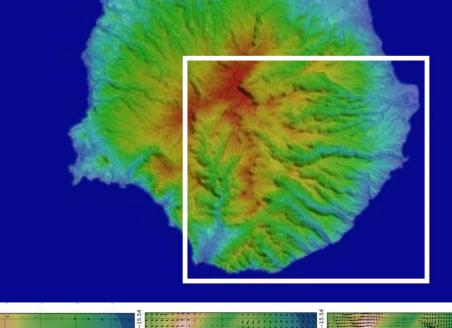


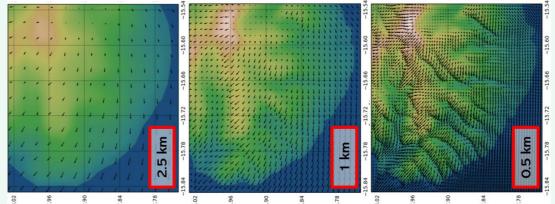
Soundings entering the operational and the nowcasting suites

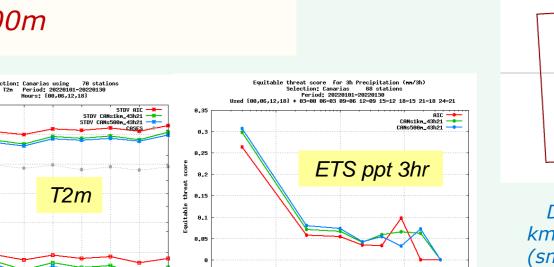


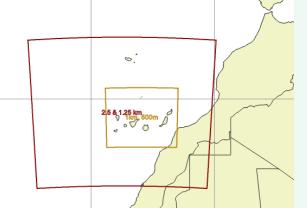


### 2) Dynamic adaptation versions at 1 km and 500m







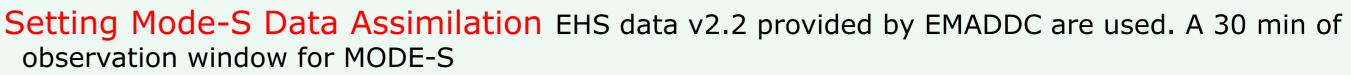


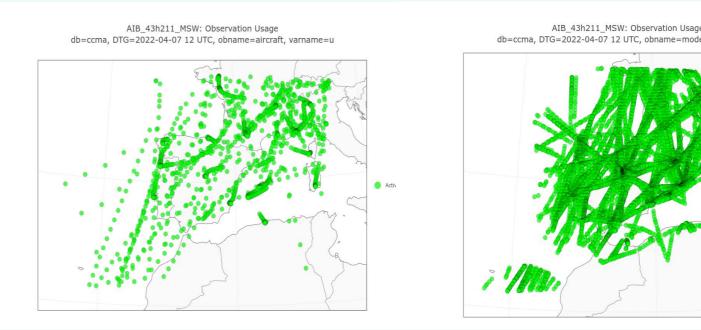
#### Domains at 2.5 and 1.25 km (big) and 1 and 0.5 km (small)

- HARMONIE-HARMONIE nesting
- Stable versions

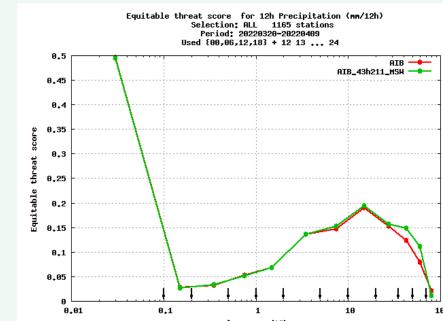
T2m

- Only at 500m the orographic channels are represented
- Small improvement from 1km to 500m
  - Challenging verification
  - Room for improvement in the 500m settings





The density of the observations is much bigger for MODE-



Some improvement is found in

#### Clear added value for surface variables



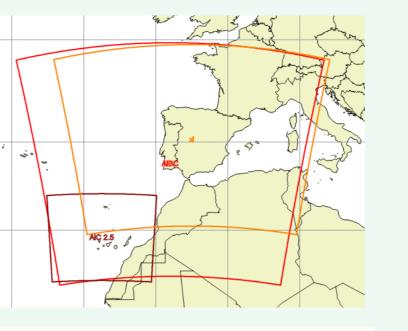
es

- Only half of the soundings arrive with 20 min cutoff time  $\rightarrow$ need to use operational background from time to time
- Working on tuning the DA for the different observations

#### > Other activities

• Ongoing tests to change operations to an unified big domain. New structure functions computed and in the process of tuning the data assimilation

(48steps=1hr) comparing 1, 2 and 3hr cycling



<sup>1</sup> Contributions: Javier Calvo, Alfons Callado, María Díez, Pau Escriba, Juan Jesús González, Daniel Martín, Gema Morales, Beatriz Navascués, Jose M. Pérez, Jana Sánchez y Samuel Viana

#### *References:*

- <sup>2</sup> Calvo et al., 2021: Evaluation of HARMONIE-AROME cycle 43h2.1 at AEMET. ACCORD Newsletter, 2 <sup>3</sup> Homleid, M. (2022). Improving model performance in stable situations by using a pragmatic shift in the drag calculations - XRISHIFT . ACCORD Newsletter, 2.
- <sup>4</sup> Rontu, L. (2006): A study on parametrization of orography-related momentum fluxes in a synopticscale NWP model. Tellus A: Dynamic Meteorology and Oceanography

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- S data than from traditional E-AMDAR data.
- Observations very useful for nowcasting although currently they arrive late for this purpose (40 min)
- We hope to improve with a more suitable thinning

# **Highlights**

#### > New HPC system available since April 2021

- In its 1<sup>st</sup> phase increases the computer capacity about 8 times.
- HARMONIE-AROME 2.5 km resolution operational deterministic suite updated to cy43h2.1 with positive results.

#### > SEVIRI data assimilation

- Slight positive impact.
- Complex DA: selection of channels, varbc, etc. Entering in operations using WV6.2 and WV7.3 channels
- Radar preprocesing
  - Assimilating ODE(BALTRAD) or OIFS(OPERA) radar data in the operational run has shown similar results and OIFS could be used to secure operations

#### > Objective verification of radiation

- Routine verification of Global and Direct SW and LW is performed. Complex verification due to the diverse quality of the radiation observations. Also, not easy to relate with other model variables.
- Very High Resolution modelling
  - Good results increasing the resolution for the Canary Islands domain to 1.25 km (quadratic grid) in an operational setup.
  - Dynamic adaptation versions at 1 km and 500m: stable versions with clear improvement on 2m temperature and 10 m wind. So far the added value of 500m is not clear.

precipitation using MODE-S wind. Neutral impact in other variables