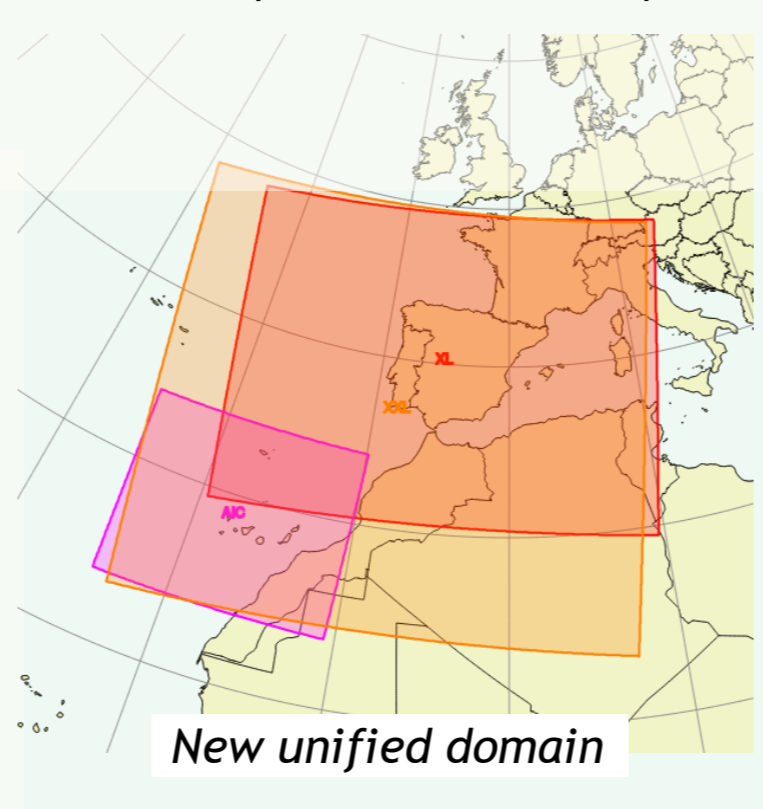


Deterministic e-suite

- An e-suite based on HARMONIE-AROME cycle 46h1.1¹ is almost ready for its operational use
- 2.5 km, 65L** runs 4 times per day with a forecast length of 72 hours for a **single unified domain** instead of 2 domains (Iberian Peninsula and Canary Islands). Main impact over the Canary Islands due to the increase of observations, specially satellite obs
- Single precisión** in the forecast model (may produce a small degradation in RH field)
- 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 (NIMBUS optional). Radar wind assimilated in passive mode.
- Increase roughness increasing heterogeneity of open land patch (FAKETREES)
- Orographic roughness parametrization OROTUR enabled (to alleviate a positive wind bias which is still too large)

Impact of cy46 compared to cy43: Neutral to slightly positive



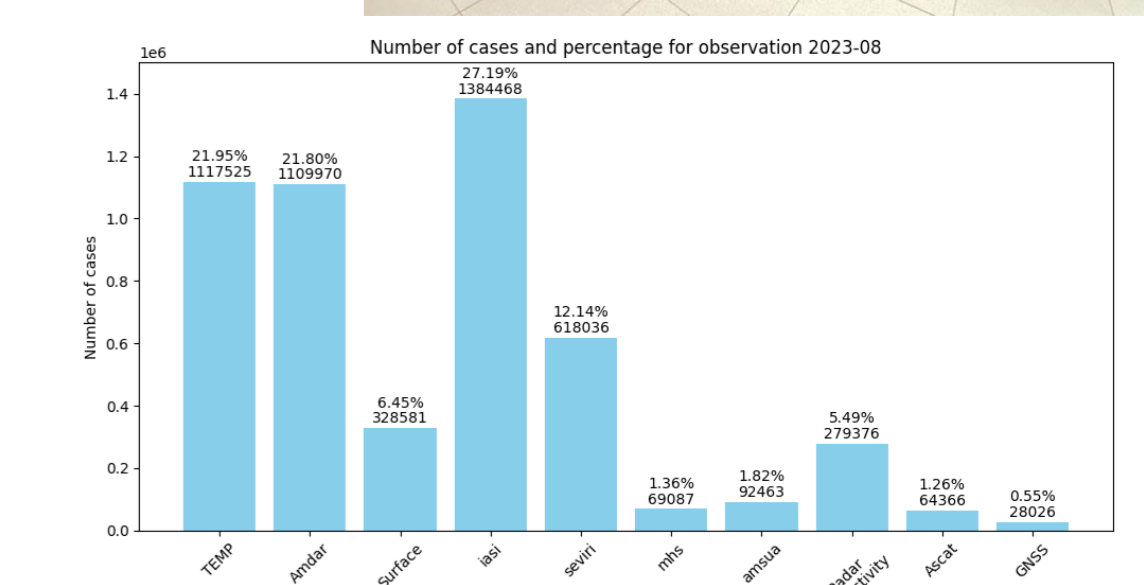
Evident-ATOS-Bull HPC It is composed of two identical clusters each with 188 compute nodes mounted on Bull Sequana X440 A5 chassis. Each node with

- 2 AMD EPYC™7742 processors (64 cores)
- 256 GB DDR4-3200 memory
- 25% of the nodes with 384 GB



Use of satellite data

Satellite	MW T sounding	MW hum sounding	IR sounding
NOAA-18	AMSUA		
NOAA-19	AMSUA	MHS	
METOP-B	AMSUA	MHS	IASI
METOP-C	AMSUA	MHS	
MSG			SEVIRI



IASI CHANNELS

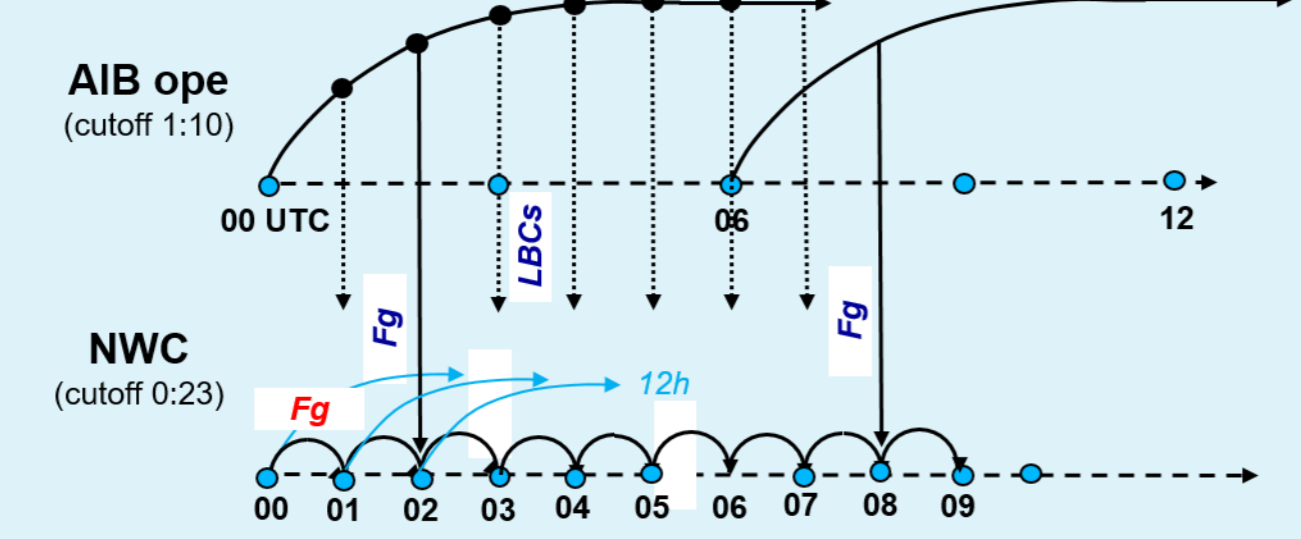
CO2 High	38,51,63,85,104,109,167
CO2 Middle	173,180,185,193,199,205,207,212,224,230,236,239,242,243,249,296,386
CO2 Low	333,337,345,389,432
WV	2701,2819,2910,2919,2991,2993,3002,3008,3014,3098,3207,3228,3281,3309,3322,3438,3442,3484,3491,3499,3506,3575,3582,3658,4032

Number observations entering the Minimization during a month and relative distribution for the different types

AMSU-A: 6, 7, 8, 9
MHS: 3, 4, 5
SEVIRI: WV6.2, WV7.3

Nowcasting suite

- Operational since 10 Dec 2023 running over the Iberian peninsula and Balearic Islands. Based on Harmonie-Arome cycle 43h2.1.1 with **1.25 km resolution**, Harmonie-Arome nesting, 3DVar hourly cycle with **+23 min cut-off time**. Using conventional observations + radar reflectivity + GNSS-ZTD (fast processing) + SEVIRI WV + Mode-S. H+12 in hourly cycles.



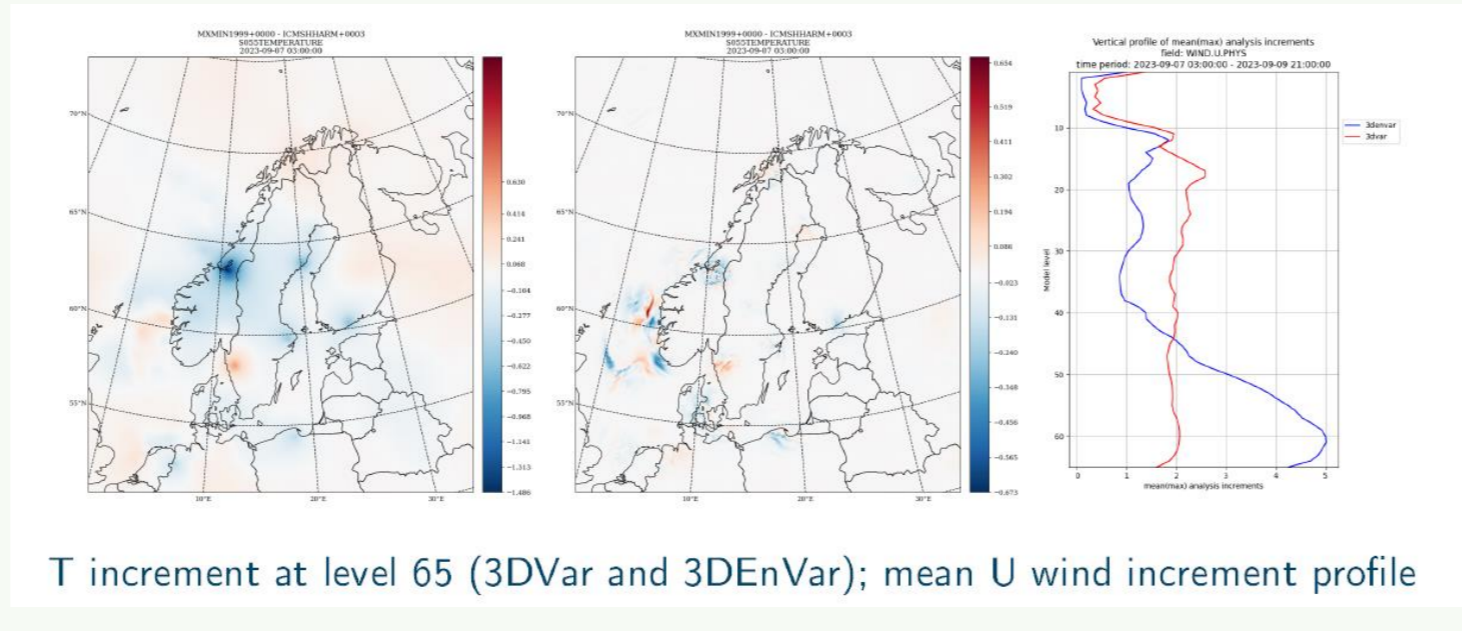
To benefit from the better obs coverage in the operational suite, every 6hr and H+2 First Guess from the host is used for upper air fields

4DVar and 3DEndVar

- 4DVar in MASTERODB**
- On-going tests with new tunings (so far neutral impact)
 - Preparing a paper with KNMI, SMHI and METNO

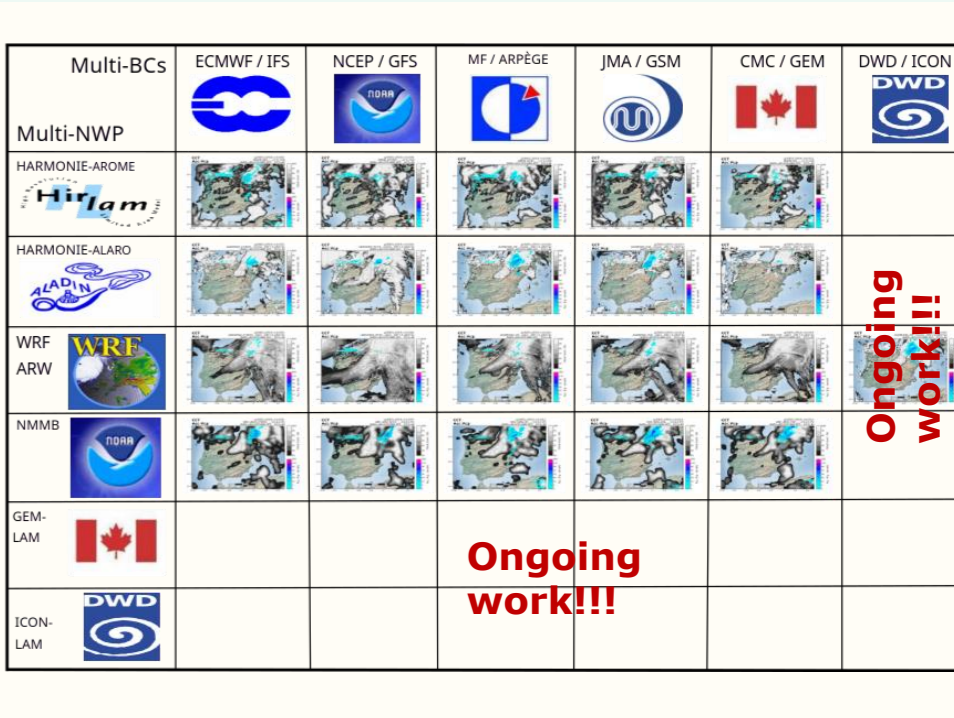
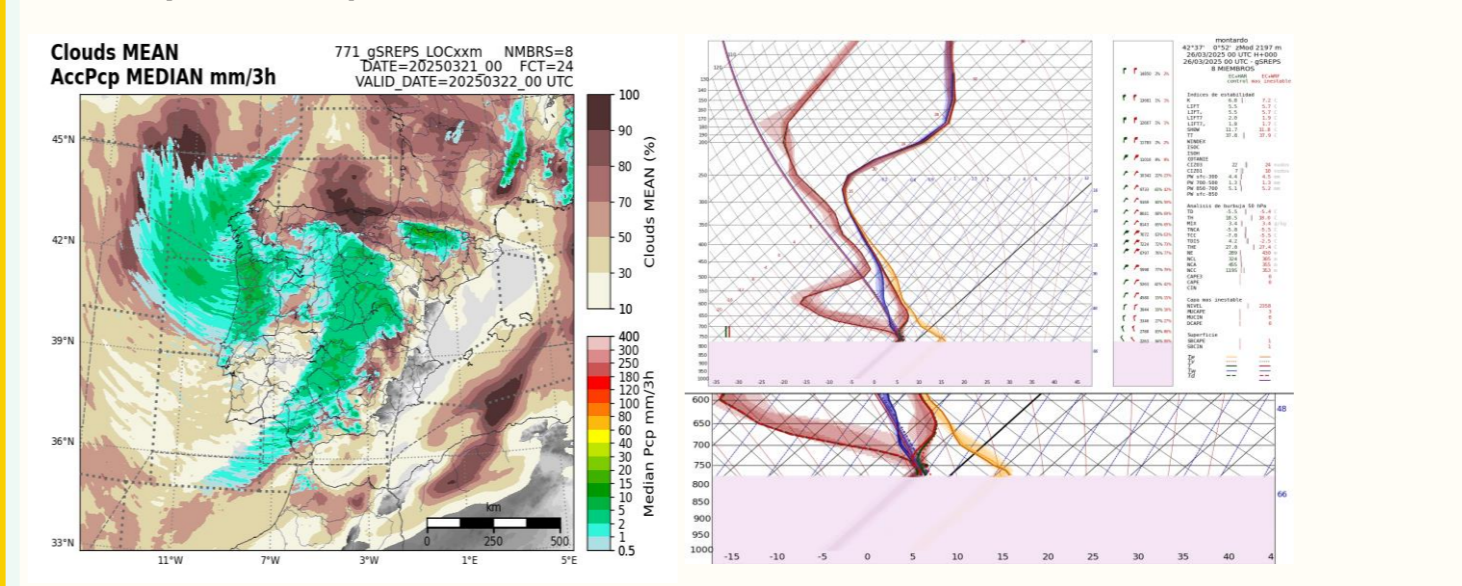
- 4DVar in OOPS**
- On development for Cy49T2h
 - Single obs expts show nice analysis increments
 - Still some issues with the gp2sp transformation of Humidity and the HR propagation

- 3DVar in HARMONIE**
- Based on OOPS and it is fully technically working
 - First steps: tuning of inflation factor and using the ELDA ECMWF-IFS EPS to get the ensemble members from



Mesoscale EPS

- AEMET-gSREPS:**
- Multi-model (4 mesoscale NWP models)
 - Multi-boundary conditions (5 Global models)
 - at 2.5 km on 3 domains: Iberian Peninsula, Canary Islands and Antarctica
 - 2 cycles up to 72 hours each



- On-going work**
- Upgrading LAMs: WRF to 4.6.1 and HARMONIE-AROME and ALARO to 46h1.1
 - Larger domain over Iberian Peninsula
 - New products as Vertical profiles and probability matrix

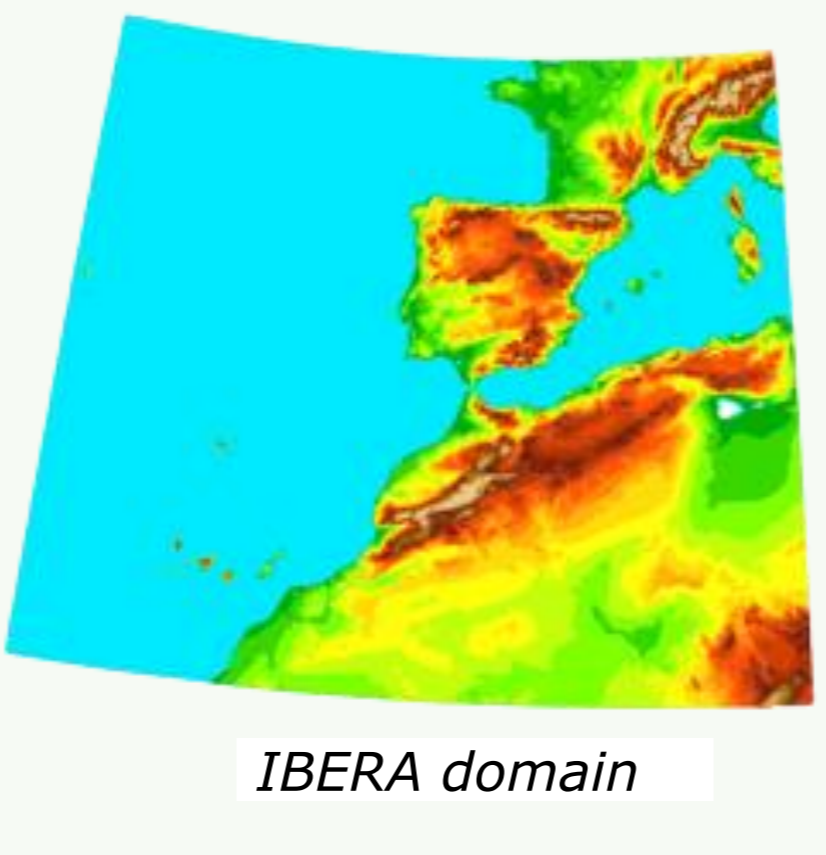
- Future steps**
- Maybe more members: new BCs (e.g. Global ICON) & new LAM-NWPs: (e.g. ICON-LAM, GEM-LAM)
 - Exploring to replace gSREPS with ACCORD HarmonEPS

IBERA Reanalysis Project

Reanalysis at 2.5 km over AEMET operational domain (IBERA)

The goal is to add value compared to other existing reanalyses at global scale (ERA5, 33km) or European scale (UERRA 11km, CERRA 5.5km). The benefits will come from the increased model resolution and from the additional observations ingested in the system. The domain uses is the AEMET operational domain

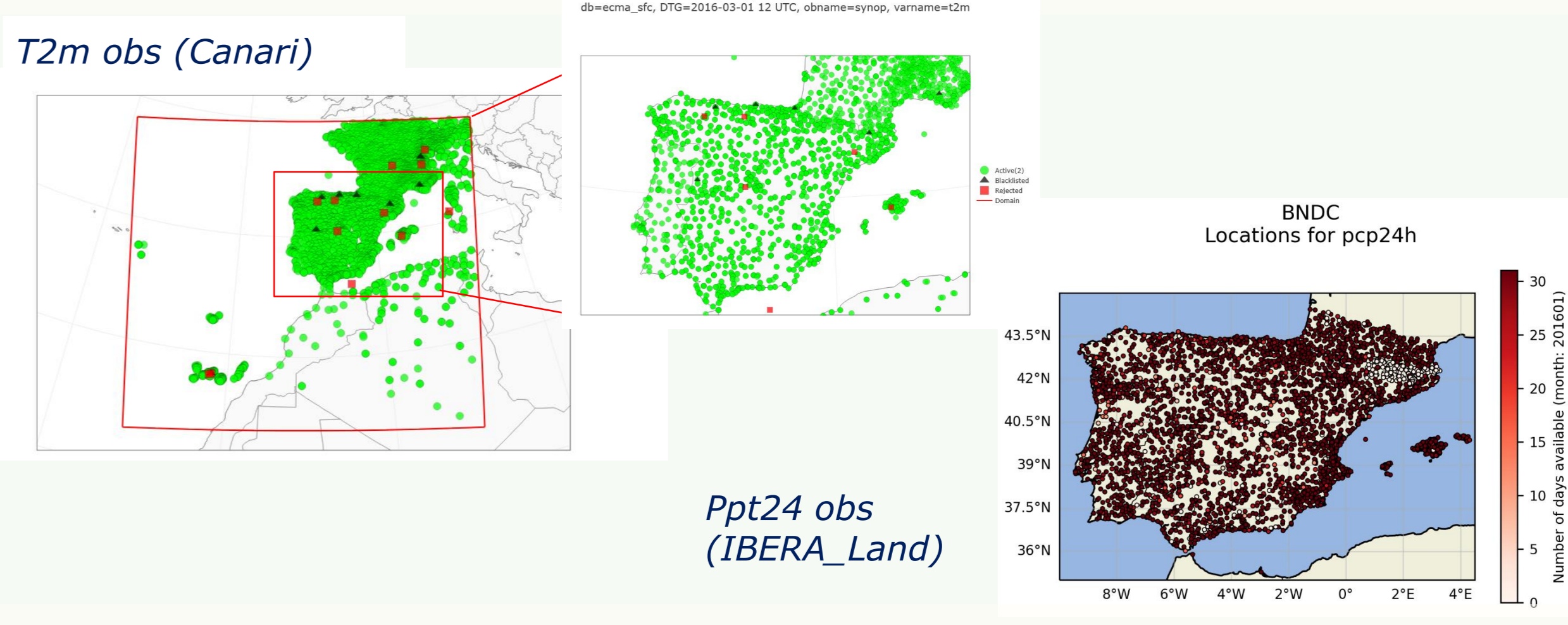
- The reanalysis system includes two components:
- IBERA: based on HARMONIE-AROME cy46h11** using 3DVar and Canari OI for Surface fields
 - 3 hr cycle with H+30 forecasts only at 00 utc
 - Non-Hydrostatic at 2.5 km horizontal resolution with 90 vertical levels
 - IBERA_Land²: Offline Surface analysis**
 - OI analysis for some variables as 24 hr precipitation and extreme temperatures
 - In principle, in smaller sub-domains but this needs to be defined



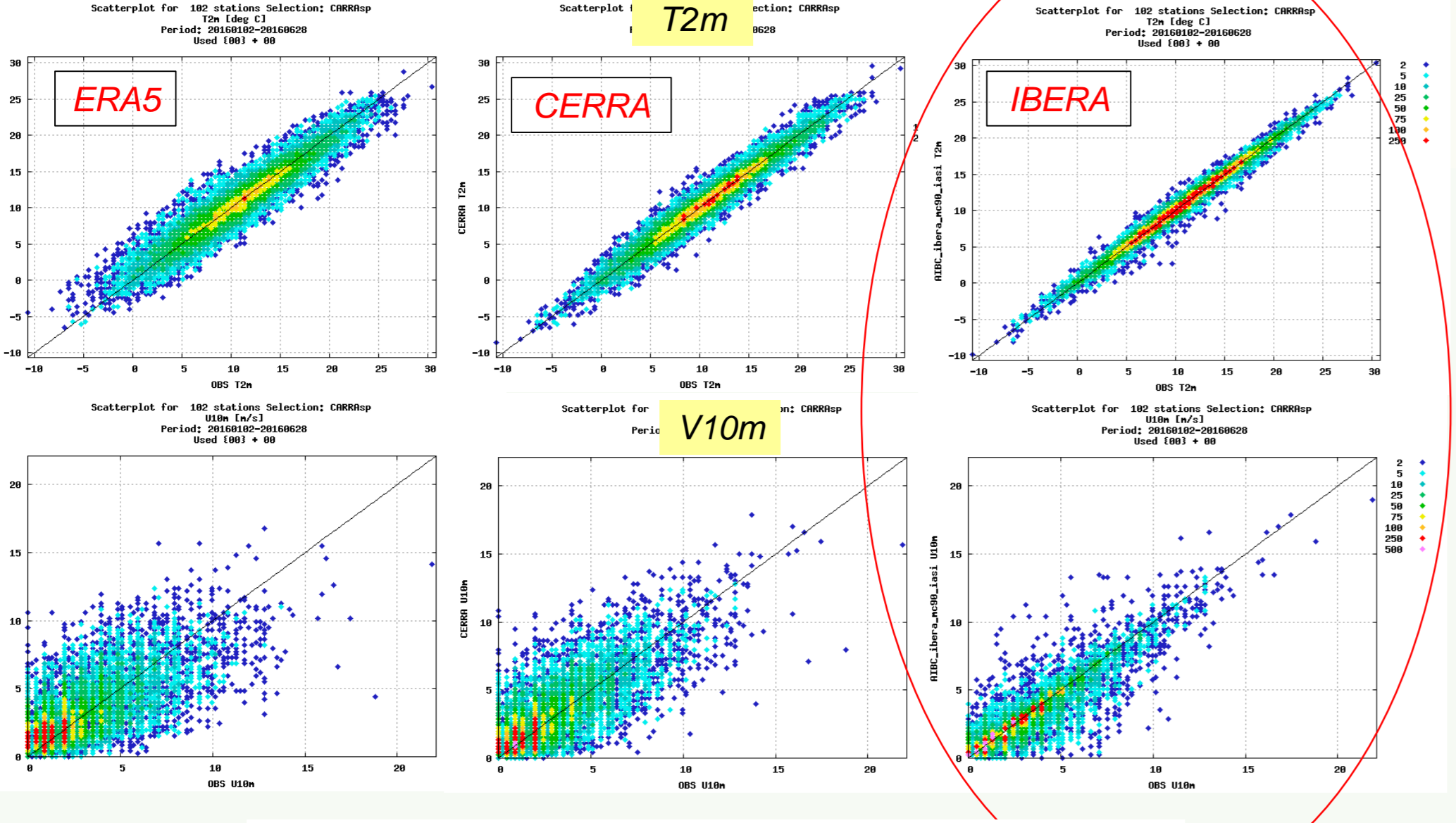
Use of observations

Surface: additional observations from climatological networks of AEMET, Meteo-France, IPMA and Moroccan DGM apart from other institutions in Spain (Confederaciones Hidrográficas, SIAR, Xunta de Galicia).

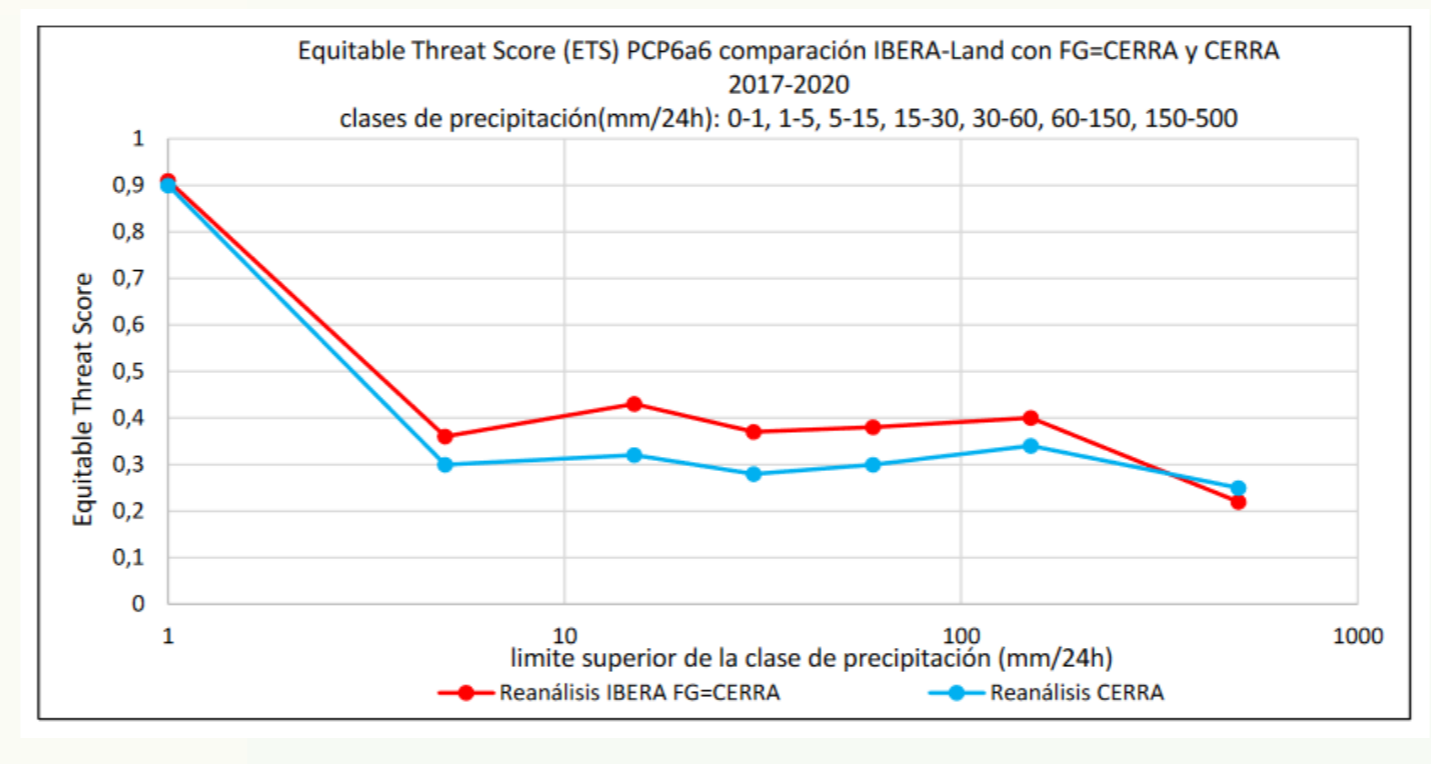
Non-conventional observations include AMSU, ASCAT, [GNSS], [IASI], [SEVIRI]: In brackets pending on sensitivity test on-going



Impact, objective verification (IBERA using Canari):

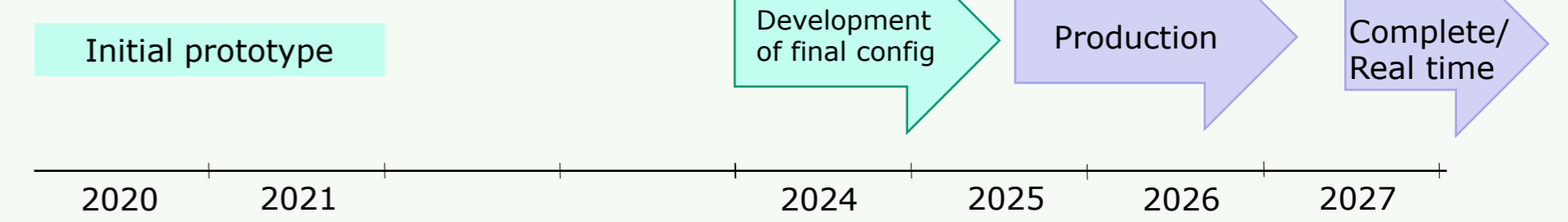


Added value of the off-line analysis (IBERA_Land)



Equitable Threat Score for 24-hr accumulated precipitation: Comparison of CERRA analysis with IBERA_Land analysis using CERRA as First Guess. The verification has been performed using an independent set of observations

Production plan



30 years of results expected early 2027

Highlights

- A e-suite based on Cy46h1 almost ready for its operational use.
 - It includes a **unified domain** including the Canary islands (instead of 2 smaller domains).
 - Overall, the meteorological impact is neutral to slightly positive.
 - Over the Canary Islands the benefit is larger. We think this is due to the higher number of observations ingested in the surroundings.
 - Single Precision** seems to work well in cy46h1 forecasts and will be used in operations.
 - We expect to change to GRIB2 for the product dissemination.

IBERA Reanalysis

- A 30 years reanalysis is on-going (1990-2020)
- The final production system is almost finished and we expect to start production soon
- Additional observations have been gathered thanks to our neighborhood Meteorological Services (Meteo-France, IPMA, Moroccan DGM) and some Spanish Institutions
- Additional active collaboration with IPMA and DGM is expected in the development and evaluation of the system
- Sensitivity test have shown the added value of IBERA compared to other reanalyses as CERRA. The use of a off-line analysis gives additional improvement and allows us to produce precipitation and extreme temperature analysis.

See also talks

- M. Díez: Progress in HARMONIE-AROME satellite data assimilation
- J. Sanchez-Arriola: Tuning results of cy46 Harmonie-AROME
- C. Gejo-Guerrero: Modelling Flow-Dependent Covariances with Gaussian Integrals
- D. Marin-Perez: Cloud Aerosol Radiation developments

Contributions:

Javier Calvo, Alfons Callado, Joan Campins, María Díez, Pau Escribà, Jaime Hernandez-Lasheras, Alberto Jimenez, Antonio Jiménez-Garrote, Ana Montoro-Mendoza, Candelas Peral, Jana Sánchez-Arriola

References:

- ¹ Morales et al. (2024): Evaluation of HARMONIE-AROME cycle 46h1 at AEMET. ACCORD Newsletter, 5
- ² Peral, C., Navascues, B. and Ramos, P. (2017): Serie de precipitación diaria en rejilla con fines climáticos. AEMET Technical Note, No. 24

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