The NWP Activities at AEMET (Spain)

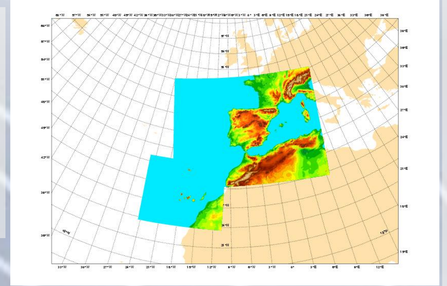
29th ALADIN Workshop & HIRLAM ASM, 1st/04th April 2019, Madrid

GOBIERNO DE ESPAÑA — MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA — AEMet Agencia Estatal de Meteorología

1. Operational suite

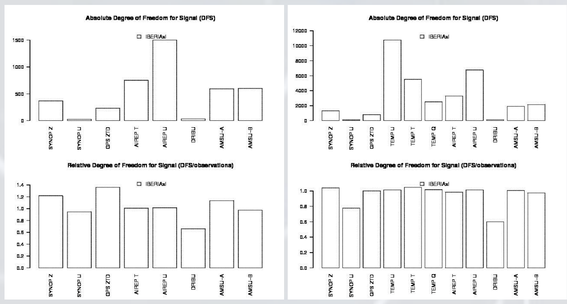
HARMONIE-AROME operational suite is based on v40h1.1 and it is one of the HARMONIE RCRs used to monitor the quality of the reference system:

- **2.5 km** runs 8 times per day with 48 hours forecast length and 15 min output 2 geographical domains (Iberian Peninsula and Canary Islands).
- AROME physics: Explicit deep convection, SURFEX and ICE3 microphysics
- Unified scheme for shallow convection (EDMFM)



- Run in BULL-ATOS supercomputer 7760 processors with hyperthreading
- Surface data assimilation with optimal interpolation.
- 3DVar upper air analysis with 1:10 cutoff time including ATOVS and GNSS slant delay data

Weight of different observations in the DA: DFS for different assimilation times



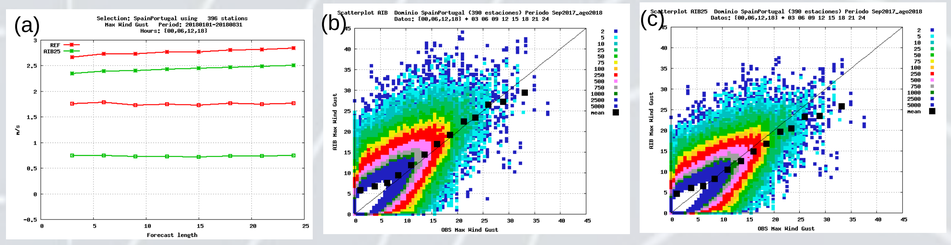
06 UTC No RS — 12 UTC

2. Estimation of wind gusts

The wind gust estimation is based on 10 m wind and the Turbulent Kinetic Energy

$$F_{gust} = F_{10m}\left[1+\alpha\sqrt{\frac{TKE_{20m}}{F_{10m}^2}}\right]$$

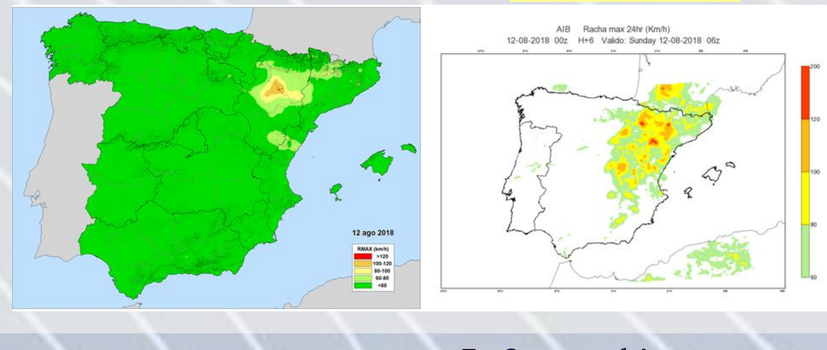
Period: 1 sep 2017-31 aug 2018 (1 year)



The rafagosity factor, α, has been decreased from 3.5 to 2.5 to decrease the positive bias and avoid to many false alarms. (a) STDV and BIAS of Reference and new setup, plots events observation-forecast for Reference (b) and new setup (c).

3. Overestimation of convective gusts

Observation analysis — *HARM-AROME forecast*



Max wind gust on 12-08-2018:

Overestimation with intense deep convection

Thresholds:

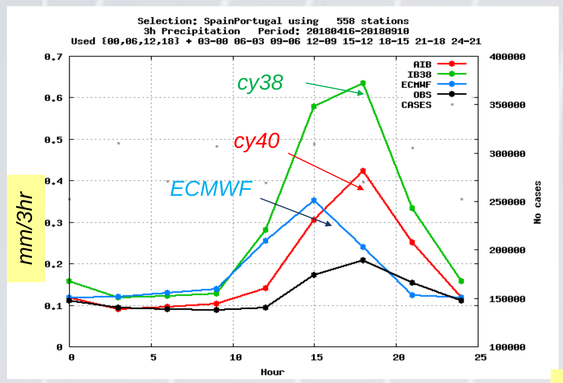
> 80 km/h

> 100 km/h

> 120 km/h

4. Precipitation evaluation

4.1 Diurnal cycle (point verification)

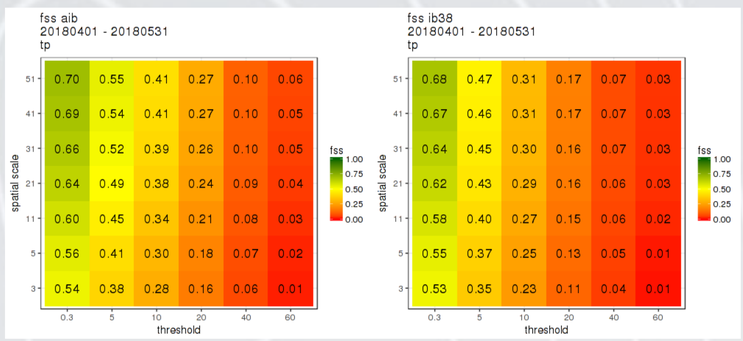


UTC

Diurnal cycle of precipitation. As expected, convection-permitting models reproduce better the diurnal cycle than models with parameterized convection (ECMWF). The maximun takes place between 15-18 UTC whereas in ECMWF occurs 3 hr earlier. All models tend to kill convection too quickly after the maximum

4.2 Scale dependencce (spatial verification)

Gema Morales



Fractional Skill Score function of the grid scale and the threshold (ppt/24h). for 2 exps cy40 (left) and cy38 (right). Scores improve with the length scale and seems to saturates around 40-50 km. Cy40 verifies better for all the thresholds.

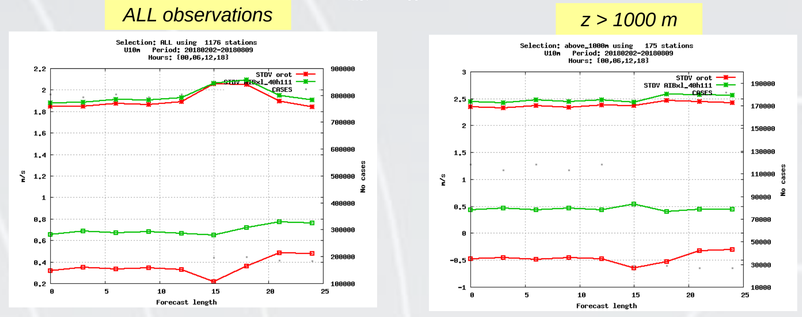
5. Orographic parameterization

Verification of the operational suite shows a clear positive wind bias in 10 m wind field that is not present in the METCOOP RCR. This suggest a need of an enhanced roughness over the Iberian Peninsula. The OROTUR parameterization (Rontu et al, 2018) has been tested with the following setup

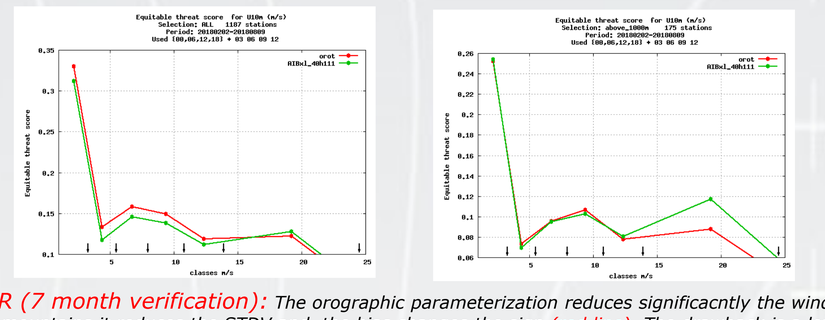
$$\tau_{tot} = \left(1 + C_0\sigma_{SSO}^2\right)\tau_{ts} \quad with \quad C_0 = \frac{\alpha}{\Delta x^2}\frac{V_{00}^2}{V_{nlev}^2 + V_{00}^2} \quad and \quad \alpha = 1000 \quad and \quad V_{00}^2 = 8$$

ALL observations — *z > 1000 m*

STDV & Bias



ETS



OROTUR (7 month verification): The orographic parameterization reduces significacntly the wind bias. Over the mountains it reduces the STDV and the bias changes the sign (red line). The drawback is a lower performance for high wind speeds specially over the mountains. We think that there is room for improvement tuning further the OROTUR settings

6. Status of radar reflectivity Data Assimilation

Jana Sánchez

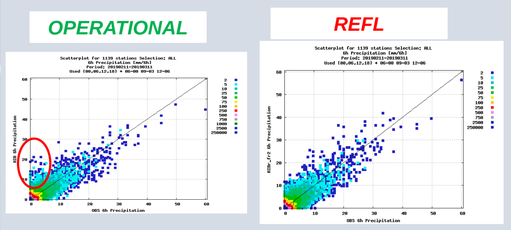
- **Spin-up PERIOD**: 23 jan-10 feb 2019. GNSS ZTD BIAS coeff adjustment (GNSS ZTD Passive)
- **PERIOD of study**: 11 feb – 24 march 2019, 2 experiments Cy40h11 at Nimbus: 3DVar, 3h cycle

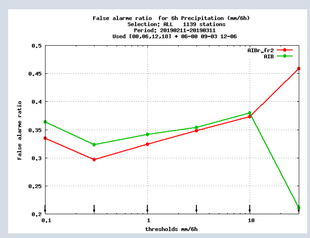
1) **AIB**: operational run NO radar, 3DVar: conv, **GNSS ZTD,** ATOVS

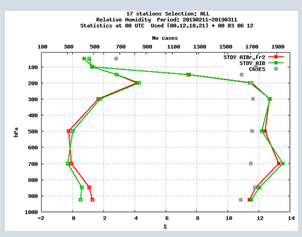
2) **AIBr_fr2** (REFL): 3DVar: obs conv**, GNSS ZTD,** ATOVS**, radar reflectivity (ES, PT, FR)**

* Updated GNSS White List and increase of its obs error * Updated ATOVS channels/sats selection * Radar reflectivities from ES+PT+FR assimilation

OPERATIONAL — *REFL*





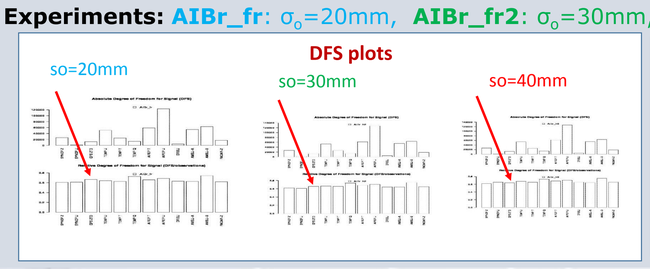


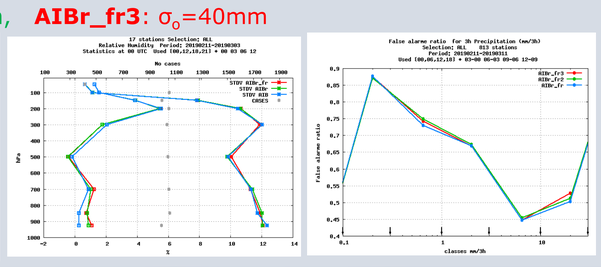
The assimilation of radar reflectivities together with conventional observations, gnss ZTD and ATOVS leads to a reduction of False Alarm Rate of 3h accumulated precipitation and then an improvement on the model precipitation forecast skill.

Impact of different gnss σ_o

- **PERIOD** 11 feb – 11 march 2019, radar reflectivities ES+PT+FR , New gnss WL, updated ATOVS channels/sats select

Experiments: **AIBr_fr**: σ_o=20mm, **AIBr_fr2**: σ_o=30mm, **AIBr_fr3**: σ_o=40mm



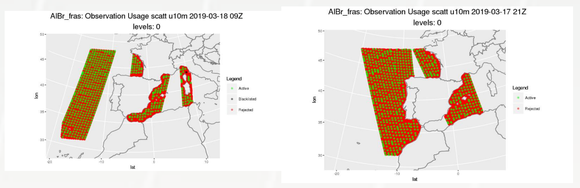


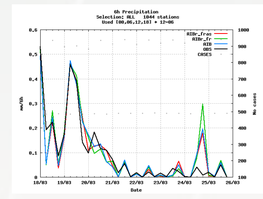
Little impact of changing σ_o values,diferent thinning distances will also be tested

7. First results of scatterometer DA

Jana Sánchez and Isabel Monteiro (IPMA)

- PERIOD of study: 17 mar-25 mar 2019
- Cy40h11, 3DVar, 3h cycle 3DVar: obs conv, GNSS ZTD, ATOVS, radar reflectivity (ES, PT, FR) . 2 experiments:
  - **AIB_fr**: Reference
  - **AIBr_fras**: Including also **ASCAT data**
  - Operational without radar and ASCAT data





The ASCAT DA is working well with promising results after the work of Monteiro (2018). Further tests are needed to tune the assimilation of this data in combination with radar and other data sources currently included in the operational system.

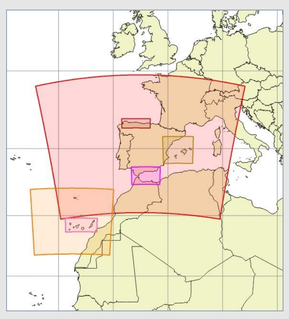
8. HARMONIE-AROME at 1 km over Spanish Harbour Areas

I. Santos Atienza, E. Padorno Prieto, J.A. Ruíz Pacheco, I. Martínez Marco

In the frame of SAMOA Project, AEMET is running HARMONIE-AROME over 4 domains at 1 km resolution and 30 seconds time step twice per day in an operational mode with a forecast length of 48 hours.

SETUP

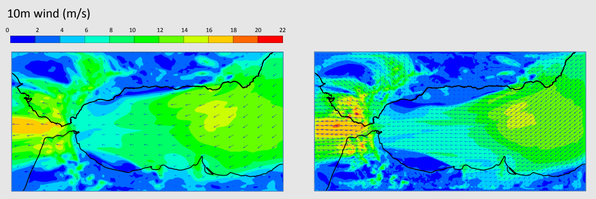
- IFS 0.1º nesting. Dynamical adaptation with IFS nesting.
- Cycle 40h1.1 with PC scheme, original HARATU turbulence (update reversed).
- SL horizontal diffusion (SLHD) for hydrometeors and spectral variables.



Domains at 1.0 km, compared with operational 2.5 km domains.

RESULTS

Improvement of 10 m wind at the 4 areas providing more accurate forecast.

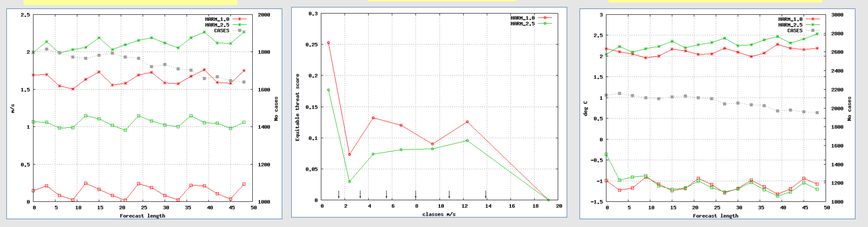


10 m wind maps for the Alboran Sea area. 20180819 00 UTC H+10. One wind arrow out of eight plotted

VERIFICATION

Significant improvement of 10 m wind for all areas and wind speed categories. Also improvement in 2 m temperature

V 10m STDV & Bias — *V 10m ETS* — *T 2m STDV & Bias*



Gulf of Biscay verification during March 2017. Operational 2.5 km (red) compared to 1 km runs (green).

9. Additional activities

- Camipns, Joan: Assimilation of AMDAR humidity observations (talk)
- Geijo, Carlos: Towards a NWC application based on HARMONIE-AROME (talk)
- Escribà, Pau: LETKF with a like-operational HARMONIE-AROME in AEMET (talk)
- Viana, Samuel: Testing target cy43h surface options in climate mode for assessment & reduction of surface bias: First results (talk)
- Martín, Daniel: Use of CAMS Aerosols in Harmonie-Arome (talk)
- Hernández, Ángeles: Simulated Satellite Imagery from Harmonie-Arome – Applications (talk)
- Callado, Alfons: AEMET-gSREPS: The Convection-permitting LAM-EPS at AEMET (talk)

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10. Highlights

- Operational suite is based on HARMONIE-AROME cycle 40h1.1 at 2.5 km resolution.
- Significant progress including new observations in the DA system
- The assimilation of radar reflectivities leads to a reduction of False Alarm Rate of precipitation and and improvement on the model precipitation forecast skill.
- The scatterometer data is working in the DA system and we are in the process of tuning the system in combination with radar data and other observations
- Clear positive bias in 10 m wind suggests a need of an enhanced roughness. Tests with OROTUR orographic parametrization are encouraging although a balance needs to be found between reducing wind bias while keeping accuracy for high wind speeds
- Besides, the wind gust estimation has been tuned to reduce False Alarms. This do not solve the problem of too high wind gusts associated with intense convection in the model.
- 1 km resolution runs clearly improve wind forecasts in Harbour Areas