Assessment of HARM-AROME model at 1.0 km over the Spanish coast for wind forecast

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• SAMOA PROJECT

• HARMONIE-AROME

• MODEL CONFIGURATION

• VERIFICATION

• UNDER WORK

• FUTURE WORK
SAMOA PROJECT

**SAMOA**

System of Meteorological and Oceanographic Support for the National Harbours.

Integration of a very fine resolution weather forecast module in SAMOA system to get high quality wind forecast on the harbours.

SAMOA I, Sept 2014 – Sept 2017
SAMOA II, under negotiation
HARMONIE-AROME

• Final version: 40h1.1
• Four domains of 1.0 km and 30 seconds time step:
  - Gulf of Biscay (432x150)
  - Mediterranean Sea (480x432)
  - Alboran Sea (480x300)
  - Canary Islands (576x256)
• Two runs per day: 00 and 12 UTC
• 48 hours forecast length

• AEMET 2.5 km operational domains:
  - Iberia (1152x864)
  - Canary Islands (576x480)
### MODEL CONFIGURATION

• **NESTING - IFS vs HARMONIE 2.5 km**

ha40h11b5 - Gulf of Biscay - July 2016

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**U10m**

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<th>Forecast Length</th>
<th>RMSE STDV (*) and bias (□)</th>
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**T2m**

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IFS --- HARM 2.5
MODEL CONFIGURATION

• DYNAMICS SCHEME - PC vs SETTLS

ha40h11 trunk - Gulf of Biscay - 10-15/01/2017

--- PC  --- SETTLS

U10m  RMSE STDV (*) and bias (□)

T2m  RMSE STDV (*) and bias (□)
MODEL CONFIGURATION

• DYNAMICS SCHEME - PC vs SETTLS

ha40h11 trunk - Gulf of Biscay - 10-15/01/2017

GPNORMS

--- PC --- SETTLS

Divergence

TKE

Vorticity

Divergence - GPNORMS - 10-15/01/2017

TKE - GPNORMS - 10-15/01/2017

Vorticity - GPNORMS - 10-15/01/2017
MODEL CONFIGURATION

- DYNAMICS SCHEME - PC vs SETTLS

ha40h11 trunk - Alboran Sea - 15/01/2016

GPNORMS

--- PC --- SETTLS

Divergence

log(PRE/PREHYD)  TKE  Vorticity

Toulouse, 16-19/04/2018  isantosa@aemet.es
• **DIFFUSION & HARATU**

- ha40h11
- SLHD
- noUPD HARATU
- SLHD+noUPD

U10m  RMSE STDV (*) and bias (□)

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**Canary Islands 16-21/03/2017**

**Alboran Sea – 01-07/12/2017**

**Gulf of Biscay – 10-15/01/2017**

**Mediterranean Sea 12-18/01/2017**
• FINAL CONFIGURATION

- HARMONIE-AROME ha40h1.1
- 1.0 km resolution and 30 seconds timestep.
- IFS 0.1° nesting.
- Dynamical adaptation.
- Predictor-corrector scheme.
- Original HARATU turbulence (update reversed).
- Semi-lagrangian horizontal diffusion (SLHD).

  Applied to hydrometeors and spectral variables except temperature.
• GULF OF BISCAY - MARCH 2017

--- HARM 1.0 km --- HARM 2.5 km --- Observations

U10m RMSE STDV (*) and bias (□)

U10m Equitable Threat Score

T2m RMSE STDV (*) and bias (□)

• GULF OF BISCAY - MARCH 2017

U10m DayVar

U10m HARM 1.0km - Observations

U10m HARM 2.5km - Observations

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Orographic drag of surface wind

• Z01D

Orographic drag is a function of orographic roughness length $Z_0$ from PGD not depending on wind direction.

$$D_{Z01D} = \rho^2 \left( \frac{0.4}{\ln \frac{H}{Z_0}} \right)^2 U$$

$$Z_0 = \min \left( Z_0, \frac{H}{XFRACZ0} \right)$$

• BE04

Orographic drag is related to subgrid orographic standard deviation

$$D_{BE04} = 2\alpha\beta C_{md} C_{corr} C_\alpha S_{st}^2 H^{-1.2} \left( e^{-\frac{H}{1500}} \right)^1.5 U$$

XCOEFBE
UNDER WORK

• DIFFUSION - SUBGRID SCALE OROGRAPHY vs SLHD

ha40h11 - Alboran Sea - October 2017

U10m RMSE STDV (*) and bias (□)

HARM 1.0 km  HARM 2.5 km
HARM 1.0 km noSLHD+Z01D_10

T2m RMSE STDV (*) and bias (□)

Toulouse, 16-19/04/2018
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• Subgrid scale orography
• Energy spectrum analysis
• Wind gusts study
• HARATU tuning
• Higher resolution orography
• Use of bigger and less domains
THANKS TO
CARL FORTELIUS
PHILIP VANA
AND ALL THE AEMET NWP DEPARTMENT
FOR THEIR SUPPORT