

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

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## OUTLOOK

- SAMOA PROJECT
- HARMONIE-AROME
- MODEL CONFIGURATION
- VERIFICATION
- UNDER WORK
- FUTURE WORK

## • 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

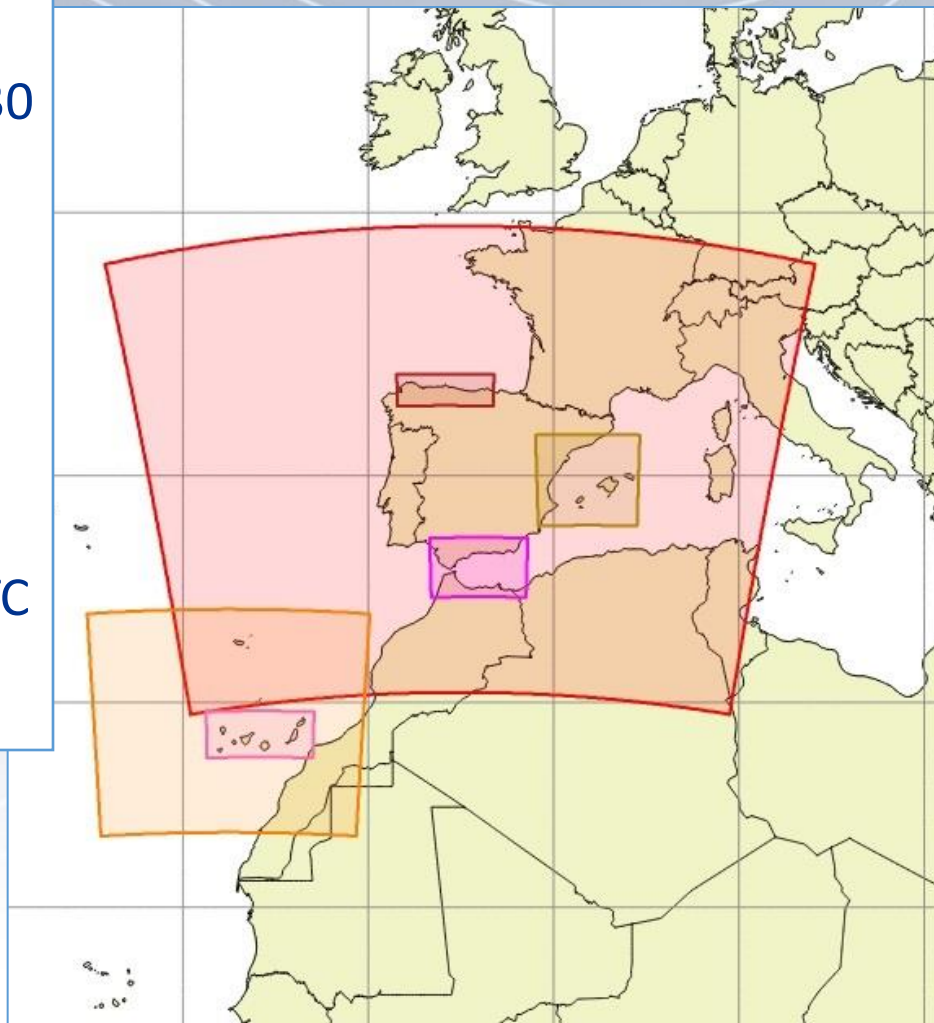
SAMOA





## 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)



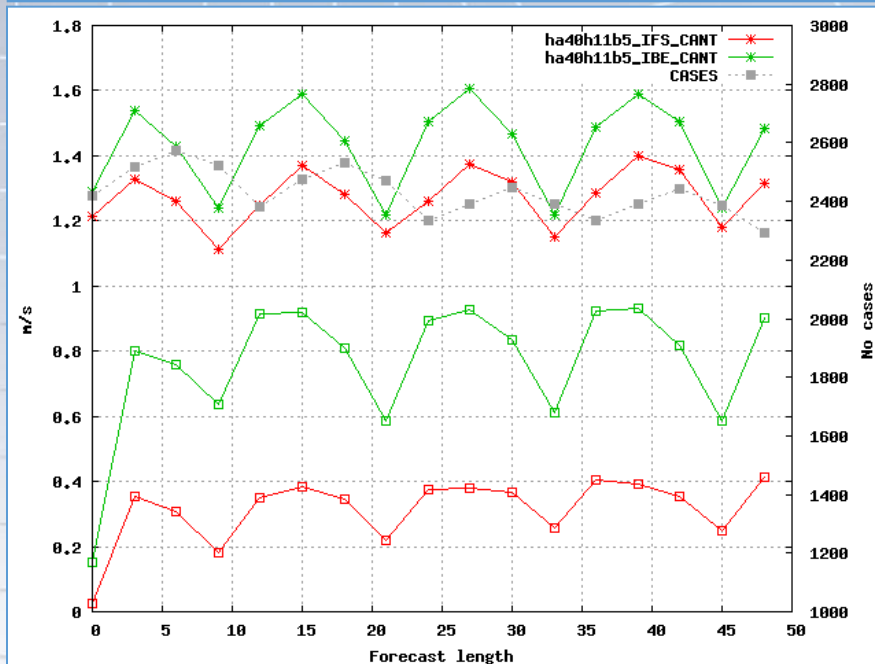
# MODEL CONFIGURATION

## • NESTING - IFS vs HARMONIE 2.5 km

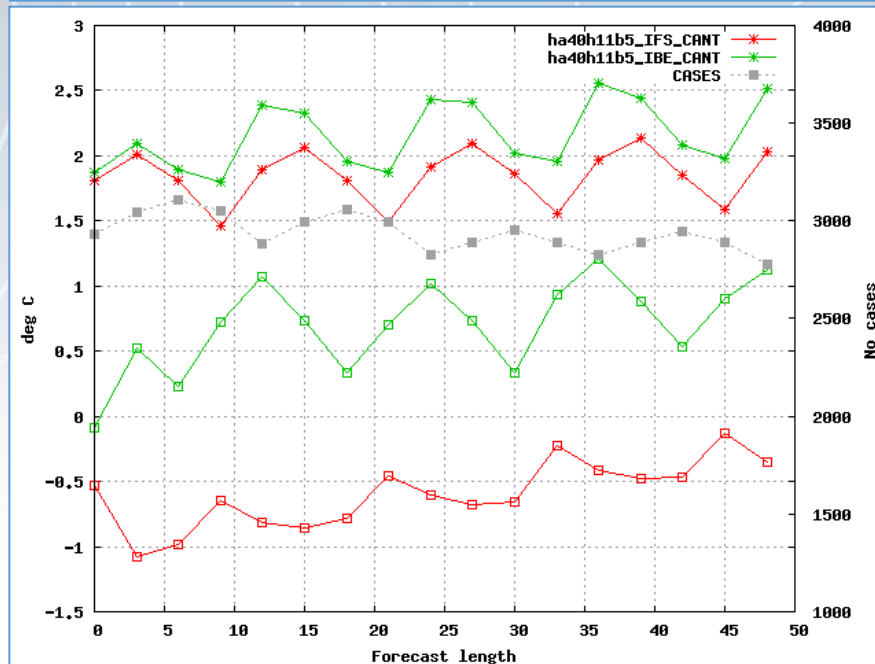
ha40h11b5 - Gulf of Biscay - July 2016

--- IFS --- HARM 2.5

U10m RMSE STDV (\*) and bias (□)



T2m RMSE STDV (\*) and bias (□)



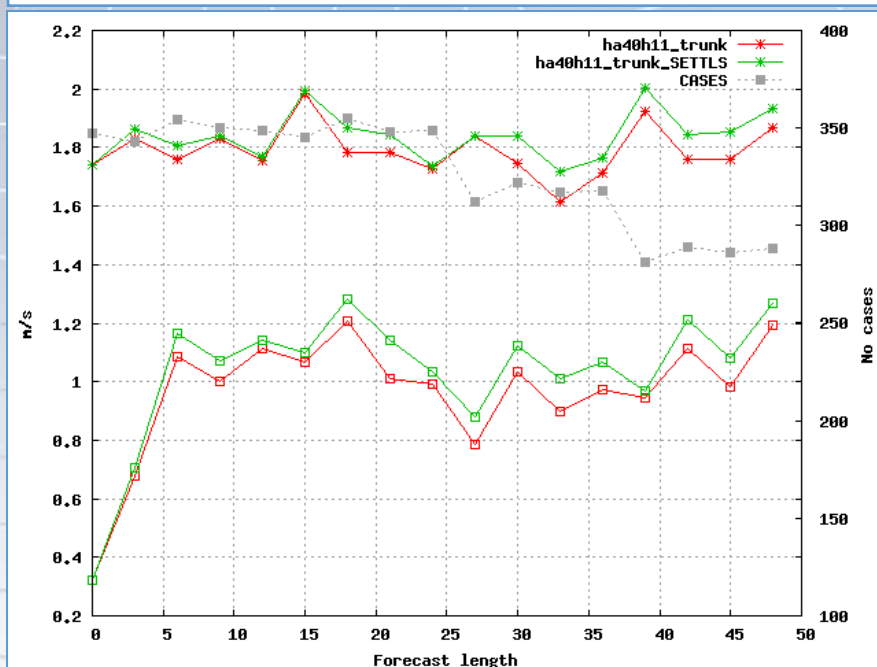
# MODEL CONFIGURATION

## • DYNAMICS SCHEME - PC vs SETTLS

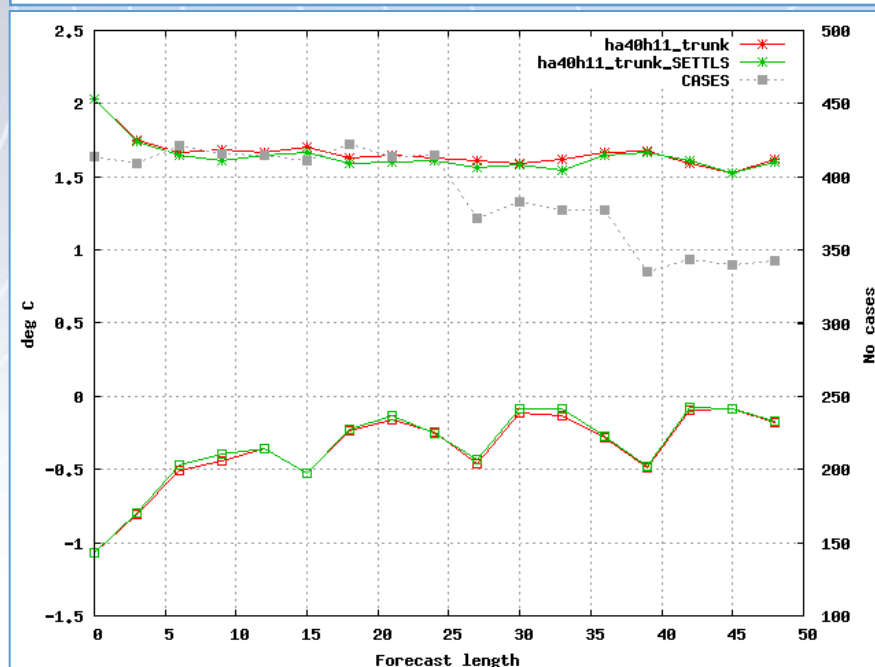
ha40h11 trunk - Gulf of Biscay - 10-15/01/2017

--- PC --- SETTLS

U10m RMSE STDV (\*) and bias (□)



T2m RMSE STDV (\*) and bias (□)



# MODEL CONFIGURATION



GOBIERNO DE ESPAÑA

MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE



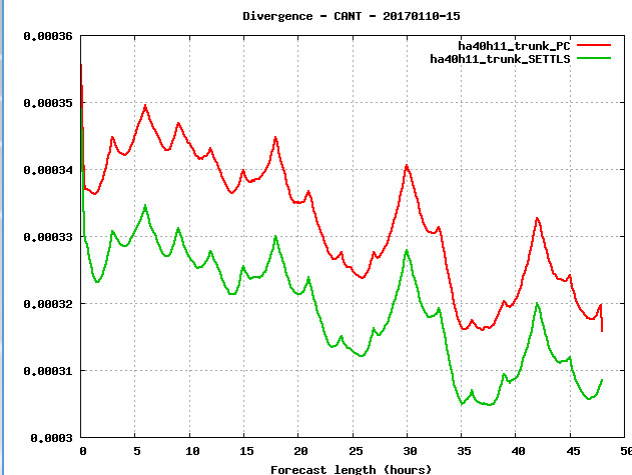
## • DYNAMICS SCHEME - PC vs SETTLS

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

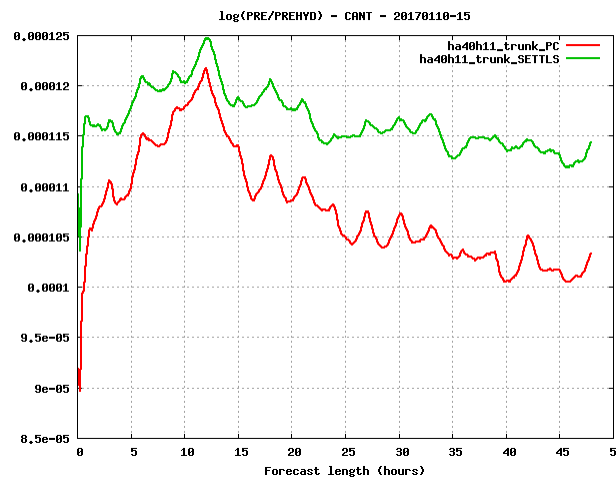
GPNORMS

--- PC --- SETTLS

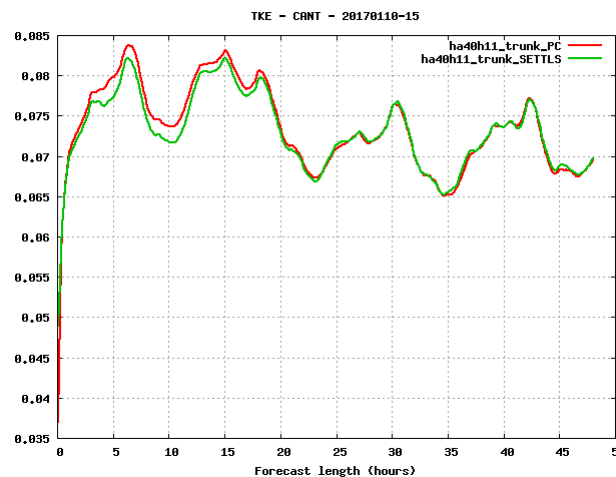
### Divergence



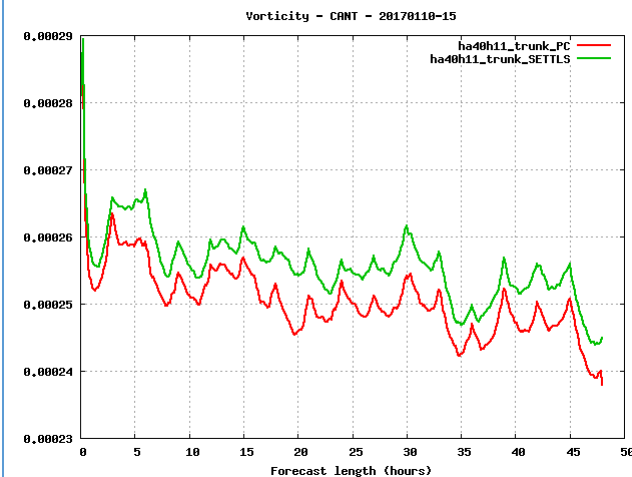
### log(PRE/PREHYD)



### TKE



### Vorticity





# MODEL CONFIGURATION

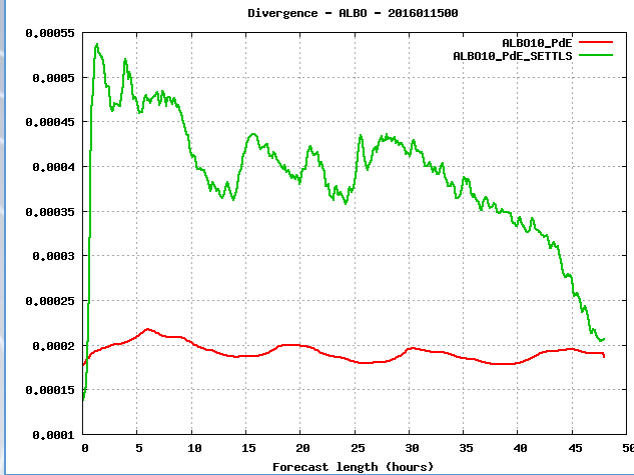
## • DYNAMICS SCHEME - PC vs SETTLS

ha40h11 trunk - Alboran Sea - 15/01/2016

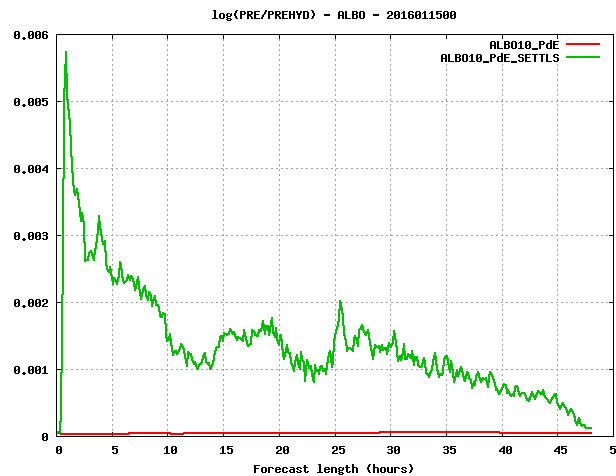
GPNORMS

--- PC --- SETTLS

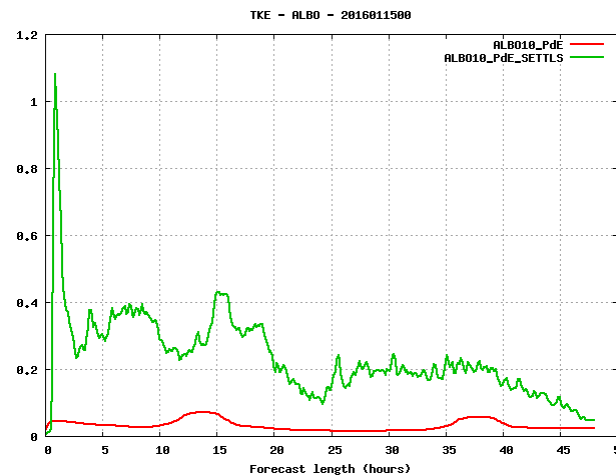
### Divergence



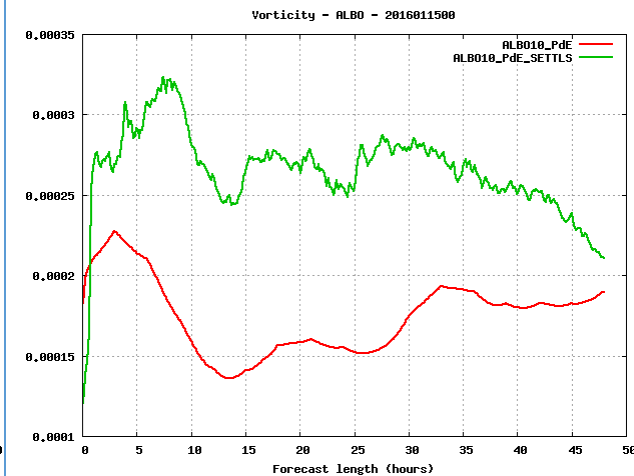
### log(PRE/PREHYD)



### TKE



### Vorticity





# MODEL CONFIGURATION



GOBIERNO DE ESPAÑA

MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE

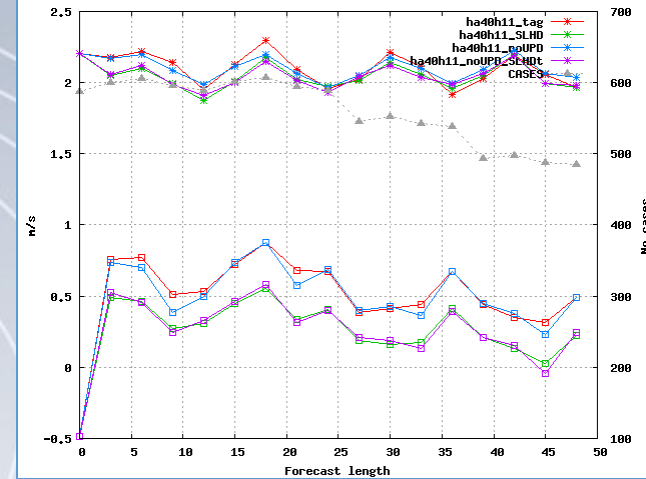


## • DIFFUSION & HARATU

- ha40h11
- SLHD
- noUPD HARATU
- SLHD+noUPD

U10m RMSE STDV (\*) and bias (□)

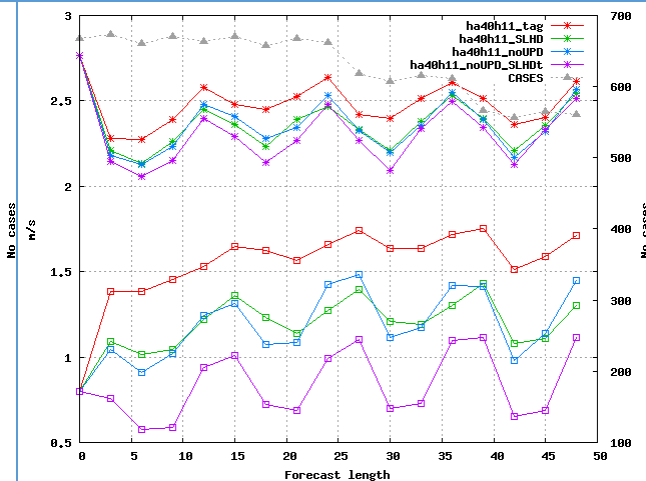
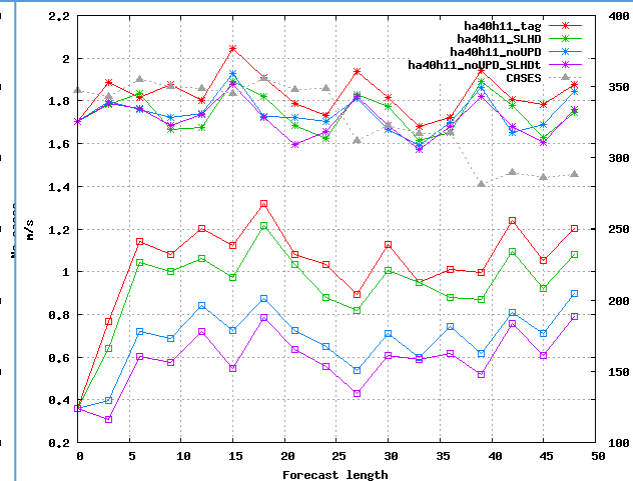
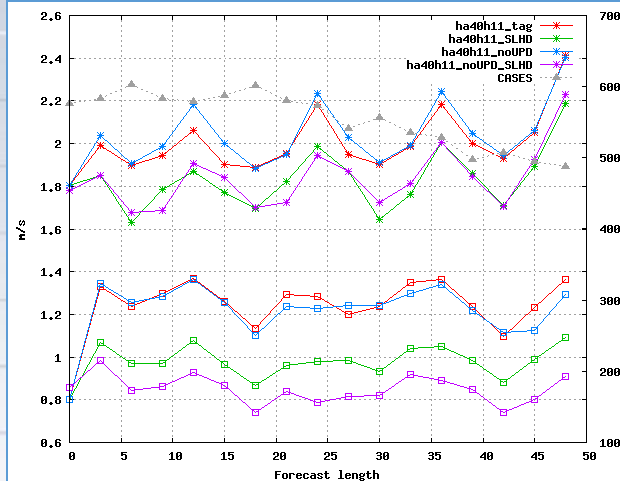
Canary Islands 16-21/03/2017



Alboran Sea – 01-07/12/2017

Gulf of Biscay – 10-15/01/2017

Mediterranean Sea 12-18/01/2017



## MODEL CONFIGURATION



### • 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).

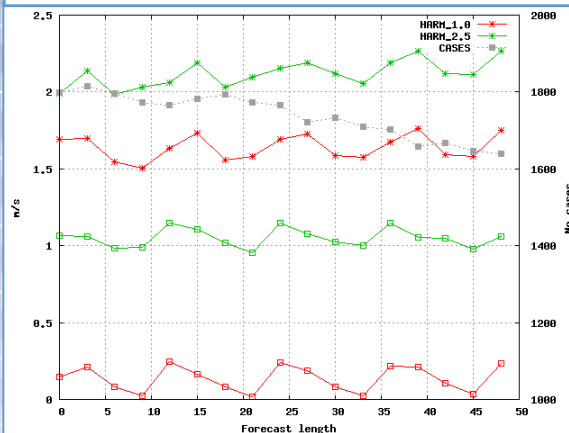
Applied to hydrometeors and spectral variables except temperature.

# VERIFICATION

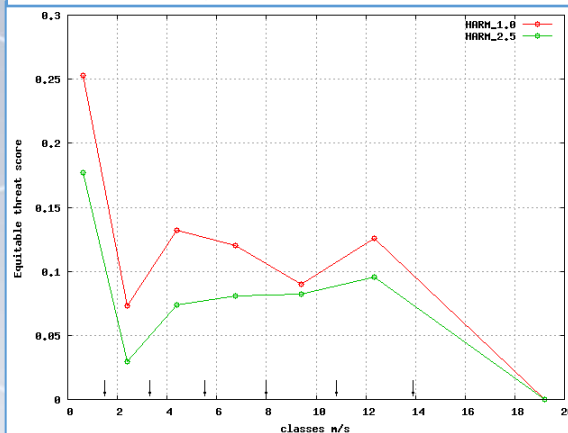
## • GULF OF BISCAY - MARCH 2017

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

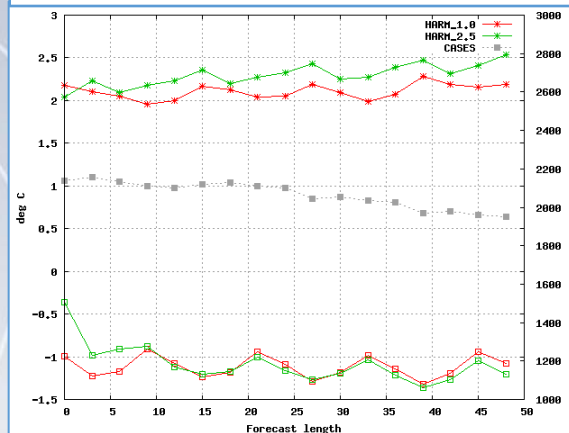
U10m RMSE STDV (\*) and bias (□)



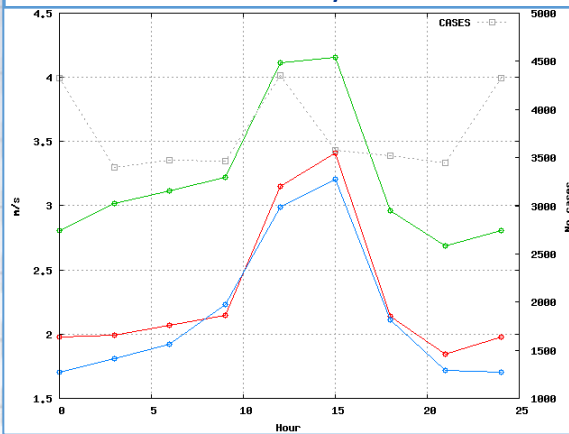
U10m Equitable Threat Score



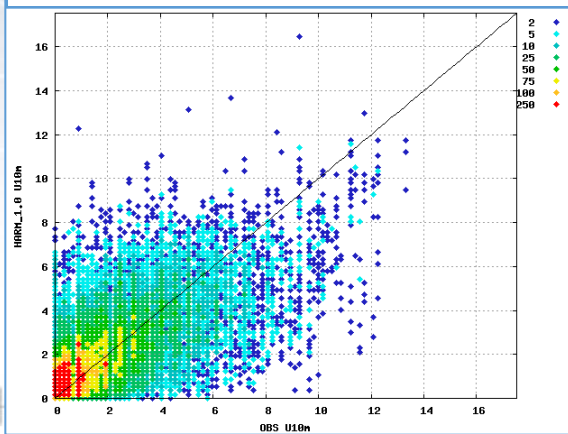
T2m RMSE STDV (\*) and bias (□)



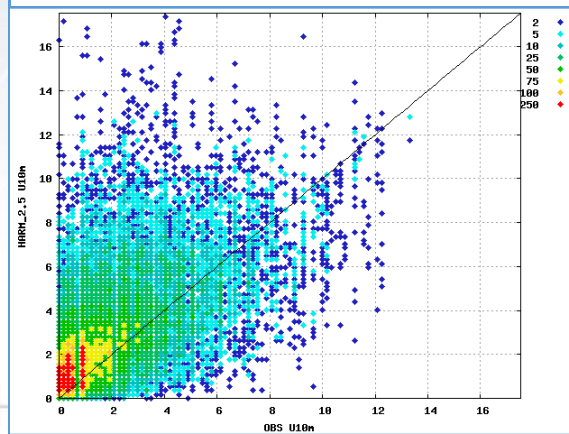
U10m DayVar



U10m HARM 1.0km - Observations



U10m HARM 2.5km - Observations



• DIFFUSION - SUBGRID SCALE OROGRAPHY vs SLHD

Orographic drag of surface wind

• Z01D

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

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

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

• 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



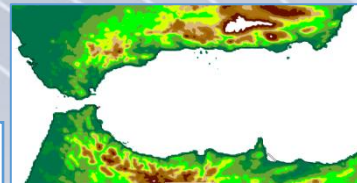
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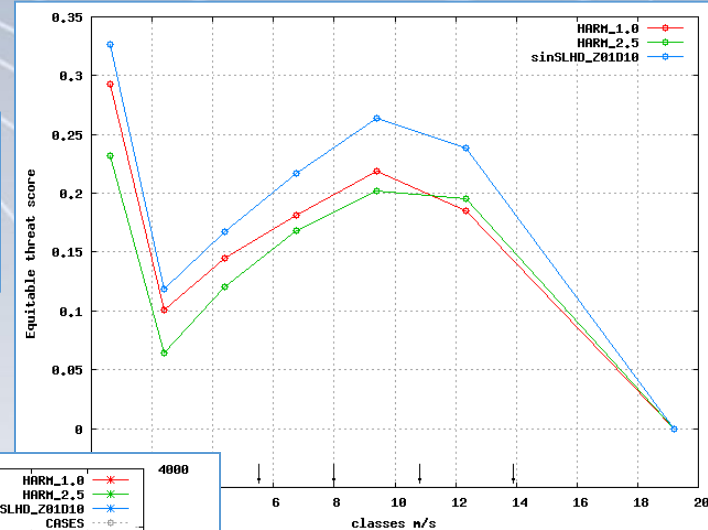


## • DIFFUSION - SUBGRID SCALE OROGRAPHY vs SLHD

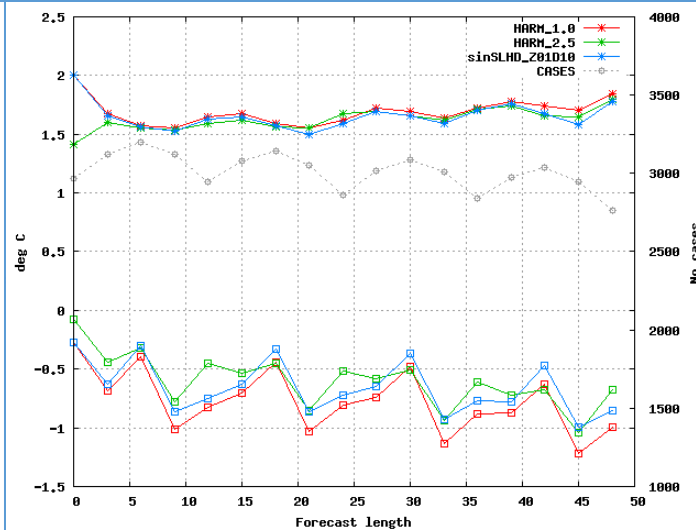
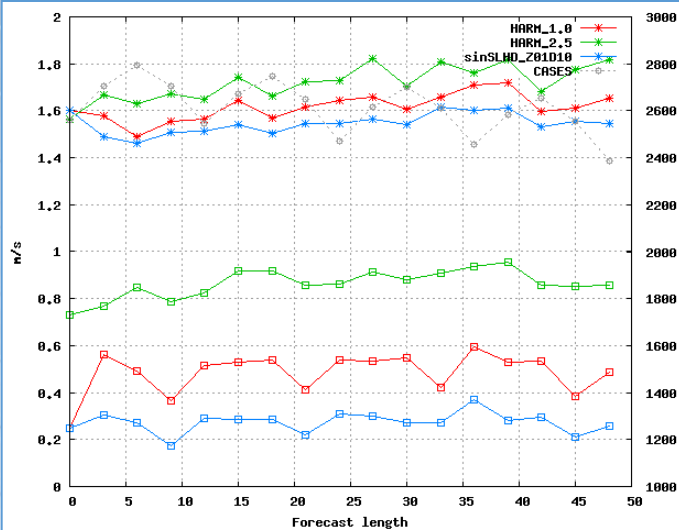
ha40h11 - Alboran Sea - October 2017



- HARM 1.0 km    --- HARM 2.5 km
- HARM 1.0 km noSLHD+Z01D\_10



U10m RMSE STDV (\*) and bias (□)



U10m ETS

T2m RMSE STDV (\*) and bias (□)

## FUTURE WORK

- Subgrid scale orography
- Energy spectrum analysis
- Wind gusts study
- HARATU tuning
- Higher resolution orography
- Use of bigger and less domains

THANKS TO  
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PHILIP VANA  
AND ALL THE AEMET NWP  
DEPARTMENT  
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