AEMET-gSREPS: an Iberian Ensemble Prediction System for predicting the uncertainty of the Short Range Forecasts

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IPMA partners: Joao Rio and Vanda Costa

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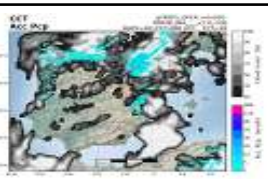
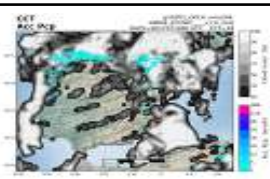
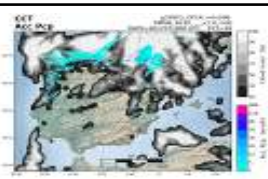
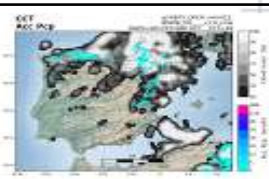
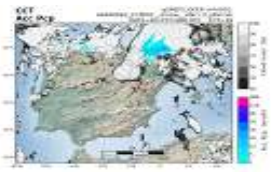
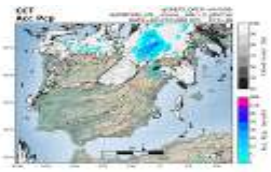
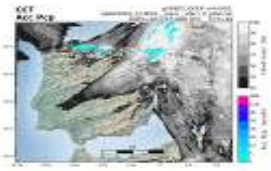
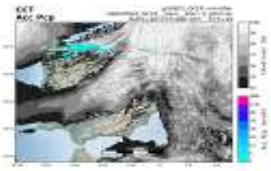
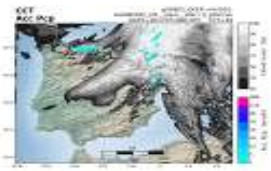
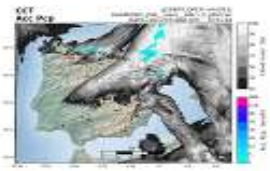
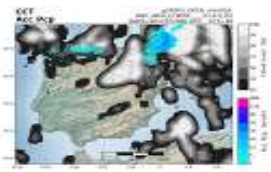
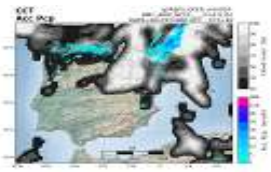
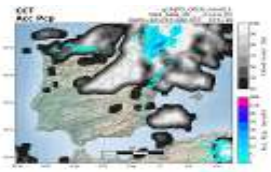
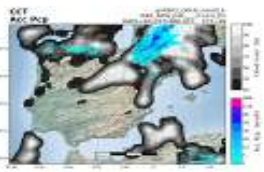
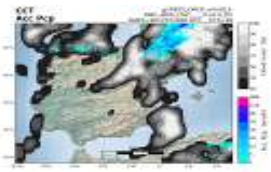
"A previsão numérica do tempo em Portugal:
estado da arte e novos desafios"

I will talk about...

- Some words on the design of AEMET-gSREPS
- A real operational case at the prediction centre of Barcelona
- Presentation of the web tool and collaboration with IPMA

- Some words on the design of AEMET-gSREPS

- 20-members *non-hydrostatic convection-permitting* EPS
- Since April 2016 daily running at 00 and 12 UTC up to 36 hours ➔ currently up to 48 hours !!!

Multi-BCs / Multi-NWP	ECMWF / IFS	NCEP / GFS	MF / ARPÈGE	JMA / GSM	CMC / GEM
HARMONIE-AROME					
HARMONIE-ALARO					
WRF ARW					
NMMB					

- Developing a *convection-permitting* LAM-EPS
  - 3 sources of uncertainties

1 INITIAL CONDITIONS

2019 LETKF assimilation

2 BOUNDARY CONDITIONS

HH+24

3 MODEL *ERROR*

25 members ¿ GEM-LAM ?

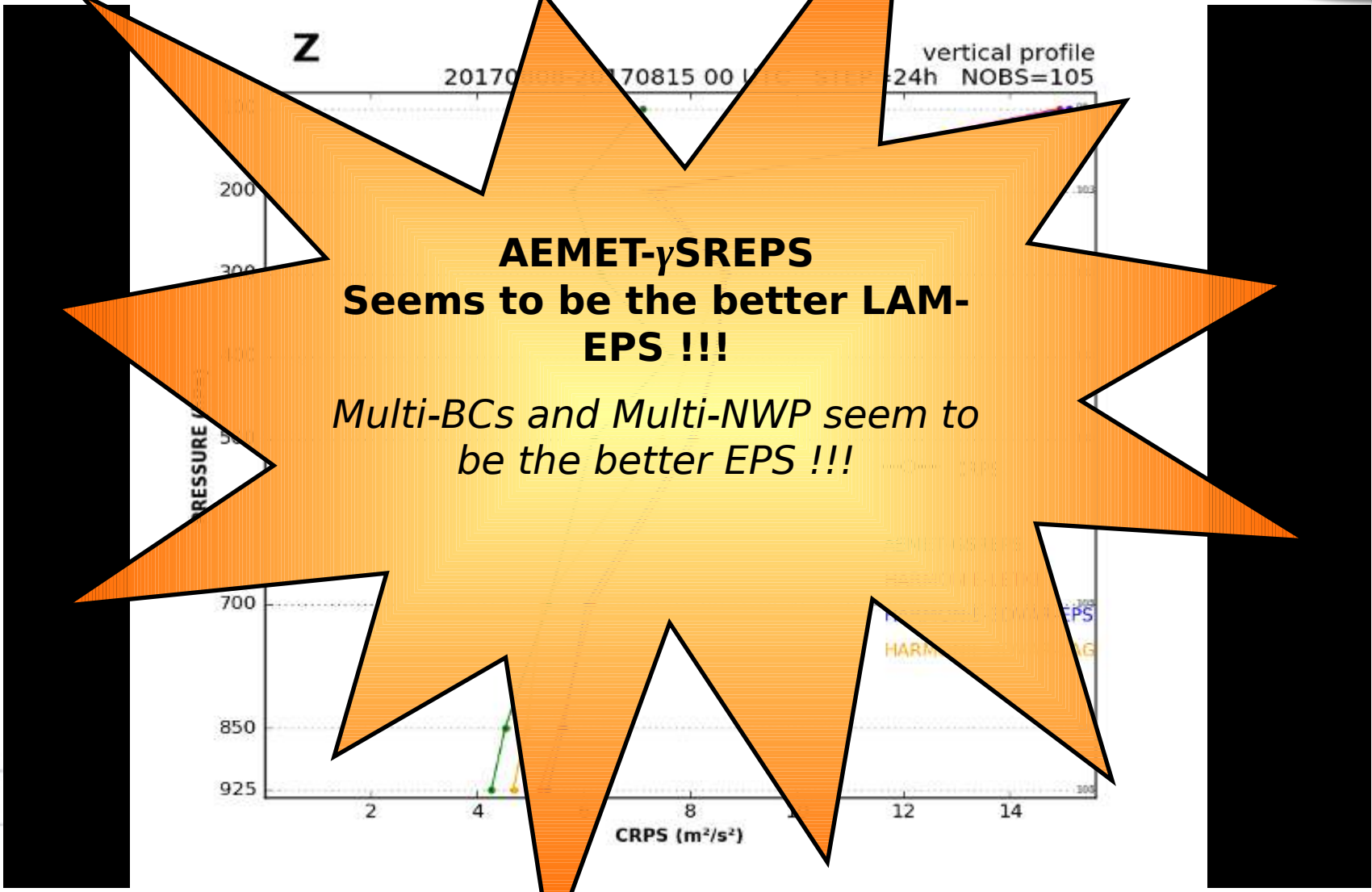
Initial conditions

HH+01 n-member ensemble

2-hour assimilation window

- **Multi-model**
  - **HARMONIE-AROME**
  - **HARMONIE-ALARO**
  - **WRF-ARW (NCAR)**
  - **NMMB (NCEP)**
  - **JMA – GSM (Japanese)**

- **AEMET-γSREPS ➔ without assimilation**
- **HARMONIE-LETKF ➔ As HarmonEPS, but with LETKF**
- **HARMONIE-3DVAR-EPS ➔ HarmonEPS ➔ 3DVAR-NMC + EC-SLAF**
- **HARMONIE-3DVAR-LAG ➔ 8 mbrs det. HARMONIE**



AEMET-γSREPS
Seems to be the better LAM-EPS !!!

Multi-BCs and Multi-NWP seem to be the better EPS !!!

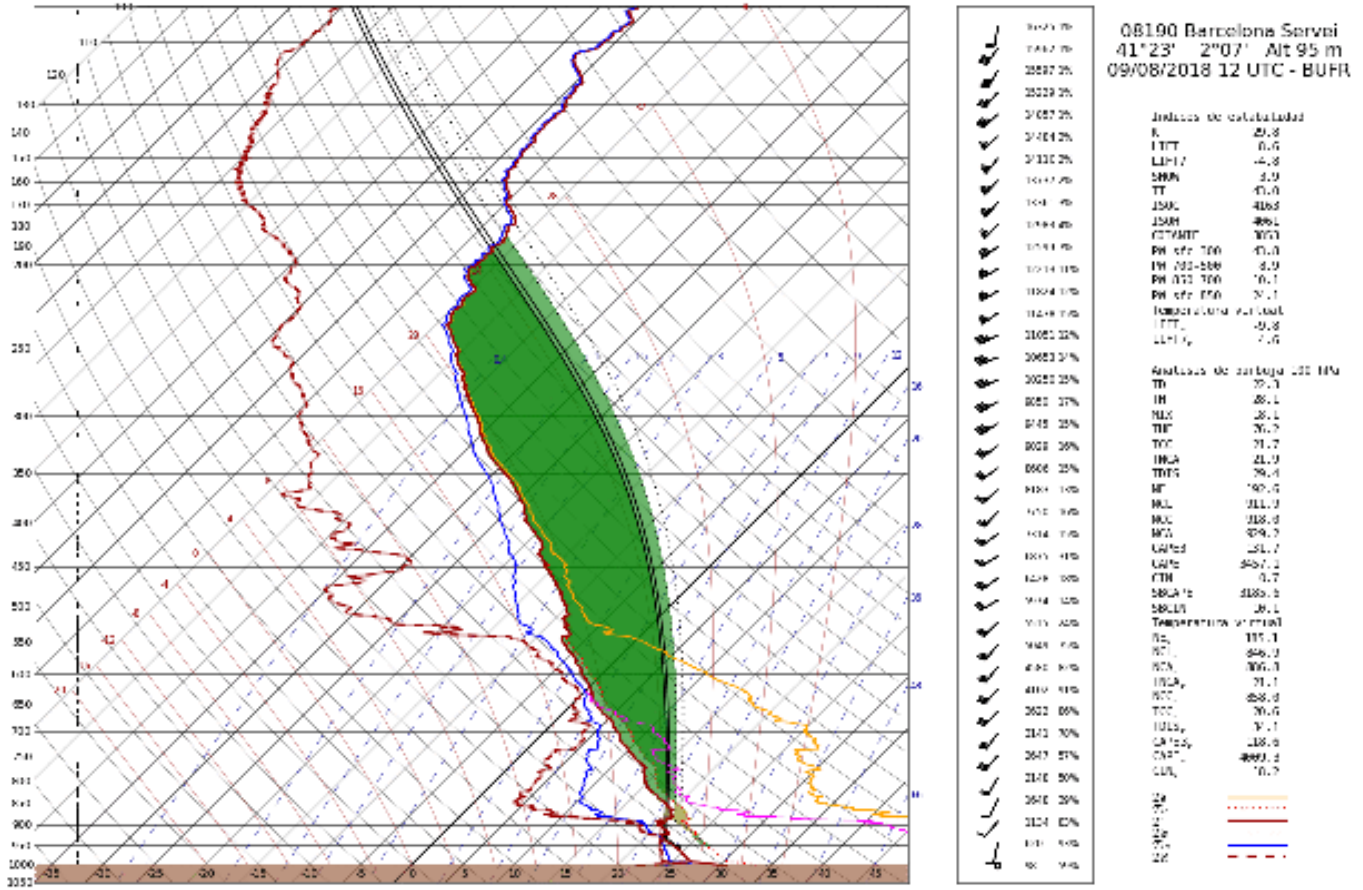
- AEMET-gSREPS in an operational case

Convection due to wind convergence with unstability between Barcelona and Balearic Islands

- Convection associated to wind convergences in a Tramontana/Cierzo winds situation with high unstability in the Mediterranean. This is quite usual weather pattern in the Catalan coast.
- Many times the problem is predicting where and when the wind convergence is going to happen, because this will define storm development.
- Barcelona Radiosonde of 12 UTC on 9th August says there is large unstability in medium to high levels.

Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

Barcelona Radiosonde for 12 UTC 9Ago18 (CAPE). **Large unstability**



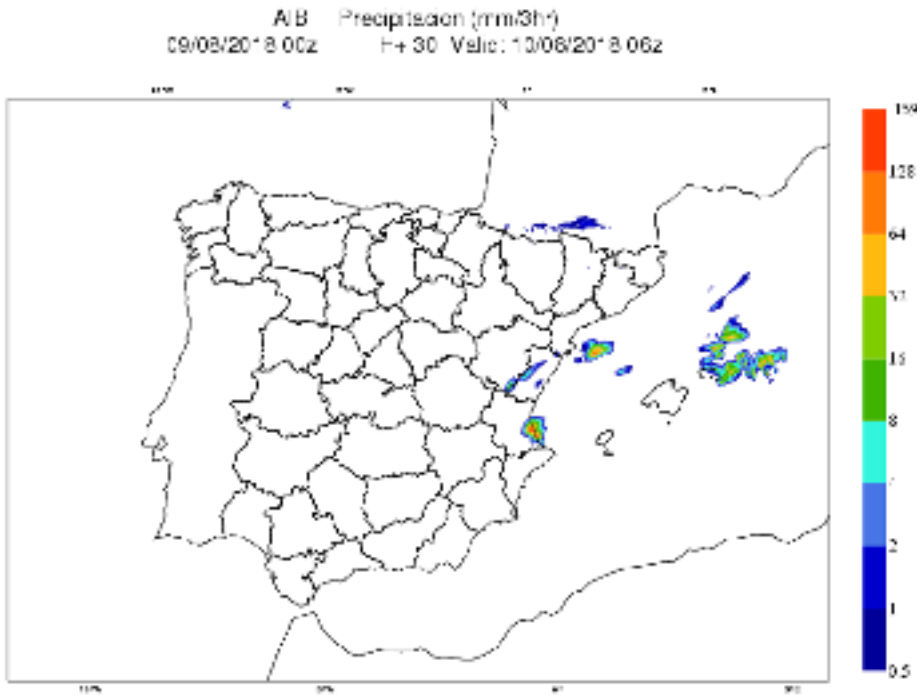
Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

- Operational HARMONIE at 00 UTC of 9Ago10 gives a strong convective development of more than 128 mm/3h that appears in the Catalan Central Coast and moves to Balearic Islands, hitting Mallorca and Menorca Islands in 24 hours
- On the other hand, HARMONIE at 12 UTC, closer to the event, doesn't forecast this event, but gives a different convective development towards Ibiza Island, some hours after.
- The 925 hPa wind convergence forecast maps show the different spatio-temporal location of convergences in front of Catalan Cost.
- In summary, it exists a clear discrepancy between runs

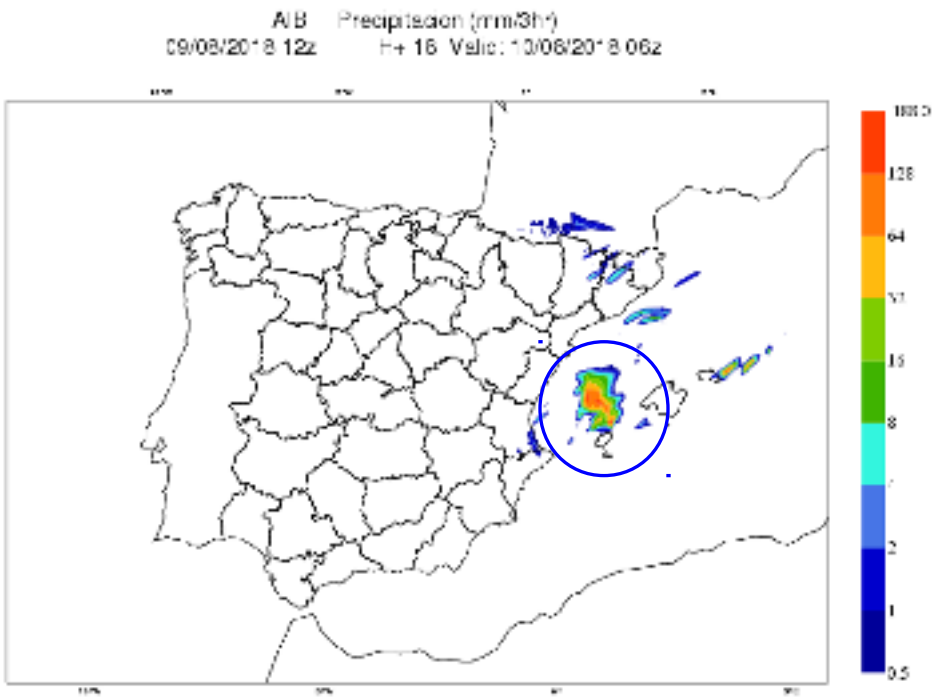
Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

3 hour Accumulated Precipitation maps

HARMONIE 40 00 UTC



HARMONIE 40 12 UTC

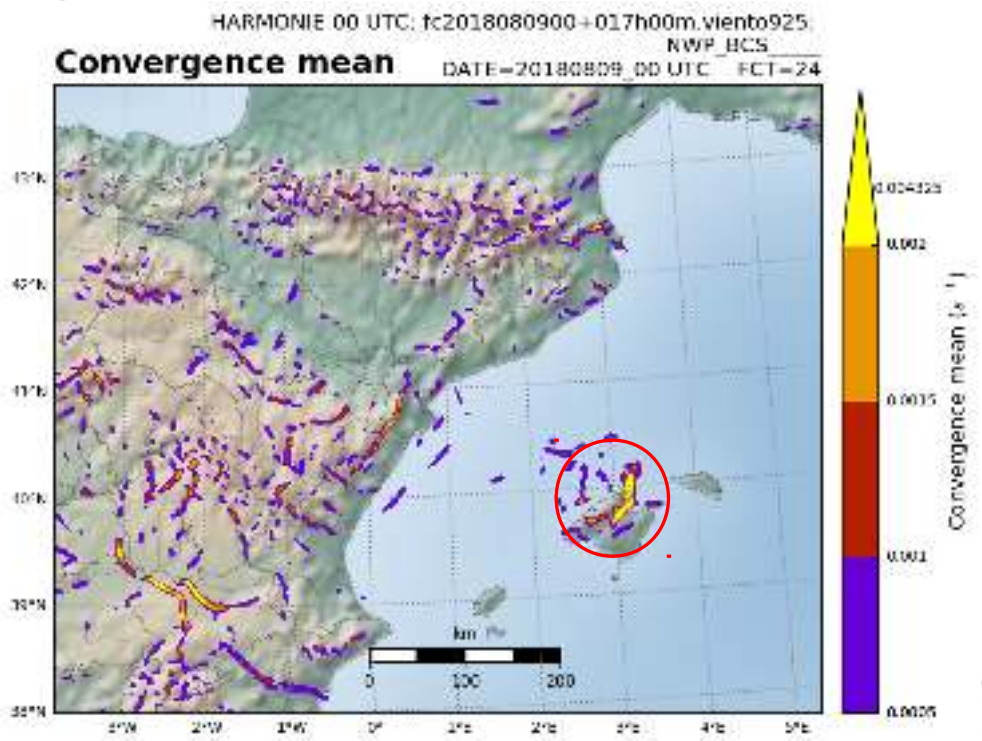


Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

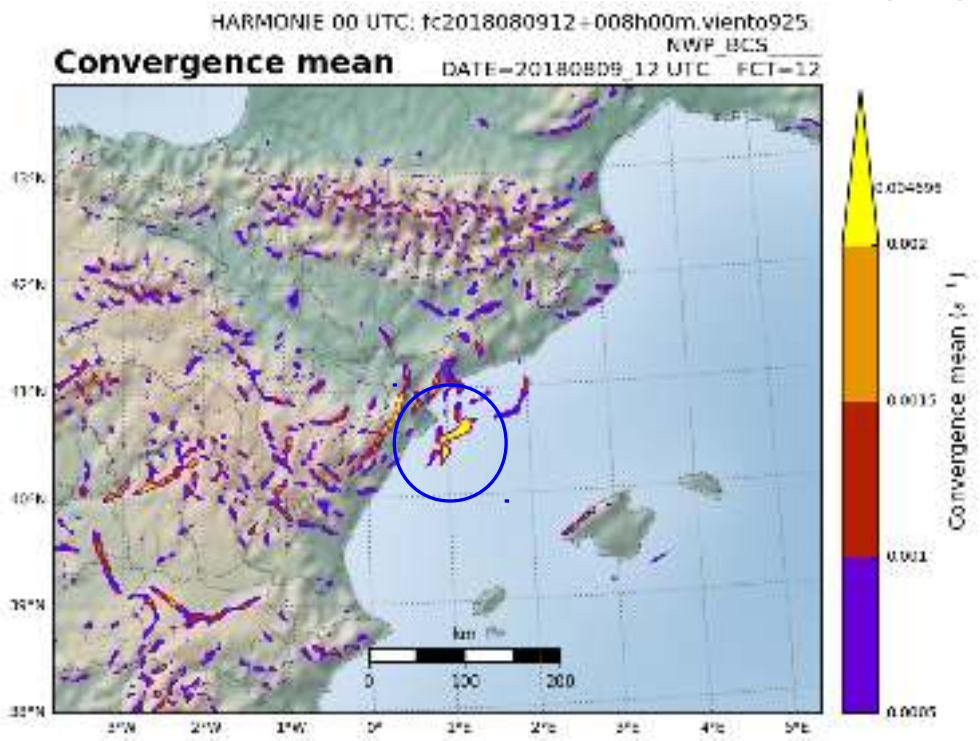
Mean Wind Convergence Maps

HARMONIE 40 00 UTC

12



HARMONIE 40 12 UTC



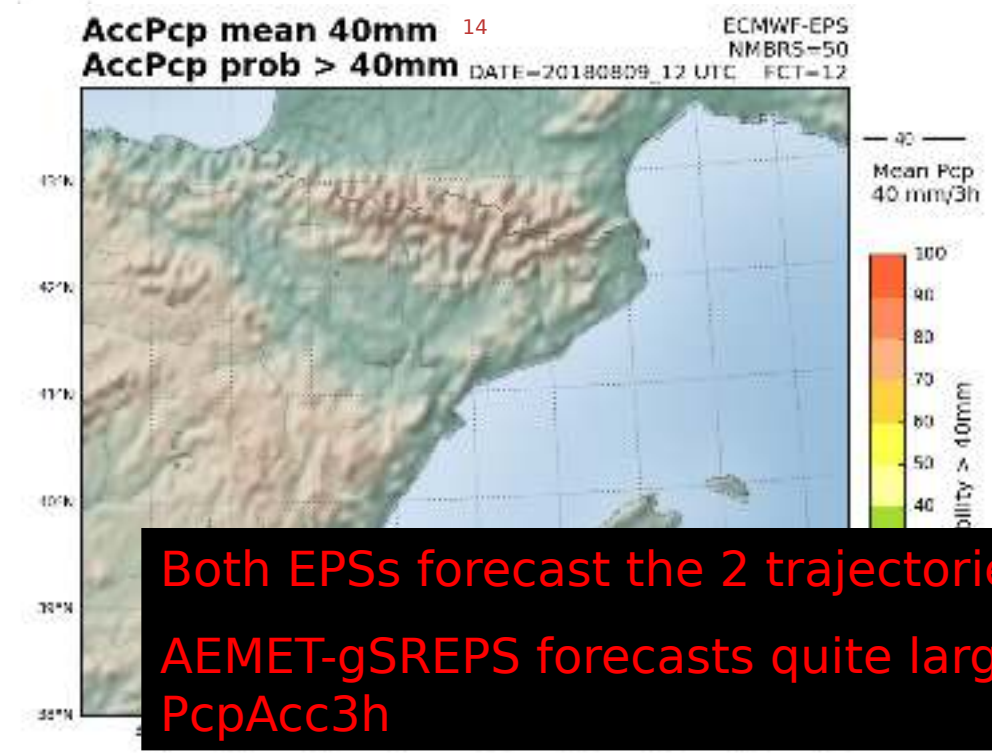
Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

- From HARMONIE log files there is apparently no problem in the Data Assimilation. At 12 UTC we have the largest number of observations assimilated: 11146
- With all this information we shouldn't trust only the latest run. What is more likely is that we are facing a weather situation with high uncertainty, so here an EPS tool can be very useful.

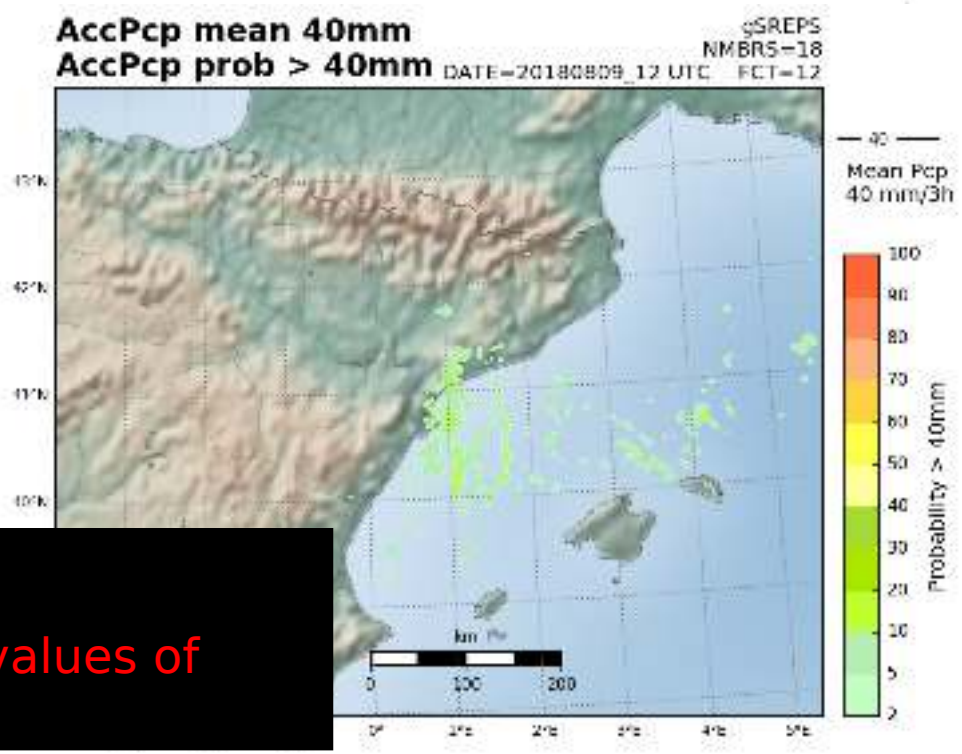
Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

3 hour AccPcp Probabilities for different thresholds at H+12. First hit in Mallorca and Menorca

ECMWF-EPS 12 UTC



AEMET-gSREPS 12 UTC



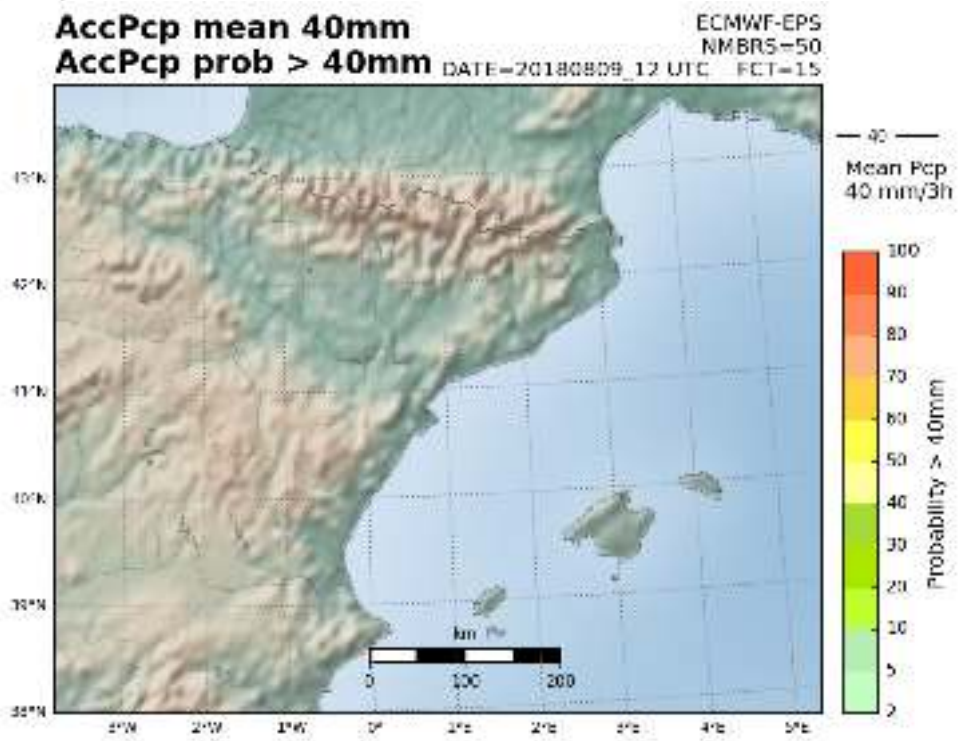
Both EPSs forecast the 2 trajectories

AEMET-gSREPS forecasts quite larger values of PcpAcc3h

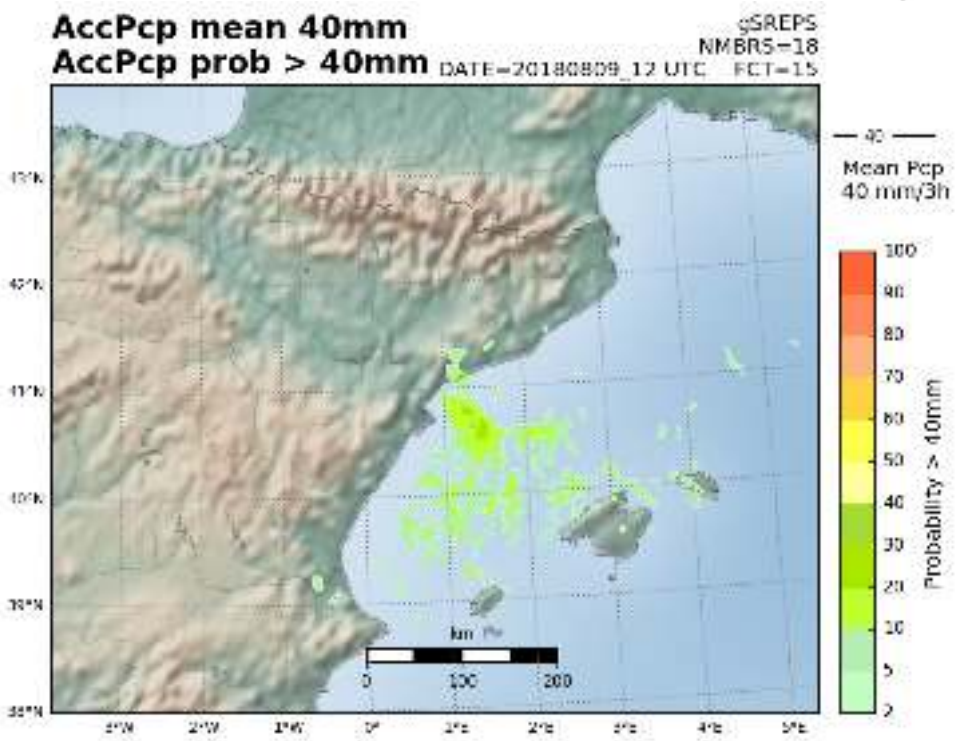
Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

3 hour AccPcp Probabilities for different thresholds at H+15. Development of the Ibiza Cell

ECMWF-EPS 12 UTC



AEMET-gSREPS 12 UTC

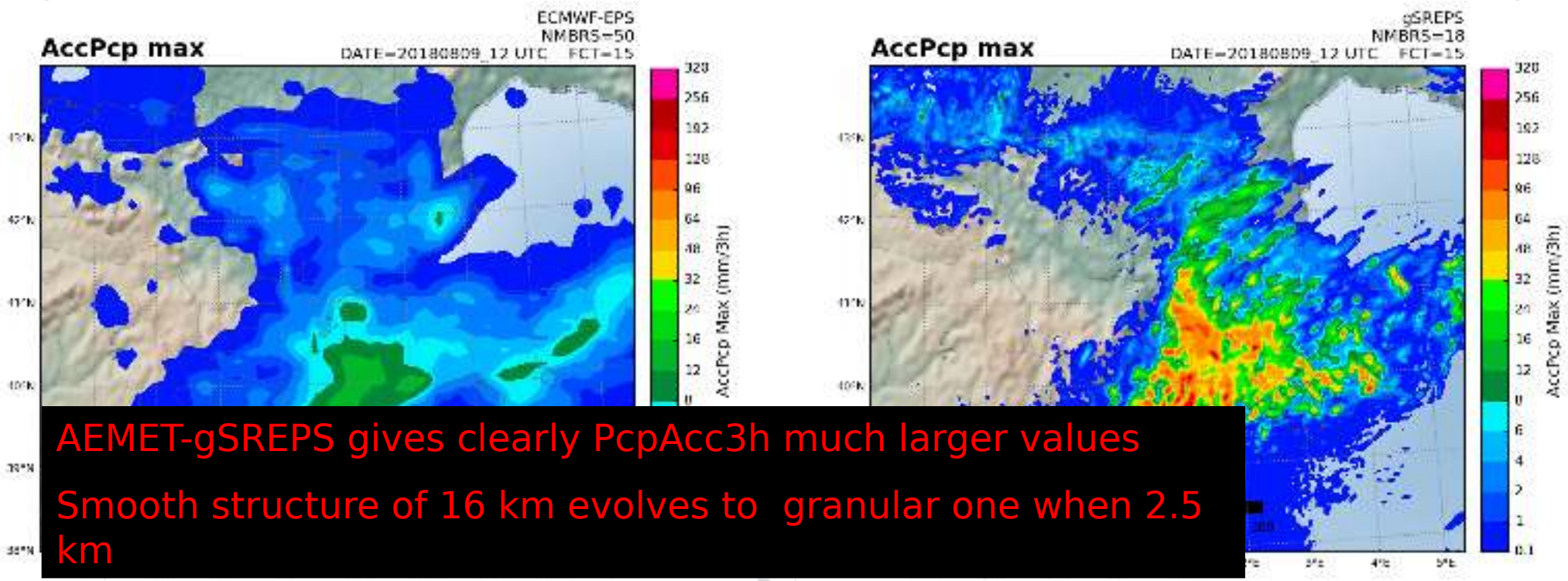


Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

Maximum 3 hour AccPcp at H+12 and H+15

ECMWF-EPS 12 UTC

AEMET-gSREPS 12 UTC



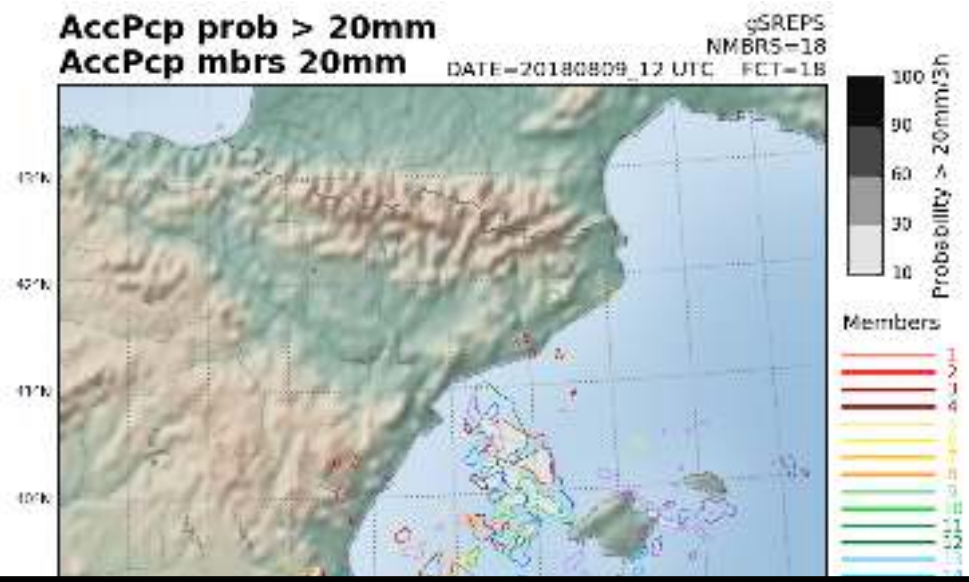
AEMET-gSREPS gives clearly PcpAcc3h much larger values

Smooth structure of 16 km evolves to granular one when 2.5 km

Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

3 hour AccPcp Areas with more than 20 mm for each member

AEMET-gSREPS 12 UTC. PCP>20mm



Members predict severe precipitation with spatial uncertainty

Members that use ECMWF as BC don’t see Mallorca/Menorca trajectory. On the other hand, the rest of members do. In particular the ones that use JMA (purple color). This is the multi-model effect...

Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

- ECMWF-EPS and AEMET-gSREPS forecast de 2 trajectories. This confirms discrepancies in HARMONIE 00 and 12 UTC come from the uncertainty due to the inherent error of prediction (caos).
- One advantage of AEMET-gSREPS in this case is that it gives probabilities for more than 40 mm of precipitation in 3 hours. This values, as we will see later, correspond better to the observed values. This result is due to the convection-permitting nature of AEMET-gSREPS at 2.5 km resolution, with respect to ECMWF-EPS, at 16 km.

Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

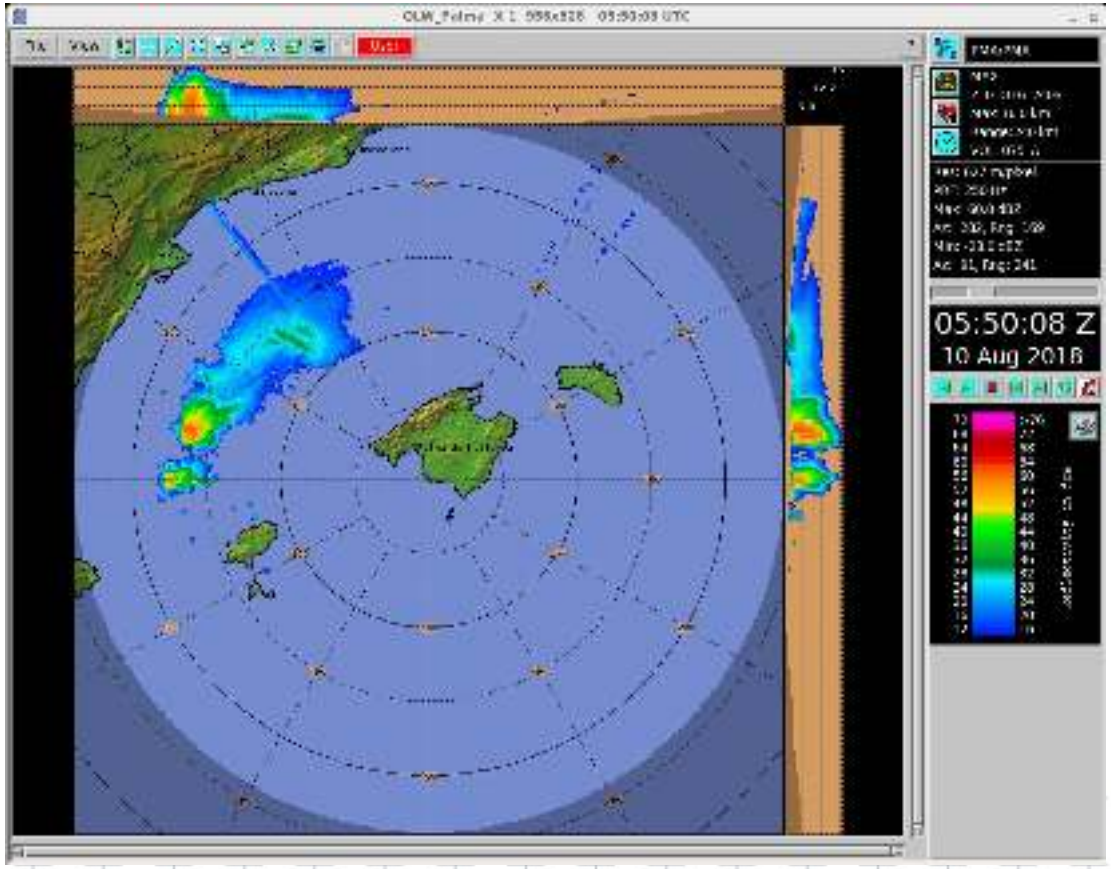
- Although probabilities of AEMET-gSREPS are low, it must be taken into account these probabilities are soften due to the spatial displacement of small convective structures. This doesn't mean in any case that precipitation intensities are not going to be (very) high, but we have uncertainty in its localization. Be careful!
- The multi-model effect of the boundary conditions of AEMET-gSREPS makes Mallorca/Menorca trajectory is seen by our system. Models JMA, GFS, MF and CMC see it, on the other hand, ECMWF not.

Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

- AEMET-gSREPS allows stronger trust on convective cells can hit either Mallorca/Menorca or Ibiza, with severe precipitation intensitites.
- In this case the forecaster decided to issue an orange warning for the 3 islands. This was the correct prediction.
- Finally, the event happened in what seemed a mixing of HARMONIE 00 and 12 forecasts… And AEMET-gSREPS supported… The storm hit the 3 islands!

Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

Reflectivity (Z-10min) from 18UTC 9Ago18 to 06UTC 10Ago18

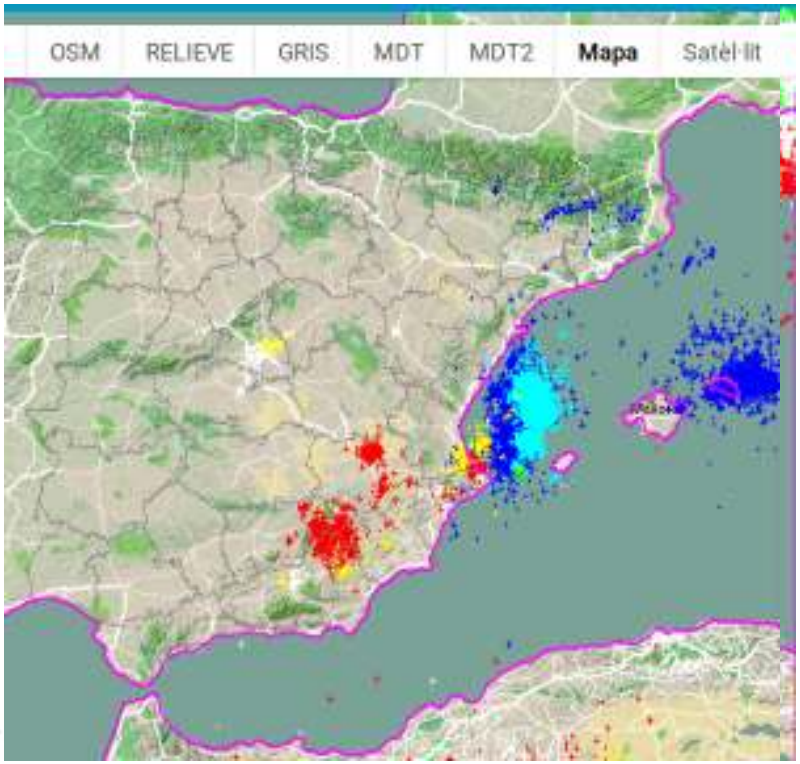


Following Marshall-Palmer Relationship (Z=200*R^1.6) we have maximum values of 3 hour accumulated precipitation around 150 mm (50-60 dBz)

Convection due to wind convergences with unstability between Barcelona and Balearic Islands (9-10Ago18)

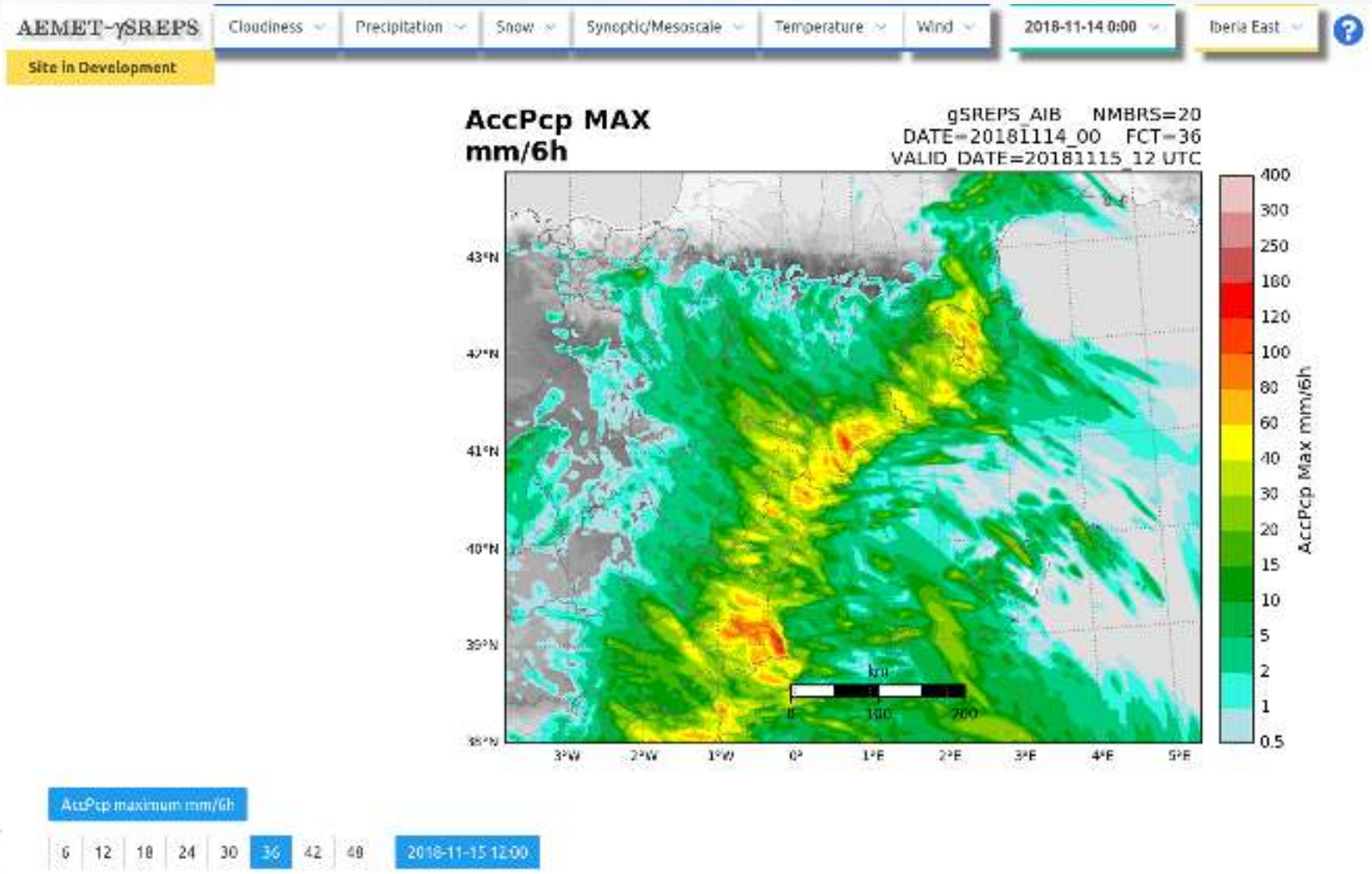
Reflectivity (Z-30min) from 03UTC to 07UTC Ago18

Accumulated lighting in the days 9Ago18 and 10Ago18



- The web tool and the collaboration with IPMA

The web tool of gSREPS (more than 3000 products)



Collaboration with IPMA

- Since Autmun 2017 we are collaborating with IPMA in Short Range EPS: Joao Rio and Vanda Costa
- The plan is IPMA can access directly our web page, this is better than look at 3000 products ☺, with the areas of PORTUGAL and MADEIRA
- IPMA is helping us with computing power on ECMWF HPCF
- We want to maintain this collaboration… larger domain?

Any question

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Gràcies/Obrigado