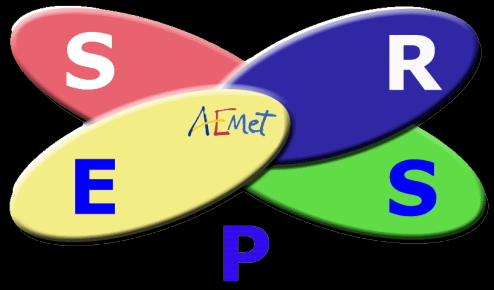


AEMET-γSREPS

Convection-permitting LAM-EPS at Spanish Met Agency

2019 ALADIN/HIRLAM Joint 29th Workshop All-Stall Meeting MADRID

AEMET γSREPS Predictability Group

Alfons Callado, Pau Escribà, David Quintero, Mauri Martínez

Maria Rosa Pons (EPSgrams collaboration), David Gil (WEB collaboration)

***Carlos Santos (consultant),* José Antonio García-Moya (retired)**

MÉTÉOFrance

François Bouttier *(AROME-EPS verification collaboration)*

Overview

- Who are we ? AEMET predictability group
- What is AEMET-γSREPS?
  - And why is multi-boundary multi-NWP LAM-EPS ?
- Designing AEMET-γSREPS
- A taste of verification:
  - Objective and subjective
- γSREPS in operations *phase test*:
  - Running and forecasters web page
- Foreseeable developments

Who are we ?

AEMET-γSREPS Predictability group

- Since 2002 an small core group working on Limited Area (LAM) Ensemble Prediction Systems (EPS) depending on Research Department
- Members of HIRLAM-HarmonEPS and involved in several projects: EUMETNET SRNWP EPS 2019-2023, PreFlexMS, COASTEPS, etc., and collaborations on EPSs with IPMA-AEMET, **AROME-EPS** **MétéoFrance**, **ALARO** people, etc.

José Antonio García-Moya
(retired on May 2018)
BCs and experiments
on all aspects of EPS

Alfons Callado γSREPS operational development

Mauri Martínez
(CLARITY project)
γSREPS support
and verification

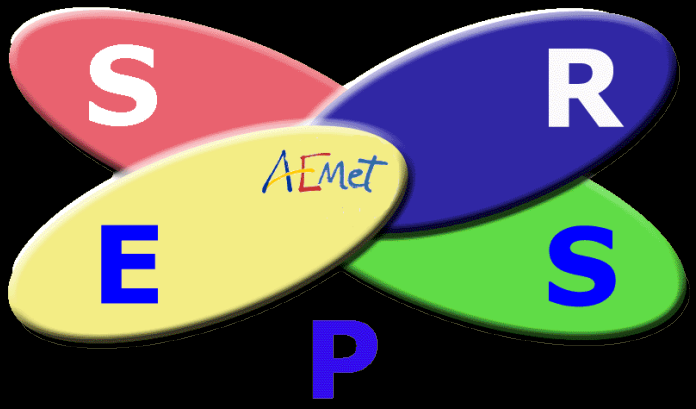
Pau Escribà
Assimilation
LETKF

XXXXX XXXX
Looking for
a new fighter !!!

David Quintero
machine learning
and γSREPS support

Mariona Pons
(collaboration)
Aeronautic products
AEROgrams

David Gil (collaboration) web page

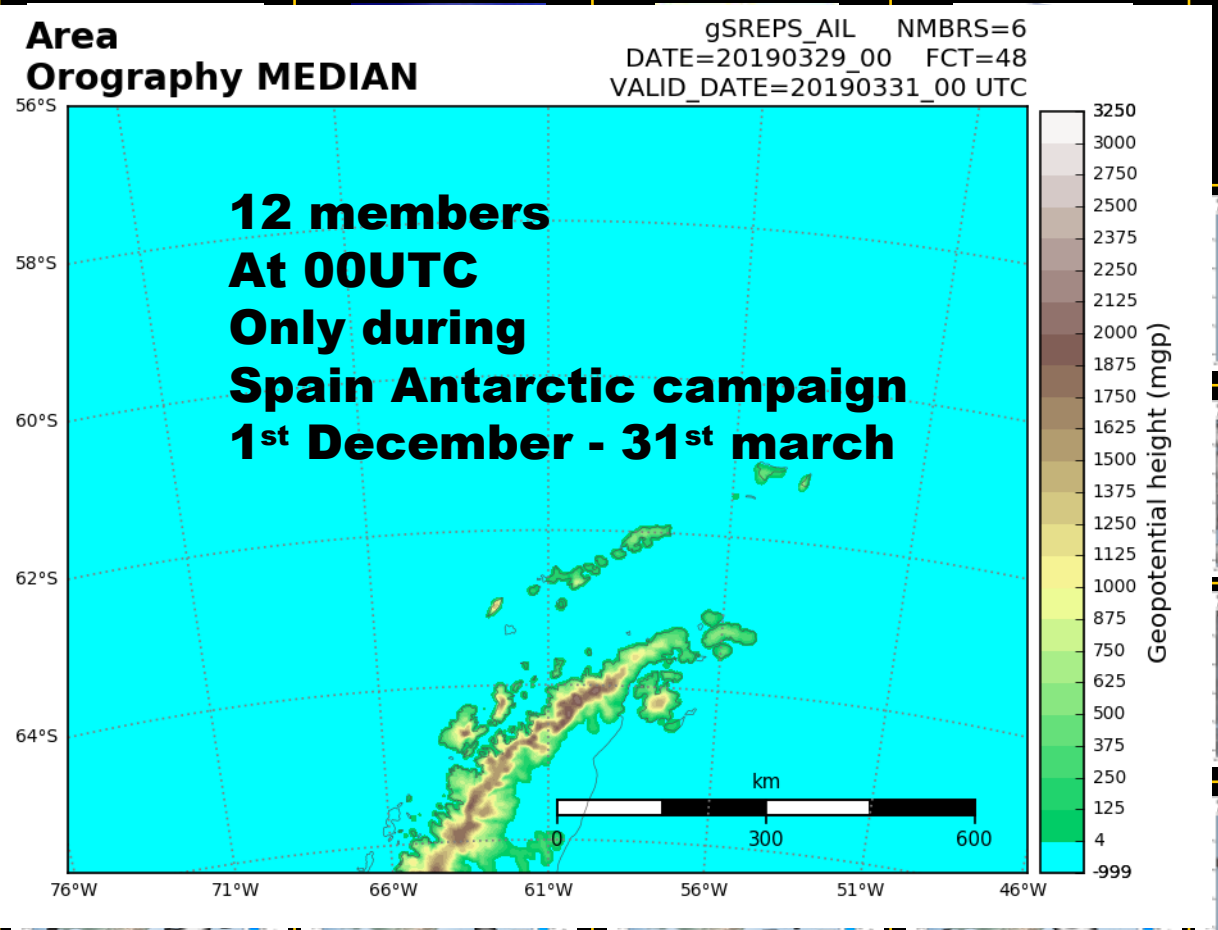


What is AEMET-γSREPS ?

AEMET-γSREPS system

- 20-members ***non-hydrostatic convection-permitting*** LAM-EPS
- Since April 2016 daily running at 00/12 UTC up to 48 hours (2018)
- **3 DOMAINS**: ***IBERIA_2.5***, ***CANARIAS_2.5*** and ***LIVINGSTON_2.5*** (Antarctica)

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



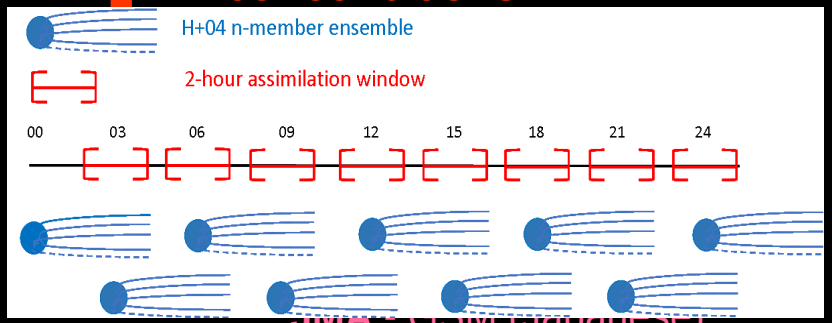
AEMET-γSREPS

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

1 INITIAL CONDITIONS

2019
Assimilation
LETKF
or 3DVAR EDA

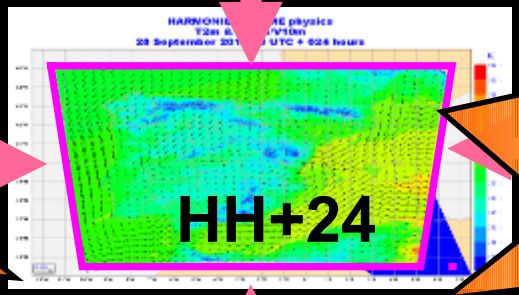
Initial conditions

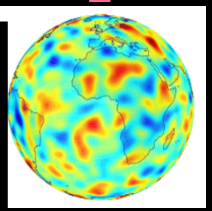


JMA - GSM (Japanese)

2 BOUNDARY CONDITIONS

~Synoptic uncertainty





3 MODEL *ERROR*

~Mesoscale uncertainty

25 members
GEM-LAM

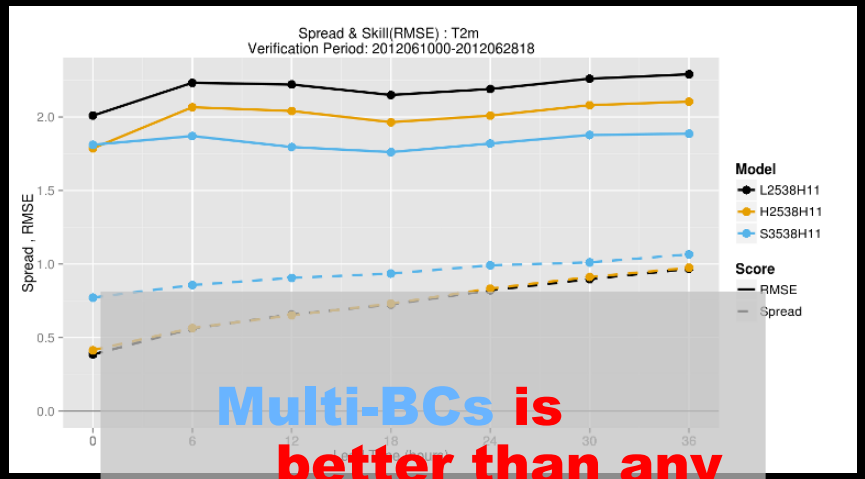
Multi-model

- HARMONIE-AROME
- HARMONIE-ALARO
- WRF-ARW (NCAR)
- NMMB (NCEP)

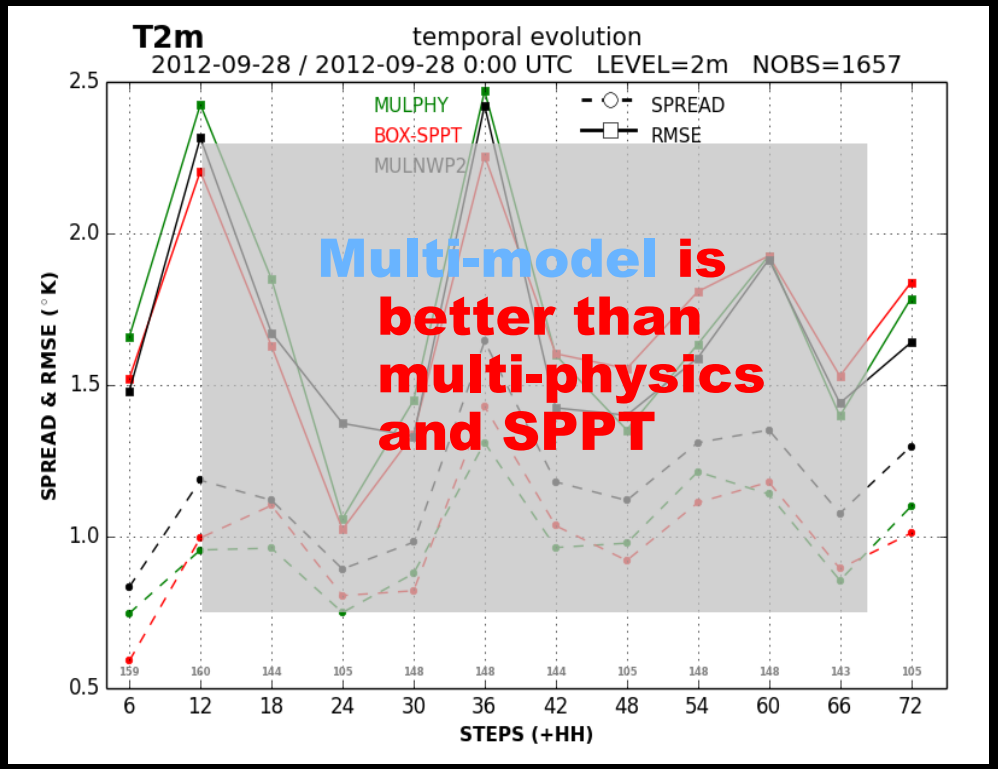
Why is AEMET-γSREPS *multi-boundaries* and *multi-model* ?

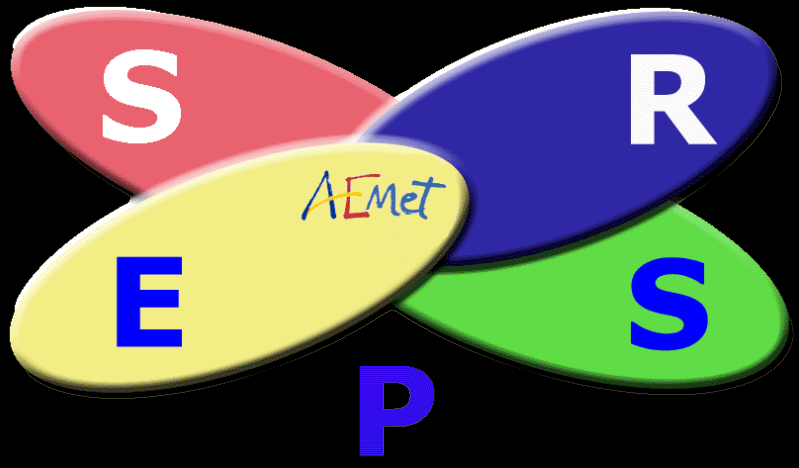
Multi-boundaries and *multi-model* γSREPS

- **Why ?**
  - **Because it holds the better LAM-EPS we can offer to our forecasters especially for convection *uncertainty***
    - **Better spread-skill relationship**



T2m verifications





Designing AEMET-γSREPS

Summary of models in γSREPS:
4 NWP MODELS

HA

AROM

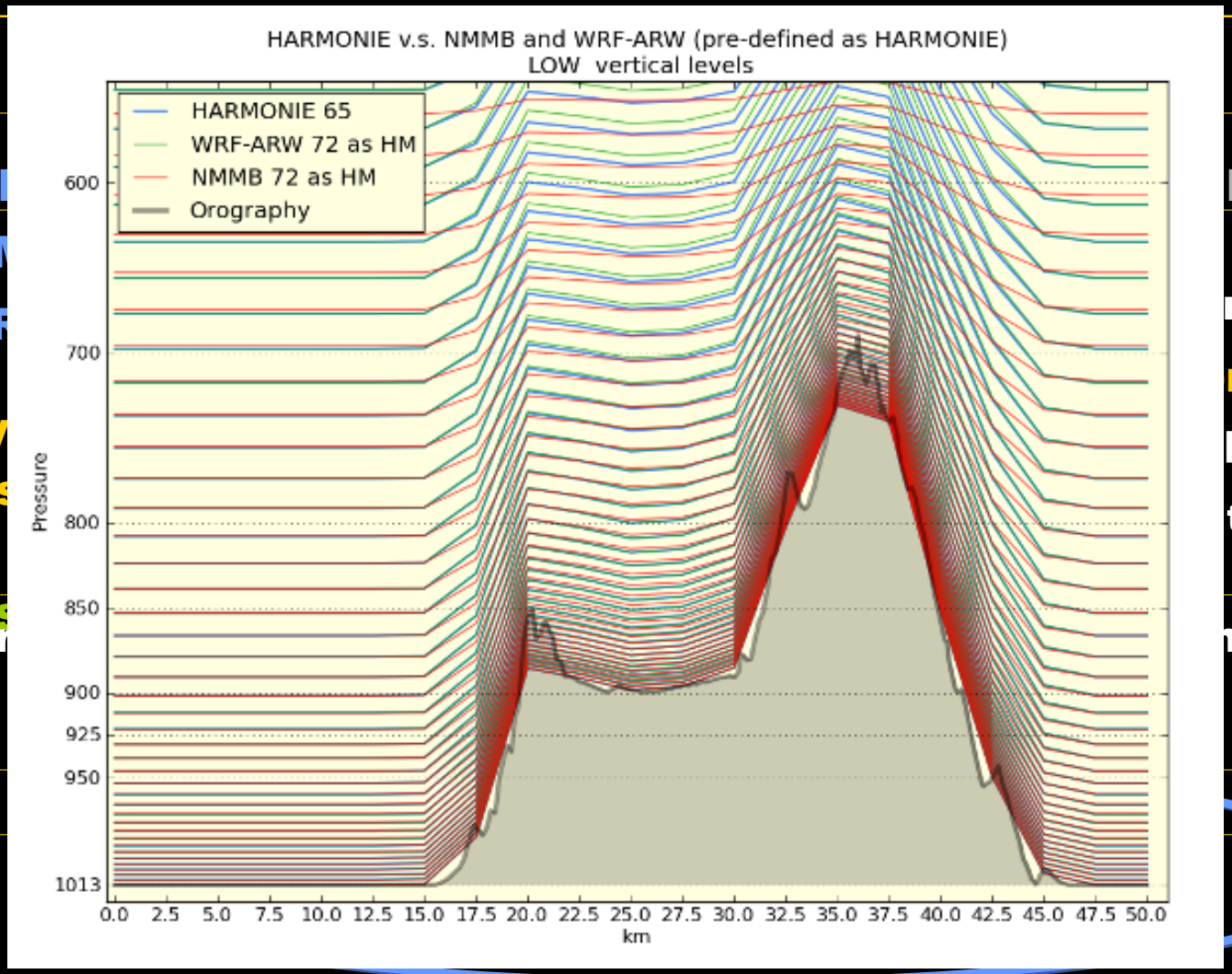
ALAR

65 Hy

press

60 s

Lamber



MB

mical core

rid sigma-

p to 40 hPa

time step

n-lat B-grid:

40.0° centre

grid-points

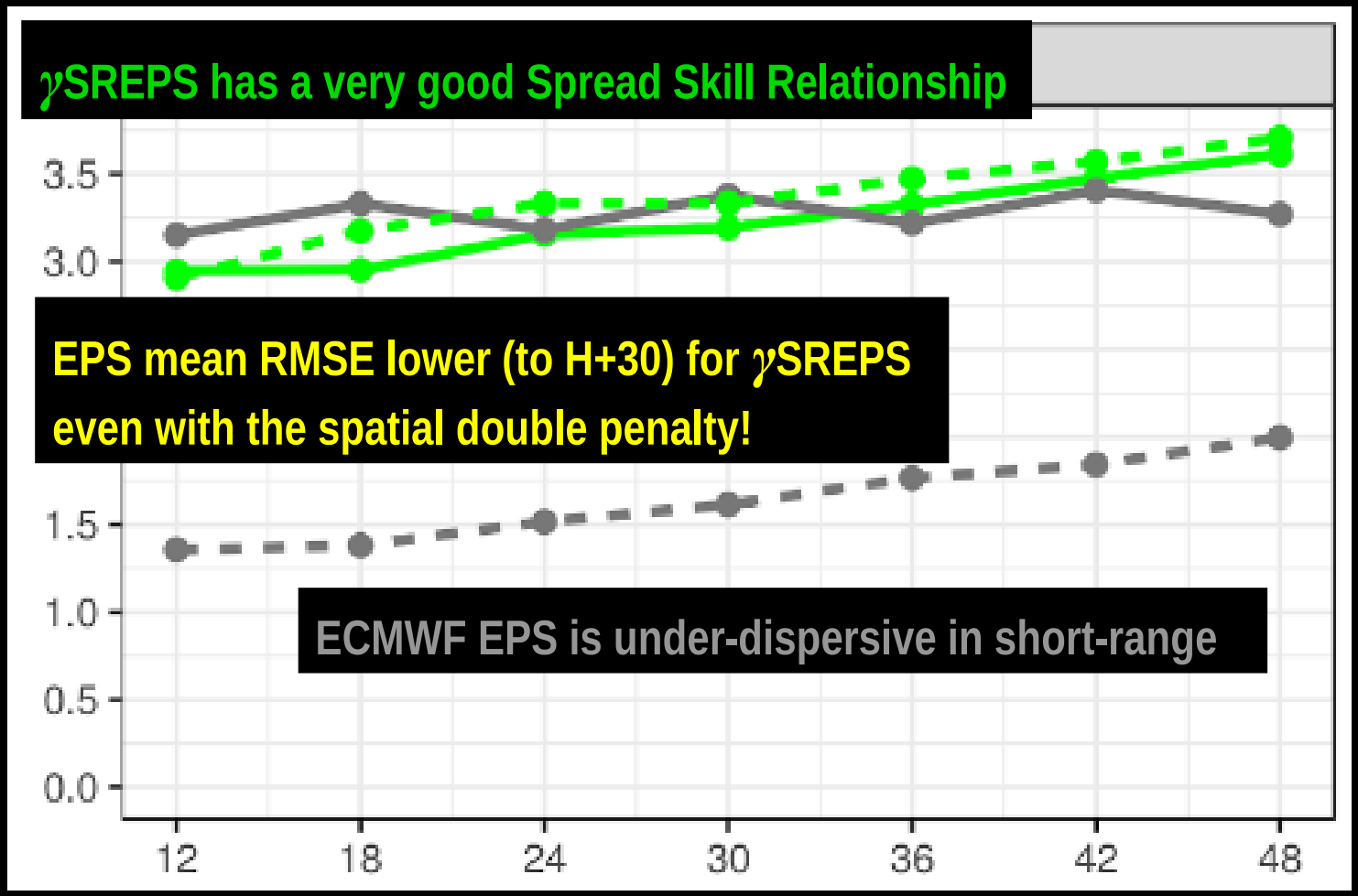
It has been intended to integrate both NWP models with the closer possible settings in order to be the comparison the more fairly possible.

A taste of verification

OBJECTIVE

γSREPS *versus* ECMWF EPS

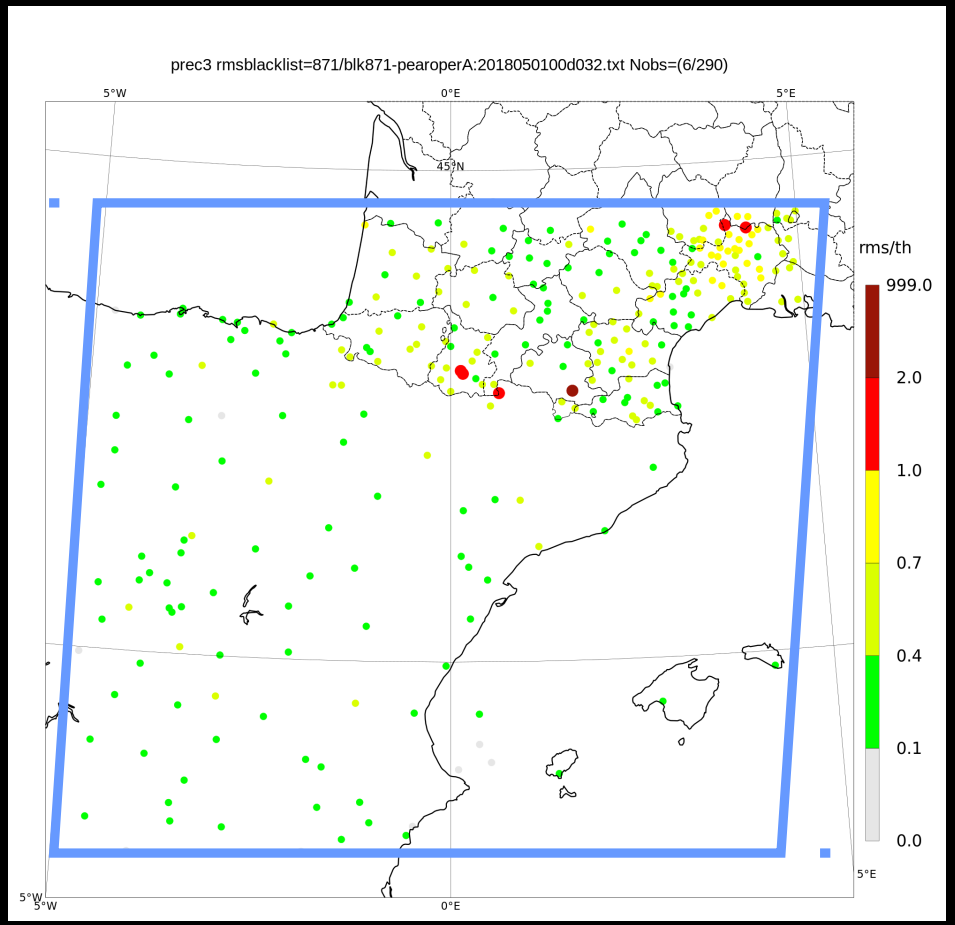
- Recent result for a coming paper about HarmonEPS system: review of HIRLAM EPSs. Comparison of 12AccPcp for 00 and 12 cycles of November 2018



γSREPS *versus* AROME EPS

- MétéoFrance collaboration:
  - Recent results for AROME EPS (MétéoFrance) and γSREPS (AEMET) intercomparison verification

Thanks to François Bouttier verification



Common area

Two periods:

- 1st - 31st May 2018 (quite rainy month)
- 8th – 16th October 2018 (Leslie time, very convective period)

High resolution LAM-EPS on Europe

	NWP	Resolution / Area / Range	N. MBR	ICs Assimilation	LBC conditions	Model error
AEMET-γSREPS	AROME + ALARO + WRF + NMMB	2,5 km x 65/72 ~1400x1200 km HH+48	20	5 Global NWP ¿LETKF? ¿3DVAR EDA?	5 Global NWP	Multi-model ¿+SPPT?
MetCoOp EPS MEPS	HARMONIE-AROME	2,5 km x 64 lev ~1900x2400 km HH+36	10	NMC → 3DVAR control Surf.Ass. All members	SLAF from ECMWF-IFS deterministic 9 km	¿Surf.Perturb.? ¿SPPT?
AROME-EPS MétéoFrance	AROME	2,5 km x 90 levs ~1900-2000km HH+45	12	3DVAR EDA	PEARP (cluster) 10 km	SPPT +Surf.Perturb.
COSMO-DE-EPS DWD	COSMO	2,8 km ~1200x130 km HH+27	20	KENDA (LETKF) + Sto.Pert. SoilMoisture + SST	ICON-EPS 20 km	Multi-parameter (fixed)
COSMO METEOSWISS (COSMO-IT-EPS)	COSMO	2,2 km x 70 levs ~1600-1650 km HH+120	21	KENDA (LETKF)	ECMWF-EPS 16 km	SPPT
MOGREPS UK	UM	2,2 km x 70 levs ~1600-1650 km HH+54	12	UKV analysis	MOGREPS-G	RP Stochastic multi-parameters

Quite different LAM-EPS
→ More difficult to interpret verification results

γSREPS *versus* AROME EPS

Thanks to François Bouttier verification

T2m

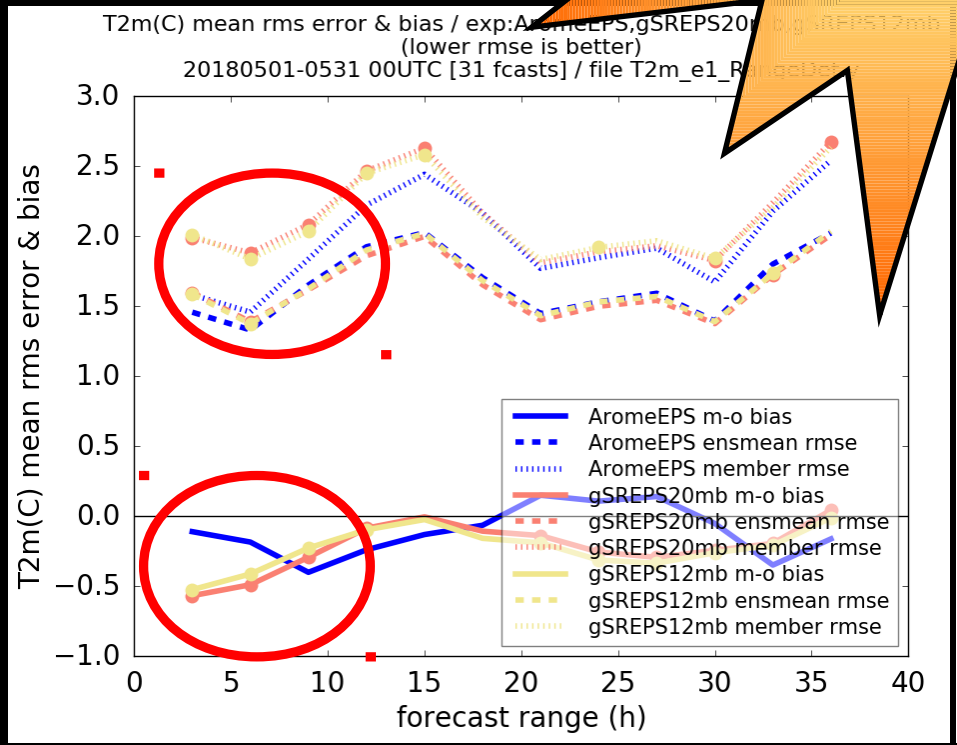
Expected AROME-EPS with a assimilation to be better during 1st hours than γSREPS

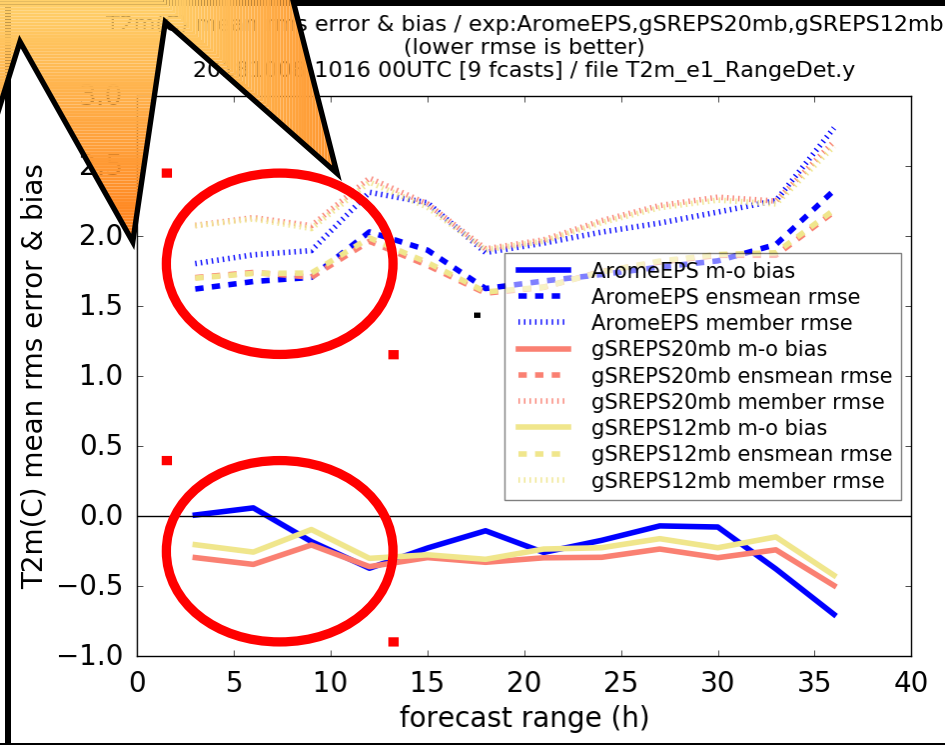
What is the role of the number of members?

AROME-EPS

➢ 1st - 31st May 2018

➢ October 2018





1st hours AROME-EPS > γSREPS **Later AROME-EPS ≈ γSREPS**

γSREPS *versus* AROME EPS

Thanks to François Bouttier

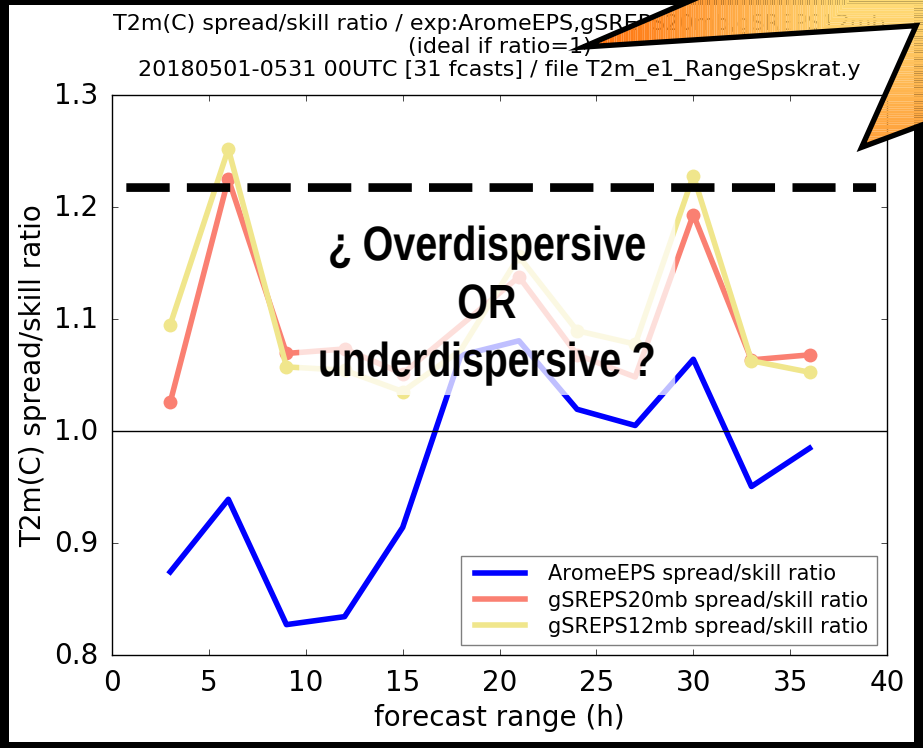
Spread / Skill

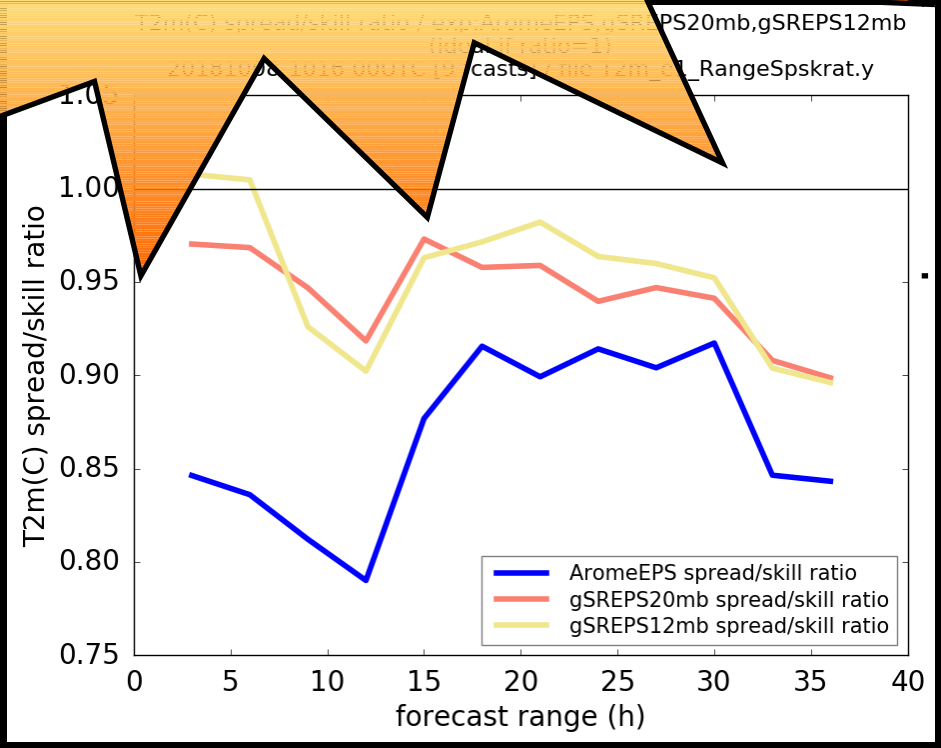
T2m

AROME-EPS

➢ 1st - 31st May 2018

Take into account that spread + errobs > *classical* spread





Spread γSREPS > AROME-EPS **But ¿γSREPS >< AROME-EPS?**

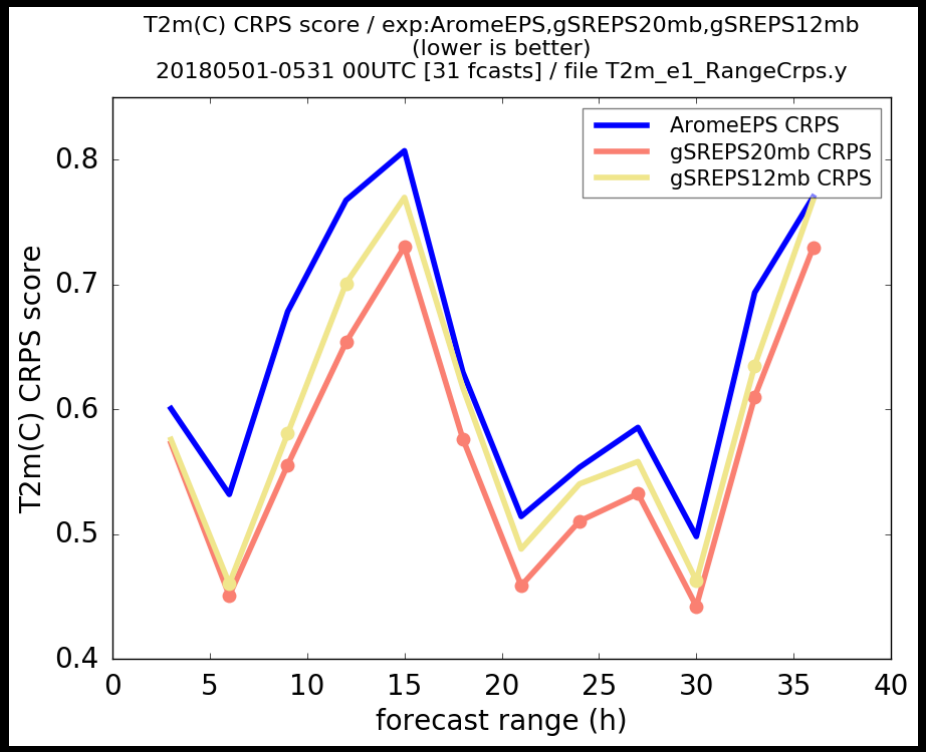
γSREPS *versus* AROME EPS

Thanks to François Bouttier verification

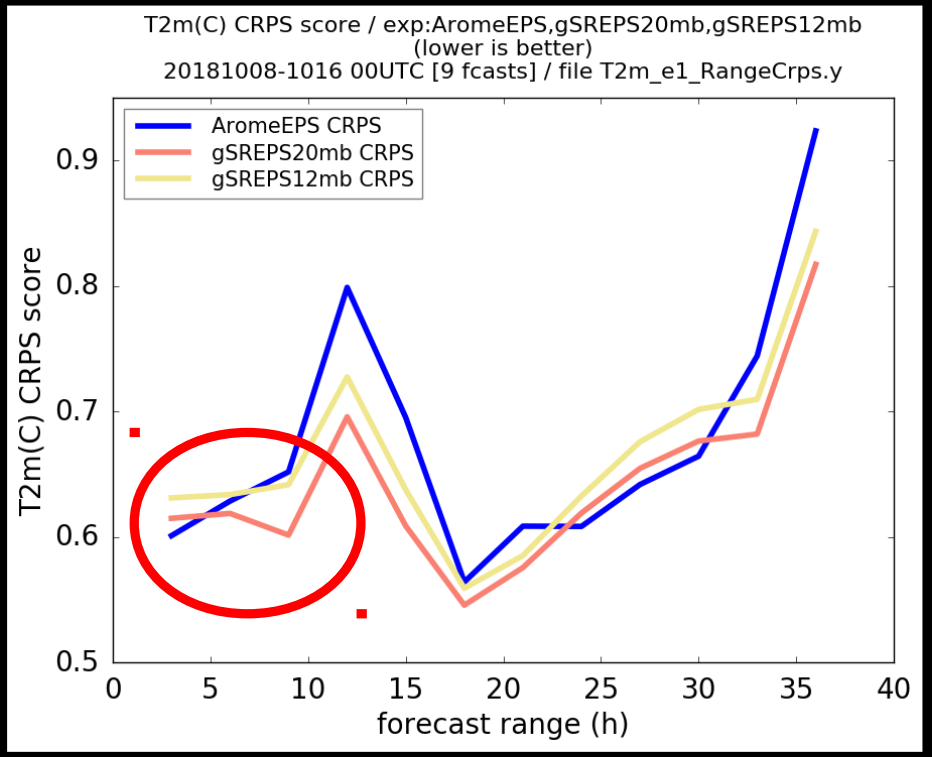
T2m CRPS score

AROME-EPS **γSREPS** **γSREPS 12 members**

➢ 1st - 31st May 2018



➢ 8th – 16th October 2018



May γSREPS > AROME-EPS **October γSREPS ≈ AROME-EPS**

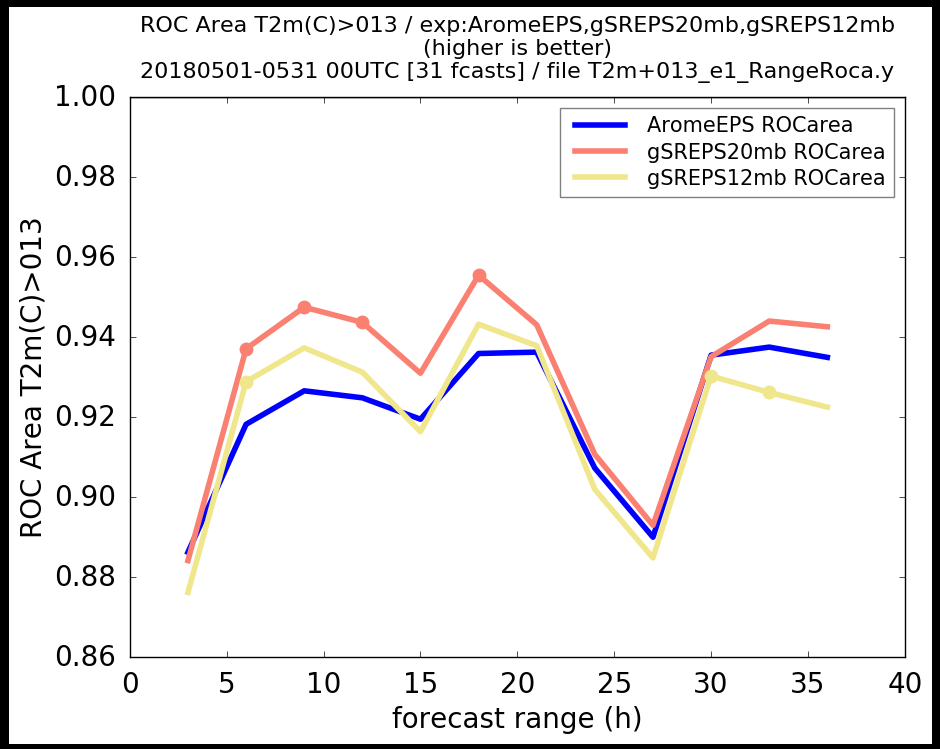
γSREPS *versus* AROME EPS

Thanks to
François Bouttier
verification

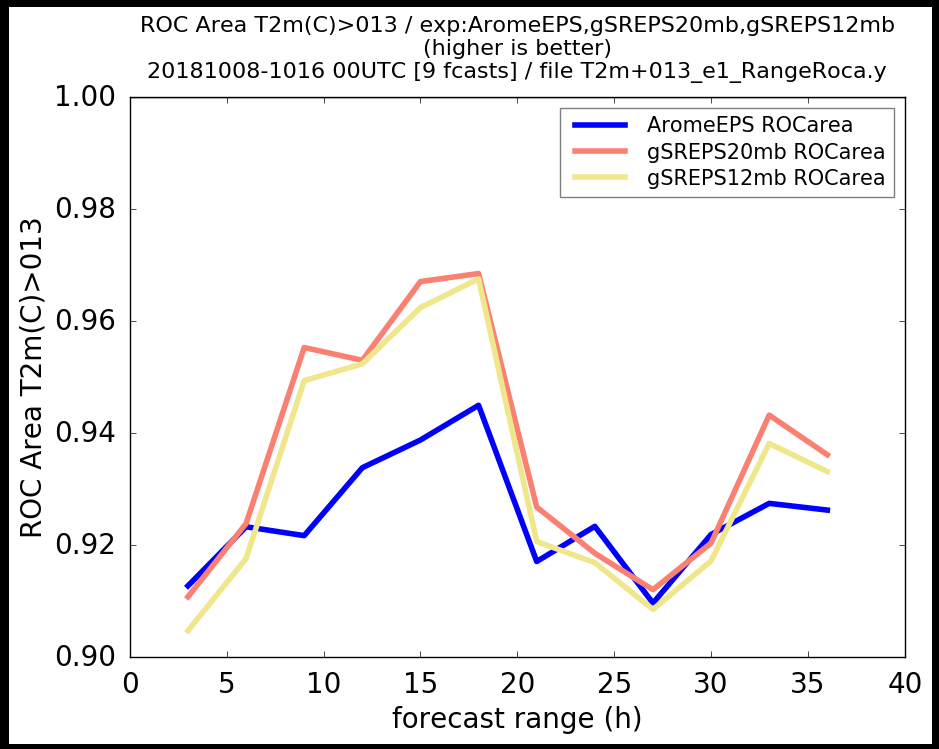
T2m > 13ºC ROC area

AROME-EPS γSREPS γSREPS 12 members

➢ 1st - 31st May 2018



➢ 8th – 16th October 2018



γSREPS > ≈ AROME-EPS

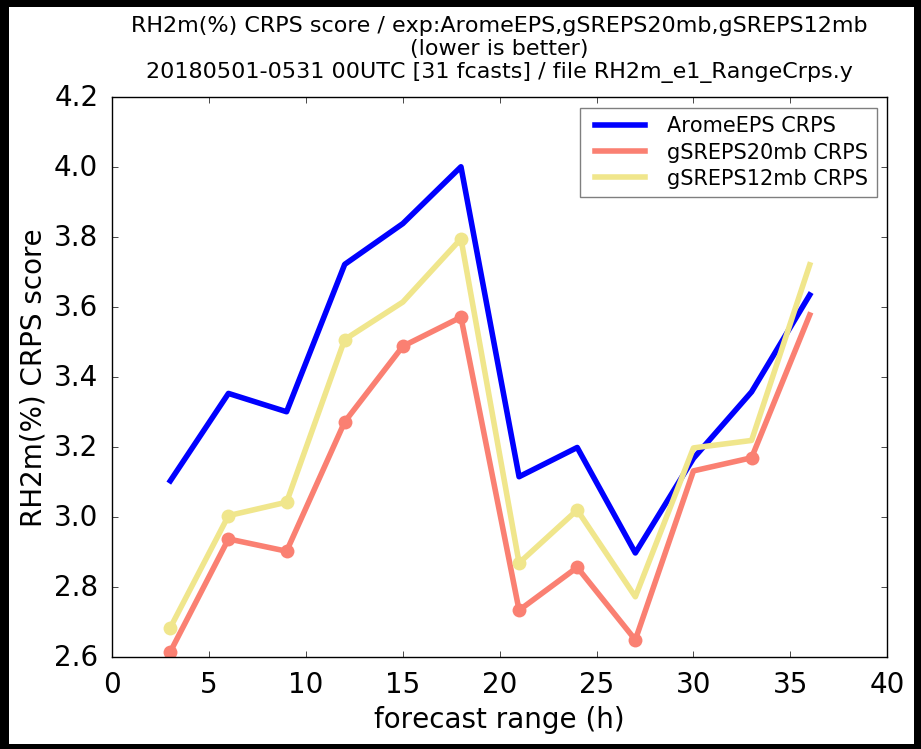
γSREPS *versus* AROME EPS

Thanks to François Bouttier verification

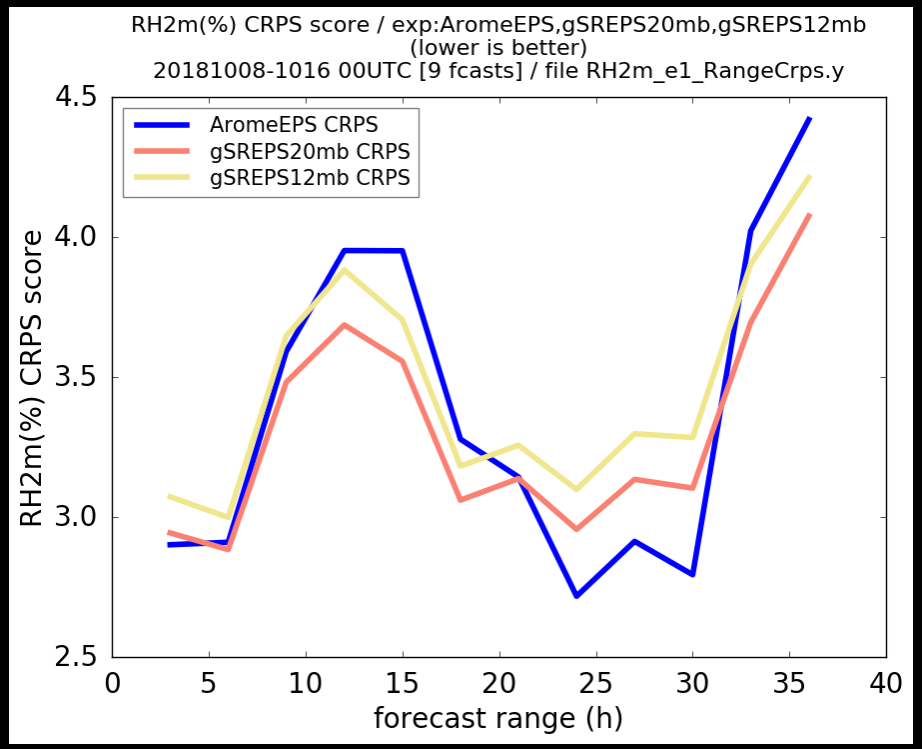
RH2m CRPS score

AROME-EPS **γSREPS** **γSREPS 12 members**

➢ 1st - 31st May 2018



➢ 8th – 16th October 2018



May γSREPS > AROME-EPS **October γSREPS ≈ AROME-EPS**

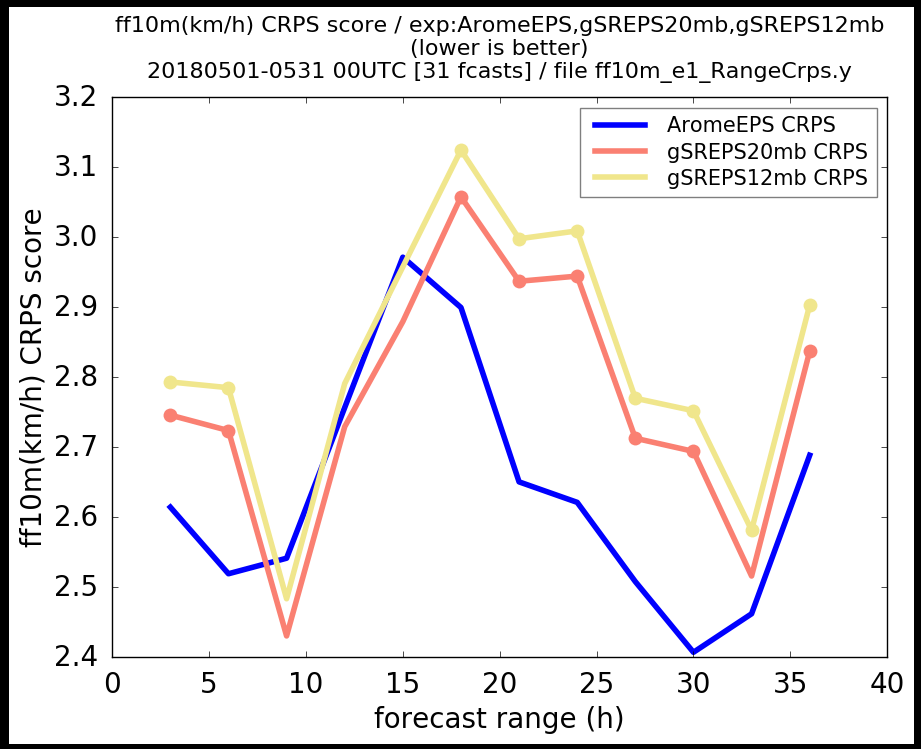
γSREPS *versus* AROME EPS

Thanks to
François Bouttier
verification

U10m CRPS score

AROME-EPS **γSREPS** **γSREPS 12 members**

➢ 1st - 31st May 2018



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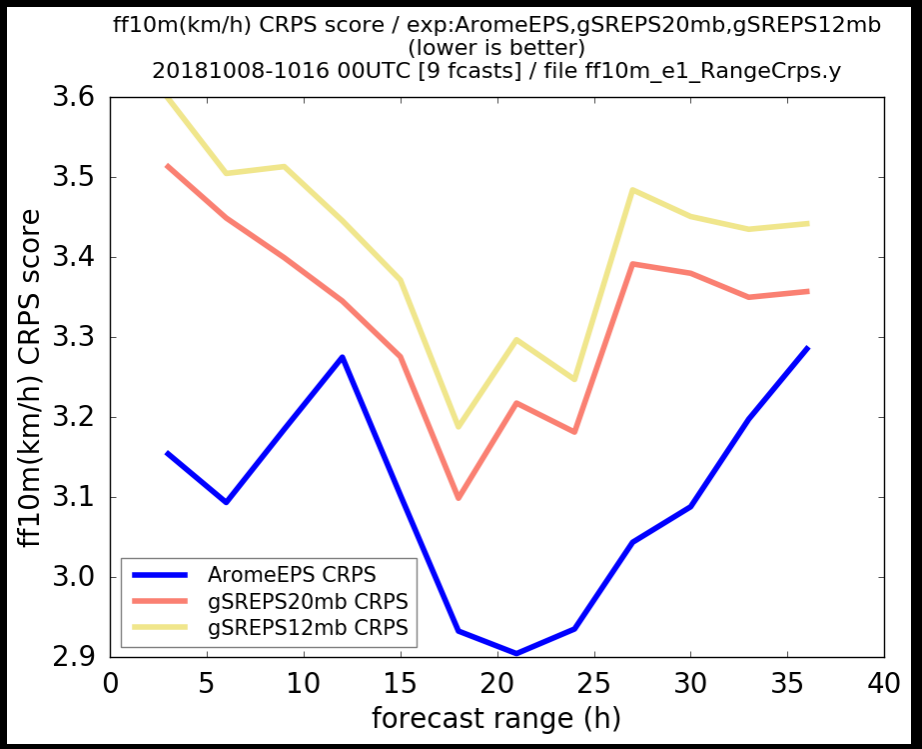


γSREPS << AROME-EPS

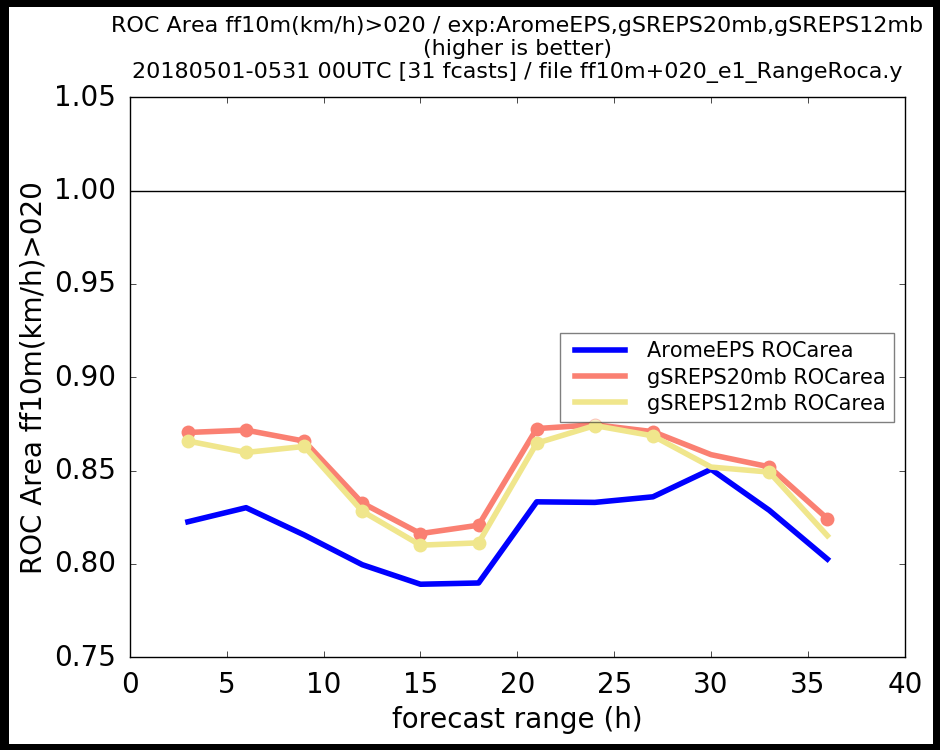
γSREPS *versus* AROME EPS

Thanks to François Bouttier verification

U10m > 20km/h ROC area

AROME-EPS γSREPS γSREPS 12 members

➢ 1st - 31st May 2018



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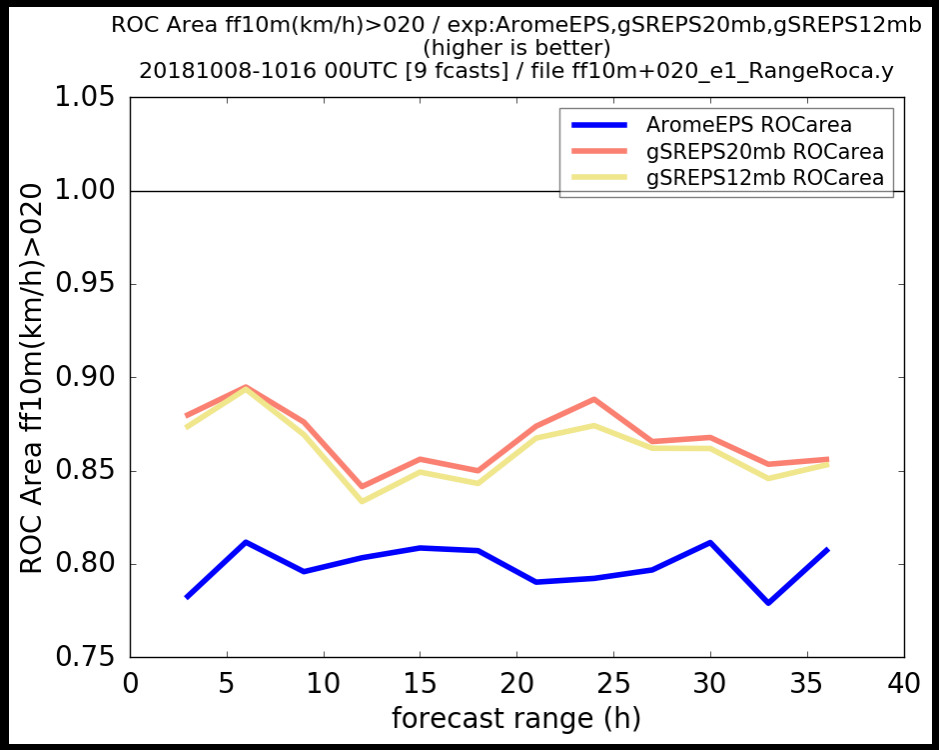


γSREPS >> AROME-EPS

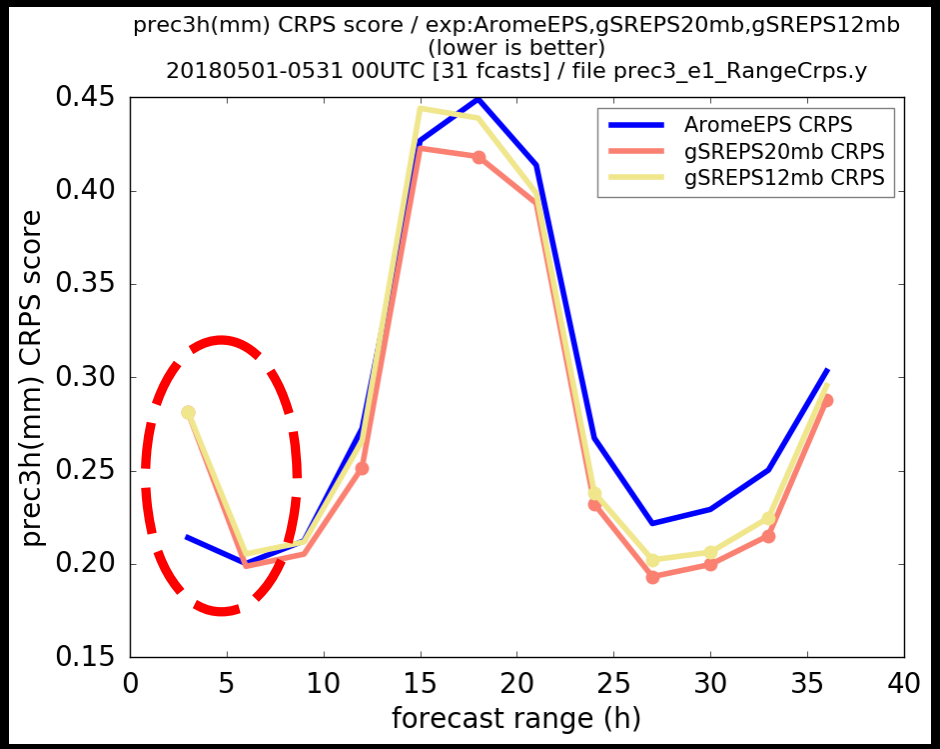
γSREPS *versus* AROME EPS

Thanks to François Bouttier verification

AccPcp 3h CRPS score

AROME-EPS γSREPS γSREPS 12 members

➢ 1st - 31st May 2018



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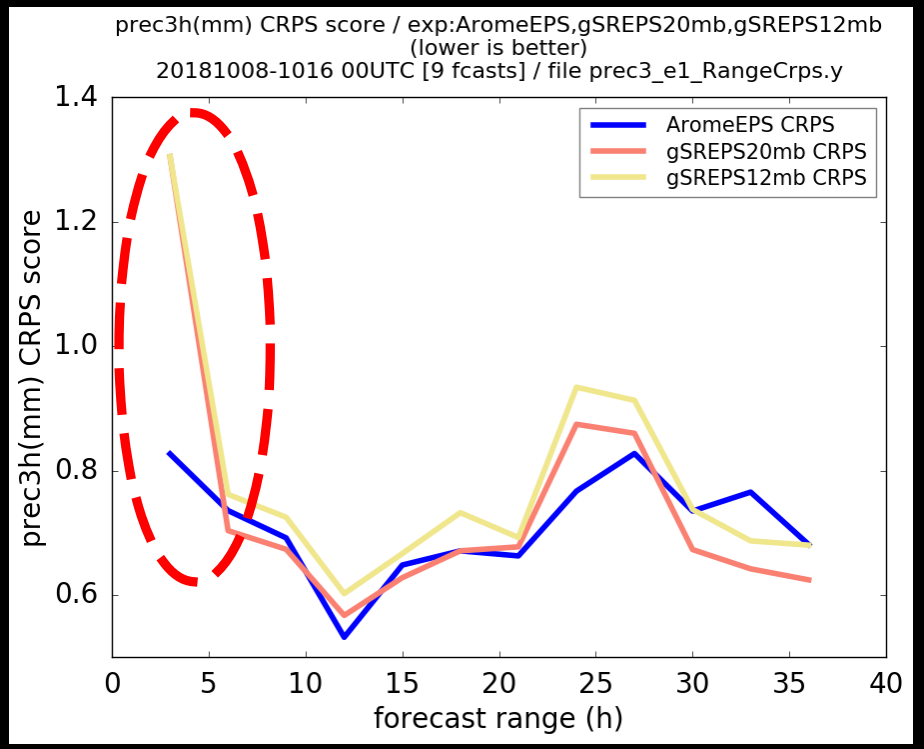


May γSREPS > ≈ AROME-EPS **October γSREPS ≈ AROME-EPS**

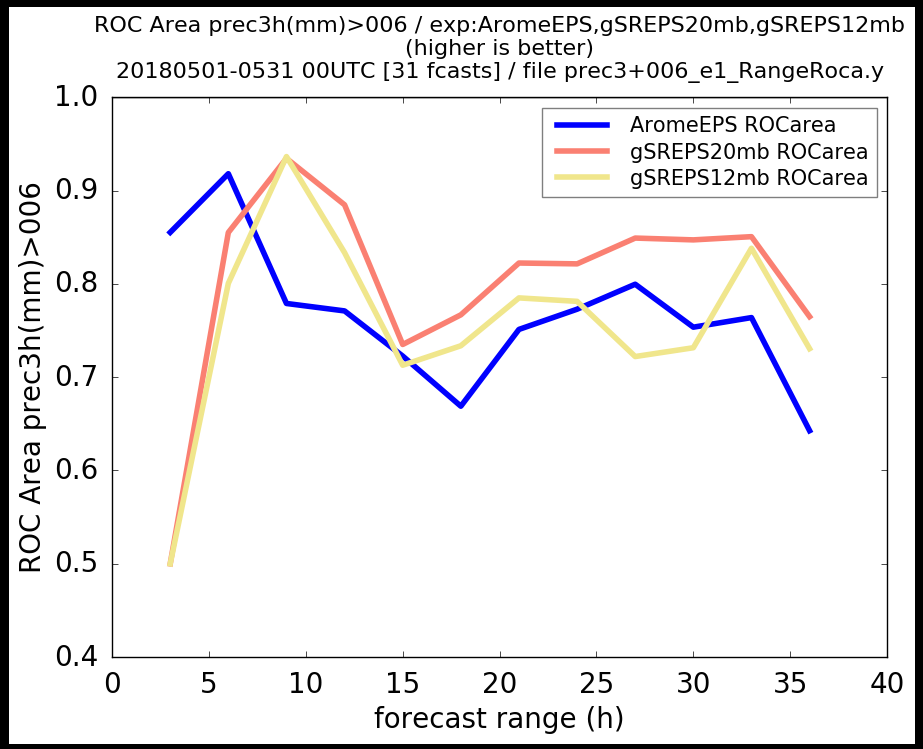
γSREPS *versus* AROME EPS

Thanks to François Bouttier verification

AccPcp > 6mm/3h ROC area

AROME-EPS γSREPS γSREPS 12 members

➢ 1st - 31st May 2018



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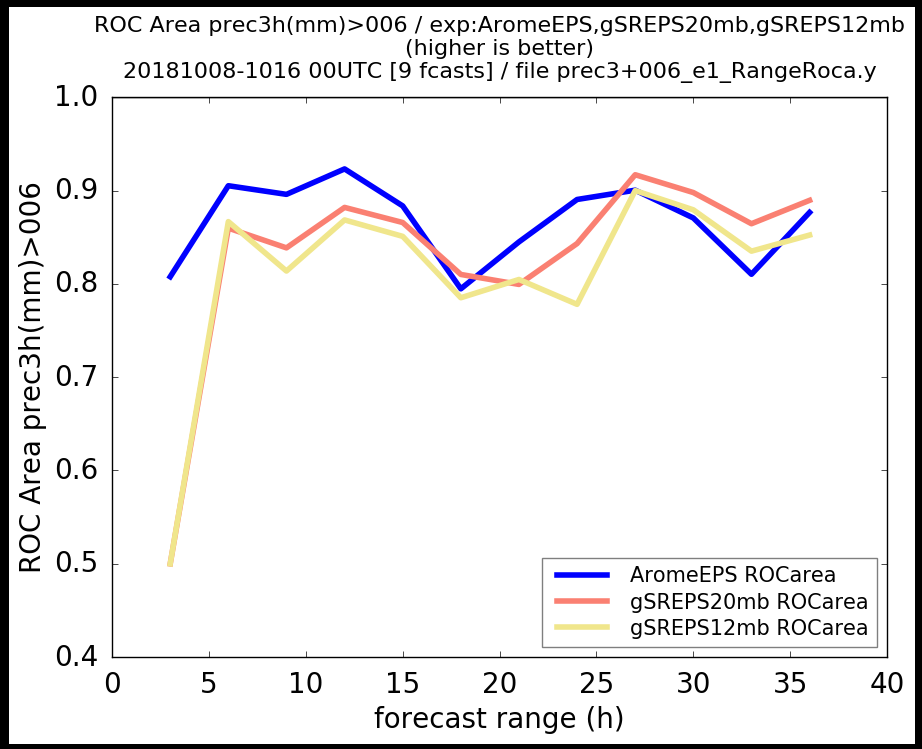


May γSREPS > ≈ AROME-EPS **October γSREPS ≈< AROME-EPS**

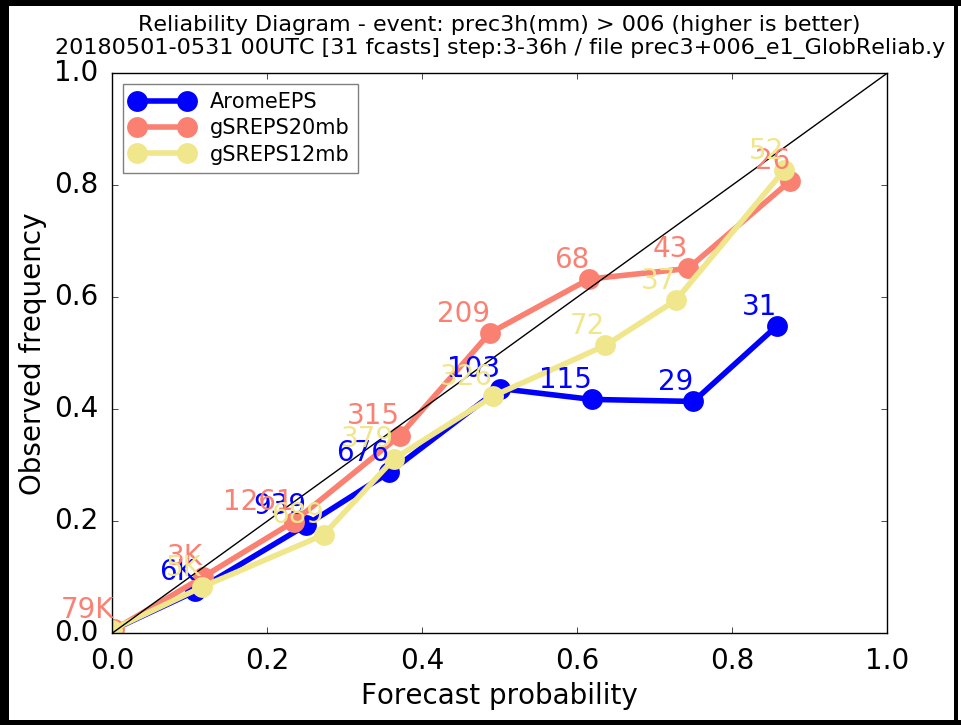
γSREPS *versus* AROME EPS

Thanks to François Bouttier verification

AccPcp > 6mm/3h Reliability

AROME-EPS **γSREPS** **γSREPS 12 members**

➢ 1st - 31st May 2018



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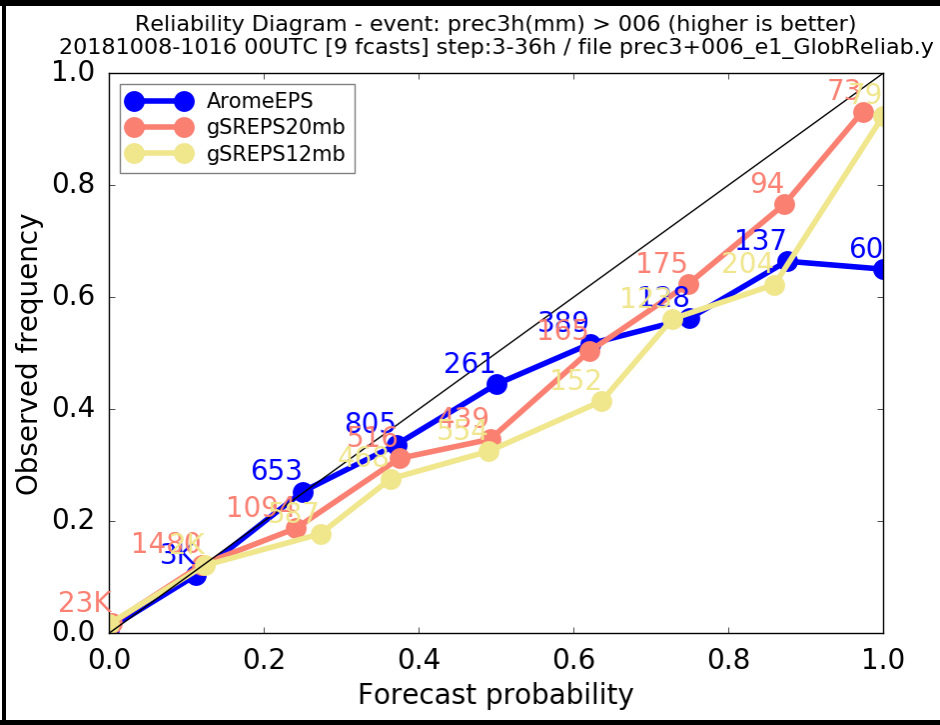


May γSREPS > ≈ AROME-EPS **October γSREPS ≈ AROME-EPS**

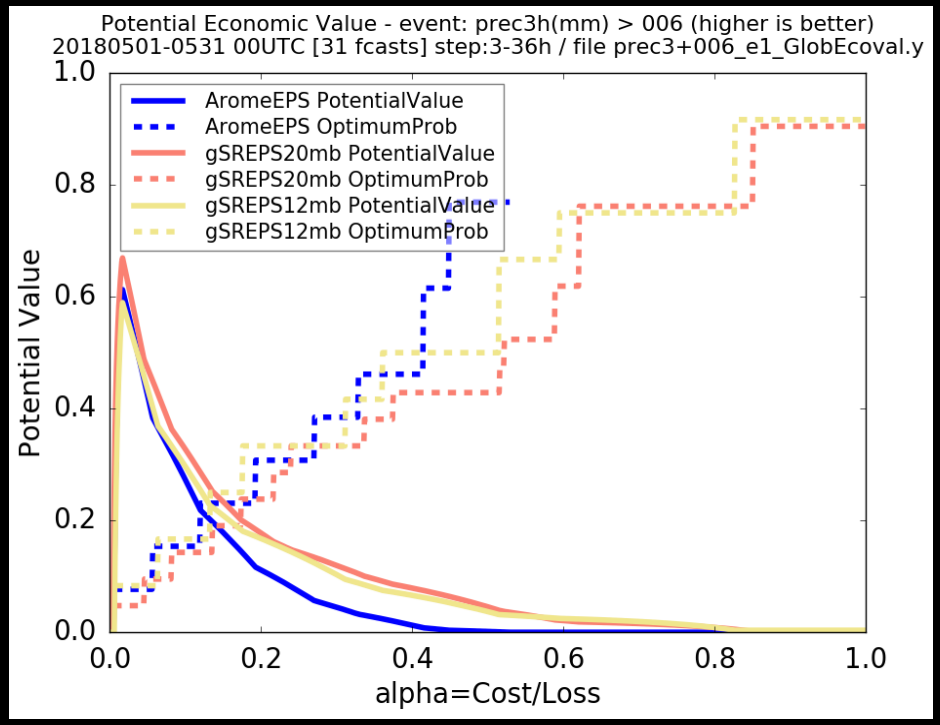
γSREPS *versus* AROME EPS

Thanks to François Bouttier verification

AccPcp > 6mm/3h Economic value

AROME-EPS **γSREPS** **γSREPS 12 members**

➢ 1st - 31st May 2018



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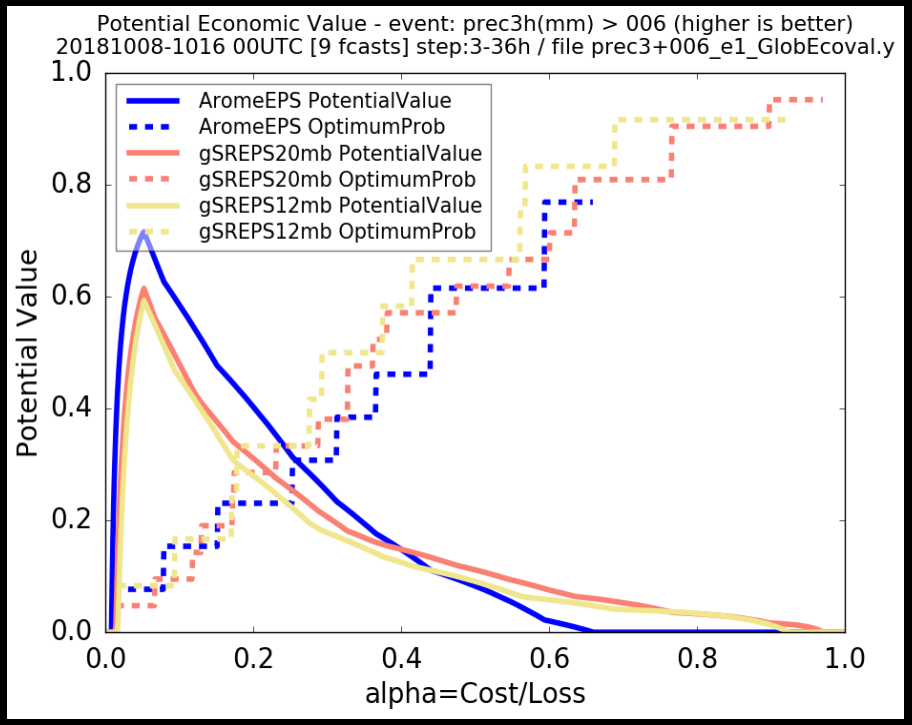


May γSREPS > AROME-EPS **October γSREPS < AROME-EPS**

Verification results from the point of view of γSREPS

- We have a **good LAM-EPS** in the current state of art of LAM-EPS, but with **room to improve**
- We **penalise the 1st hours** because we have not **assimilation**, but no so much
- We would like to have a *little* better results on the very convective and *uncertain period* of October → organised **convection** and high precipitation events are our **goals**

MétéoFrance AROME-EPS and AEMET-γSREPS future intercomparison

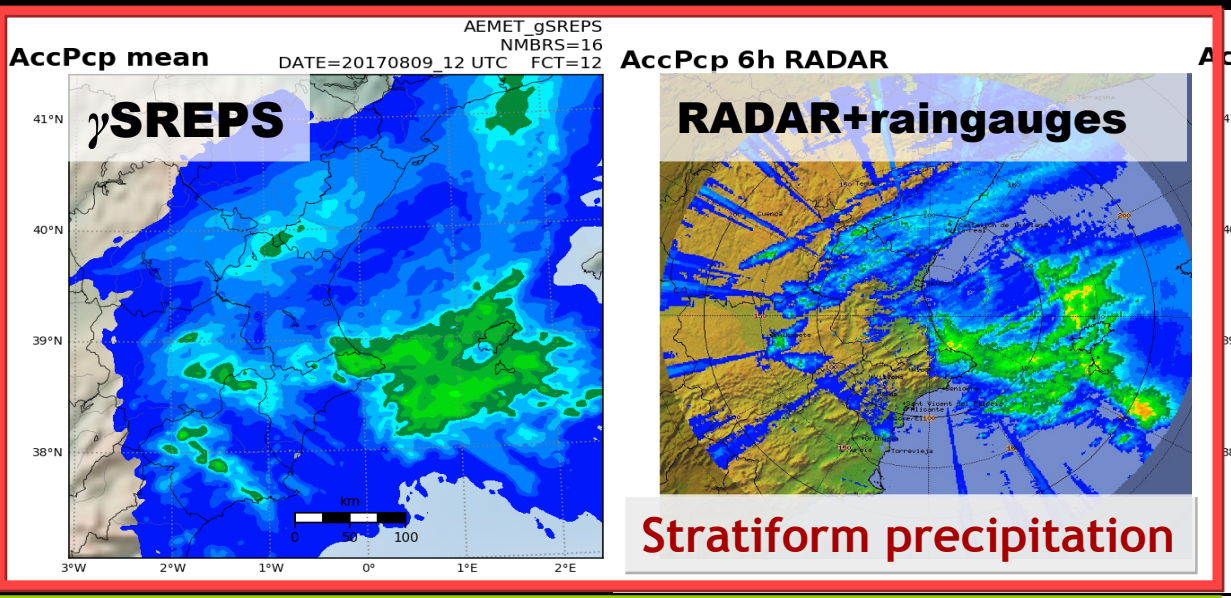
- Longer periods to verify: **3-months**
  → Better for **high thresholds**
- **More parameters**
- Bigger domain for γSREPS in 2020 → Bigger common area

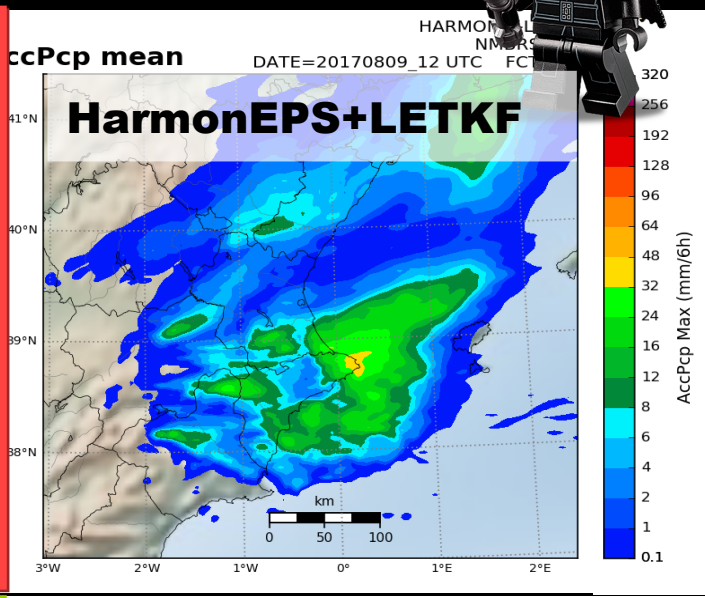
A taste of verification

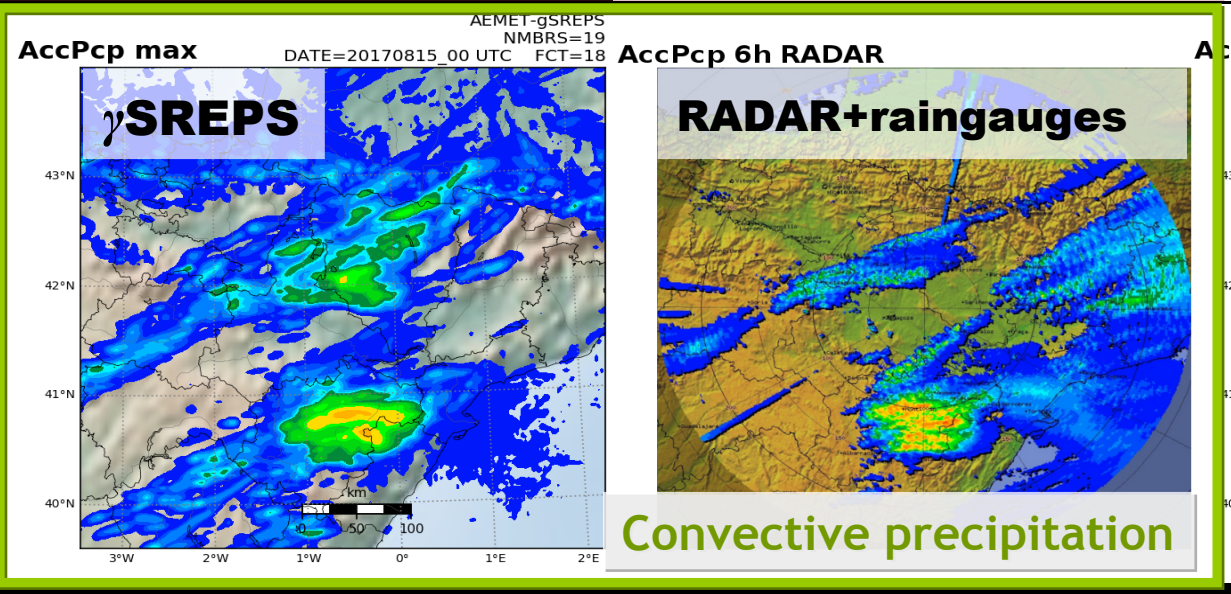
In what forecasters are more interested !!!

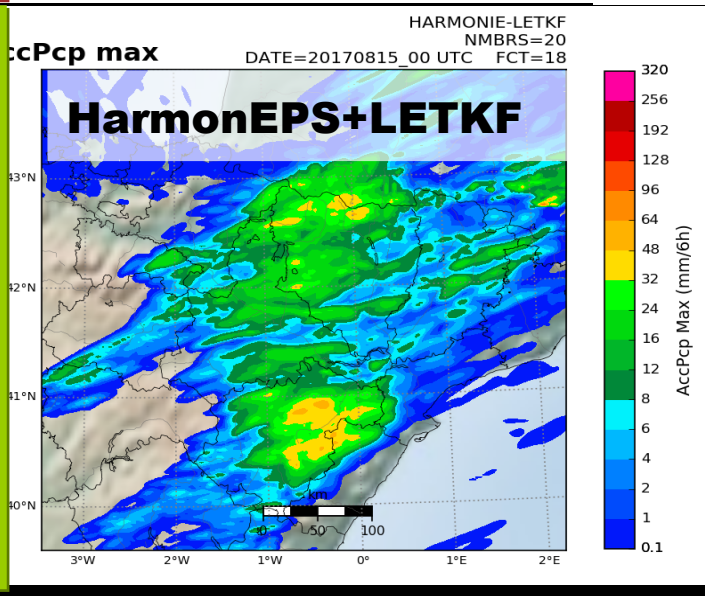
SUBJECTIVE

Qualitative verification results





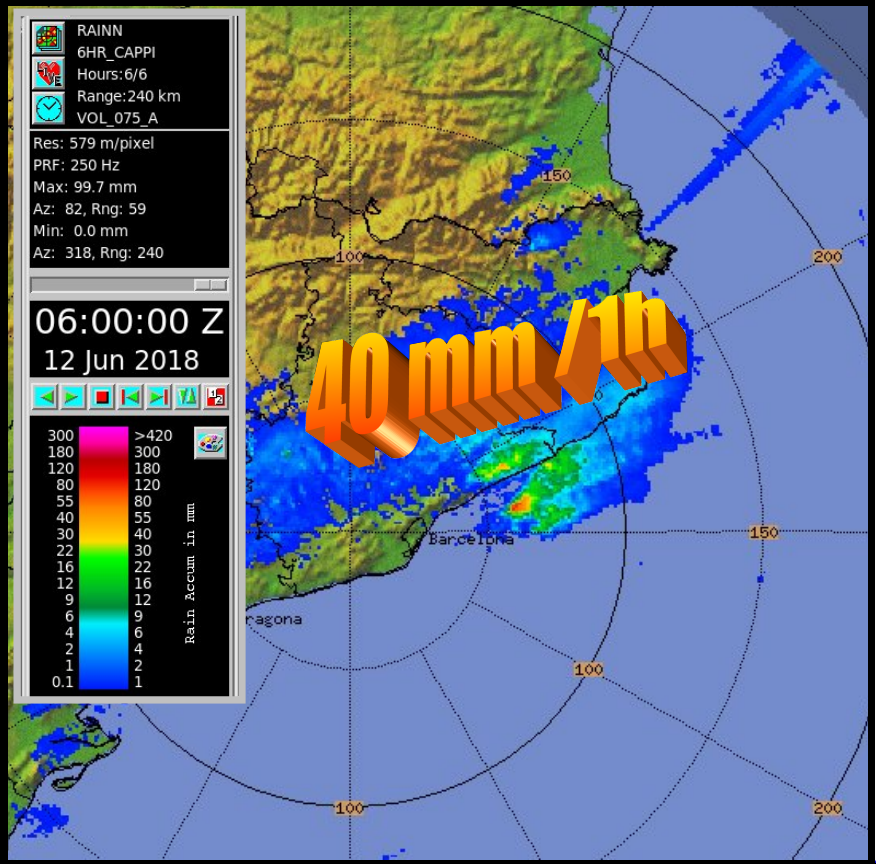


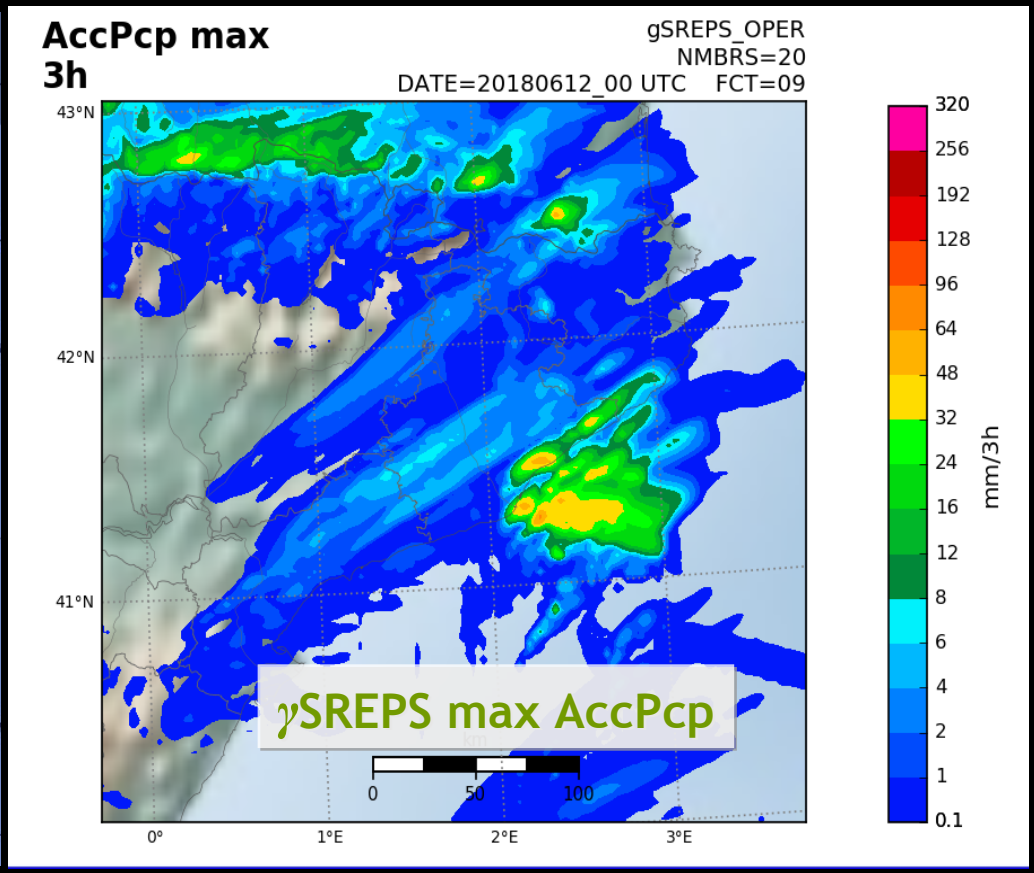


Maresme case study: *low predictability*

COASTEPS

http://meteo.uib.eu/coasteps/





AEMET-γSREPS

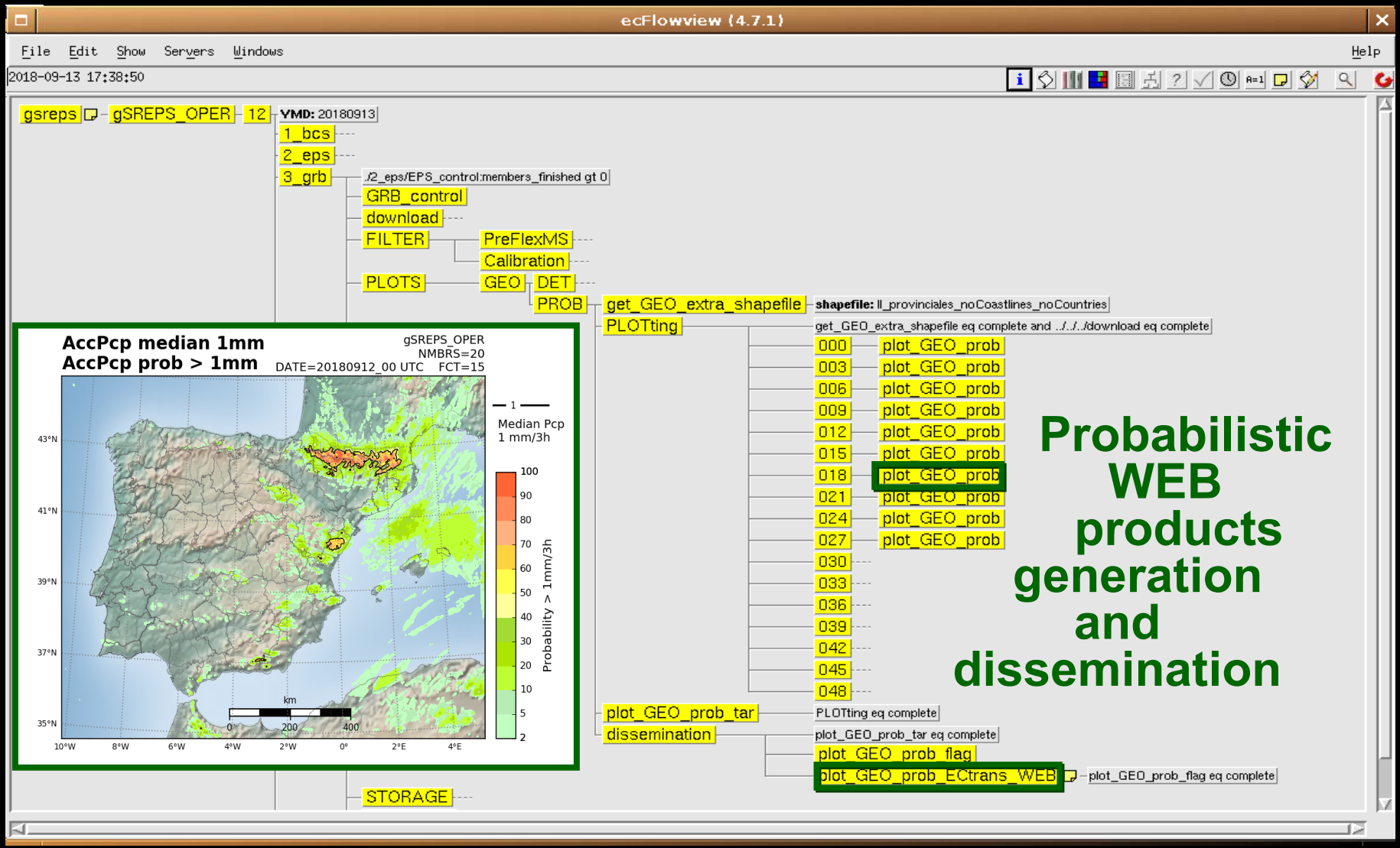
→ From ECMWF BCs not thunderstorm is developed !!!

γSREPS *nearly* operational

TEST PHASE AT AEMET FORECASTING OFFICES

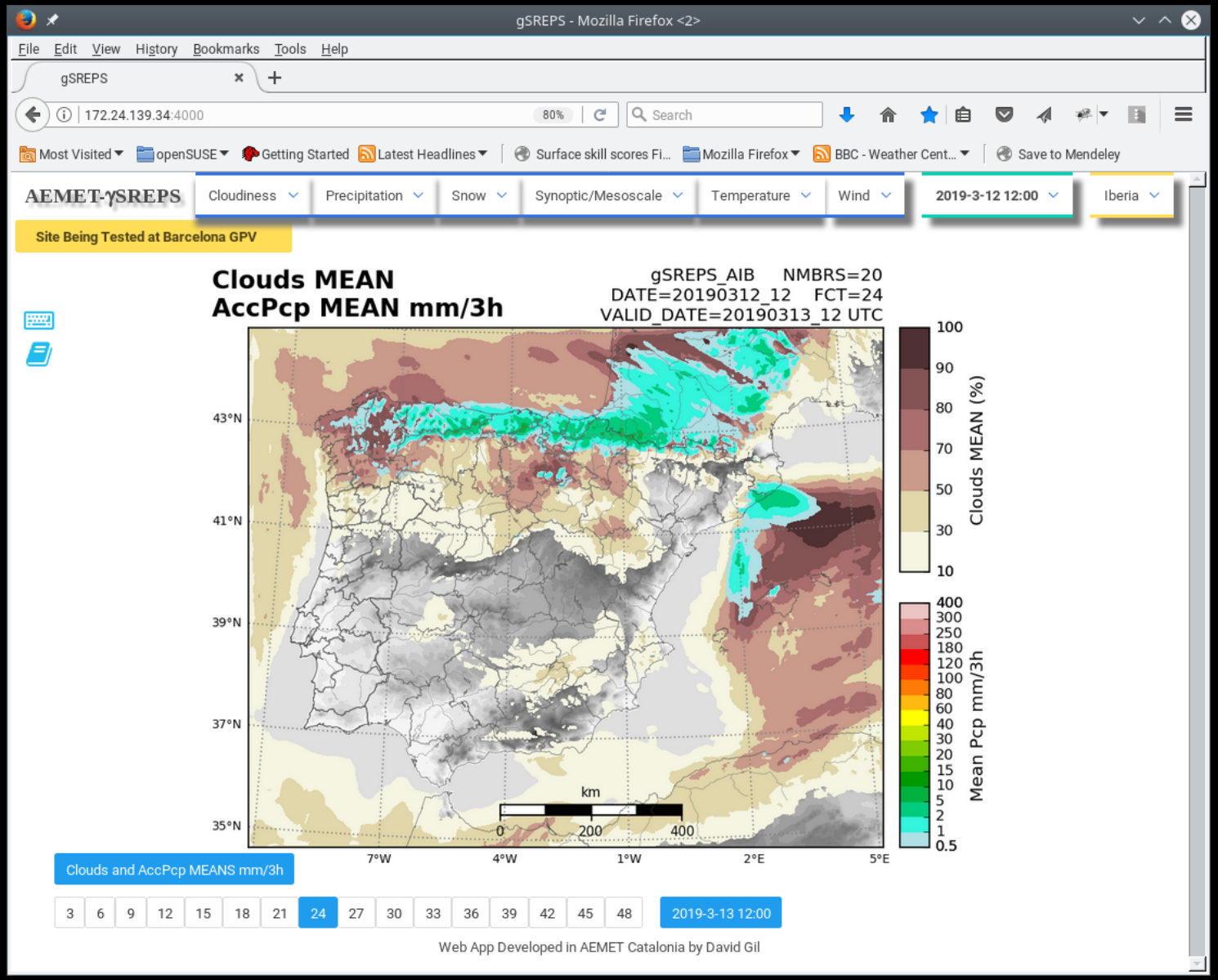
γSREPS at ECMWF Cray XC40

- **EcFlow** suite management
- 00 and 12 UTC cycle over **IBERIA_2.5** domain



γSREPS forecasters' web site

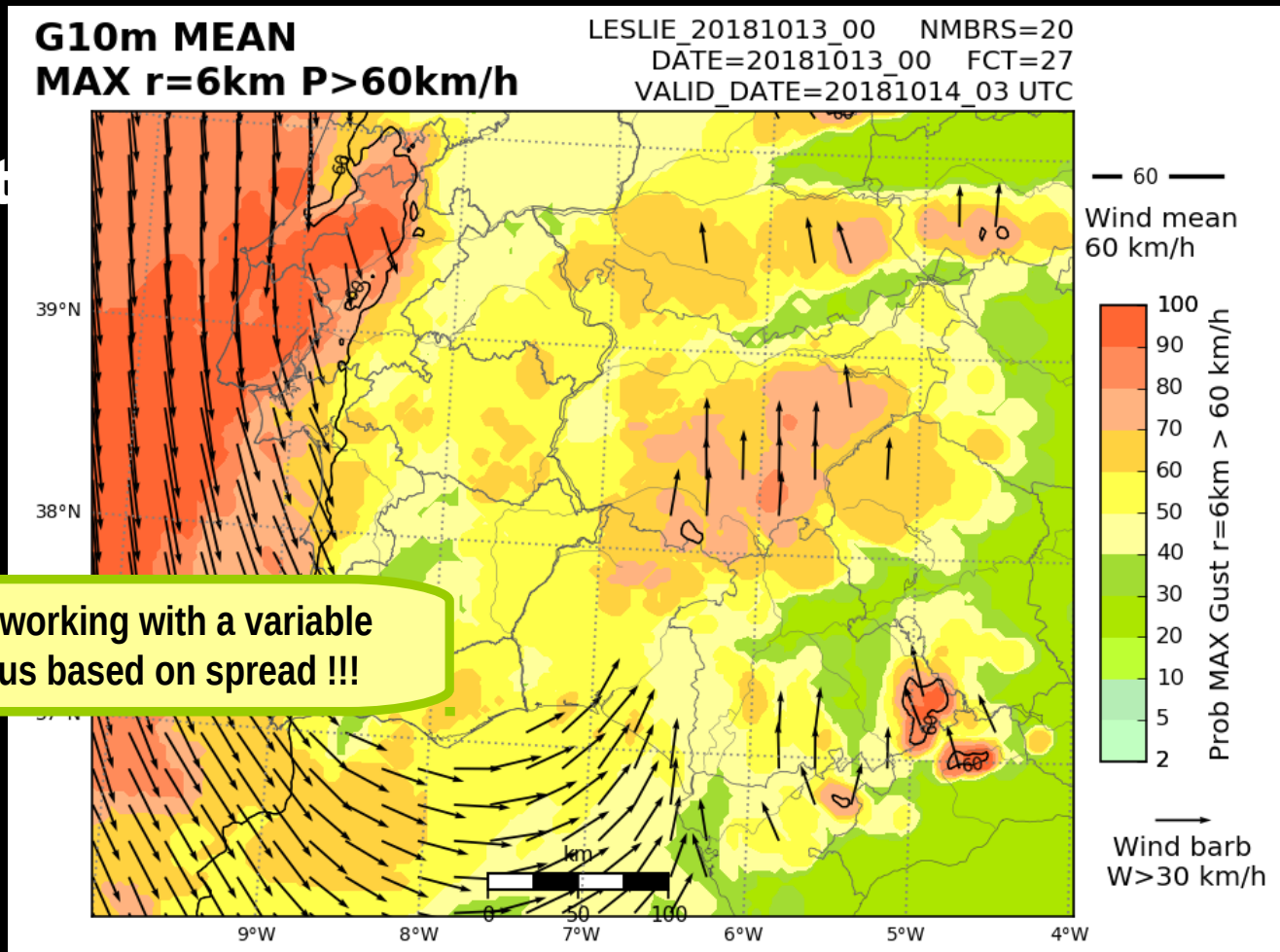
- Available for **AEMET forecasting offices** since November 2018
- **Period test** before fully operational until **30th September**
- Around **40** products with more than **3500** plots



Forecasters ask and collaborate in new EPS products

- "*spaguetti* plot" with all members → Looking for spatial uncertainty

- **Maximum** precipitation and wind gust (IPMA) → They look for the worst scenario
  - + into a radius ..



I am working with a variable radius based on spread !!!

Oriol Ripoll

Guide of Web AEMET-γSREPS products

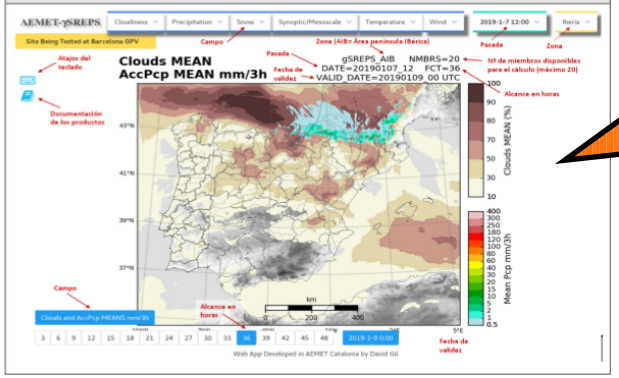
PRODUCTOS WEB AEMET-γSREPS

Grupo de Predecibilidad-γSREPS

Versión 1.3 Enero 2019

Autores	Fecha	Fase	Versión
Alfons Callado Pallarès Fco. Javier Rodríguez Marcos (revisión) María Rosa Pons Reynés (revisión)	2018/11/20	Pre-operativa hasta 31 Marzo 2019	1.3 2019/01/09
Grupo de Predecibilidad-γSREPS	Alfons Callado Pallarès, Pau Escribà Ayerbe, Mauri Martínez Sánchez David Quintero Plaza, Marc Compte Rovirola		
Colaboradores del Grupo de Predecibilidad-γSREPS	José Antonio García-Moya Zapata, David Gil Oliva, Carlos Santos Burguete, María Rosa Pons Reynés		

Características generales γSREPS y productos	
Concepto	**Valor / Comentario**
Tipo EPS	Multi-modelo multi-condiciones de contorno No hidrostático y convection-permitting Resolución horizontal de 2,5 km y vertical de 65/72 capas
Salidas: frecuencia/alcance	Cada 3 horas hasta 48
Dominio ➔ Áreas	IBERIA_2.5 ➔ IBERIA_2.5 y IBERIA_EAST CANARIAS_2.5 ➔ CANARIAS_2.5 y CANARIAS_ISLANDS LIVINGSTON_2.5 ➔ LIVINGSTON_2.5 y LIVINGSTON_ISLANDS
Disponibilidad	En IP: http://172.24.139.34:4000/
Divulgación/Comunicación	Área de Predicción Operativa: frodriguezm@aemet.es
Ejemplo WEB (descripción en **rojo**)	



Web AEMET-γSREPS products' suggestions sheet

FICHA DE SUGEREN AS
PRODUCTOS WEB AEM SREPS

Grupo de Pred PS
SPV Delegación Te n Cataluña
Versió

Expecting forecasters feedback about better web page and new/better products !!!

AEMET-γSREPS subjective validation sheet

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

Productos web
AEMET-γSREPS

n: 1.0
2 de 3

Unidad SNP: GPV de Barcelona	**Período:** dicie… hasta 31 Marzo 2019
Situación sinóptica/mesoscalar Fenómeno atmosférico	**(Opcional:**
Frente Atlántico *clásico* frío y/o ocluido Convección pre-frontal	
Convección post-frontal /descarga fría Paso de borrasca Atlántica	
Onda en circulación zonal DANA	
Situación anticiclónica. Nieblas radiativas.	5/12/18, Alfons Call… depresión del Eb… pequeña de l… mitad de… No aparecen las nieblas en la Plana…
Situación anticiclónica. *Baja térmica.* Convección en masa de aire.	

Expecting forecasters feedback about performance in different meteorological situations !!!

γSREPS current and future developments

Foreseeable future work plan: 2019-2020

*y*SREPS developments:

- Assimilation: LETKF ? 3DVAR EDA ? [→*Pau*]
  - GNSS+RADAR assimilation [⇔*Jana Sánchez*]

- ~~25 members~~ ⇔ Including the 5th mesoscale convection-permitting NWP model: ¿Canadian GEM-LAM? [→*Alfons*]

- Additional 15' stream output for high social-economic variables' impact as T2m and UV10m

Foreseeable future work plan: 2019-2020

- *y*SREPS *IBERIA/CANARIAS/LIVINGSTON* 00 UTC at ECMWF systems:
  - Time critical application level 2 [→ Alfons + *Pau*]
  - IBERIAxxm_2.5 bigger domain (~better organized convection)
  - Up to 72 hours for end-users

    ⇔ More HPCF resources → 2020 Bologna → 2021 AEMET

    ⇔ NWP in 32 bits opportunity

- *y*SREPS CANARIAS_2.5 12 UTC at AEMET systems (BULL-ATOS):
  - Currently under implementation [→ *Alfons* + *David Q.*]
  - ¿ "explotación" future management ? [⇔ *Sergio Cotera*]

Foreseeable future work plan: 2019-2020

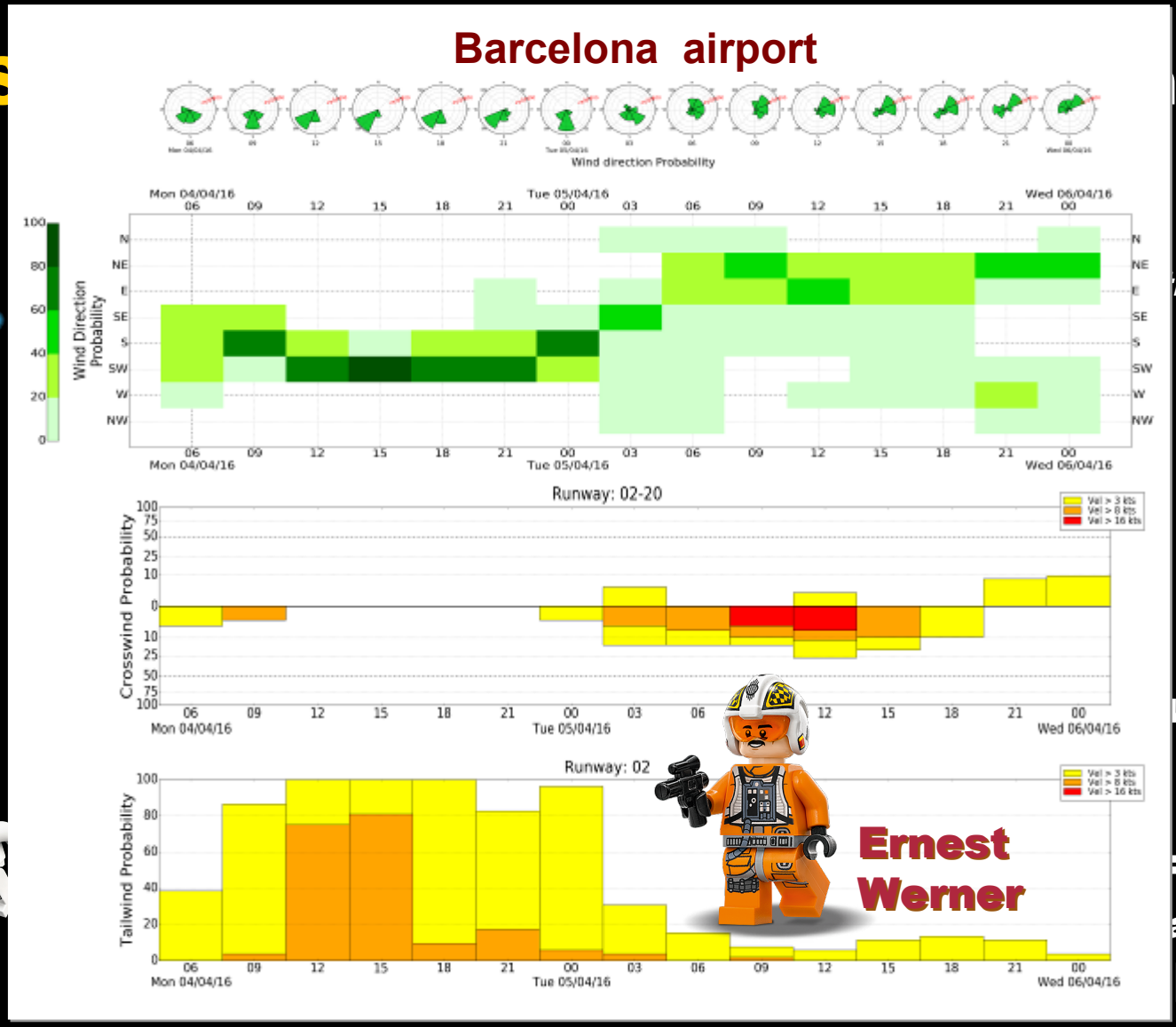
- Moving from pressure levels **ARPÈGE BCs** [MFPL] to **model levels** [MFML]
  - Waiting for **T2m**, **RH2m** and **U/V10m** [MF-IPMA] [→ Thanks to Maria Monteiro / Claude Fisher]
- **WRF-ARW** update from **3.6.0** to **4.*** version
  - From sigma vertical levels to **hybrid ones**

- **HARMONIEs** updates: **AROME** and **ALARO** [Pau]
  - HARMONIE version 40h1.1 ⇔ **cy40t1bf7** ALARO
  - Better ALARO implementation [→ Thanks to Neva Pristov]
  - Possible contribution → Multi-physics again into HarmonEPS

- **Auto-verification** ***each month*** with **HARP v3** [Mauri] [→ Thanks to Andrew Singleton and HARP team]
  - BCs and NWP **sub-ensembles** verification
  - Deterministic verification for each member

Foreseeable future work plan: 2019-2020

- γS … ents:
  - … ion]
  - … Méndez]
  - … / SRNWP-EPS]
  - … FlexMS):
  - … auri ?]
  - … [⇔ SRNWP-EPS]



Thank you for your attention !!!

acalladop@aemet.es pescribaa@aemet.es

Any question will be welcome

2019 ALADIN/HIRLAM Joint 29th Workshop All-Stall Meeting MADRID
AEMET γSREPS Predictability Group
Alfons Callado, Pau Escribà, David Quintero, Mauri Martínez
Maria Rosa Pons (EPSgrams collaboration), David Gil (WEB collaboration)
***Carlos Santos (consultant),* José Antonio García-Moya (retired)**
MÉTÉOFrance
François Bouttier *(AROME-EPS verification collaboration)*