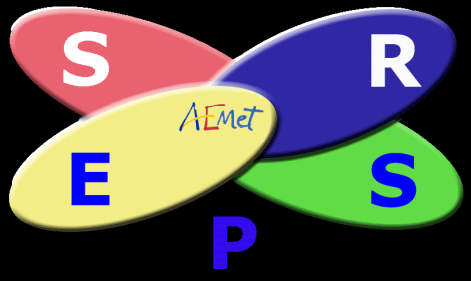


ALARO in AEMET-γSREPS

Convection-permitting LAM-EPS

ALARO-1 Working Days

SHMI, Bratislava, Slovakia, 11-13 March 2019

AEMET Predictability Group

Alfons Callado, Pau Escribà, Mauri Martínez, David Quintero, David Gil

Outline

- Who are we ? AEMET predictability group
- What is AEMET-γSREPS? Design, Operations and Future Developments
- Some verification of AEMET-γSREPS and ALARO in it...
- Update to operational ALARO1 configuration within HARMONIE and AEMET-γSREPS

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-GLAMEPS-HarmonEPS and involved in several projects: EUMETNET SRNWP EPS II, PreFlexMS, COASTEPS, EPS eCOST action, etc., and collaborations on EPSs with IPMA-AEMET, AROME-EPS MétéoFrance, etc.

Alfons Callado γSREPS operational development and model error: SPPT

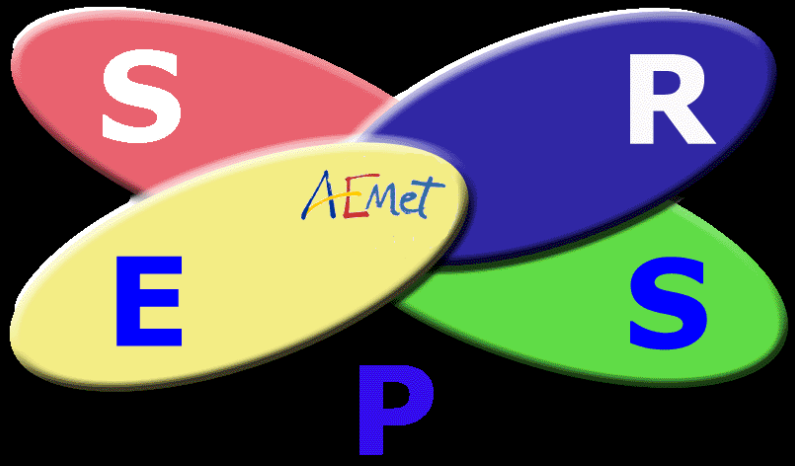
Pau Escribà
Assimilation
LETKF

Mauri Martínez
(CLARITY project)
γSREPS support and verification

XXXXX XXXX
Looking for a new fighter !!!

David Quintero
machine learning and γSREPS support

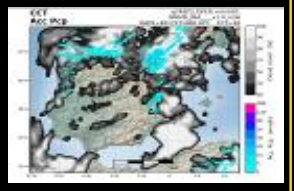
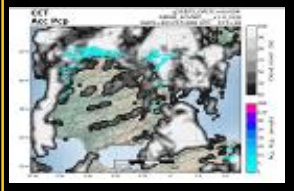
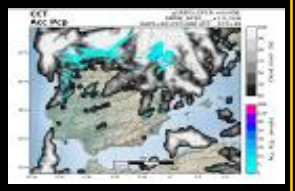
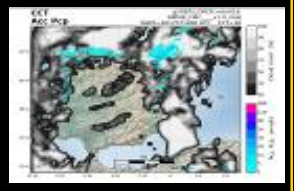
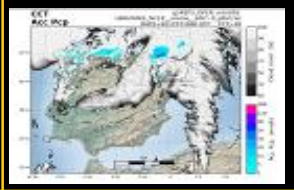
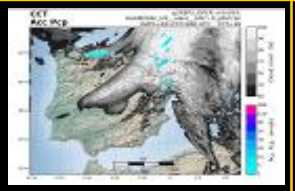
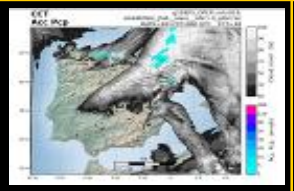
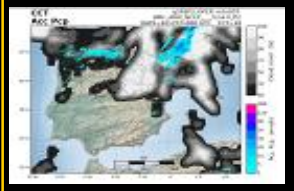
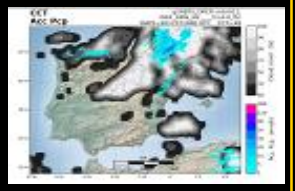
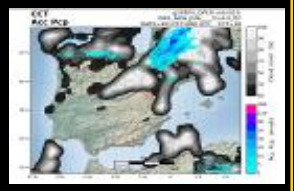
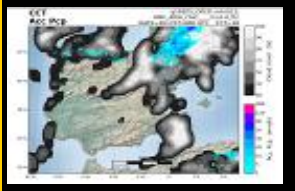
David Gil (collaboration) web page



What is AEMET-γSREPS ?

AEMET-γSREPS system

- 20-members 2.5 km *non-hydrostatic convection-permitting* EPS
- Since October 2018 daily running at 00 and 12 UTC 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					

Spain Severe Weather

Spain Renewable Energies

Cantábrico 2011-05-30
CAP gale (Galerna)

Fotoelectric
Cenicientos (Madrid)

Montserrat 2000-06-09
Flash-floods > 200mm

AEROgenerators
Serra De Burgo (Orense)

Valladolid 2011-05-30
Hailstorm

Tous 1982-10-20
Flash-floods>1000mm

ySREPS goals

Turia 1957-10-14
Flash flood>350mm/d

Cádiz 2009-12-24
Tornado

La Safor 2007--
Cut-off low>450mm/d

Algeciras 2012-03-06
Storm > 35 mm/h

Vista Alegre 1999-09-07
Tornado

CVal 2009-09-27/29
Cut-off low>300mm/d

AEMET-γSREPS

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

1 INITIAL CONDITIONS

2 BOUNDARY CONDITION

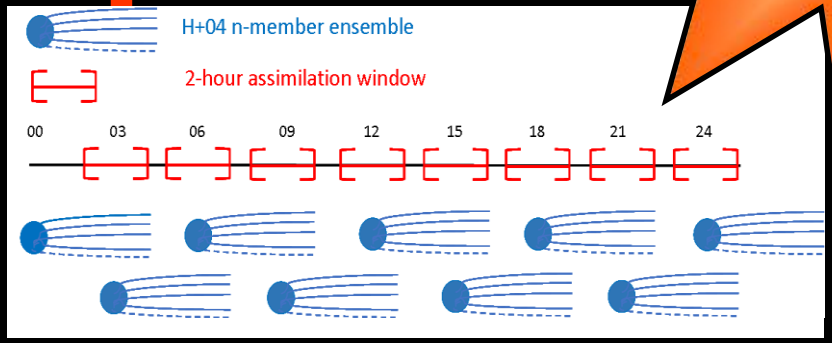
3 MODEL *ERROR*

2019 LETKF assimilation

We suffer from the fact that global models available for us have different hortizontal/vertical resolutions!

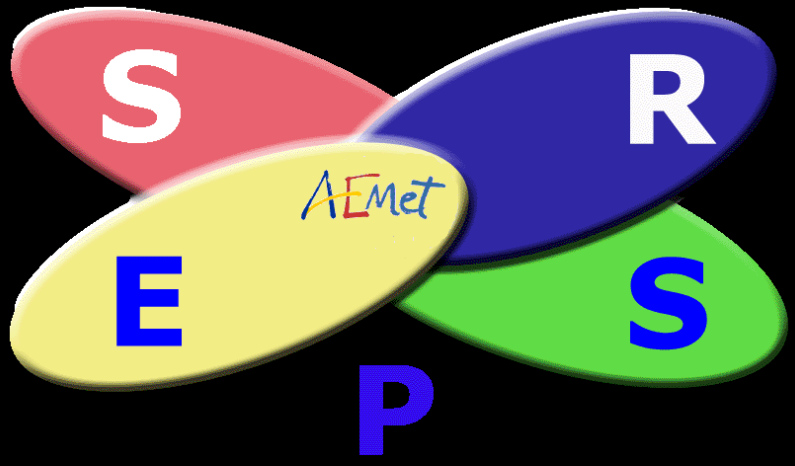
25 members I-LAM ?

Initial conditions



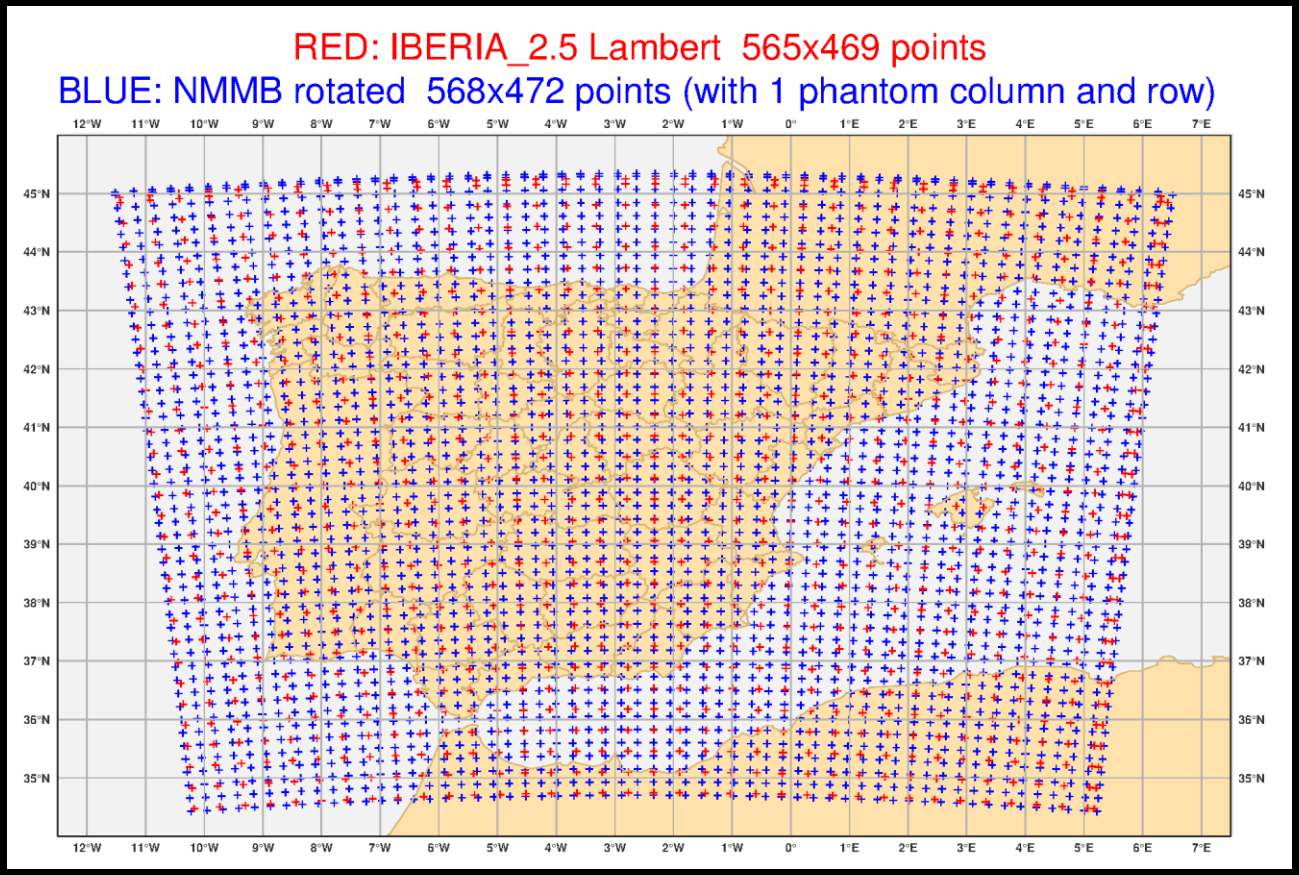
Multi-model

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



Designing AEMET-γSREPS

Horizontal resolution in GRIB files



- **Intended to run each NWP with the same / very similar internal GRID**
- **Exactly the same GRIB1 codification output as HARMONIE**
  - **Lambert 565x469**

HARMONIEs
lambert
'NLON' => '576',
'NLAT' => '480',
'EZONE' => '11'
'GSIZE' => '2500.',

WRF-ARW
map_proj = '**lambert**',
e_we = 566,
e_sn = 470,
dx = 2500,
dy = 2500,

NMMB
map_proj = '**rotated_llb**',
e_we = 568,
e_sn = 472,
dx = 0.022545,
dy = 0.022500,

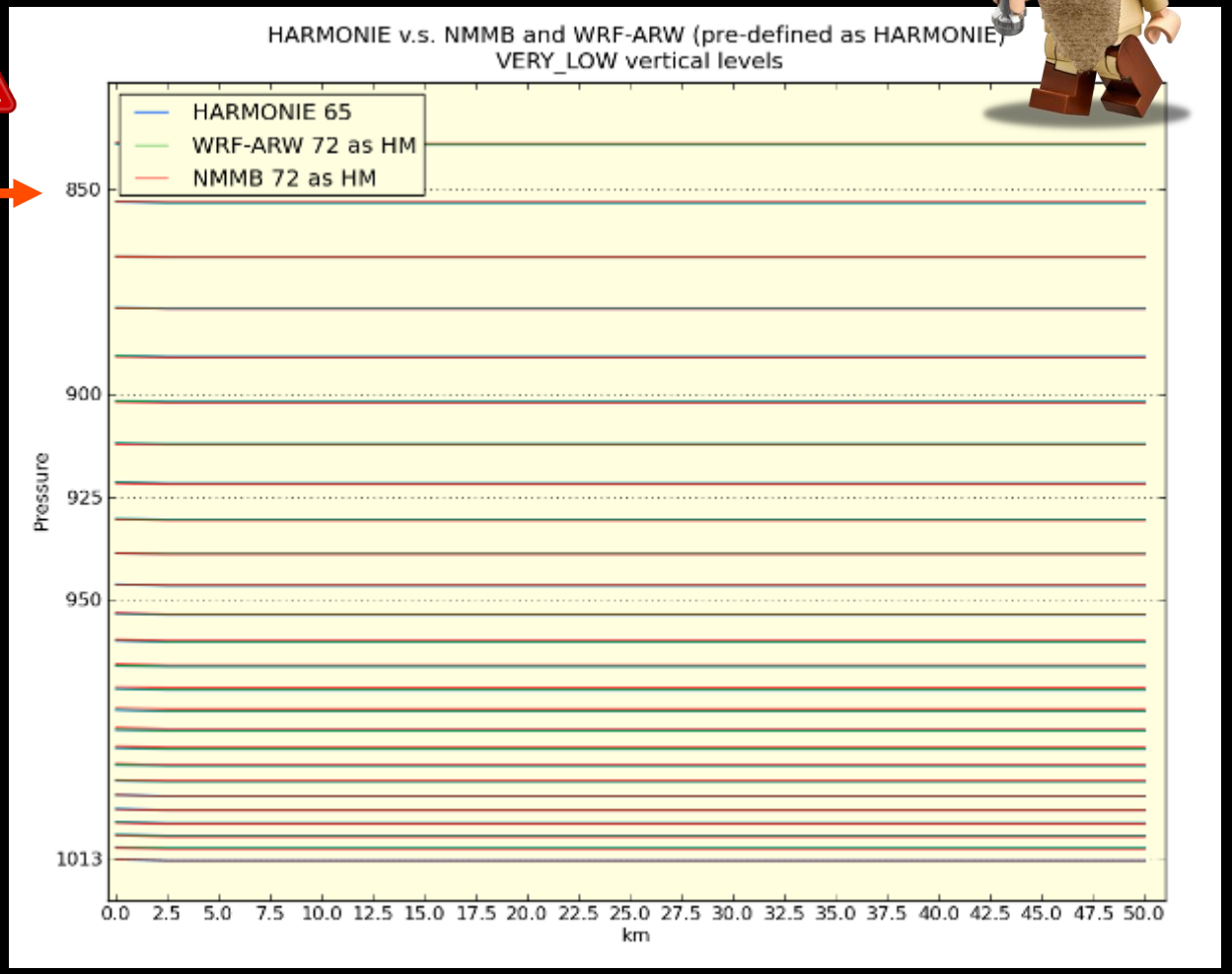
➔ NMMB bigger area than HARMONIE to interpolate to common Lambert area without missing values

Vertical levels consistence between models

- **AROME and ALARO**
  - **65 hybrid sigma-pressure layers**
  - **No top**
- **WRF-ARW:**
  - **72 sigma levels → hybrid on 3.9.1. version**
  - **Top 40 hPa**
- **NMMB**
  - **72 hybrid levels**
  - **Top 40 hPa**

8

22

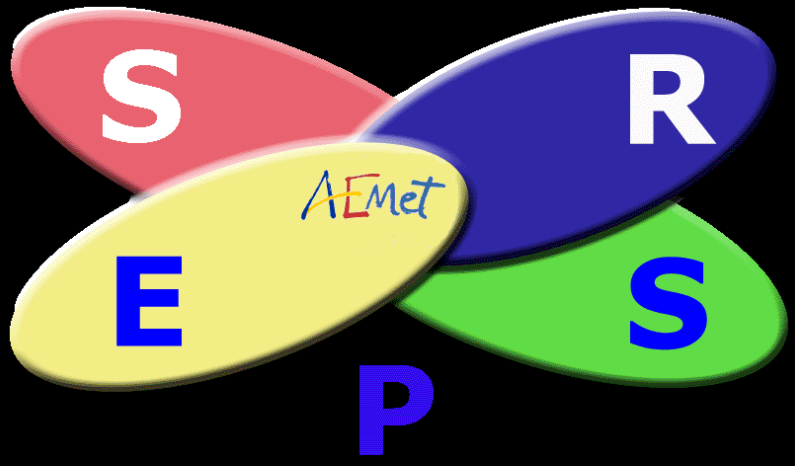


→ Consistency AT LOW LEVELS into the PBL → The very close vertical levels distribution !!!

Summary of models in γSREPS: 4 NWP MODELS

NWP models' settings		
HARMONIEs	**WRF-ARW**	**NMMB**
AROME physics ALARO physics 65 Hybrid sigma-pressure vertical levels 60 s time step	ARW dynamical core ~~66~~ 72 sigma (ETA) hydrostatic-pressure levels up to 40 hPa [there it is 64th HARMONIE vertical level] 12 s time step	NMM dynamical core ~~66~~ 72 Hybrid sigma-pressure up to 40 hPa 5.625 s time step
Lambert Conformal Conic projection: lon -2.5º / lat 40.0º centre 565 * 469 grid-points		Rotated lon-lat B-grid: lon -2.5º / lat 40.0º centre 568 * 472 grid-points
Calling radiation every 15 minutes		
8 LBC relaxation points around grid area		

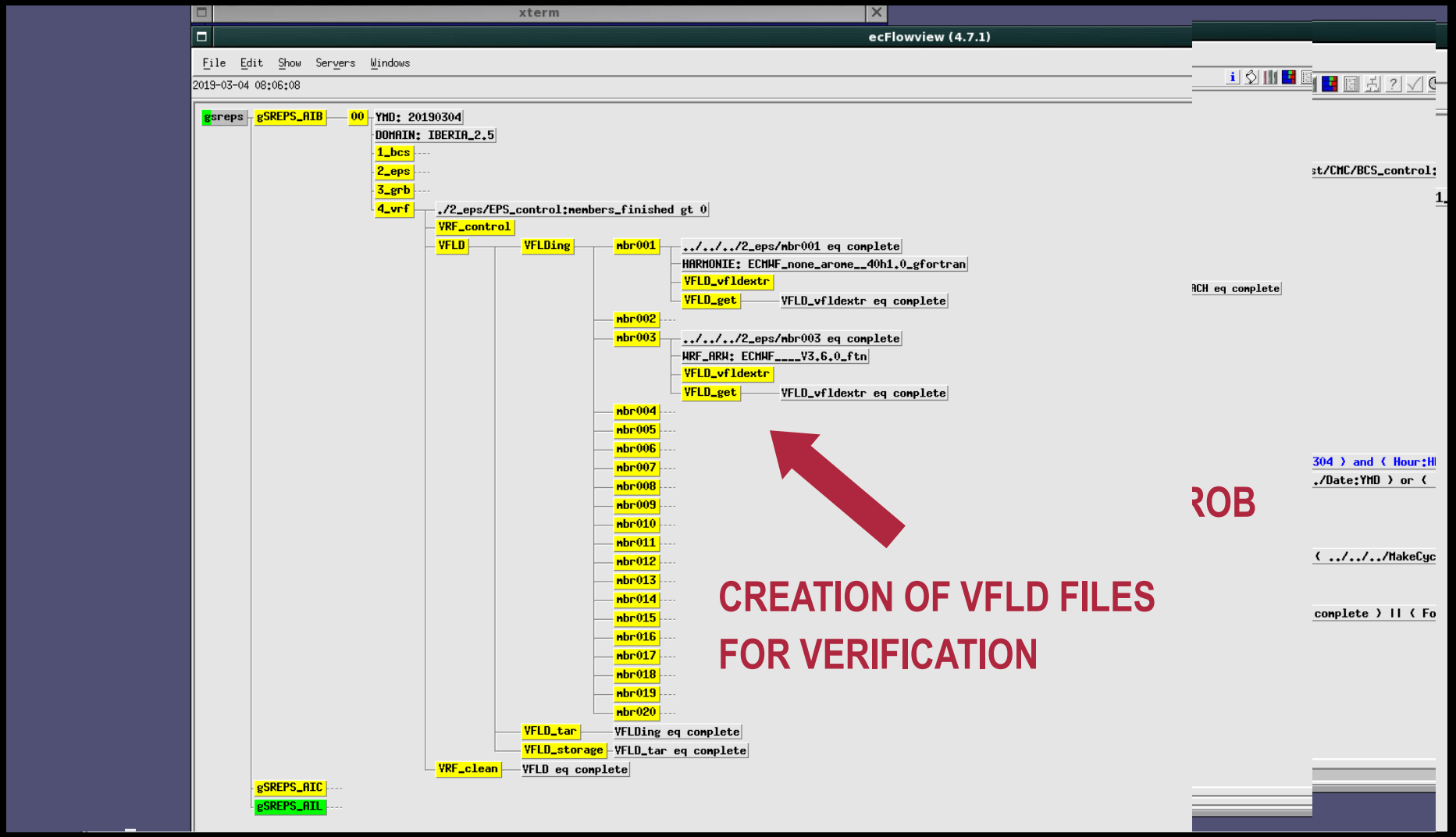
It has been intended to integrate both NWP models with the closer possible settings in order to be the comparison the more fairly possible.



AEMET-γSREPS in operations

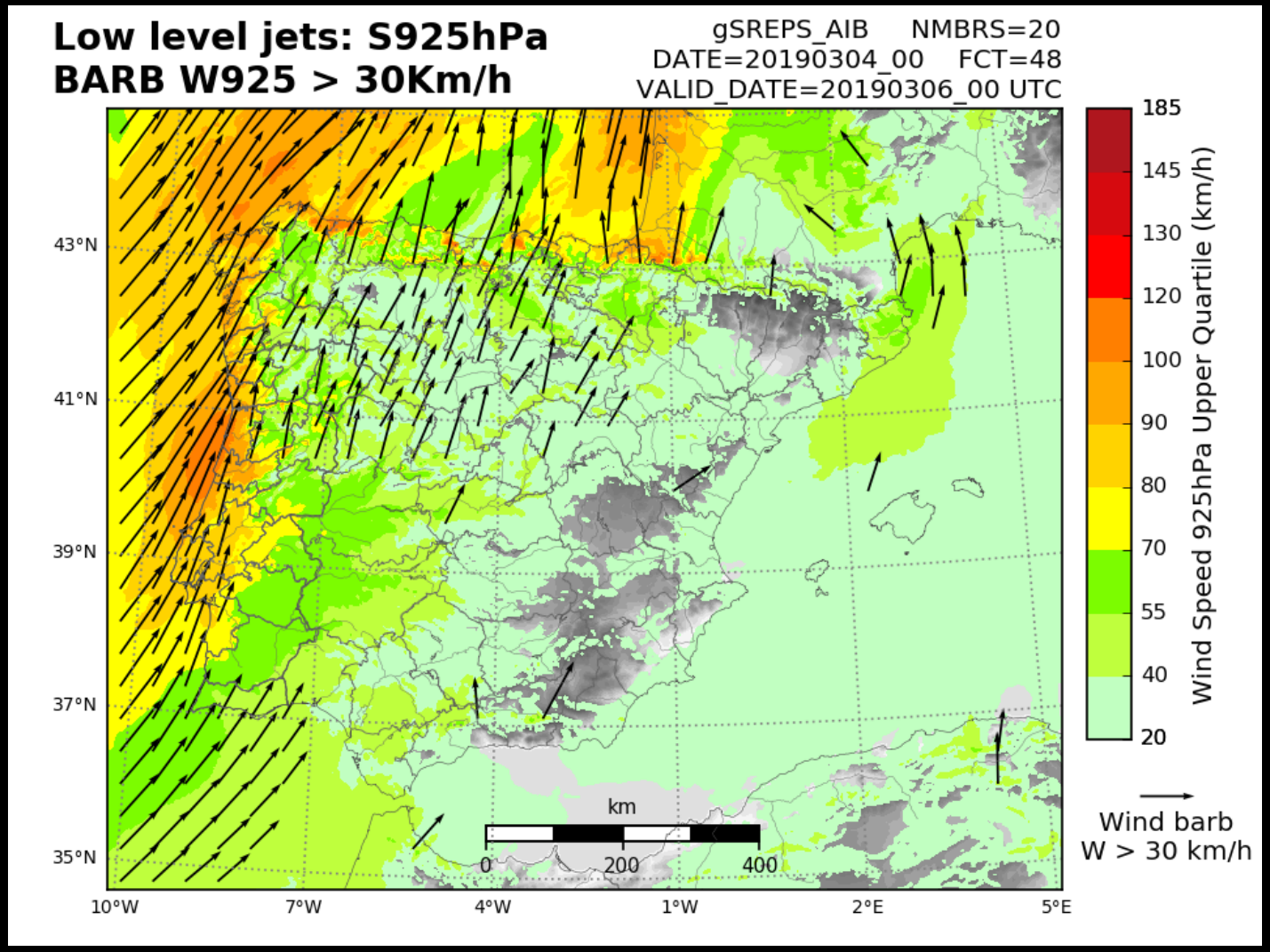
γSREPS at ECMWF Cray XC40

- 00 and 12 UTC cycle over IBERIA_2.5 domain. 00 UTC cycle over CANARIAS_2.5 and LIVINGSTON_2.5 domains.



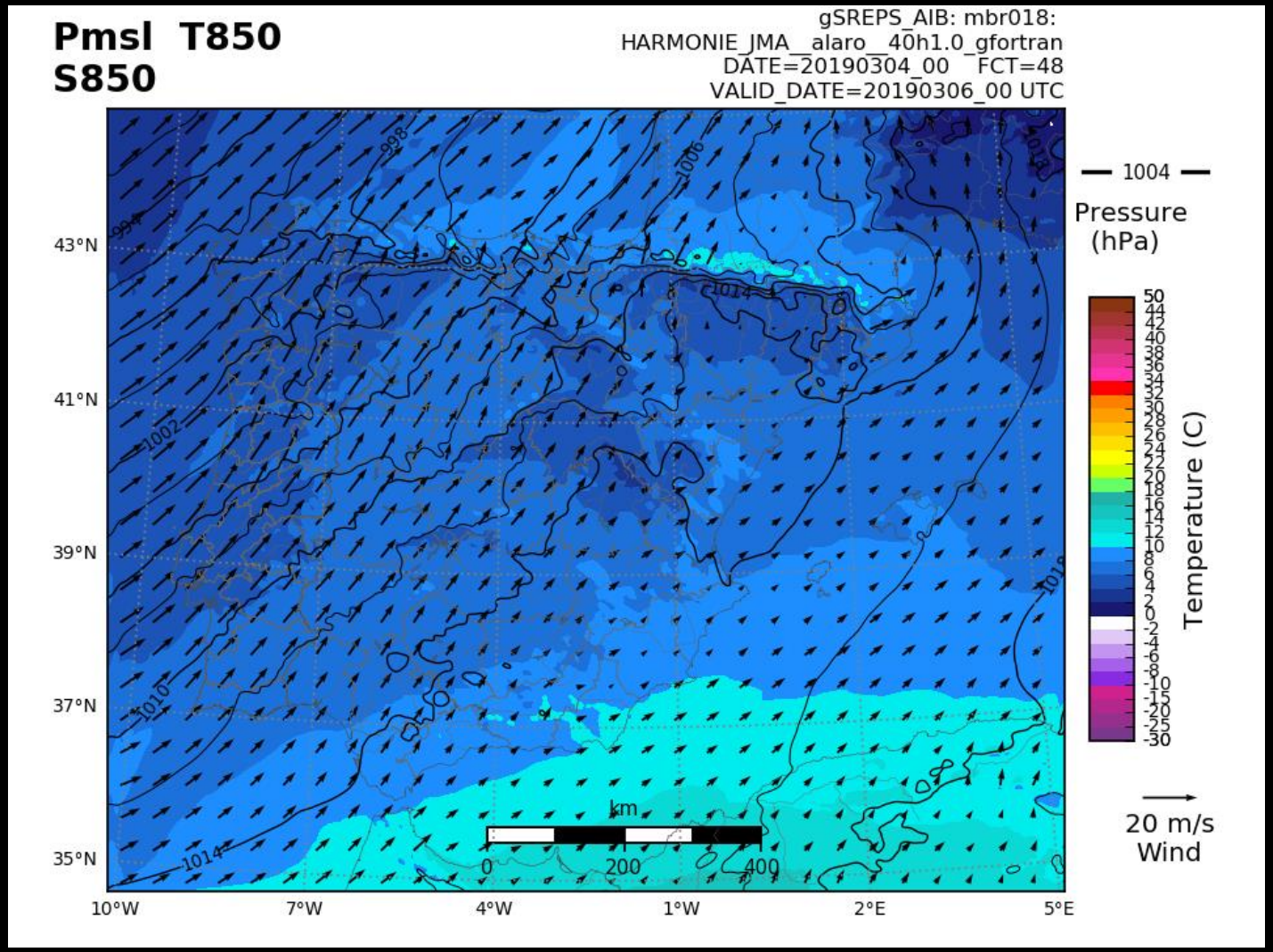
γSREPS probabilistic products

- Examples of PROBABILISTIC products for the forecasters



γSREPS determinisitic products

- Examples of DETERMINISTIC products. ALARO + JMA/GSM



*γ*SREPS and AEMET forecasters

- In total more than 3000 products per cycle for forecasters
- At the moment, AEMET-*γ*SREPS is being used operationally in the whole AEMET forecasting system: Iberia, Canarias, Antarctica…
- From forecasters we have some interesting feedback:
  - It **increases the trust** in the forecast of **intense convective precipitation**, either in **spatial and temporal localization**. Specially very useful the **"spaguetti" plot for precipitation thresholds**
  - **Localization of strong winds** (gusts) looking at g10m mean fields allows better identification and discarding of zones of ocurrence
  - Others??? (Few cases of snow to evaluate…)
  - More potential to be experienced… (I say this ☺!!)
- The **usefulness** of the tool should **depend on the *complicated* weather patterns in each region**: Convective Precipitation in the Mediterranean, Strong Winds in the Atlantic, Fogs in the Baltic Sea, …

Current and future *γ*SREPS developments

Foreseeable future work plan: 2018-2020

*y*SREPS "scientific" developments:

- Assimilation: **LETKF** without discarding **3DVAR…** [→*Paul*]
  - **GNSS+RADAR** assimilation [⇔*Jana Sánchez*]

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

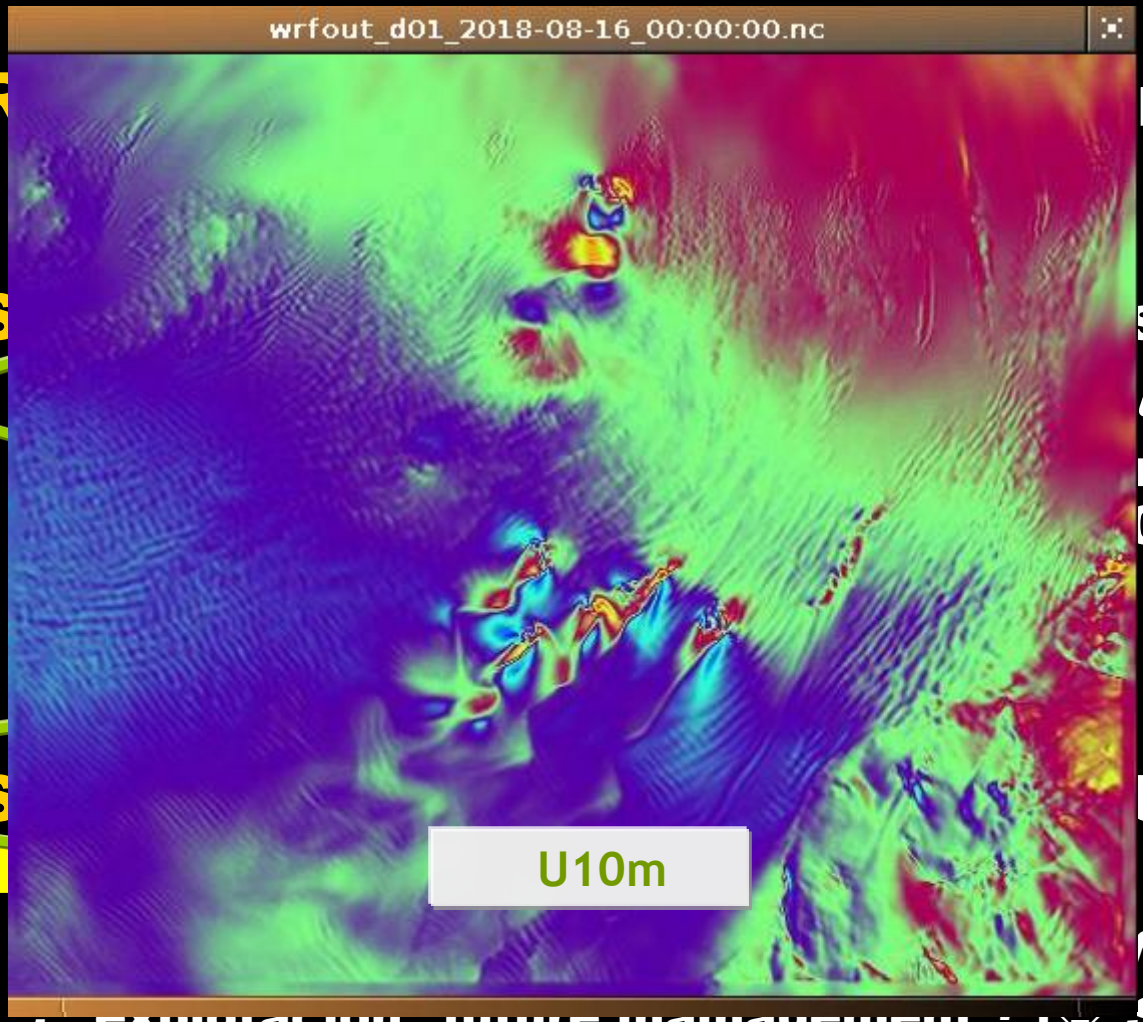
- **15'** stream output for high social-economic variables' impact as **T2m** and **UV10m**

Foreseeable future work plan: 2018-2020

γSR … nts:

- γS … s:
  - … *u*]
  - … r organized … 0 Bologna

- γS … UTC at AI …
  - … *fons* + *David Q.*]
  - ¿ explotación future management ? [↪ *Sergio Cotera*]



Foreseeable future work plan: 2018-2020

γS … ents:

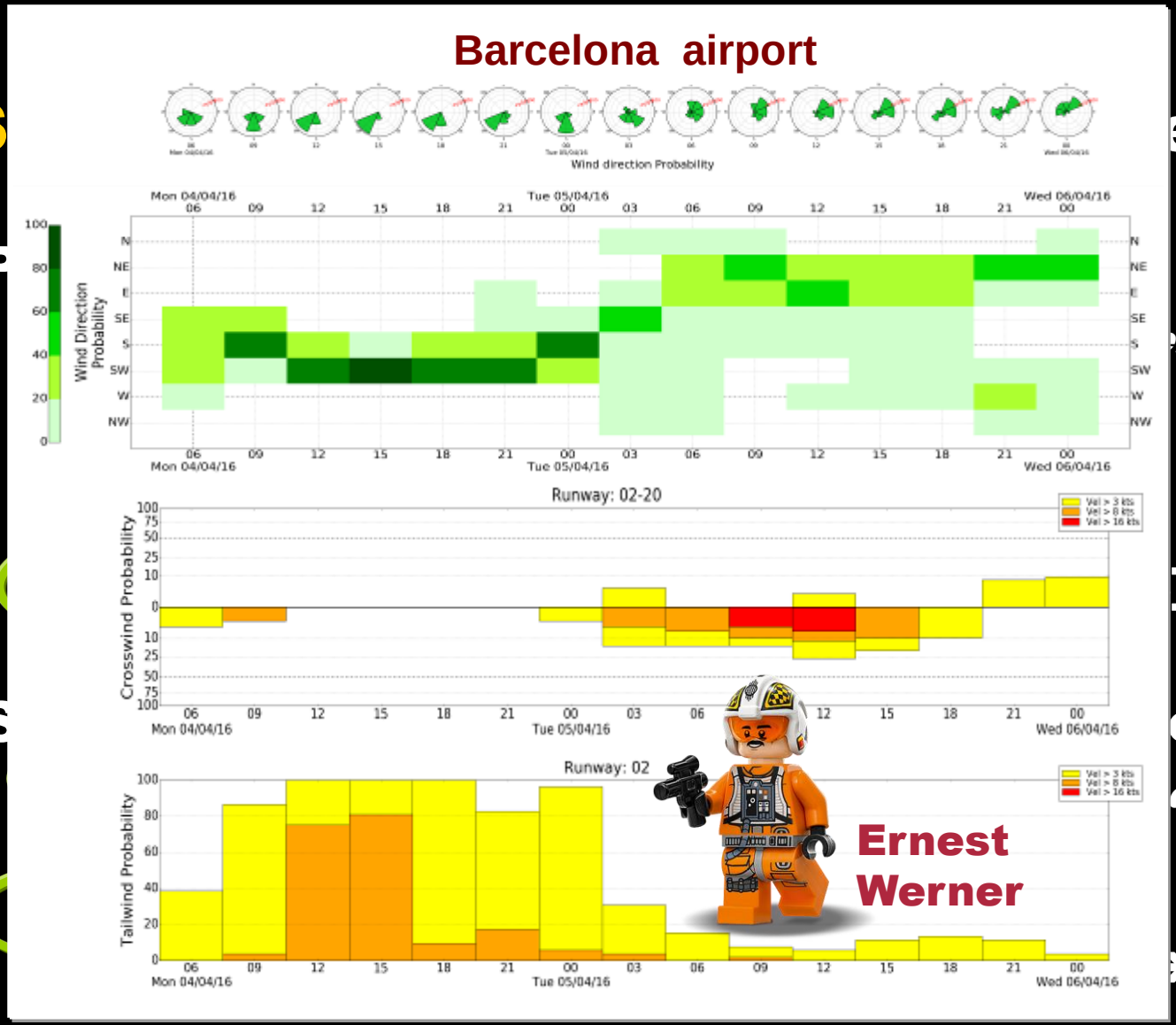
- P … *entation*]

(…]

- S … cts:

… *dro Méndez*]

… *Mauri* ?]



γSREPS

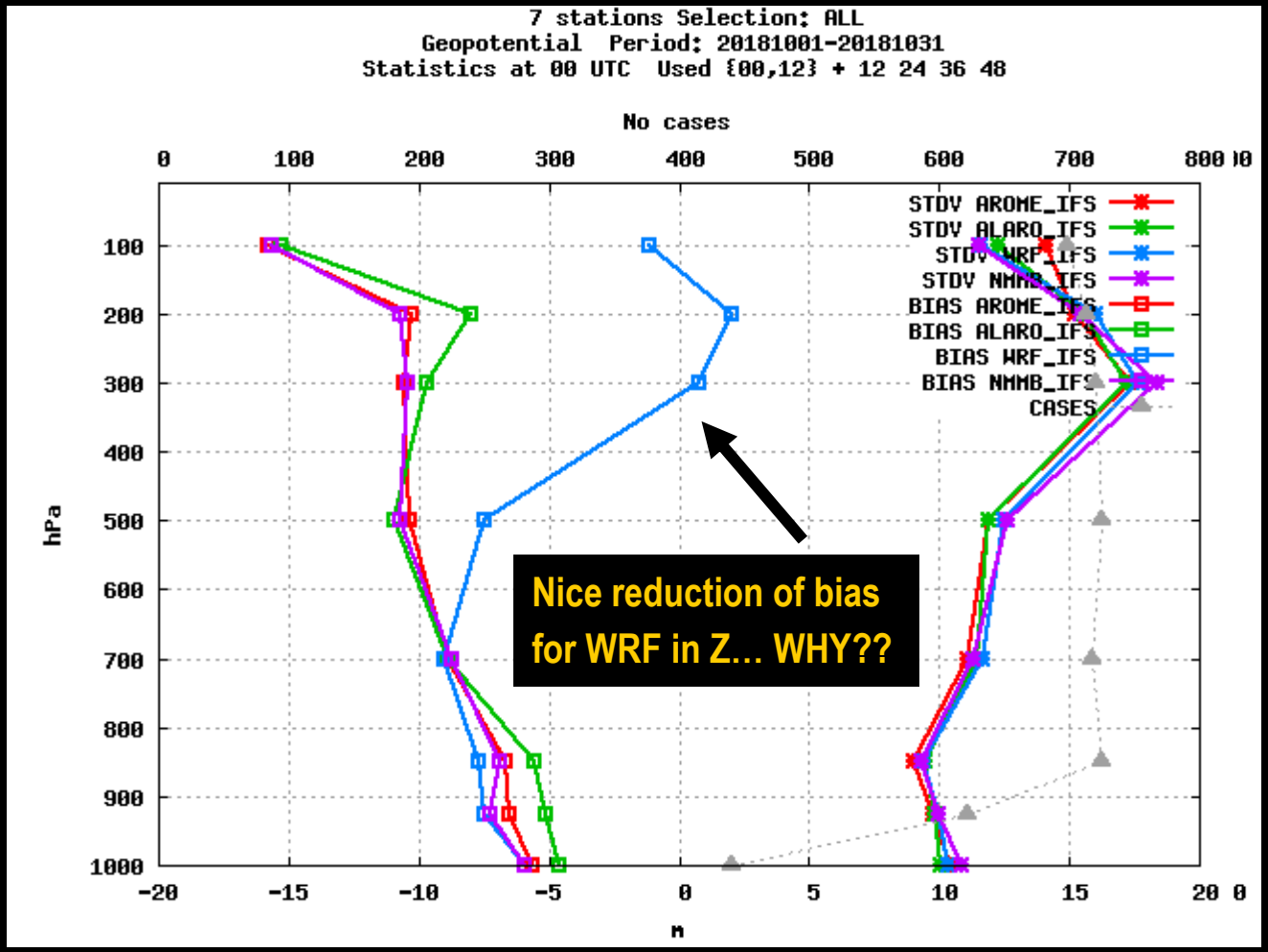
Objective VERIFICATION

Understanding verification here…

- Deterministic verification of the 4 IFS members subensemble for 00 and 12 cycle of all October 2018 is presented, to simplify
- Probabilistic verification of all gSREPS 20 members for 00 and 12 cycles only for AccPcp12 of all November 2018 is also presented.
- Both verifications have a lot of data….
- At the moment, ALARO members are running with SURFEX and not following the *reference* configuration of ALARO world. Work to addresss this in progress…
- Very important… NO Data assimilation is done either in Upper Air and Surface… So, a lot of potentional of improving all these results…. To start this year!

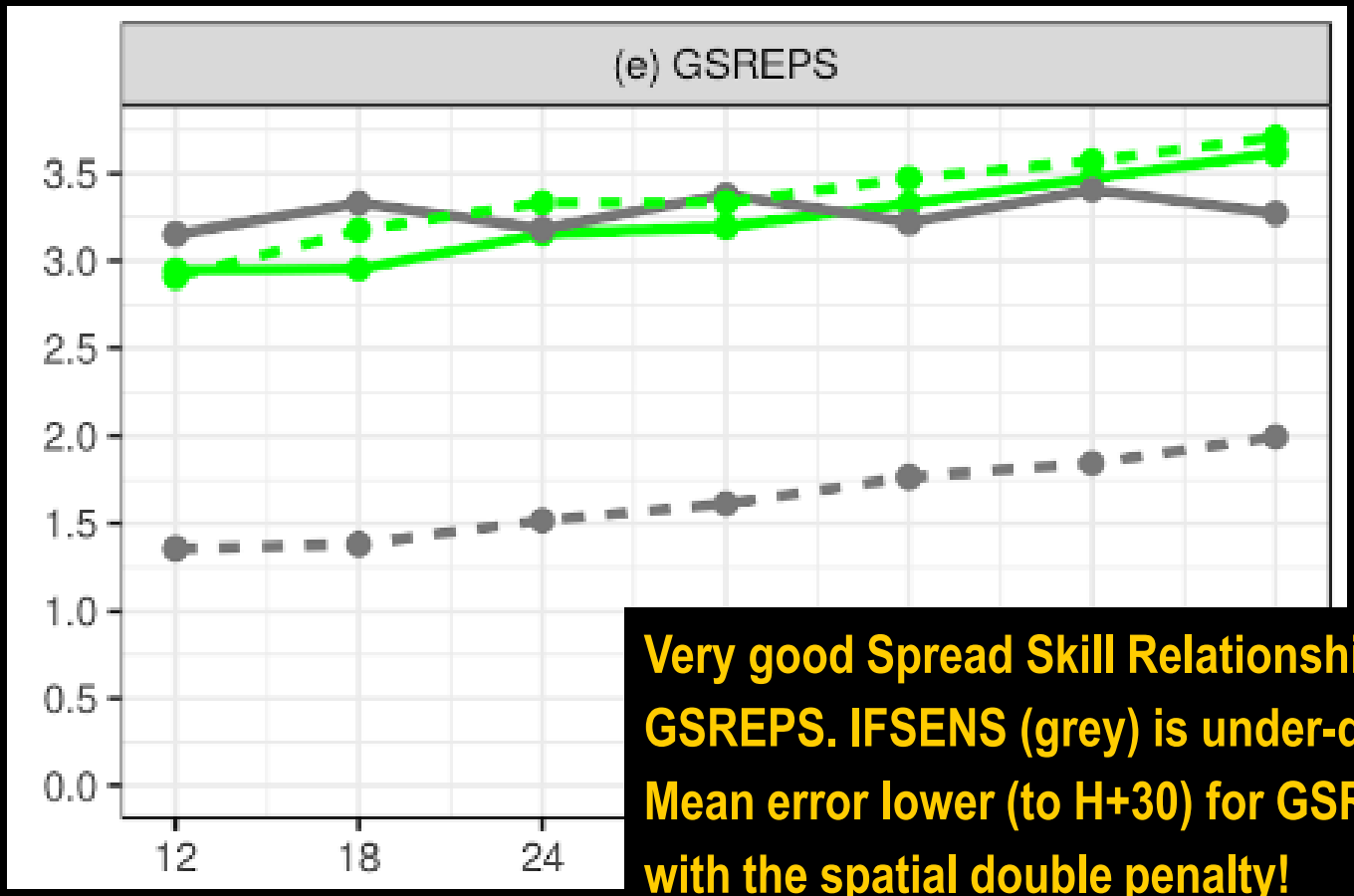
DETERMINISITIC: IFS members

- Verification of the 4 IFS members subensemble. October 2018



PROBABILSITIC: All 20 members

- Recent result for a coming paper about HarmonieEPS systems. Comparison of 12AccPcp for 00 and 12 cycles of November 2018



Very good Spread Skill Relationship. Green is GSREPS. IFSENS (grey) is under-dispersive. Mean error lower (to H+30) for GSREPS even with the spatial double penalty!

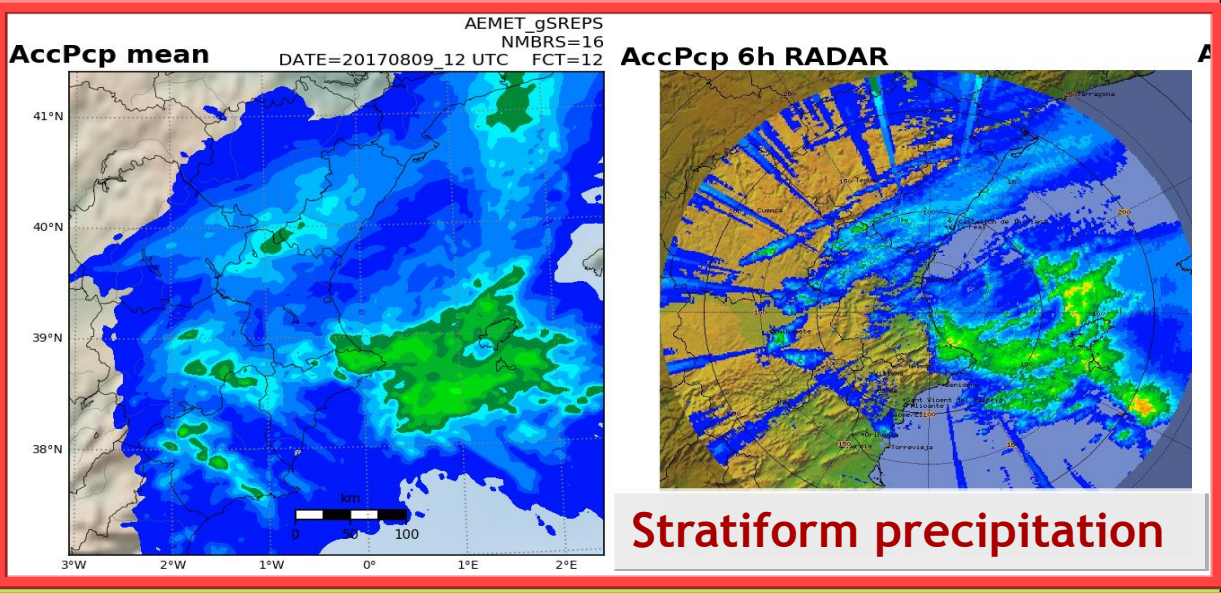
*γ*SREPS

Subjective VERIFICATION

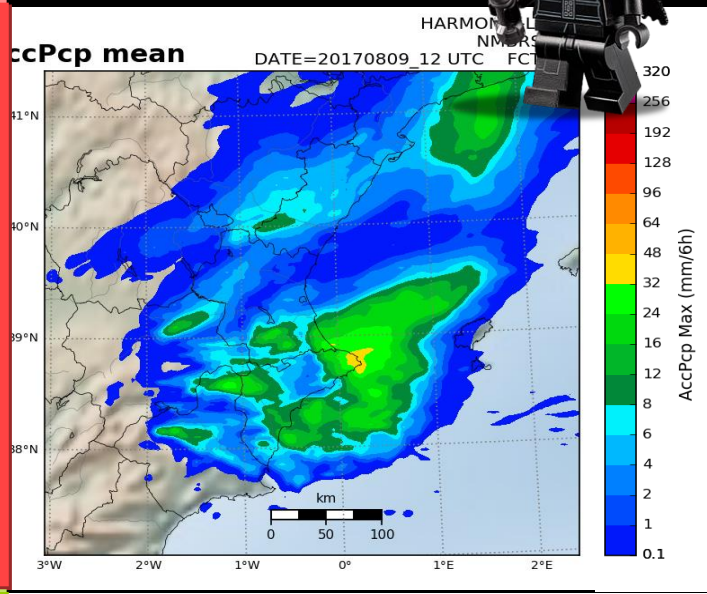
See *Pau Escribà* presentation for more subjective verifications cases

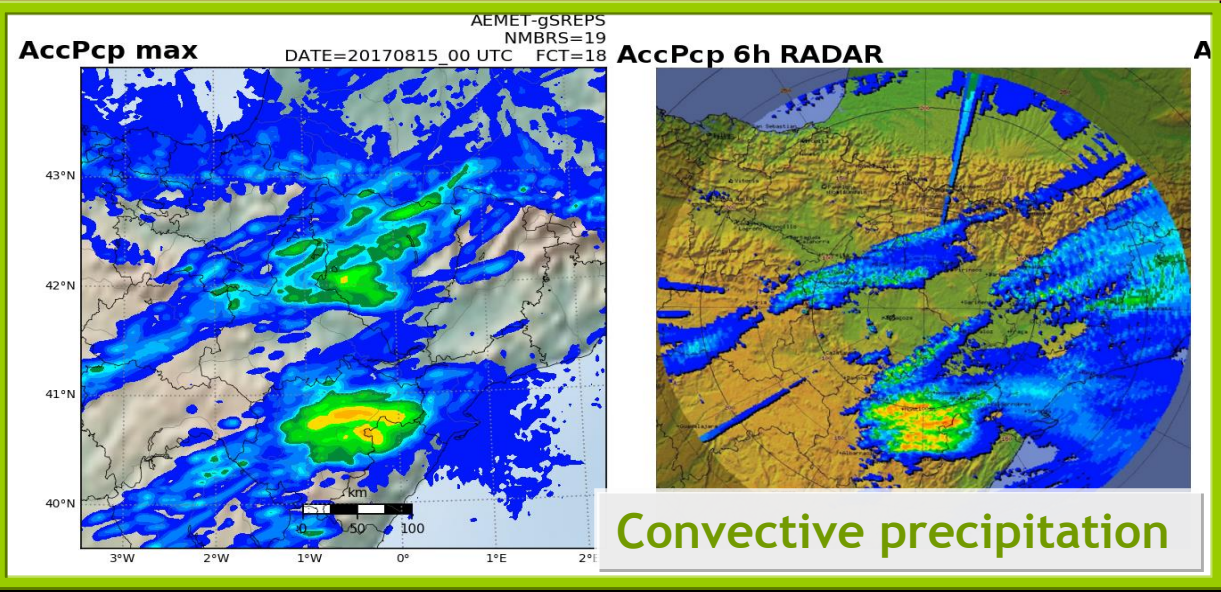
Not significant conclusions … based on only few cases !!!

Qualitative verification results

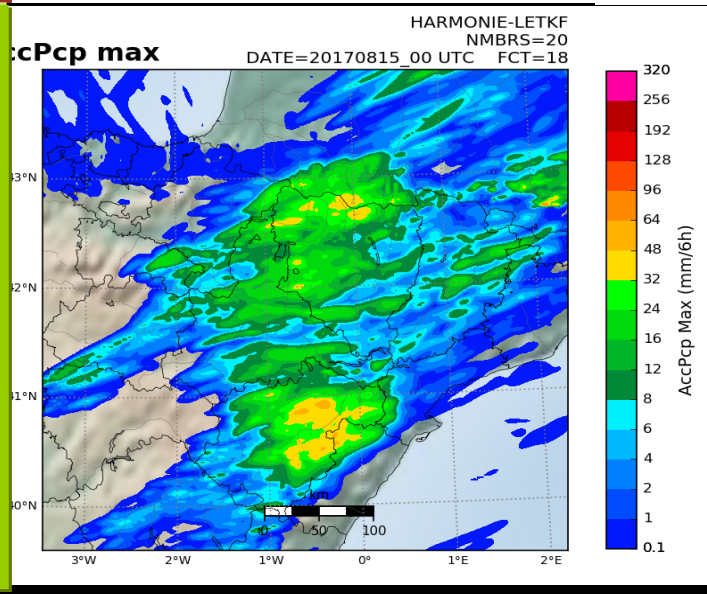


Stratiform precipitation





Convective precipitation



Maresme case study: *low predictability*

MINISTERIO DE ECONOMÍA, INDUSTRIA Y COMPETITIVIDAD

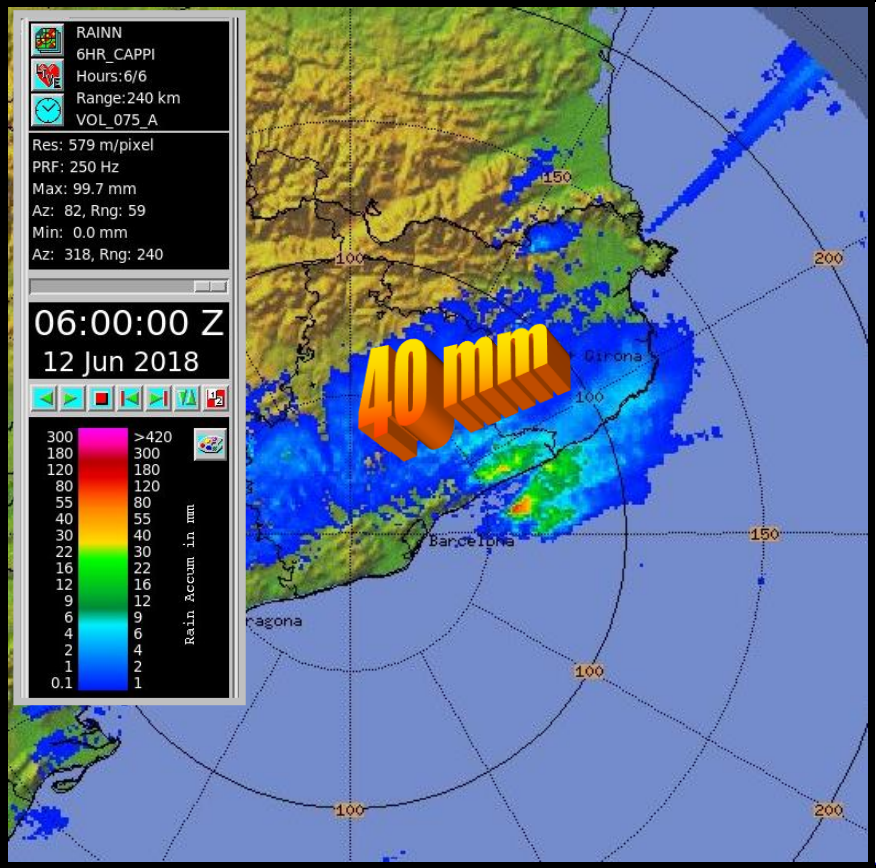
AGENCIA ESTATAL DE INVESTIGACIÓN

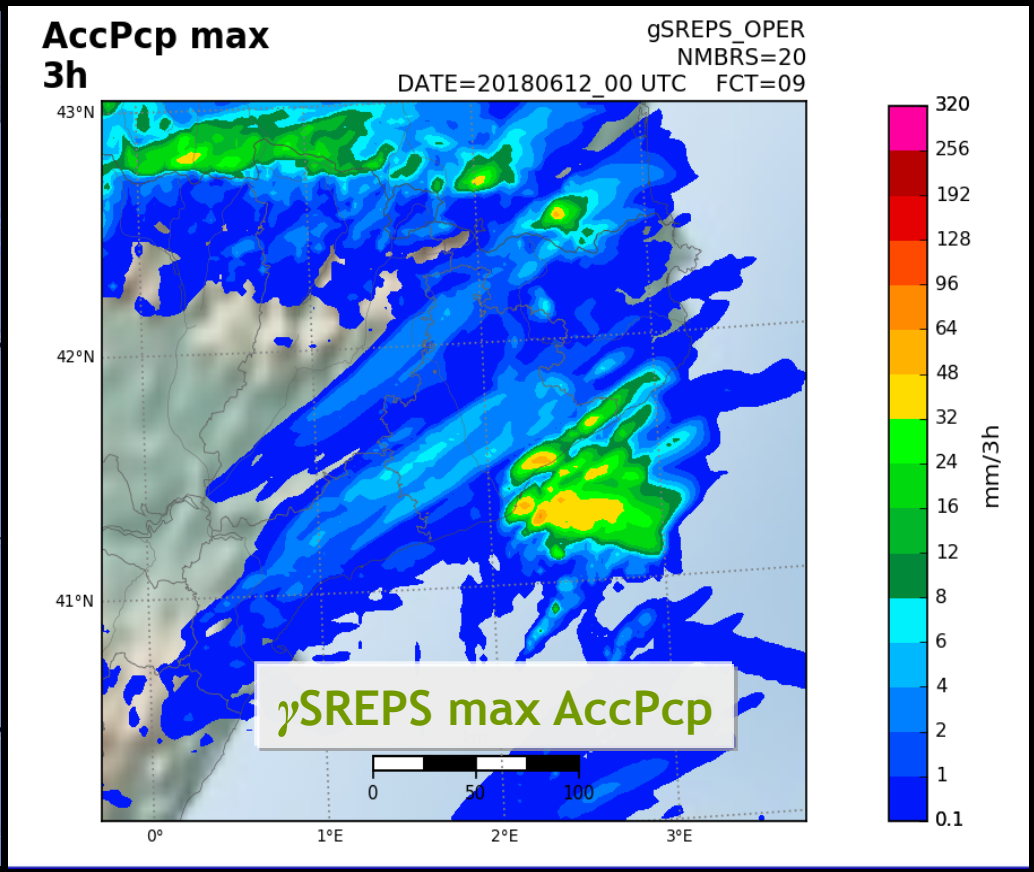
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
"A way to make Europe"

UIB Universitat de les Illes Balears

COASTEPS

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





AEMET-γSREPS

→ From ECMWF BCs not thunderstorm is developed !!!

Update to operational ALARO1 configuration within HARMONIE and AEMET-γSREPS

ALARO1 update in HARMONIE

- **ALARO has been a canonical coniguration in the HARMONIE package for many years**
- **Recently it has been decided that only HARMONIE partners that use ALARO will be the maintainers of this configuration. We are AEMET (Spain) and RMI (Belgium)**
- **Work has been devoted to update HARMONIE tag 40h111, at the level of cy40t1bf7, to make ALARO1 configuration the same as *reference* (???) in ALARO world. This work has been done specially with Neva Pristov and with Maria Derkova, Petra Smolikova and Antonin Bucanek. Thanks to all!**

ALARO1 update in HARMONIE

- The aim of this work is to keep **HARMONIE package updated with ALARO reference**, to be used by everybody. Obviously this must be **discussed with RMI (Geert, Piet)** since they are the experts ☺.
- In particular, the idea is **not to run SURFEX in tag 40h111** with ALARO… (this was not the case in HARMONIE). **In HARMONIE cy43, NON-SURFEX configurations are abandoned**… (hope this is not a problem ☺!)
- At the moment **ALARO can run with Forecast & Assimilation (3DVAR and LETKF) in tag 40h111** either in warm start and cold start… but there are still some issues to address…

ALARO1 update in HARMONIE

- Compilation/run of HARMONIE-ALARO 40h111 is being done in ECMWF HPCF. gfortran compiler
- Funny changes we have had to do:
  - -finit-local-zero compilation option, otherwise crash in 3MT parameterization of convection
  - In subroutine actkehmt.F90, when cold start in snow weather situation, we have some grid point with a value of thermal roughness length so small that Fortran traduces it to 0. This is a crash. If I put a minimum value = epsilon(), it works! The question here is, which must be the minimum value of thermal roughness length? I think this is not trivial…
- Finally a (possibly) problematic issue is that climatic files from our HARMONIE-ALARO are not the same as the ones used by you, ALARO reference ☺. This must be revised!

Happy AEMET-γSREPSing !!!

pescribaa@aemet.es

ALARO-1 Working Days

SHMI, Bratislava, Slovakia, 11-13 March 2019

AEMET Predictability Group

Alfons Callado, Pau Escribà, Mauri Martínez, David Quintero, David Gil