GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE
AEMet Agencia Estatal de Meteorología

About HARMONIE/AROME in AEMET

Javier Calvo

With contributions from

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Aladin/Hirlam ASM,15-18 Apr 2013, Reykjavic

Outline

- The Harmonie/Arome ‘operational’ runs
  - Subjective evaluation
  - Traditional point verification
- The SAL verification
  - From precipitation to clouds verification
- Towards sub-km scale modelling
- Summary and conclusions

HARMONIE at AEMET: AROME configuration

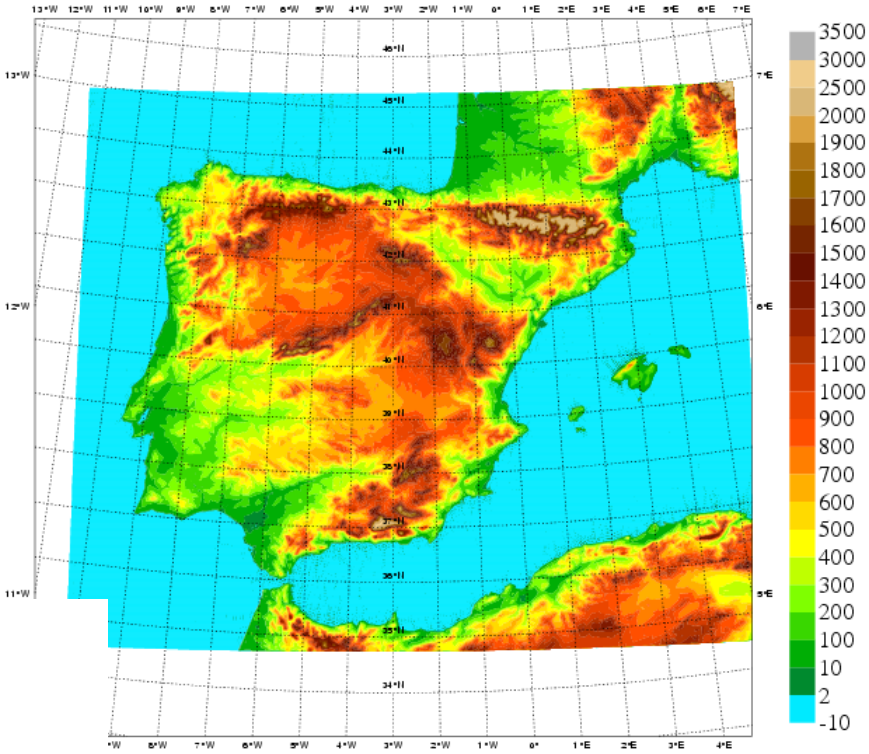
Cy36h1.4 / 37h1.2

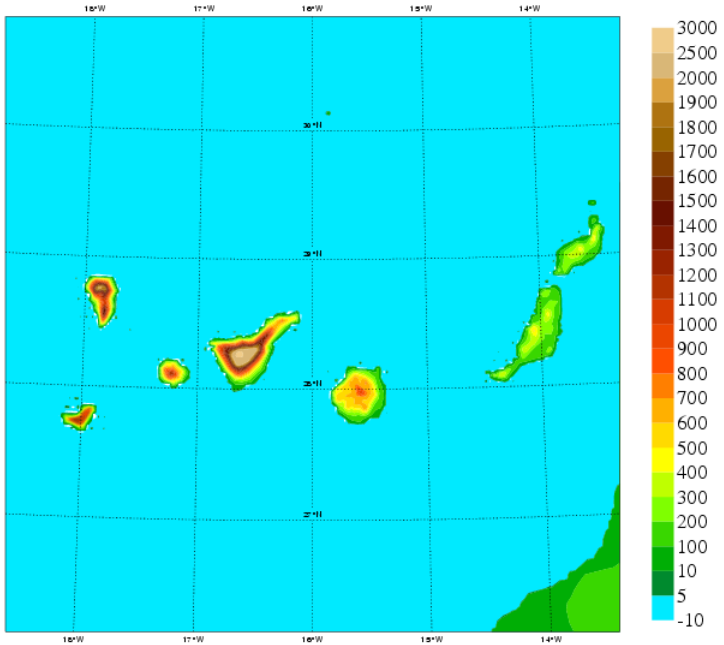
- EDMFM
- Explicit convection

- 65 vertical levels
- Δx= 2.5 km
- Run since October 2011, 4 times per day H+36 forecasts
- Only SURFEX surface analysis (OI). Only wait ½ for obs => early delivery
- Direct hourly nesting in ECMWF forecasts
- Blending (upper levels from ECMWF FG)

- It is increasingly been used by operational forecasters.
  - Main limitation so far is translate all post-procesing products from HIRLAM to HARMONIE

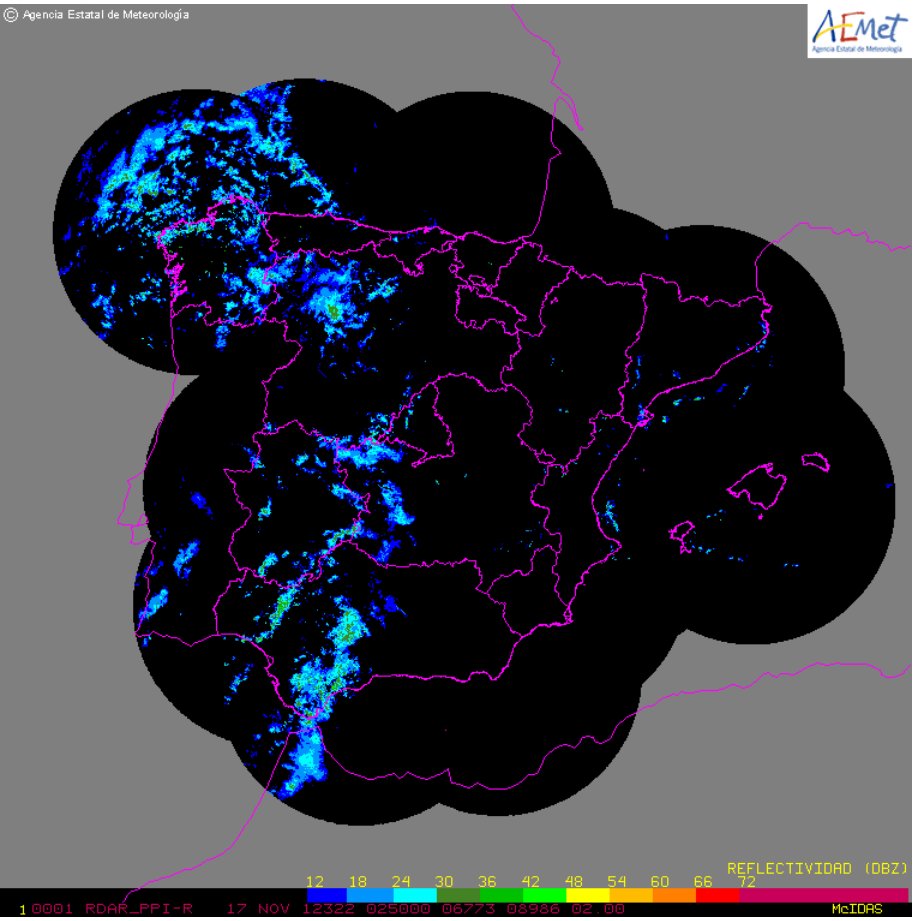
The ’Operational’ domains at 2.5 km





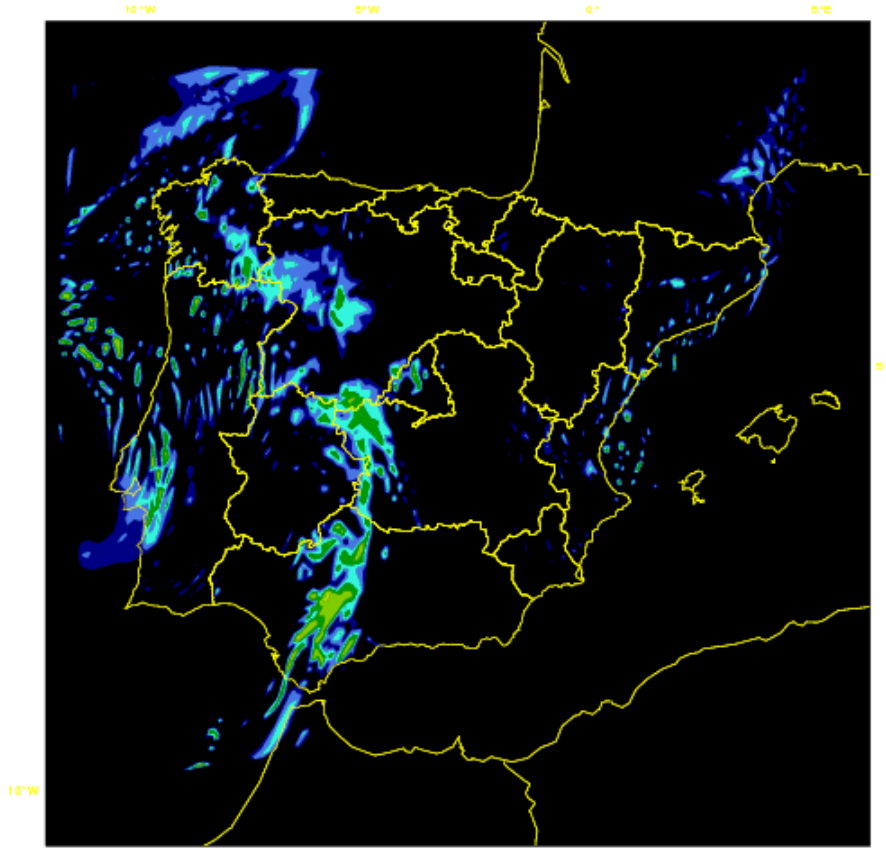
Precipitation with strong forcing (H+30 loop)

Radar



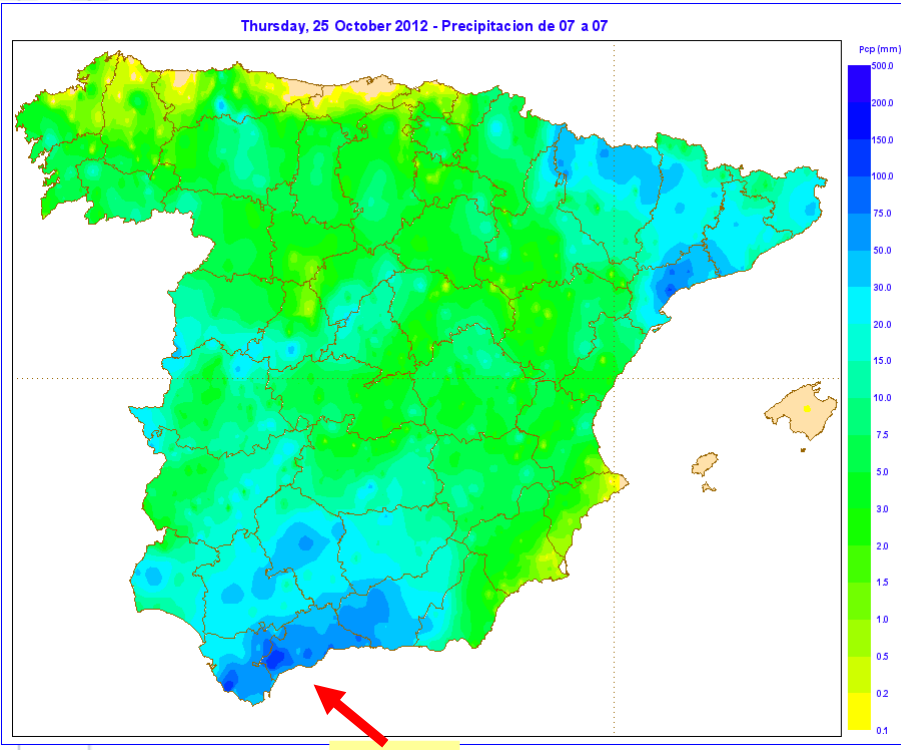
HARMONIE 2.5 km

HARM Reflectividad 300m (dBZ)
17/11/2012 00z HARM H+ 03 Valid: 17/11/2012 03z



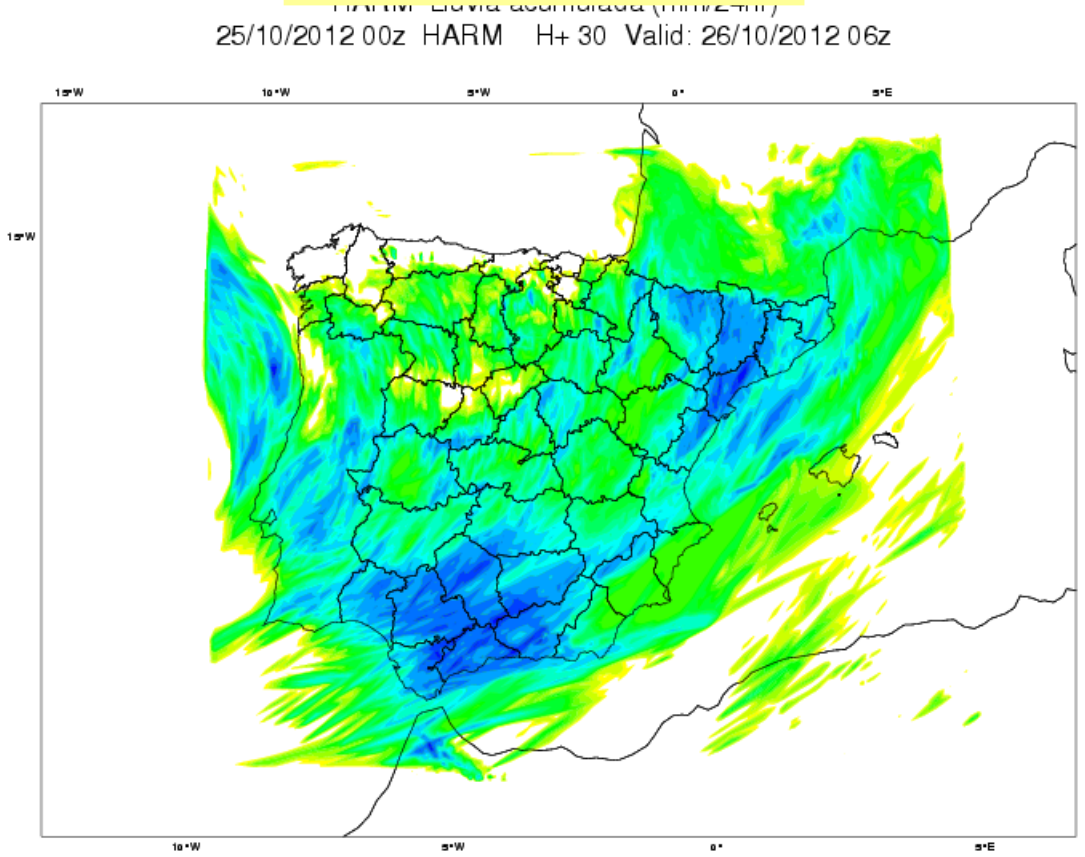
A heavy precipitation event (24 hour accumulation)

Análisis observaciones



226

HARMONIE 2.5 km



- Major precipitation events well captured
  - Side effects: False alarms

Summer convection with weak dynamical forcing

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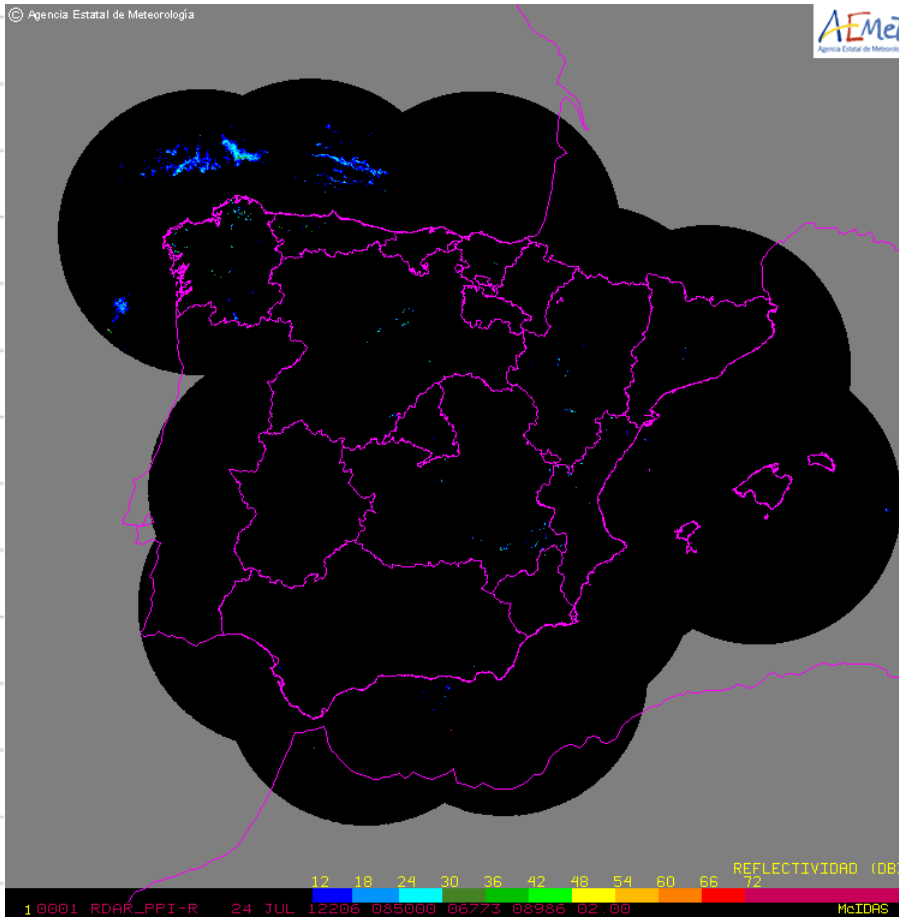
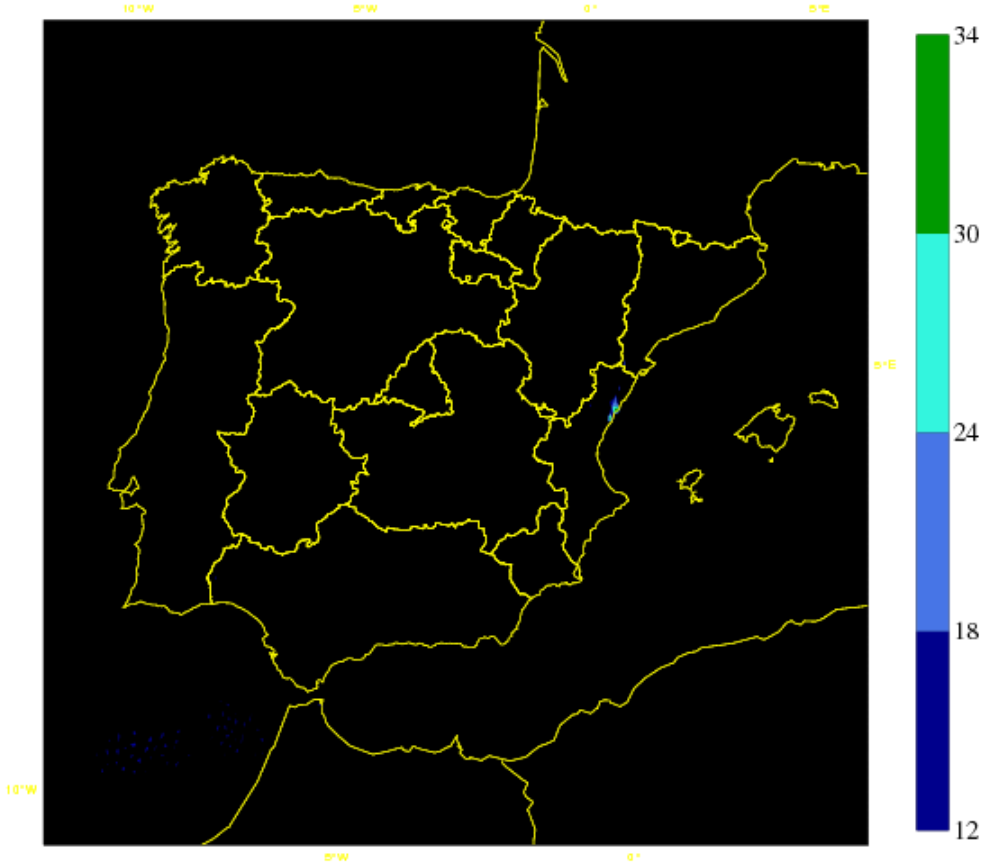
Radar

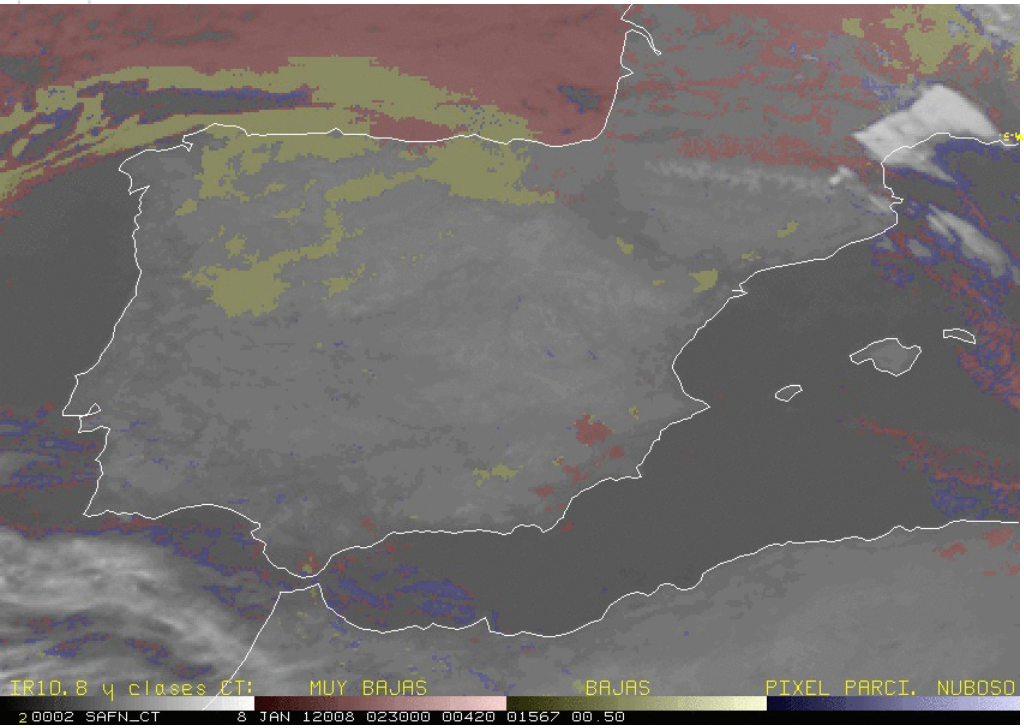


HARMONIE 2.5 km

HARM Reflectividad 300m (dBZ)
24/07/2012 06z HARM H+ 03 Valid: 24/07/2012 09z



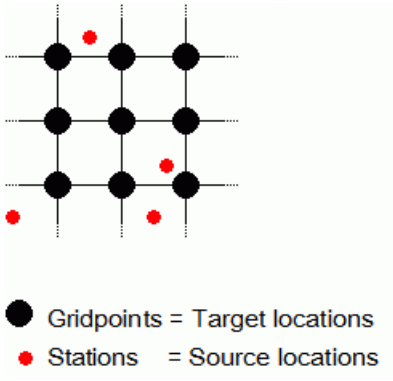
Fog case: 8 January 2012 Loop 30-hr

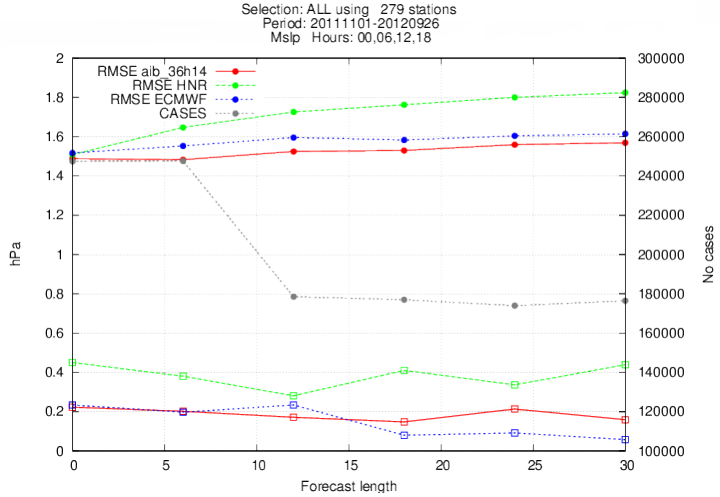


- Big errors in fog prediction: Many false alarms
- But much better than Hirlam
- Very sensitive to initial conditions and model settings

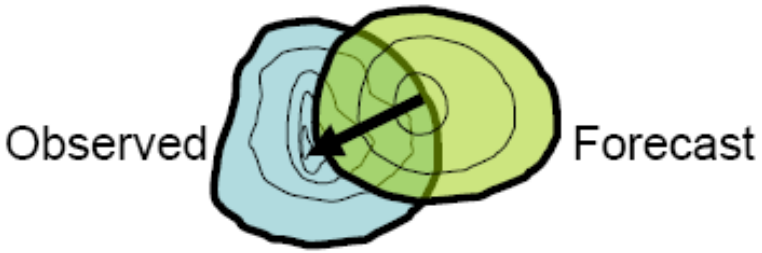
Verification at high resolution

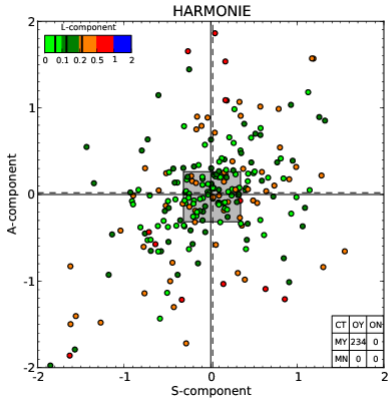
Point verification





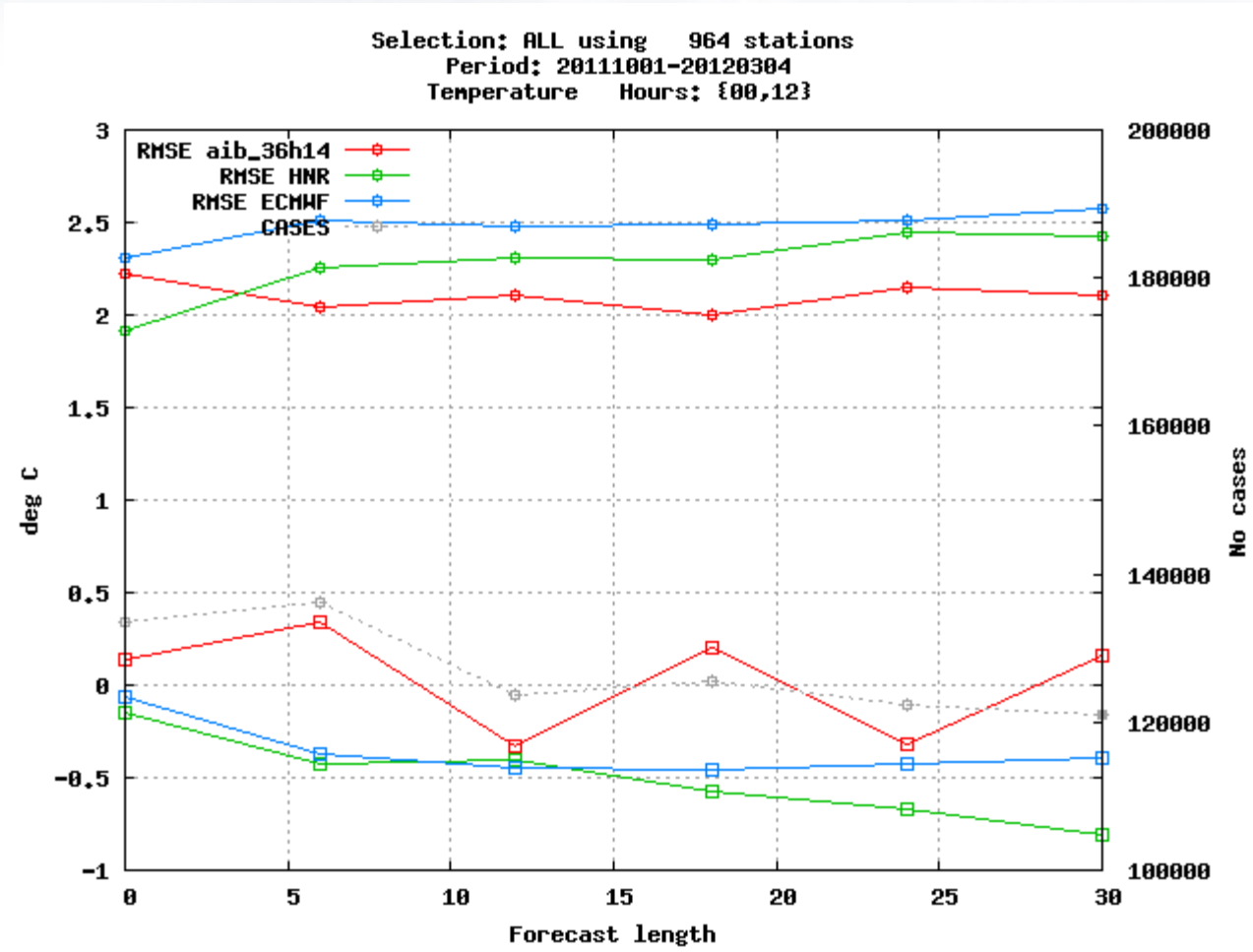
Structure verification: SAL





Verification against observations: T2m

T 2m

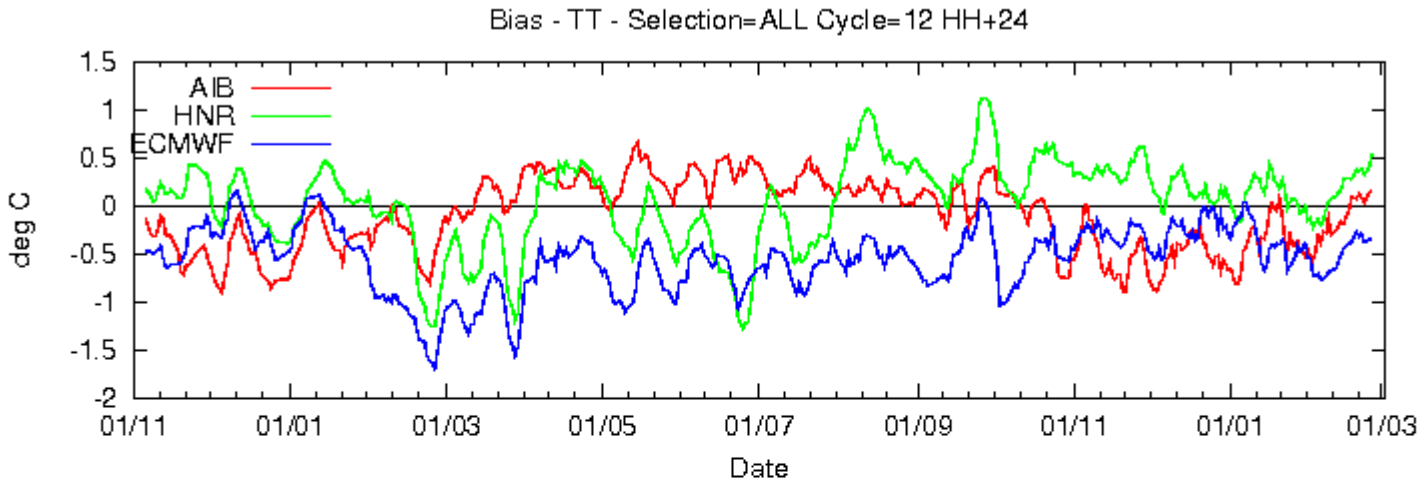


HARM 2.5 km

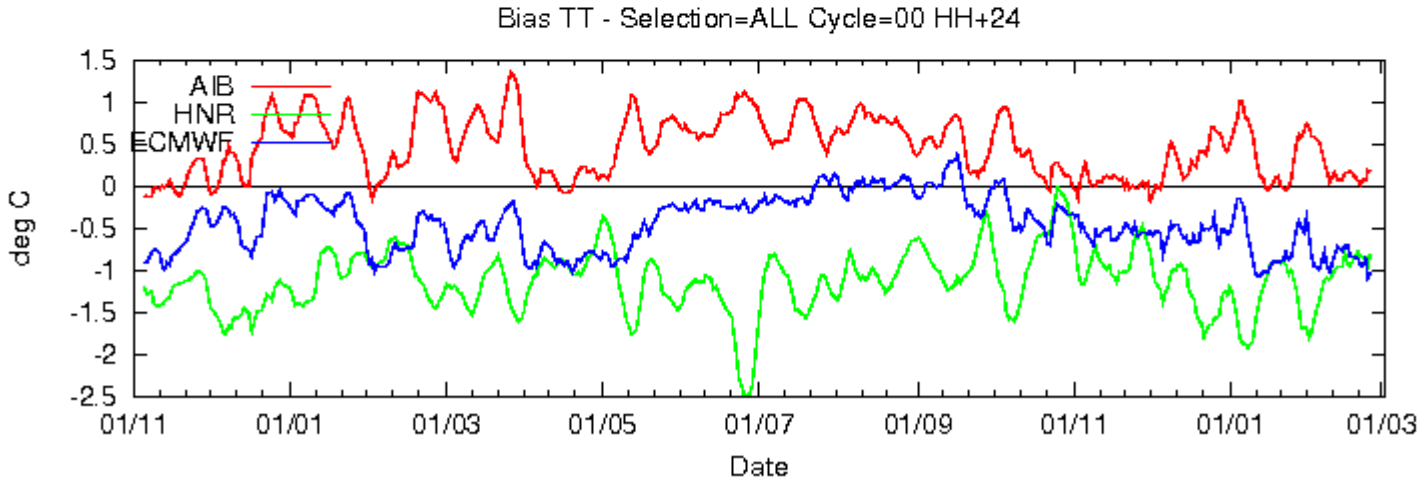
HNR 5 km

CE 16 km

Bias T2m H+24: Nov 2011/Feb 2013



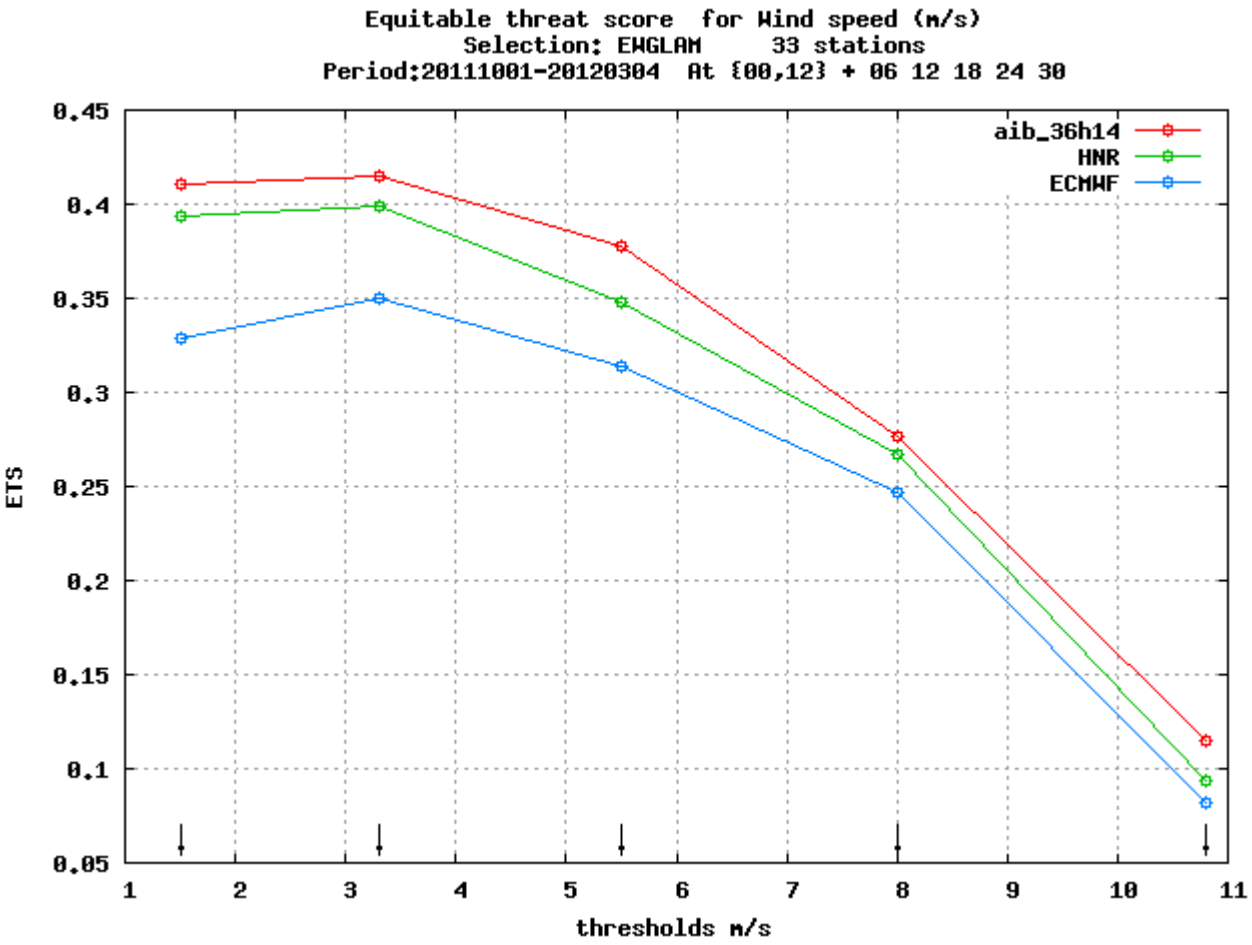
12 UTC



00 UTC

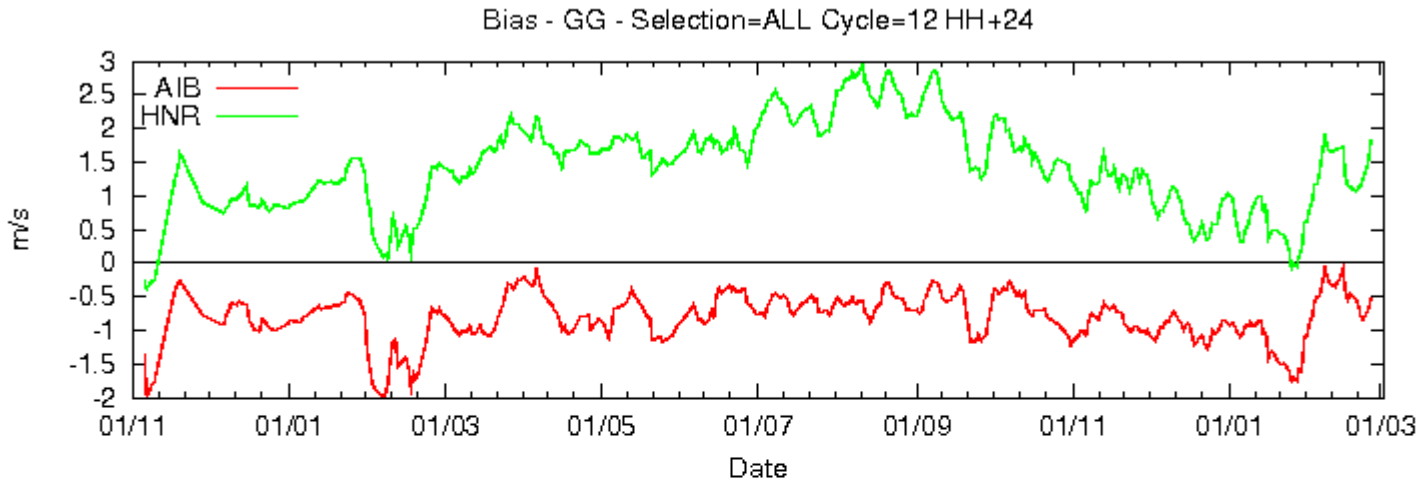
HARM 2.5 km
HNR 5 km
CE 16 km

ETS of wind speed for different thresholds

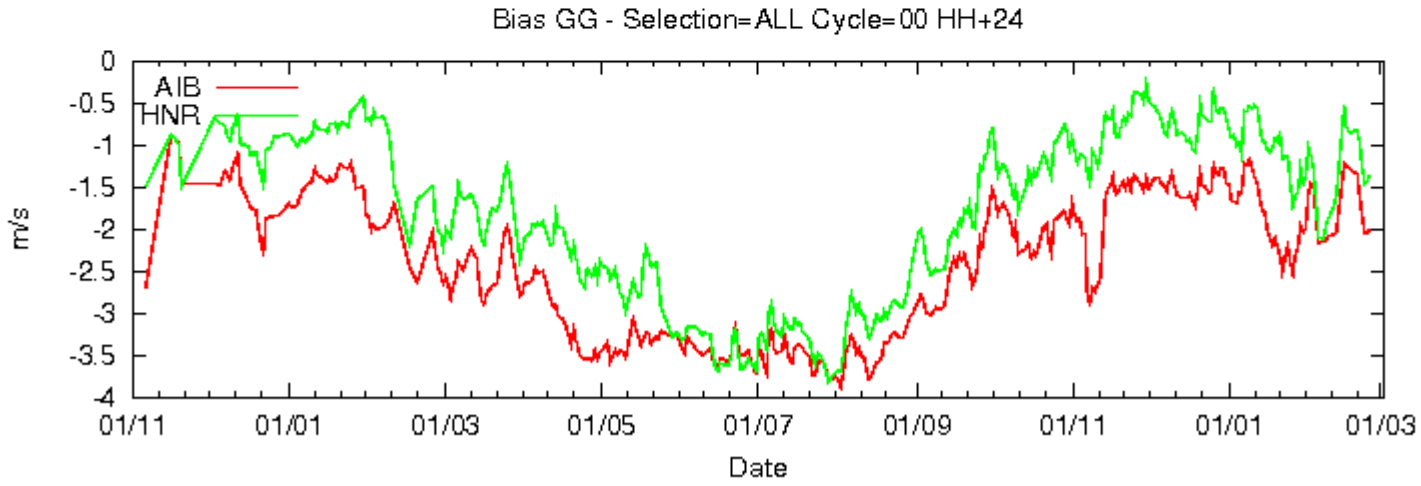


HARM 2.5 km
HNR 5 km
CE 16 km

Bias Wind Gusts H+24: Nov 2011/Feb 2013



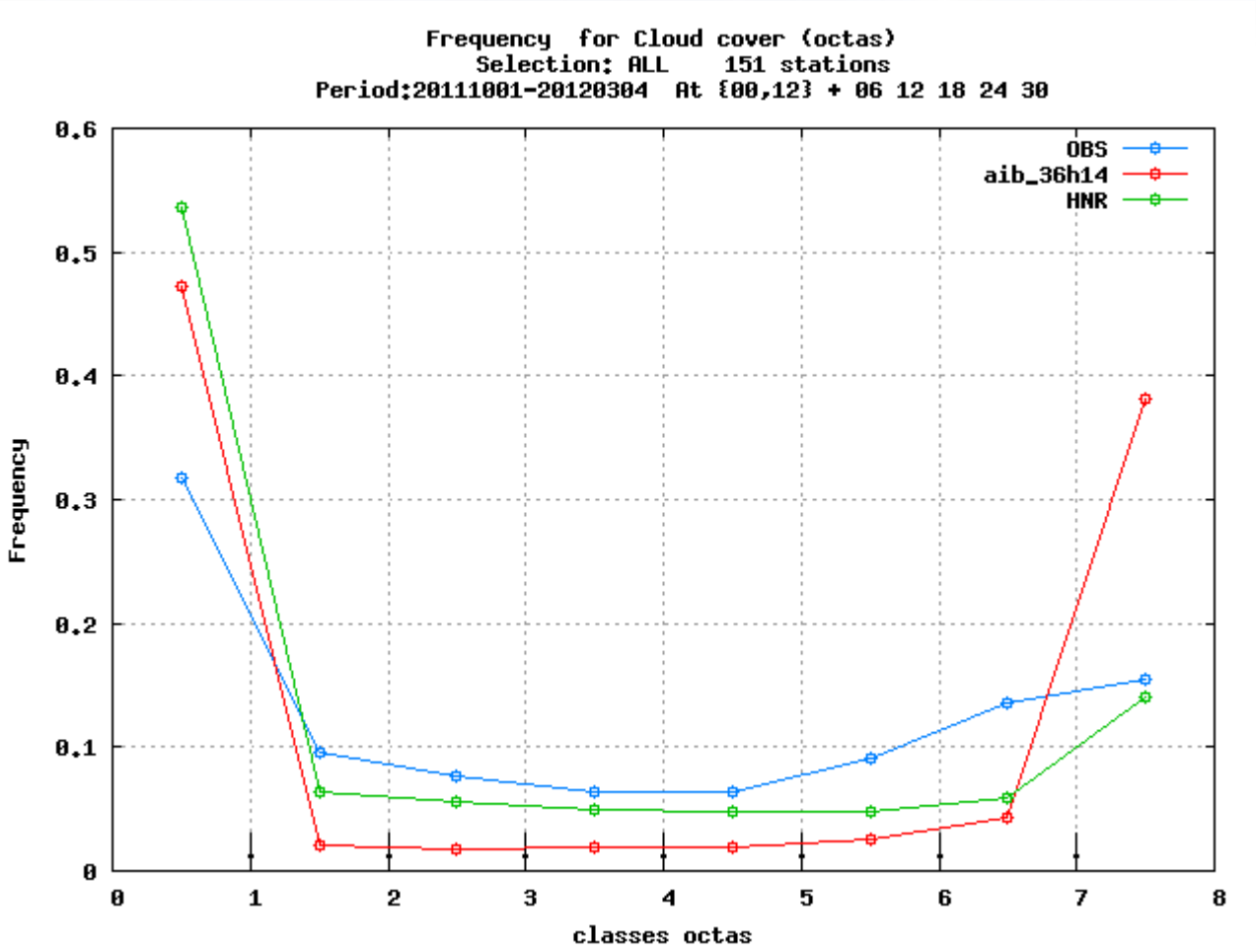
12 UTC



00 UTC

HARM 2.5 km
HNR 5 km

Frequency for cloud cover

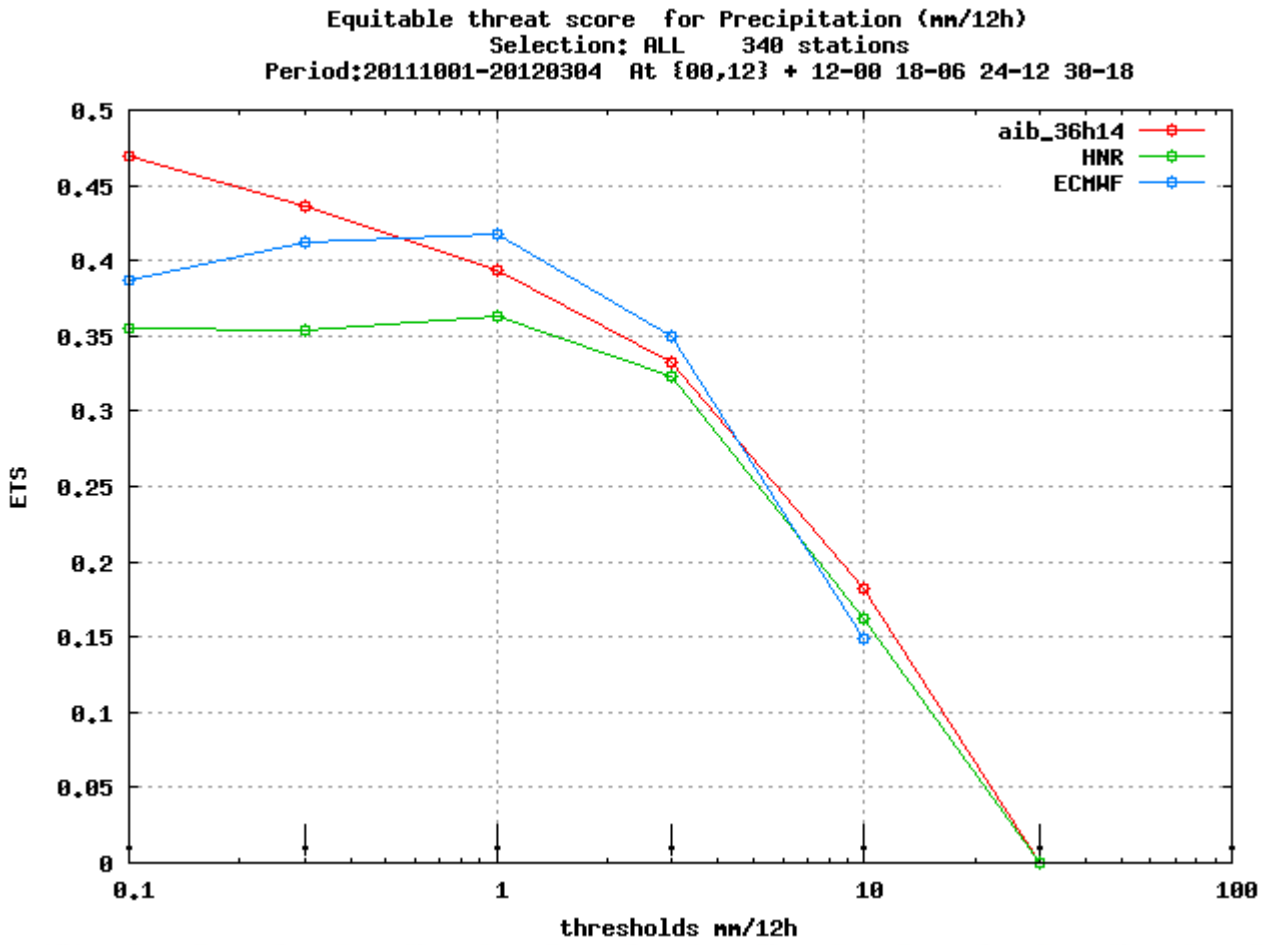


HARM 2.5 km

HNR 5 km

OBSERVATONS

ETS of precipitation for different thresholds



- Double penalty problems. Penalize models with higher resolution/variability

HARM 2.5 km
HNR 5 km
CE 16 km

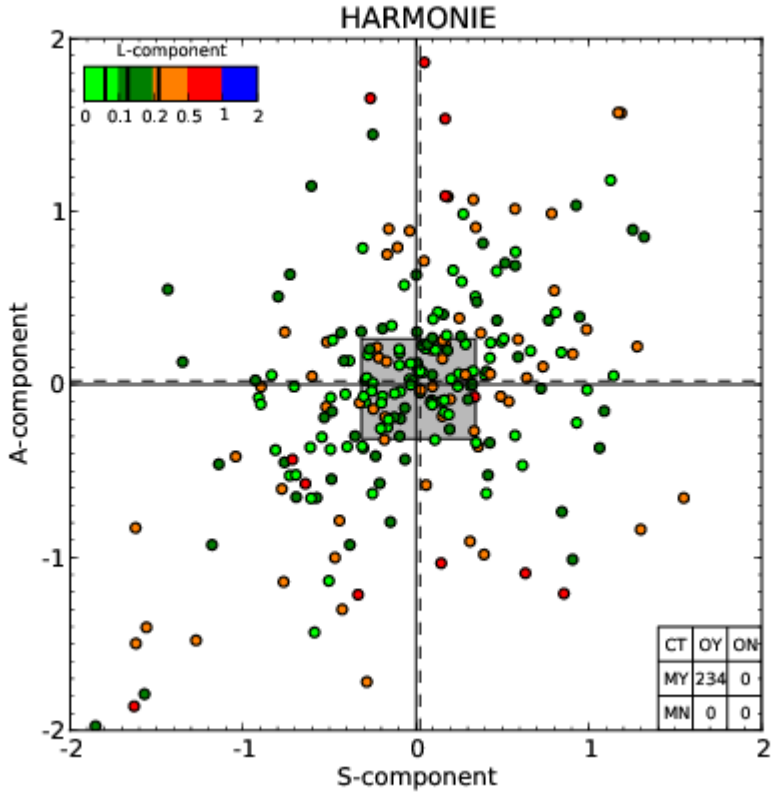
SAL method: Assessing structure errors

- Use observations up-scaled to model grid (network of 3000 stations over Iberian Peninsula). 24 hr accumulations.

- S: Shape and size of the objects
- A: Compares absolute magnitudes
- L: Compares the location of the objects

S:	Structure	-2	...	0	...	+2
		objects too small or too peaked		Perfect		objects too large or too flat
A:	Amplitude	-2	...	0	...	+2
		averaged QPF under-estimated		Perfect		averaged QPF over-estimated
L:	Location			0	...	+2
				Perfect		wrong location of Total Center of Mass (TCM) and / or of objects relative to TCM

Oct 2011-May 2012



- A point in the plot corresponds to the SAL values for the forecast and observations. The closer to zero the better.
- L is plotted in different colours.
- The dashed lines show the median of the S and A distributions, while the shadowed rectangle shows the inter-quartile ranges (IQR).

Time series of Structure and Amplitude (2 months)

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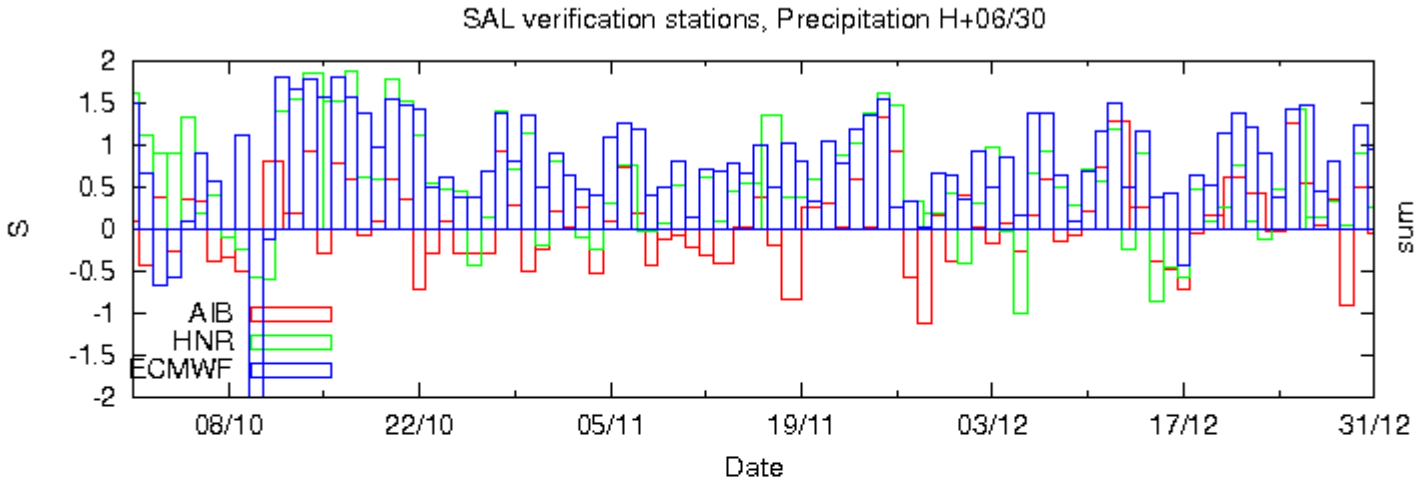
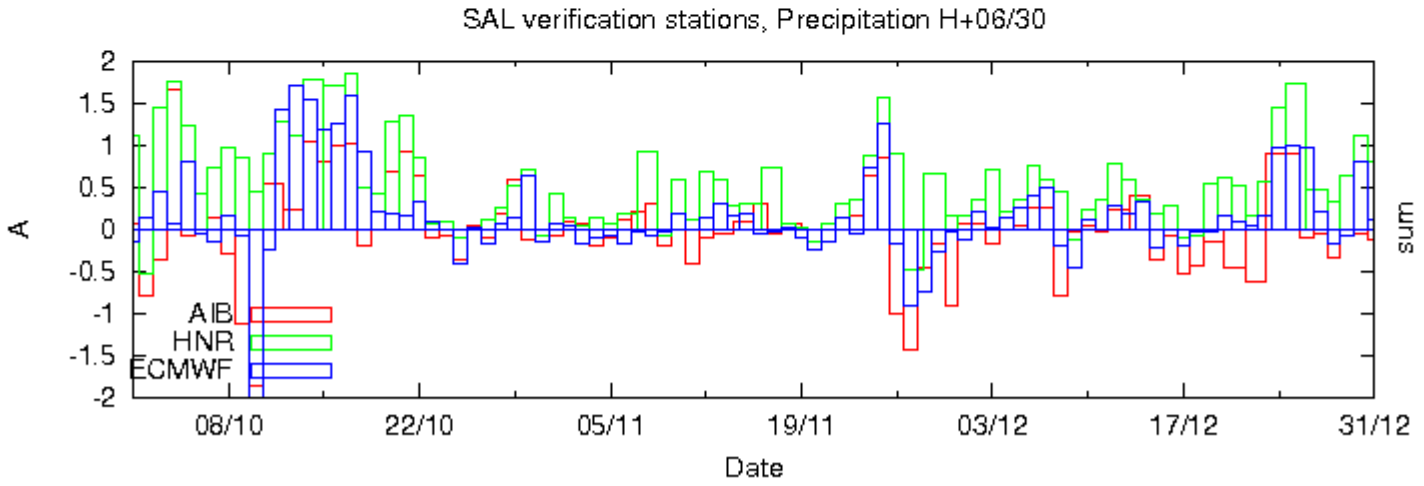
Structure



Amplitude

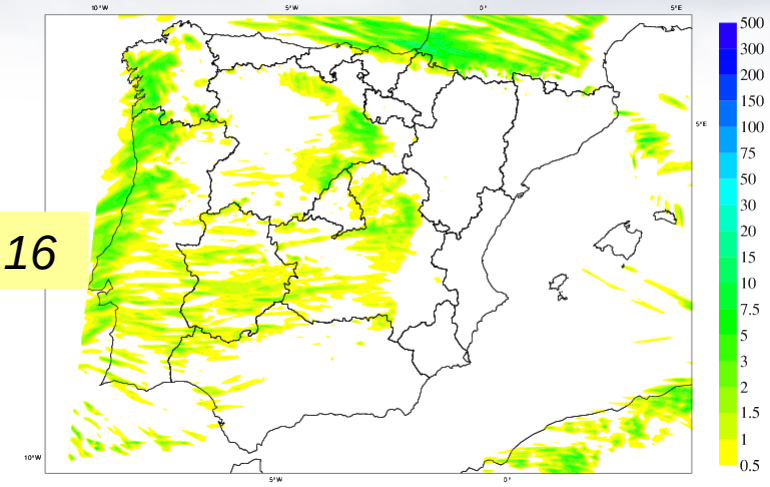


HARM 2.5 km
HNR 5 km
CE 16 km

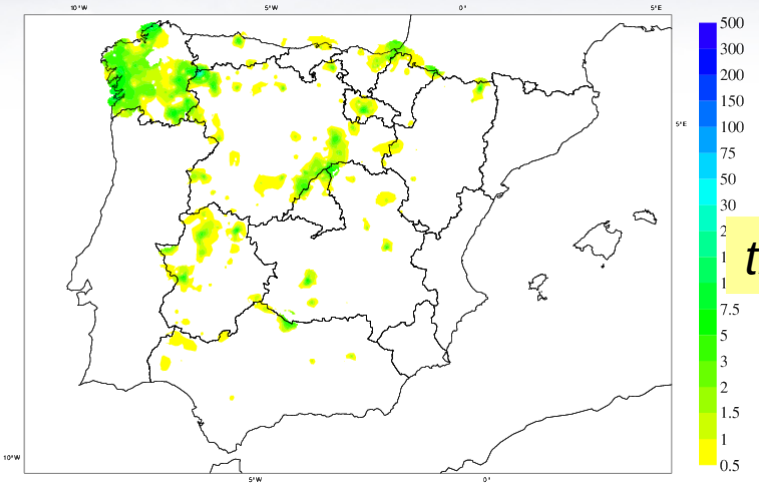
How the method is applied

Upscaled obs

AIB Acc. rain (mm/24hr)
12/12/2011 00z HIRLAM H+ 30 Valid: 13/12/2011 06z



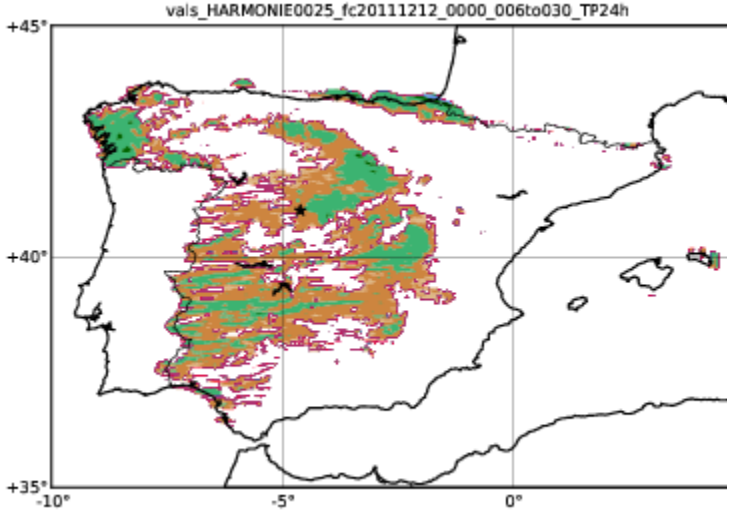
CLI Acc. rain (mm/24hr)
12/12/2011 00z HIRLAM H+ 30 Valid: 13/12/2011 06z



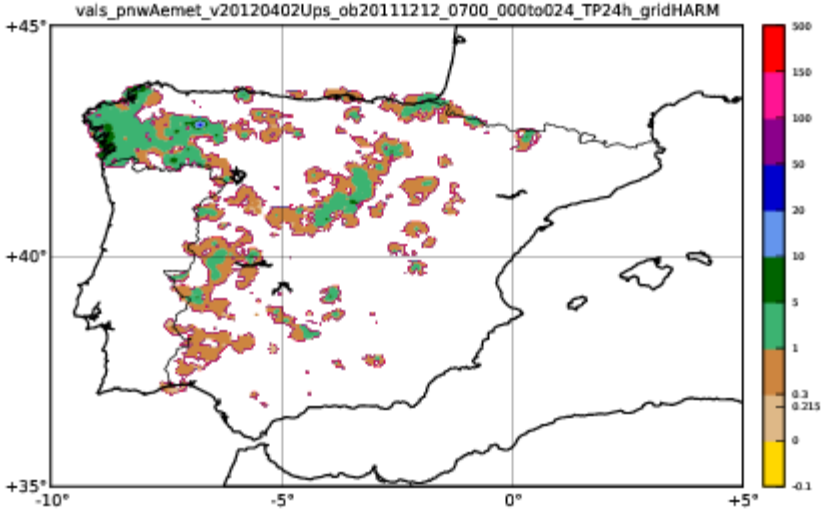
thMO=0.16

thOB=0.22

vals_HARMONIE0025_fc20111212_0000_006to030_TP24h



vals_pnwAemet_v20120402Ups_ob20111212_0700_000to024_TP24h_gridHARM

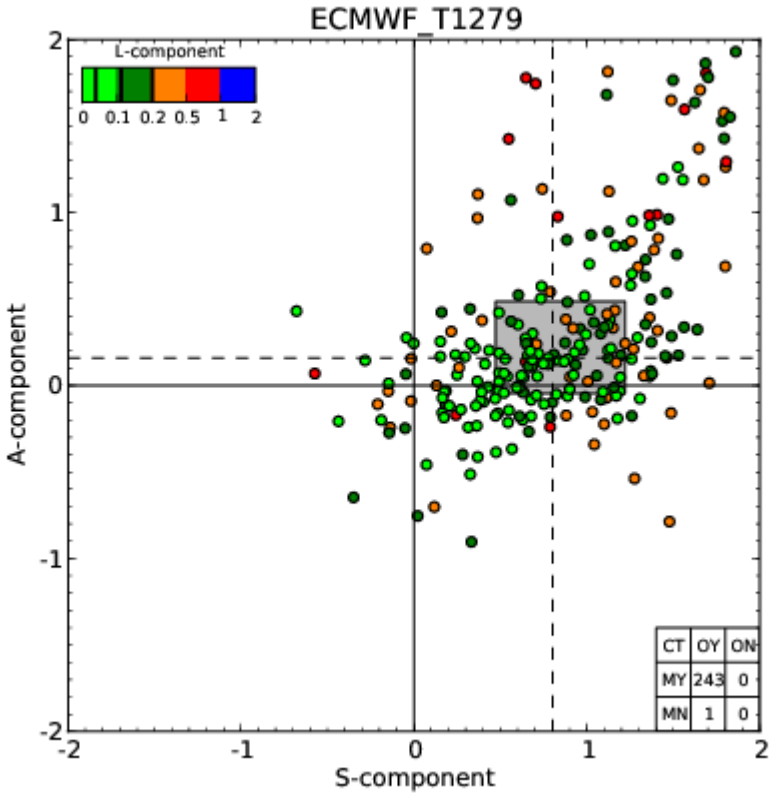


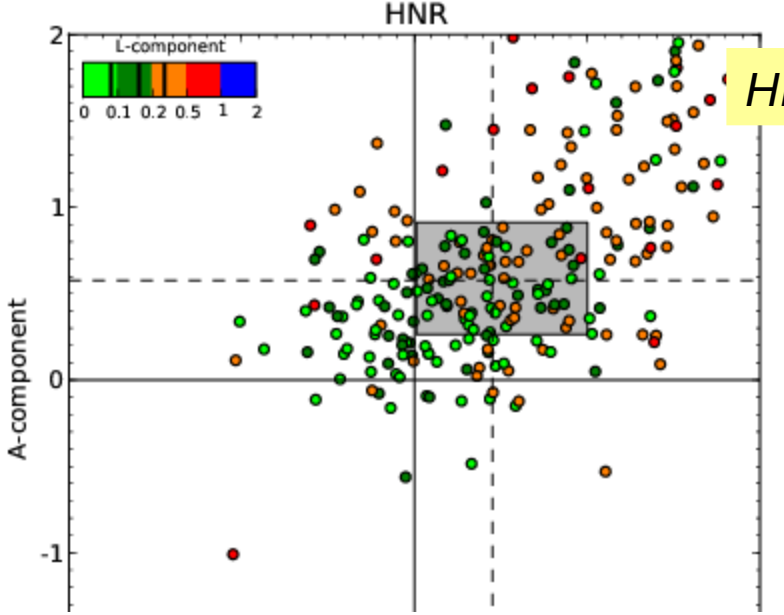
L=0.2

A=0.2

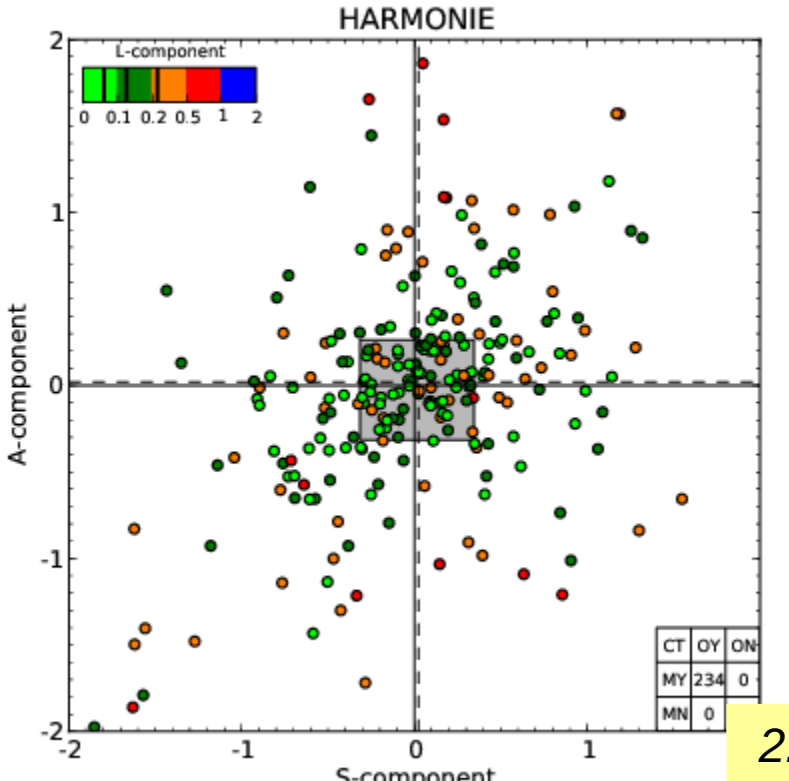
S=1.3

Oct 2011-May 2012





HIR 5 km

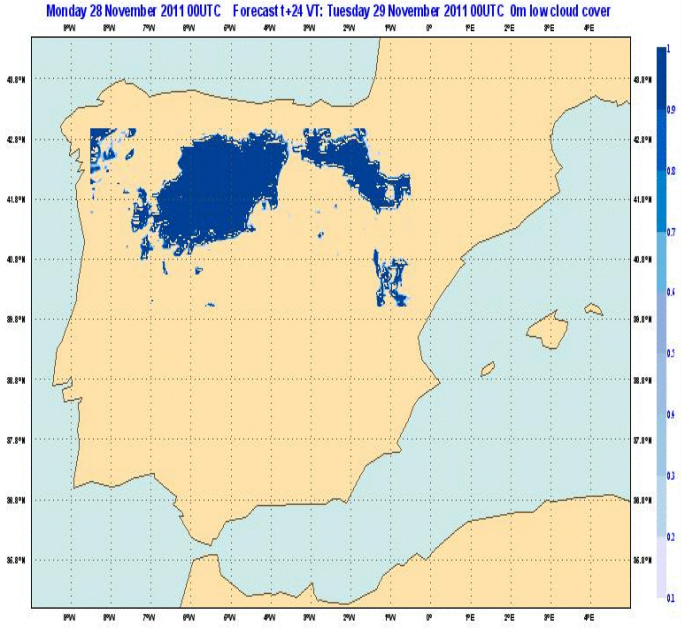


2.5 km

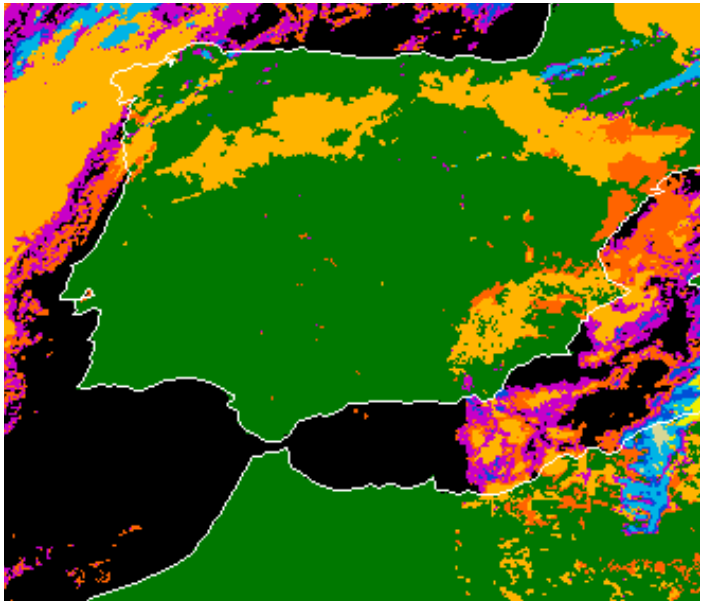
C. Santos y A. Amo

SAL verification for low clouds

Harmonie 2.5 km



SAF cloud type product



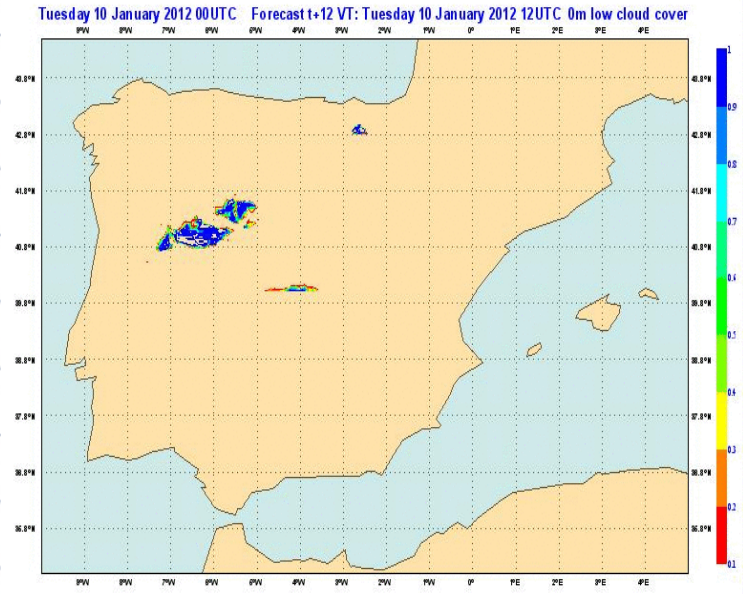
Only low and very low cloud types used. 3 km resolution

Translation from SAF type to model clouds not straightforward

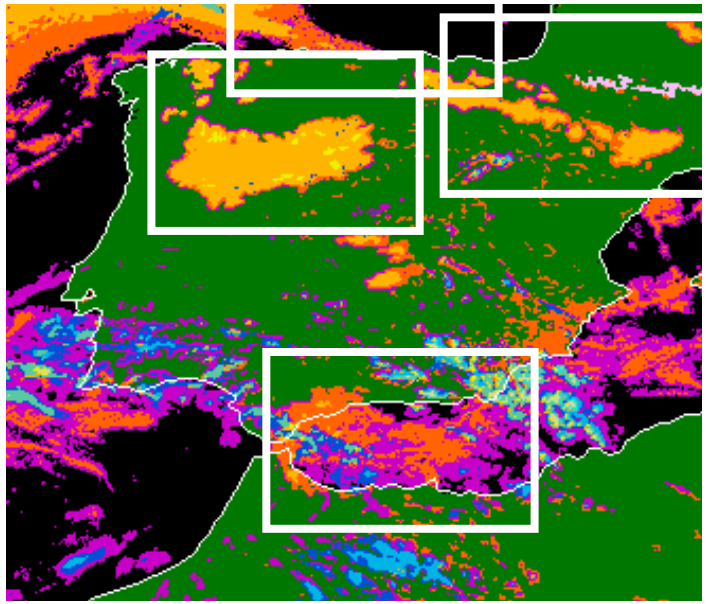
Gema Morales

SAL verification for low clouds

Harmonie 2.5 km



SAF cloud type product

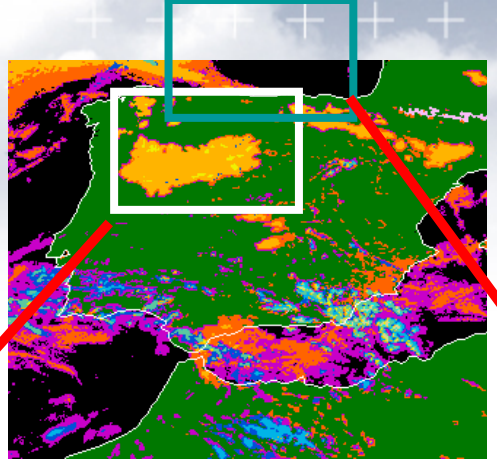


Restrict the verification to small domains

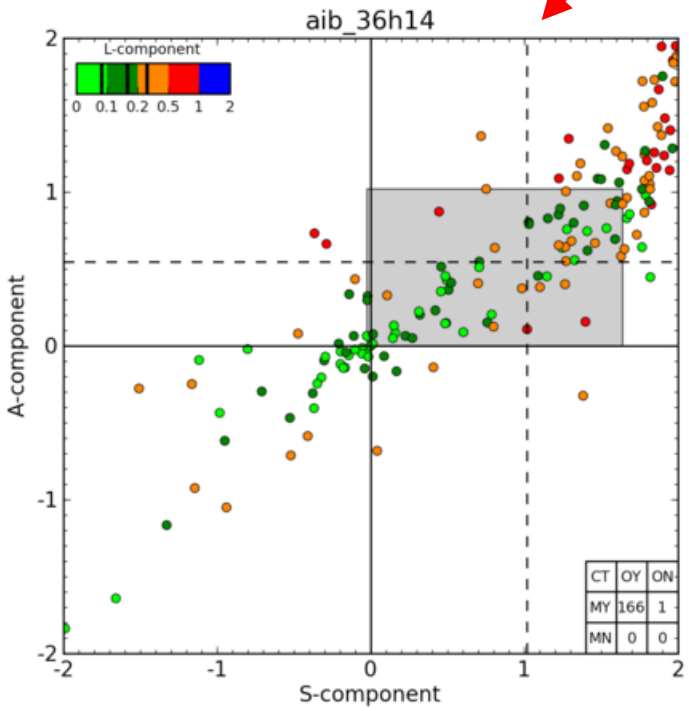
- Avoid many objects
- Try to verify same type of clouds

SAL for different regions

January 2012 & 2013

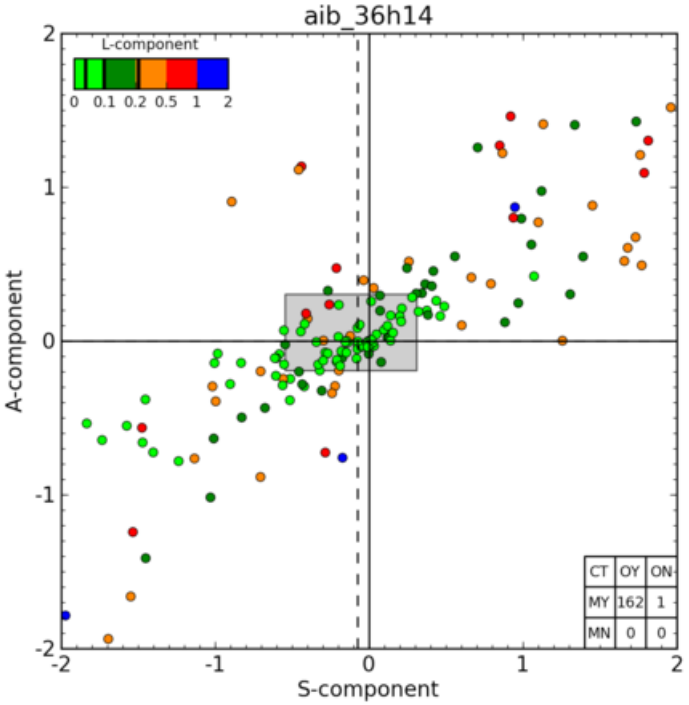


H+24



SAL_Plotaib_36h14_mesetanorte_enero_H+024.png

North Plateau

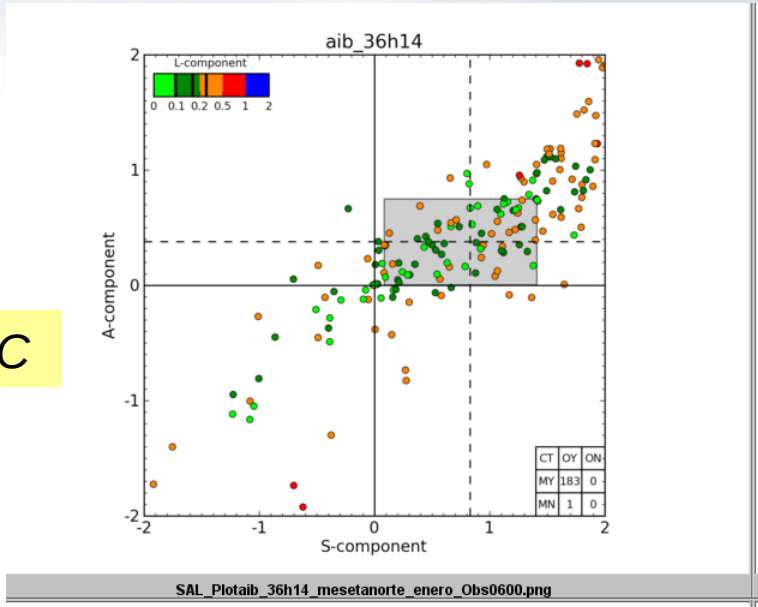


SAL_Plotaib_36h14_cantabrico_enero_H+024.png

Cantabric Sea

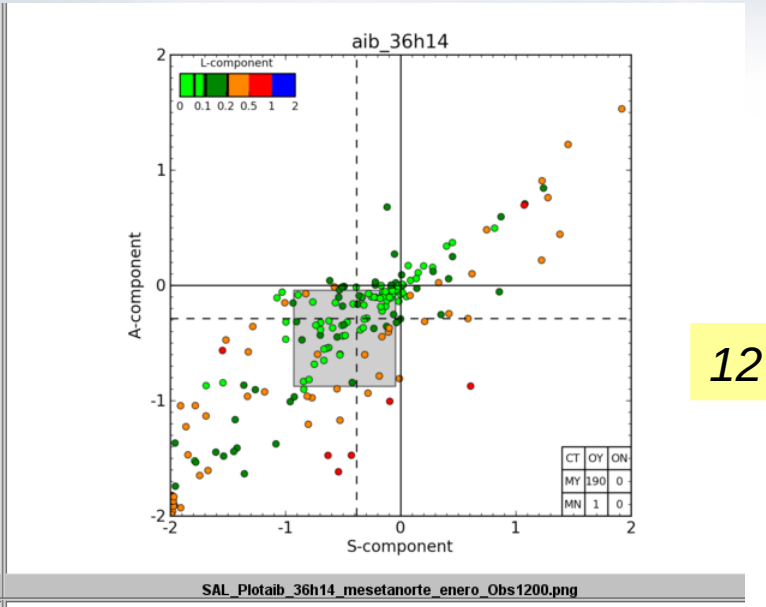
North Plateau; Diurnal cycle

06 UTC



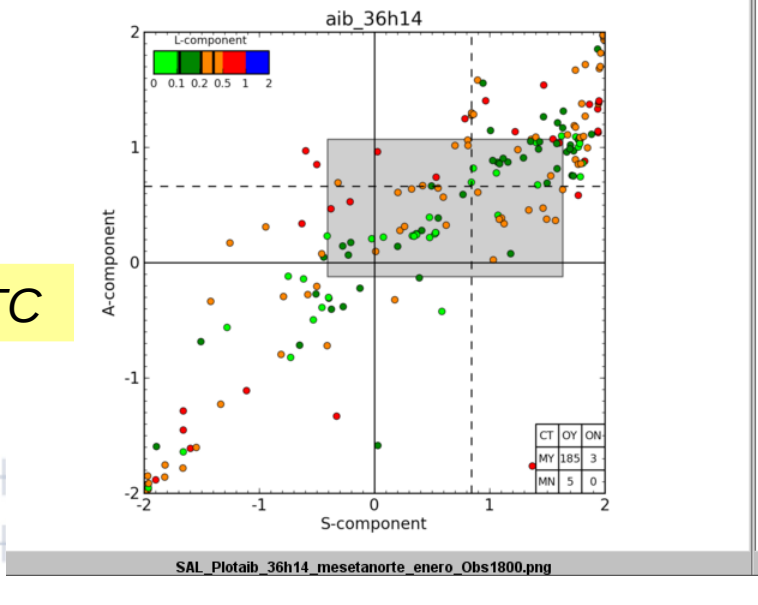
SAL_Plotaib_36h14_mesetanorte_enero_Obs0600.png

12 UTC



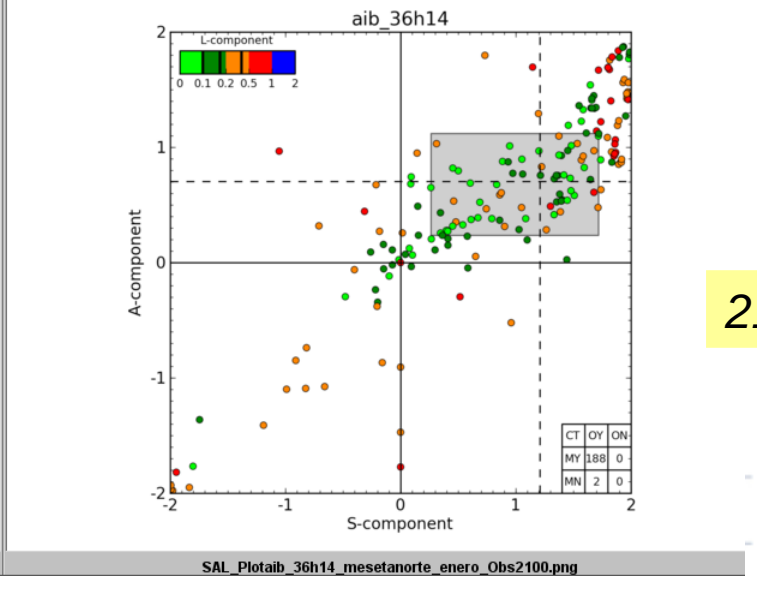
SAL_Plotaib_36h14_mesetanorte_enero_Obs1200.png

18 UTC



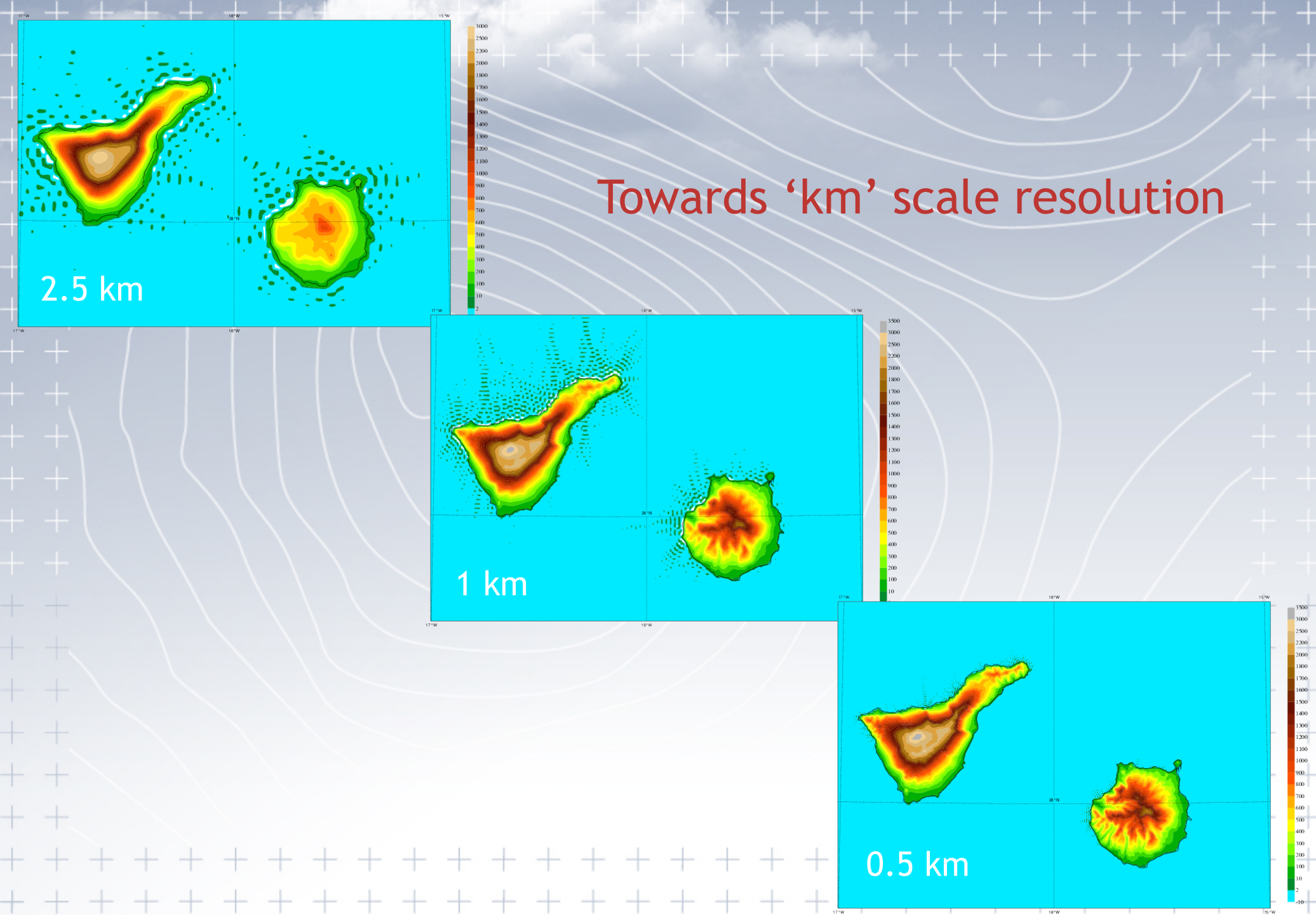
SAL_Plotaib_36h14_mesetanorte_enero_Obs1800.png

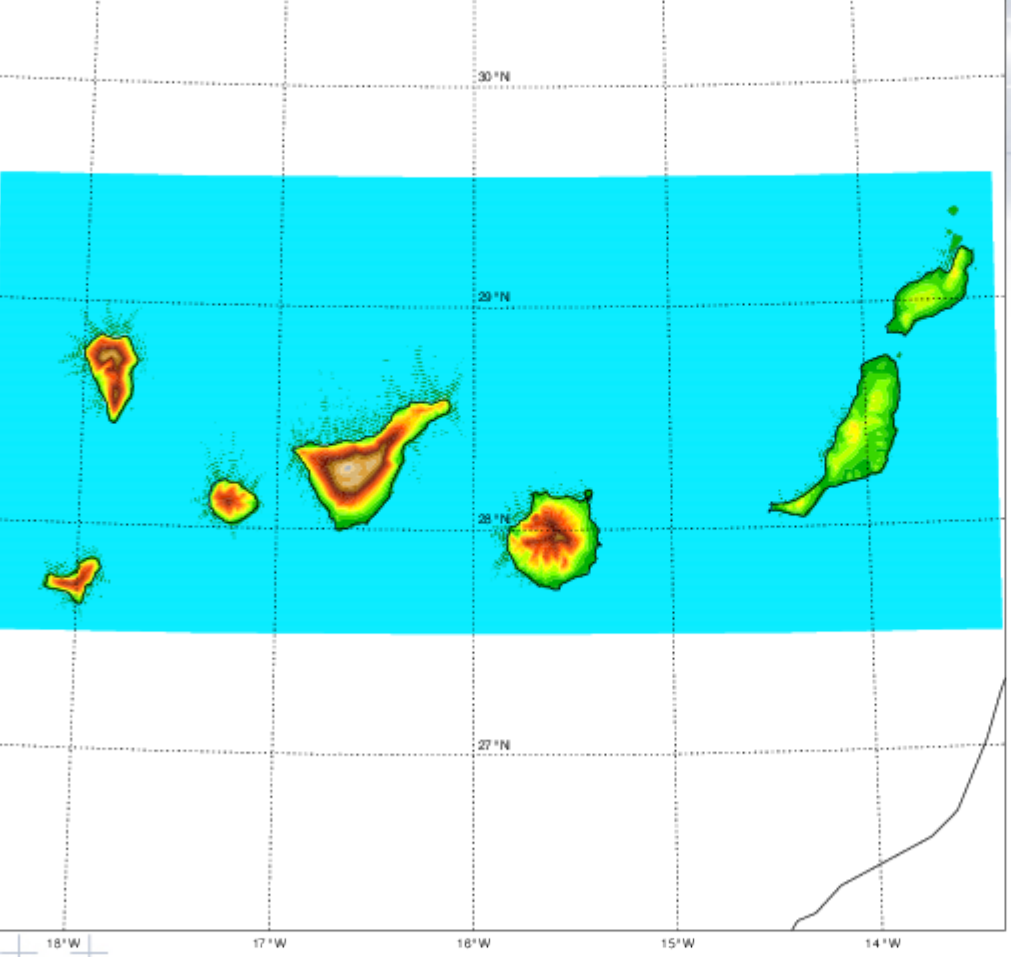
21 UTC

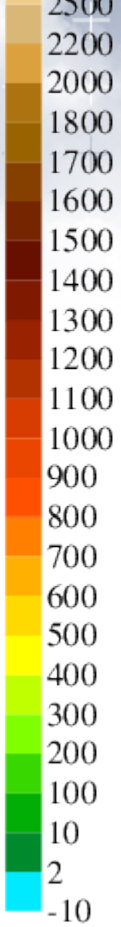


SAL_Plotaib_36h14_mesetanorte_enero_Obs2100.png

Towards ‘km’ scale resolution





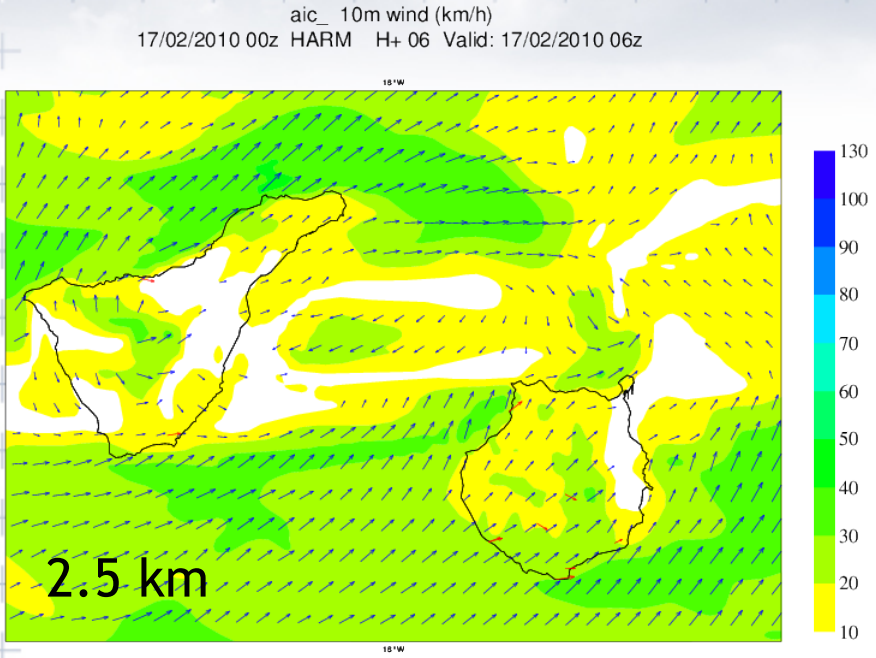


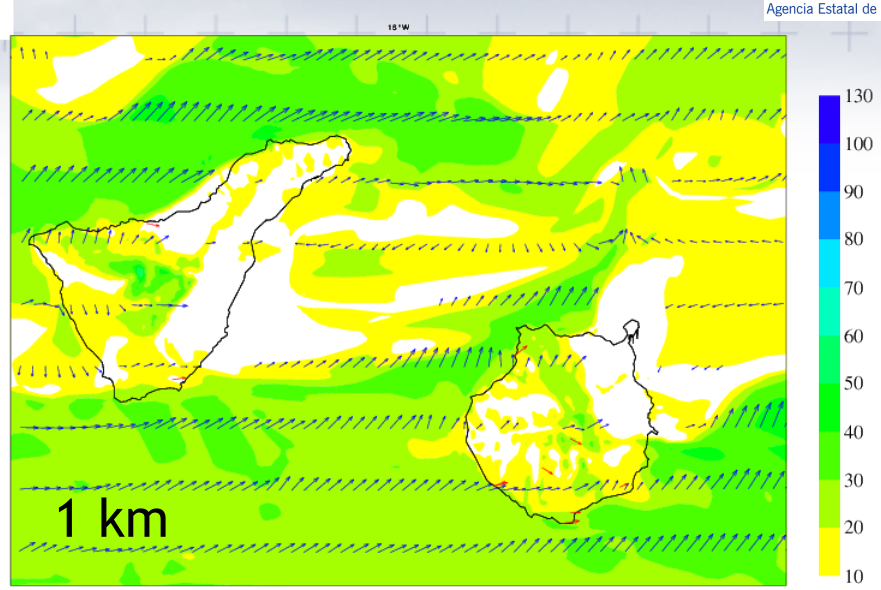
Domain at 1 and 0.5 km

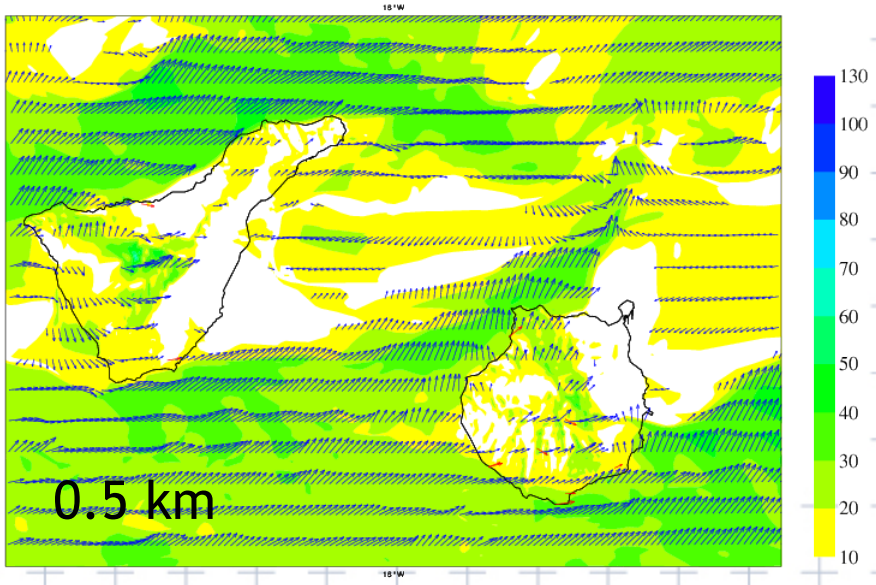
- Using local orography data set with 200 m resolution from *Instituto Geográfico*.
  - Only elevation updated.
  - Other physiographic data from default GTOPO30'

Imanol Guerrero

10 m wind compared to obs







- Better representation of wind BUT resolutions below 1 km are not stable due to noise in high levels.
- Increase diffusion doesn't solve the problem unless is very aggressive.
  - D^6
  - Sponge

Summary and conclusions (1)

- Harmonie/Arome has good added value to Hirlam and ECMWF.
- Heavy precipitation events are generally well simulated but with a tendency to produce FA.
- Temporal and spatial errors suggest the need for stochastic approaches. That is even more the case when there is not a clear dynamical forcing.
- Fog/low clouds much better represented than Hirlam but the errors are still large. Tendency to overpredict fog and to destroy then too much during the day. Also suggest the need for stochastic approaches. Performance is not the same for different regions.

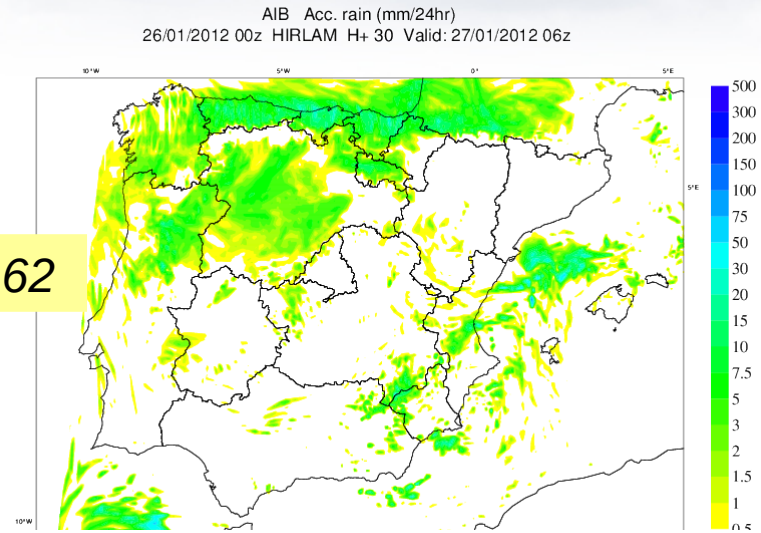
Summary and conclusions (2)

- SAL method seems to be appropriate for assessing high resolution simulations in particular to look at structures of the fields. It is able to compare models of different resolutions. The method is sensitive to the clustering hypothesis. Harmonie gives very good results for precipitation.
- The SAL method has been extended to low clouds using satellite data. The tricky part is de different definitions of clouds in the satellite and the model.
- A local orography data set with 200m resolution has been included. It has been tested for the step Canary Islands orography. We have failed in stabilizing the simulations below 1 km.

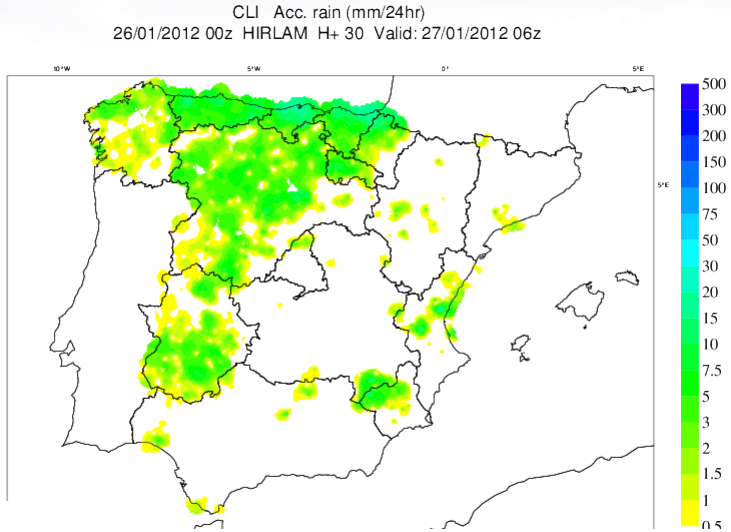
Thanks for your attention

The SAL method

Upscaled obs



thMO=0.62



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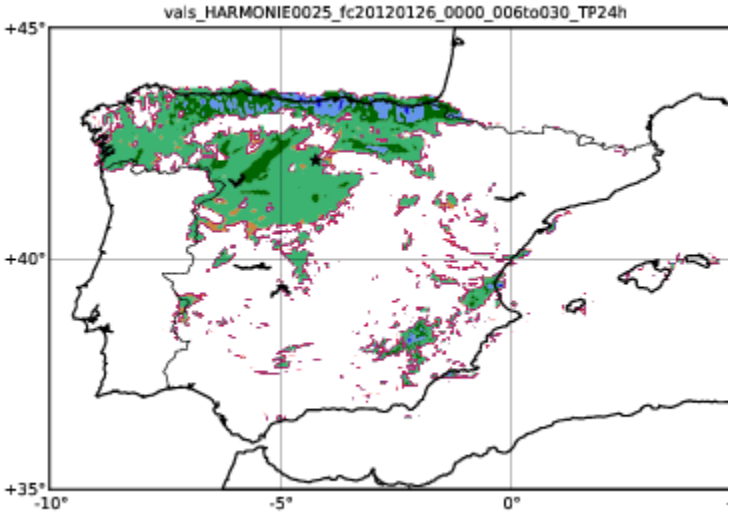
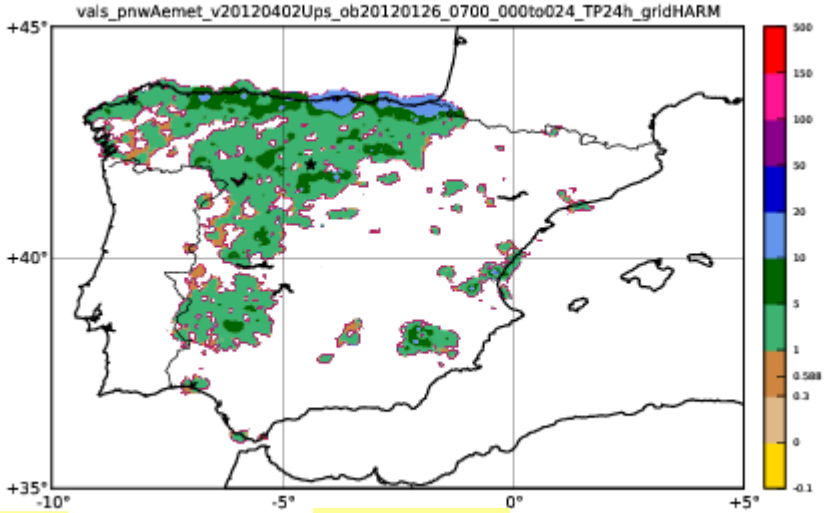


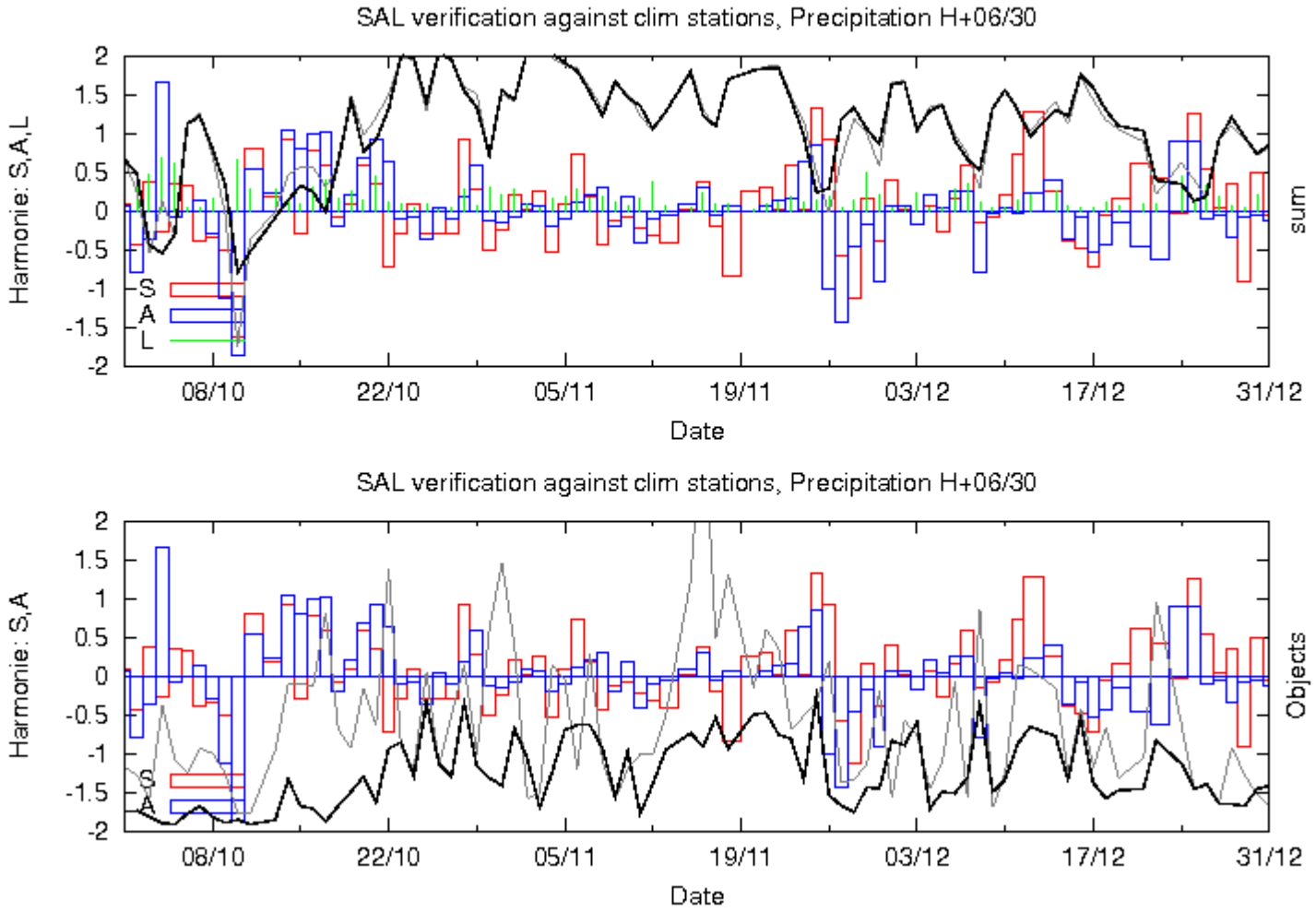
L=0.02



A=-0.1

S=-0.2

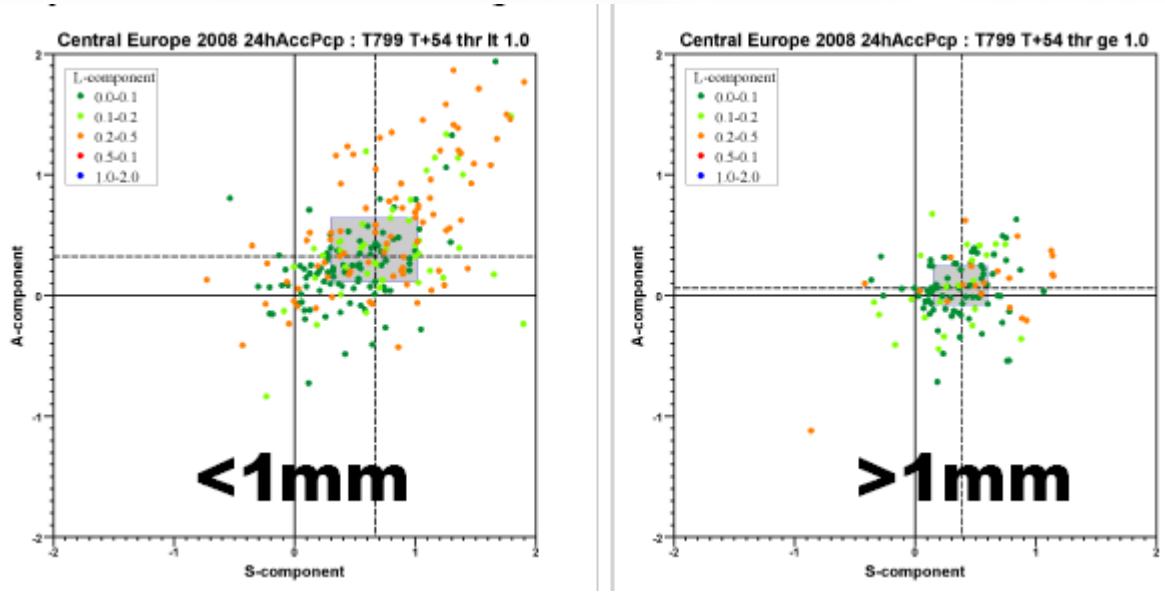
Time series of Structure and Amplitude (2 months)



+ volume

+ number obj

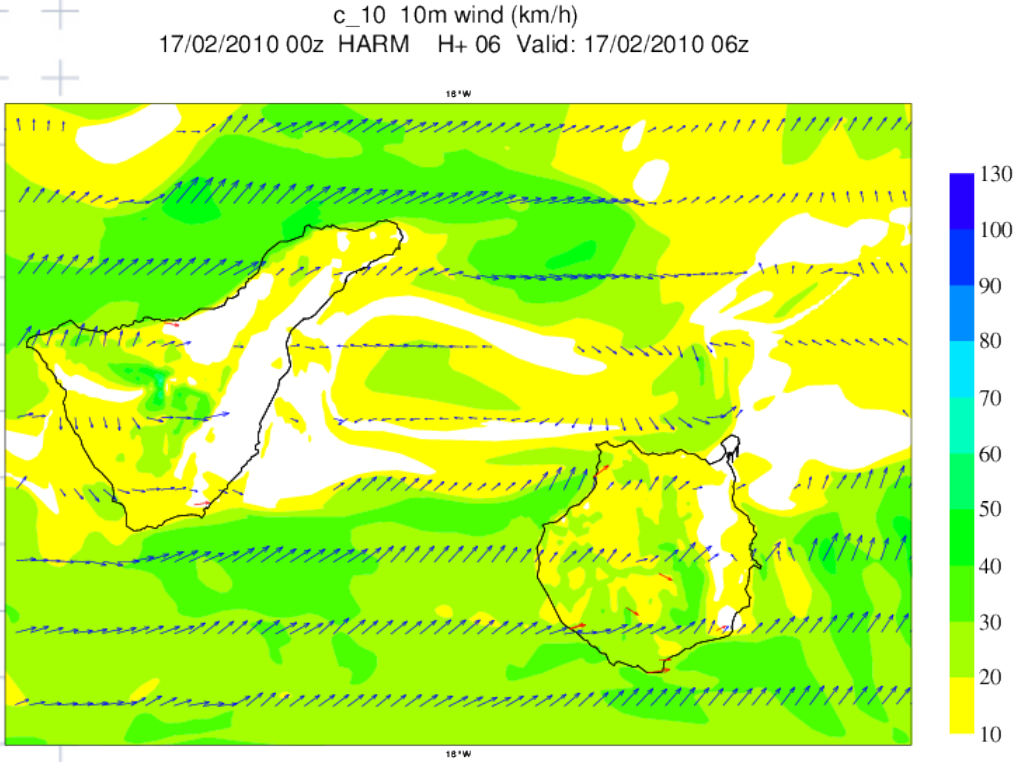
SAL for different amounts of precipitation

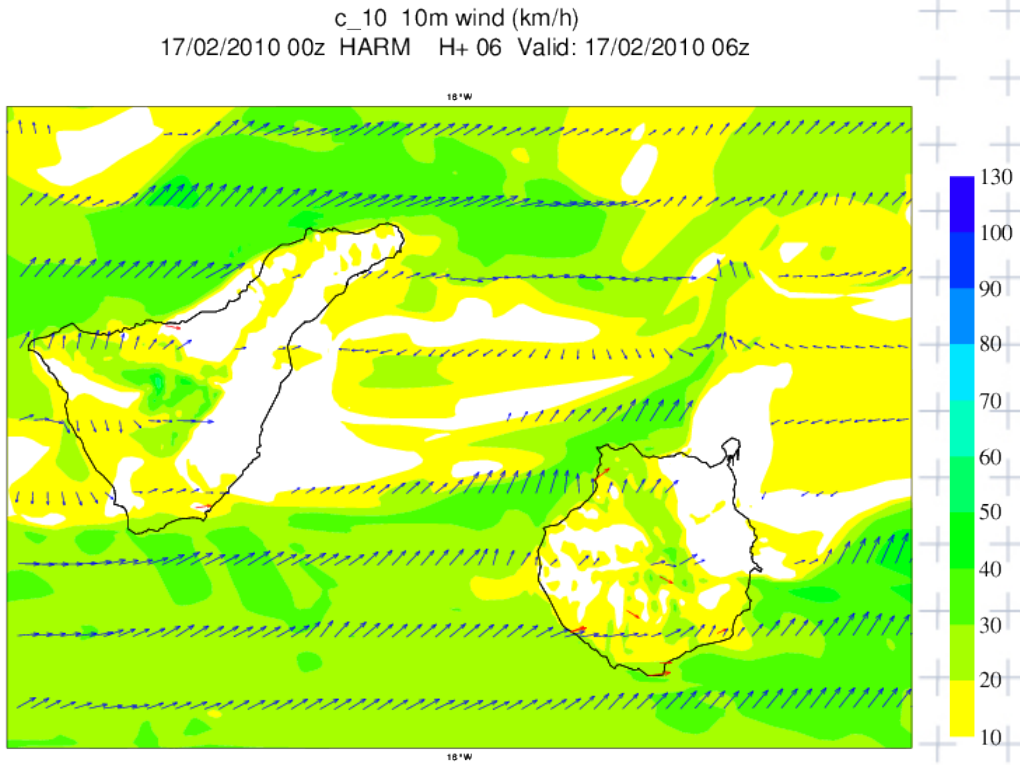


- Bigger errors for light precipitation

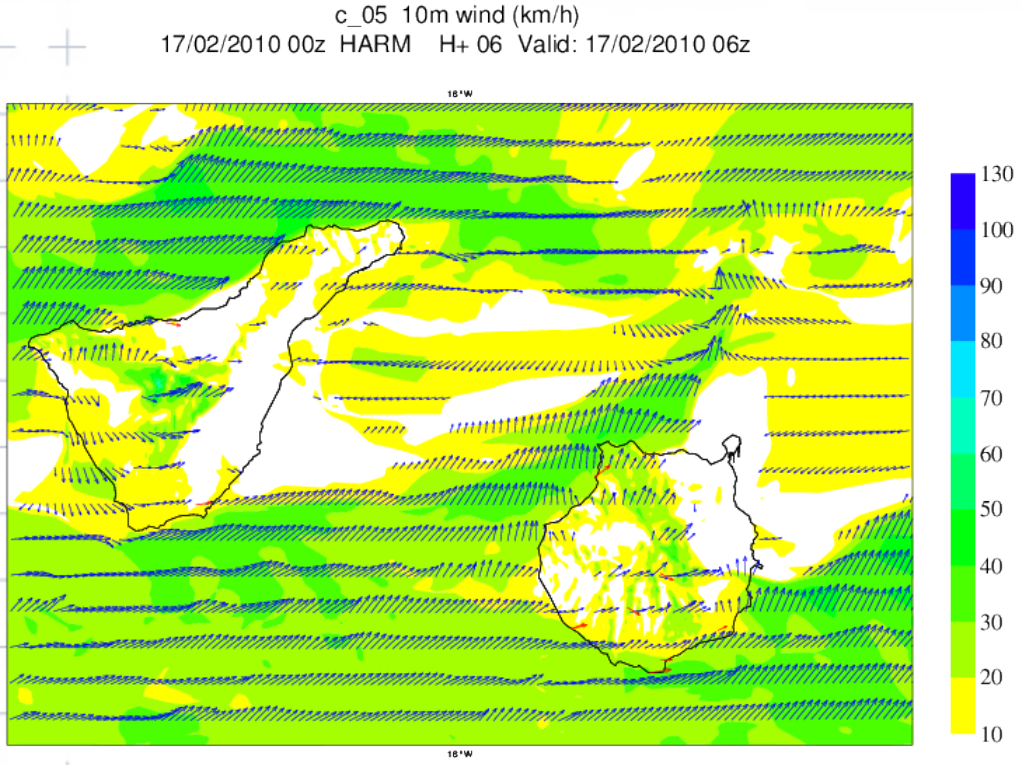
Santos, Guerrero and Ghelli, 2010

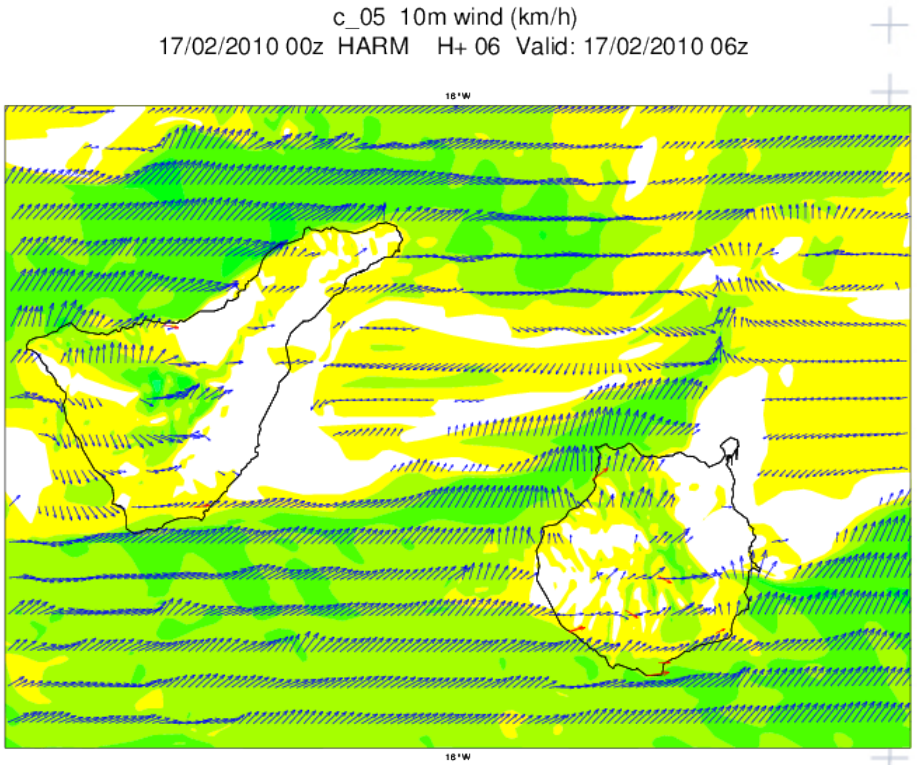
1 km: GTOPO30 vs IG 200m



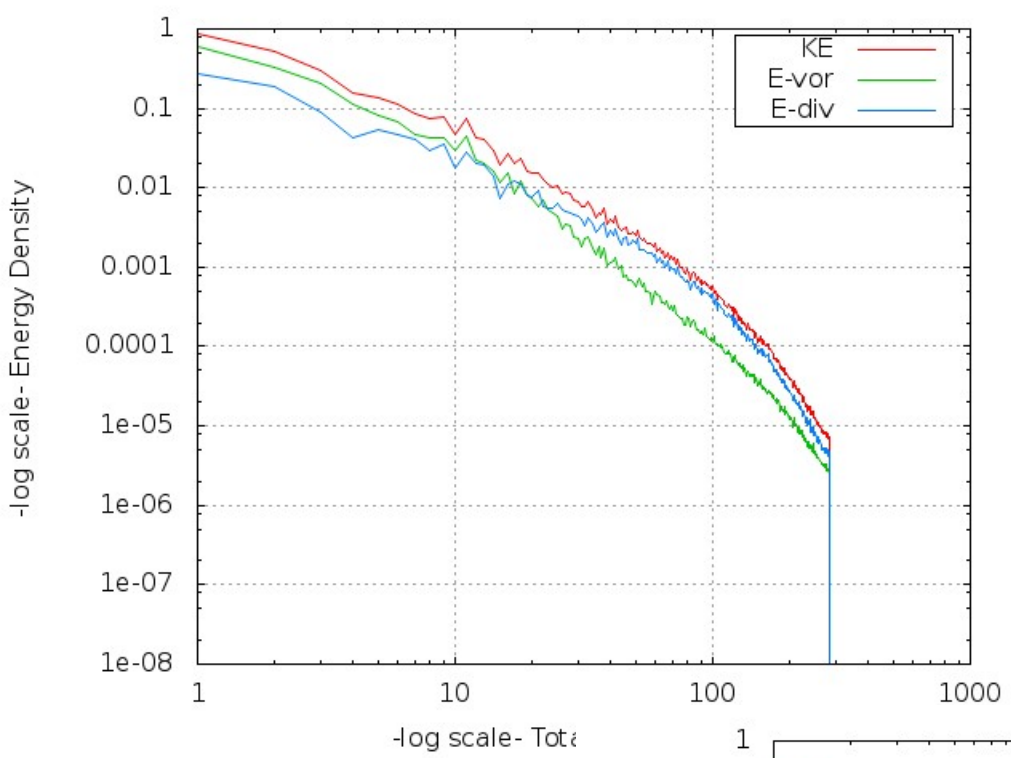


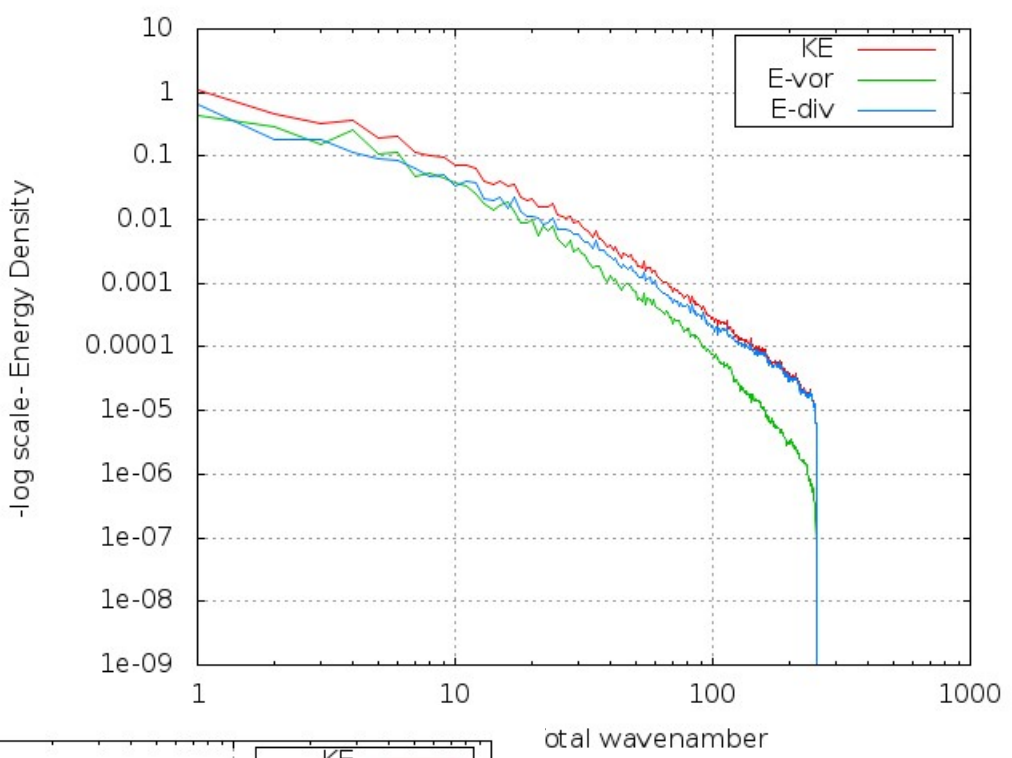
0.5 km default vs D6

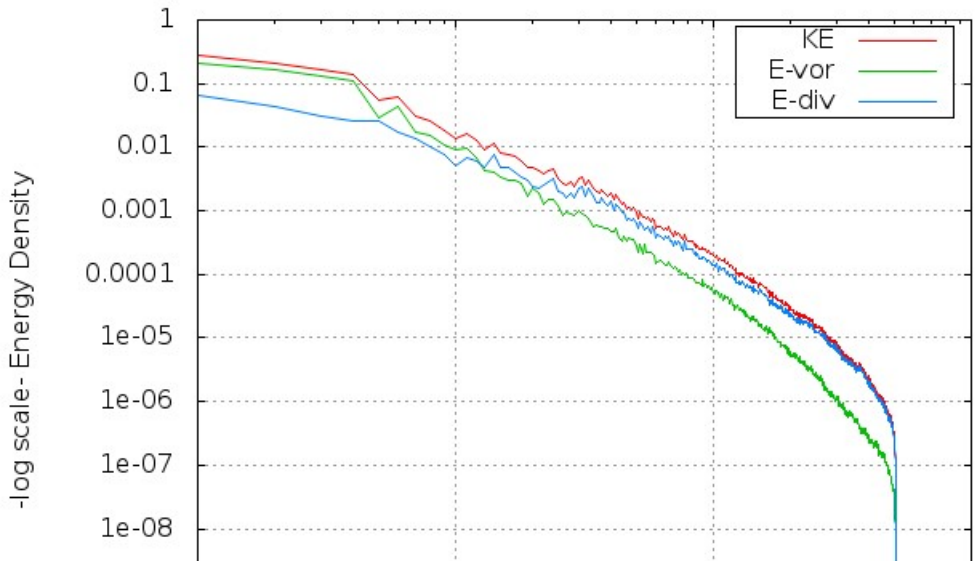




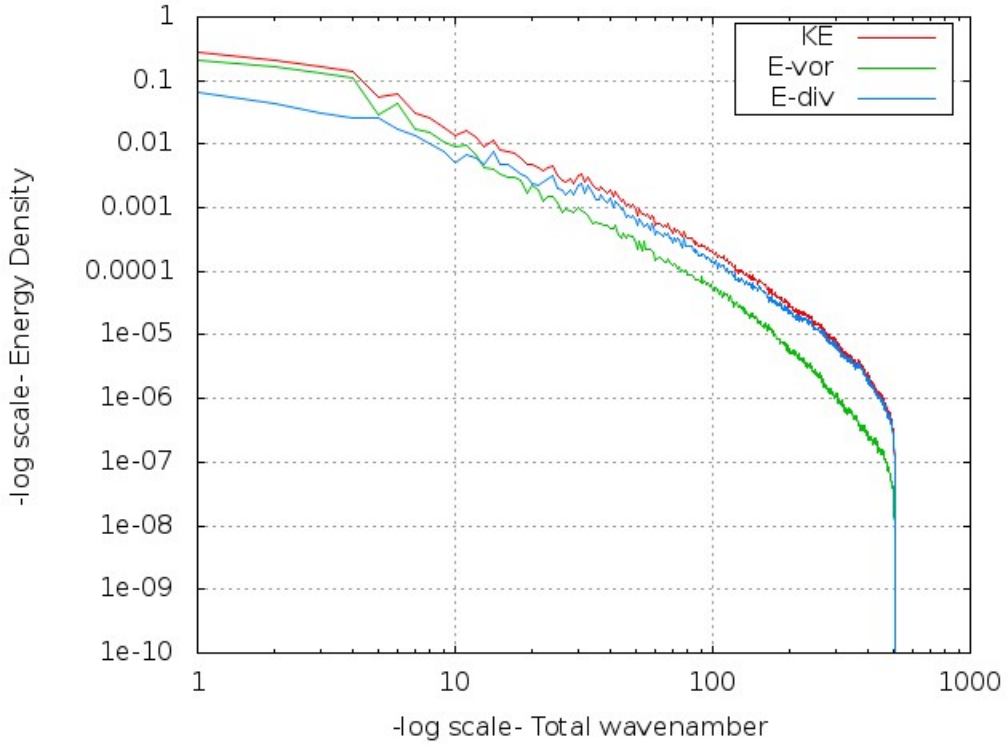
2.5 km → 1 km → 0.5 km

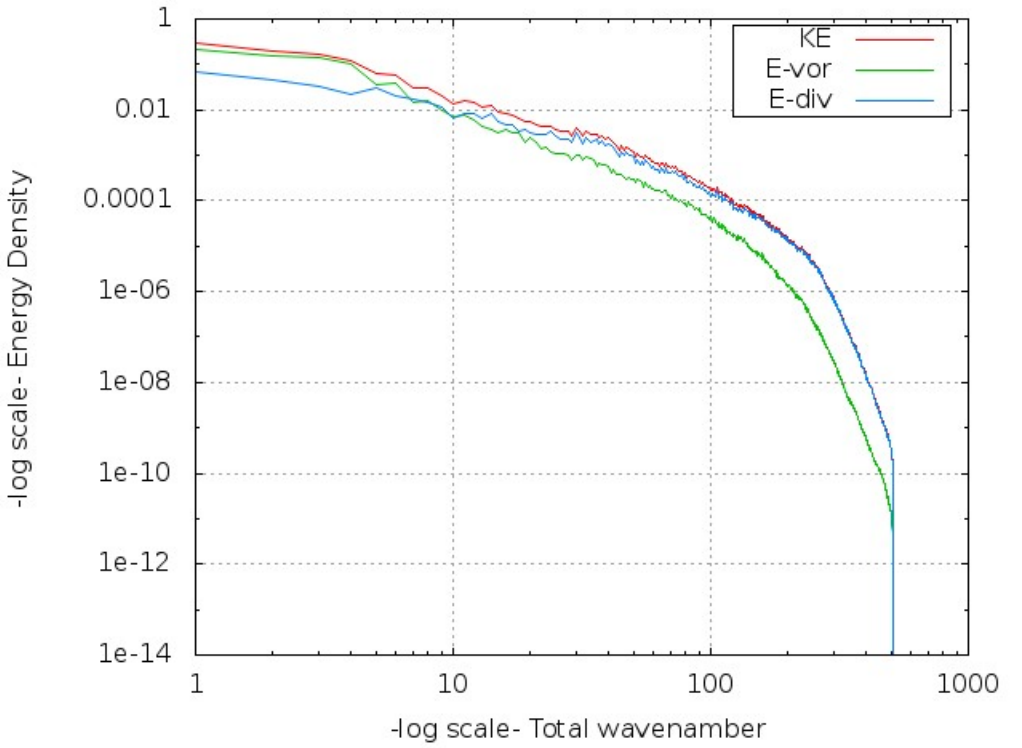




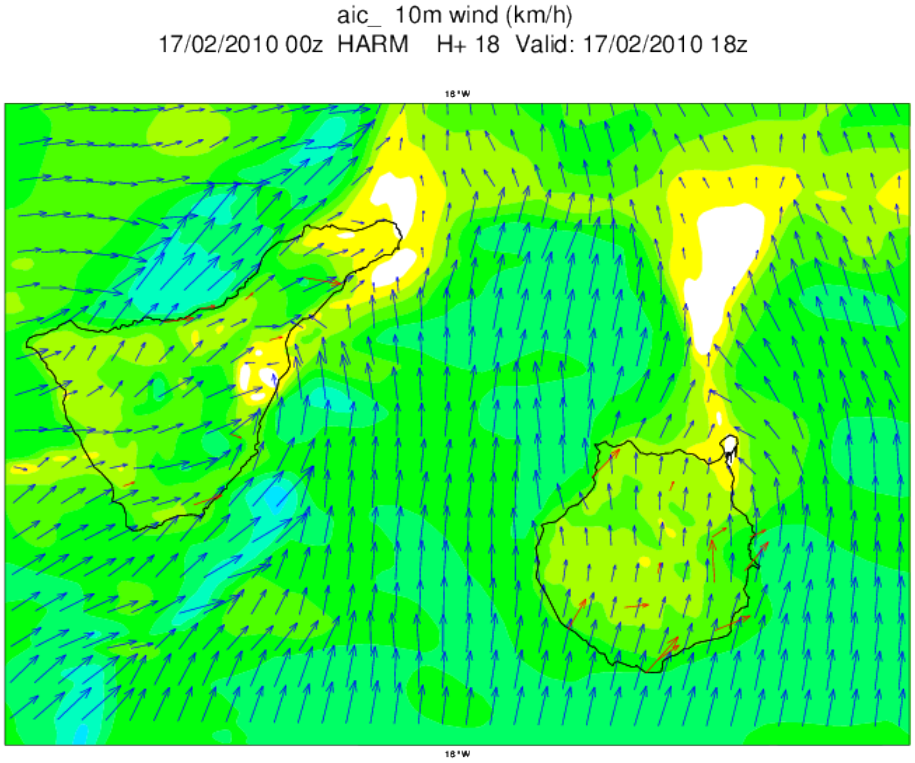


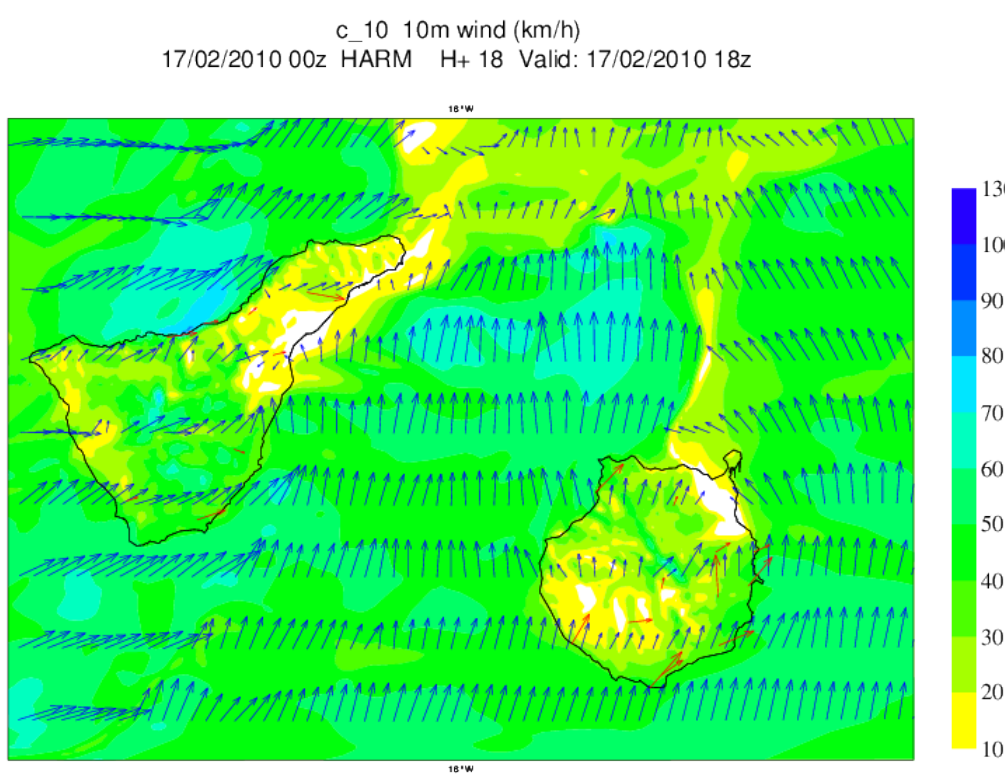
1 km default vs D6



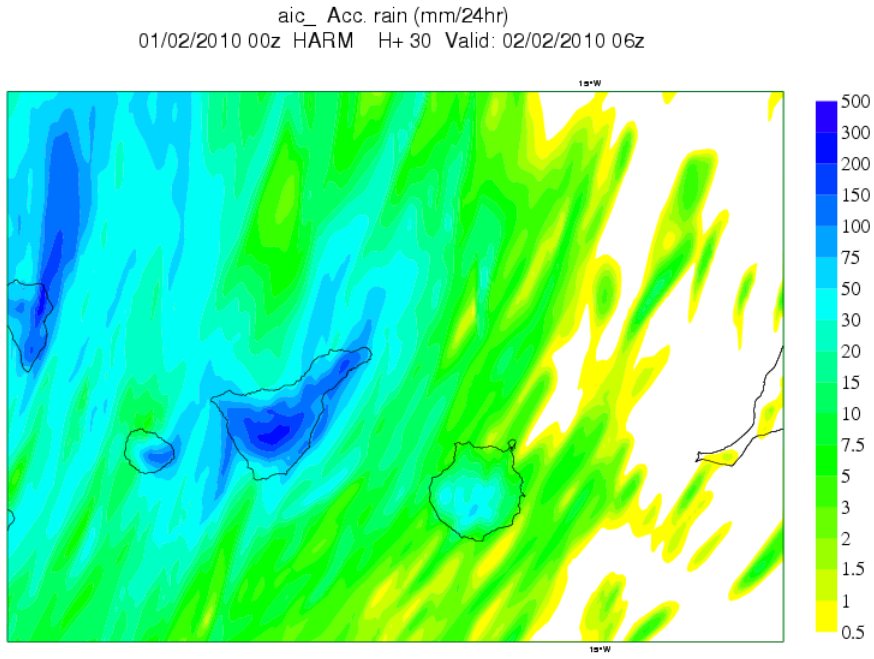


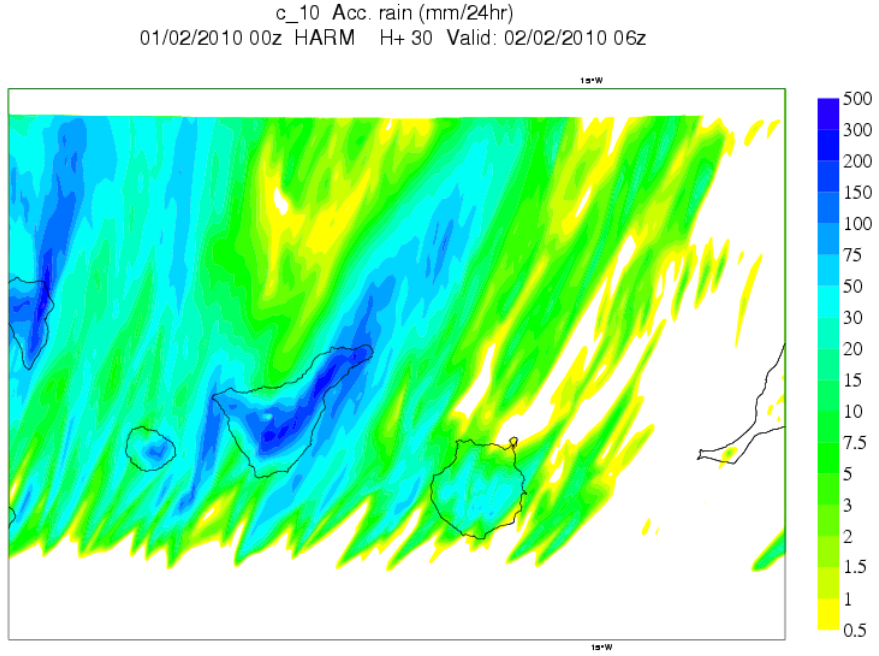
2.5 km → 1 km


aic_ 10m wind (km/h)
17/02/2010 00z HARM H+ 18 Valid: 17/02/2010 18z
18°W
18°W


c_10 10m wind (km/h)
17/02/2010 00z HARM H+ 18 Valid: 17/02/2010 18z
18°W
18°W
130
100
90
80
70
60
50
40
30
20
10

2.5 km → 1 km





24hr-precip. 1 feb