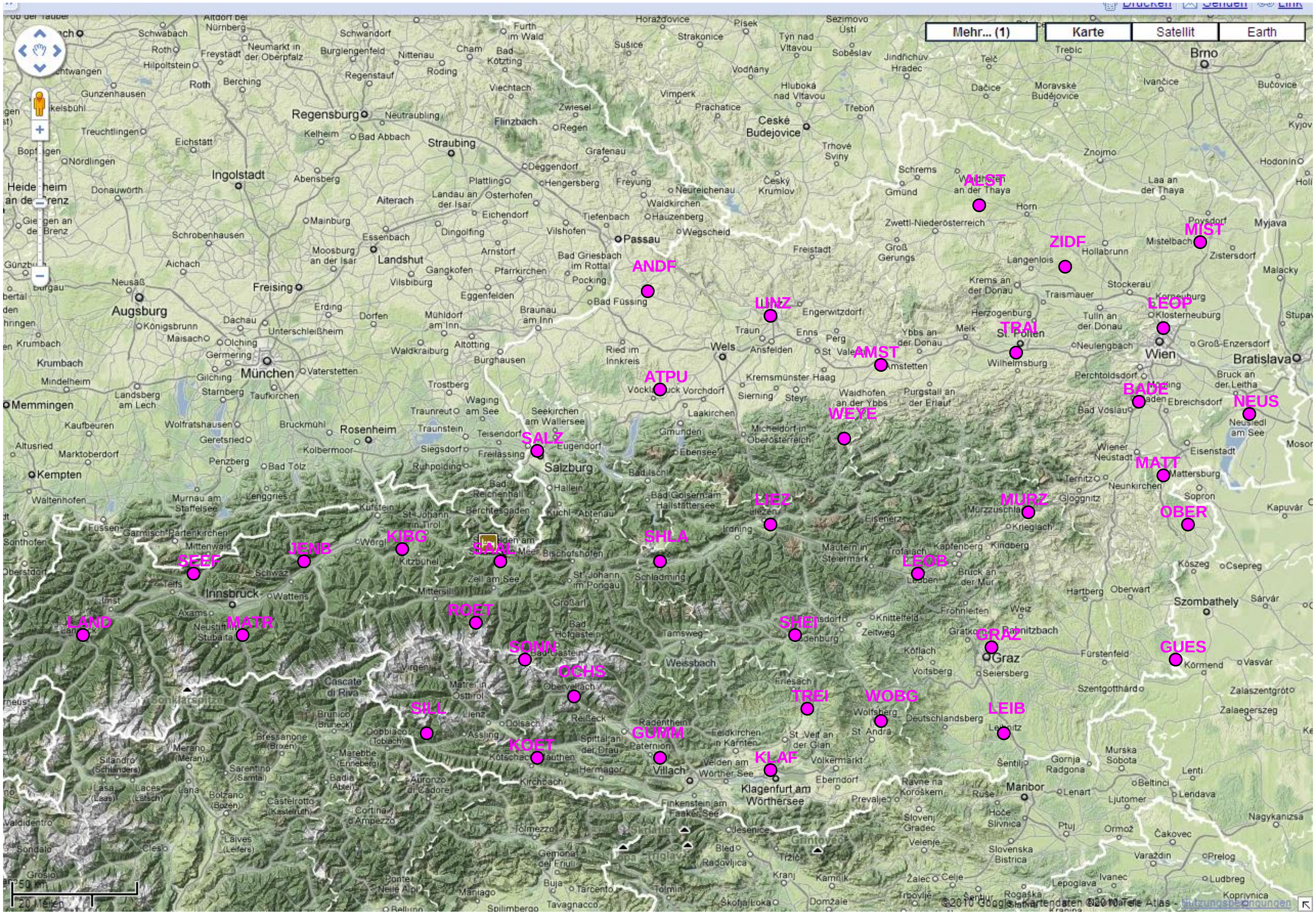
GPS ZTD data assimilation in AROME/3DVAR in Austria

DA LACE Working Days 2013.09.18-20 Vienna

Experiment design

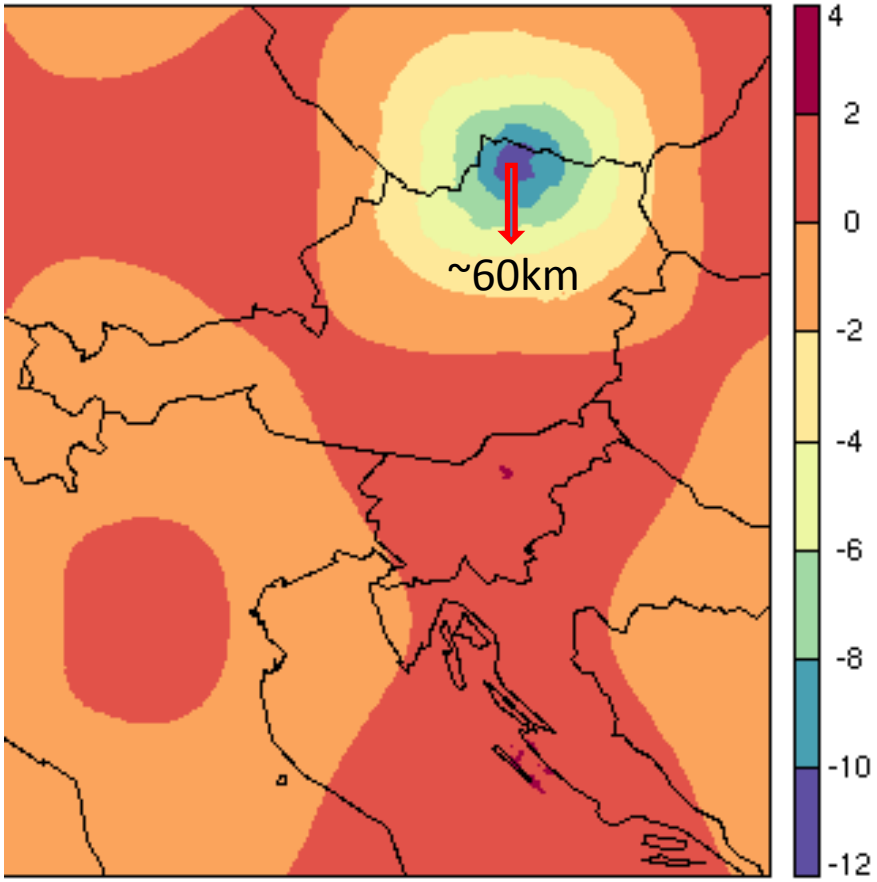
- AROME/3DVAR/60 level
- 2011.5.15---2011.7.1 (1.5 month DA run)
- AR01: NO GPS XINA: WITH GPS

GPS network

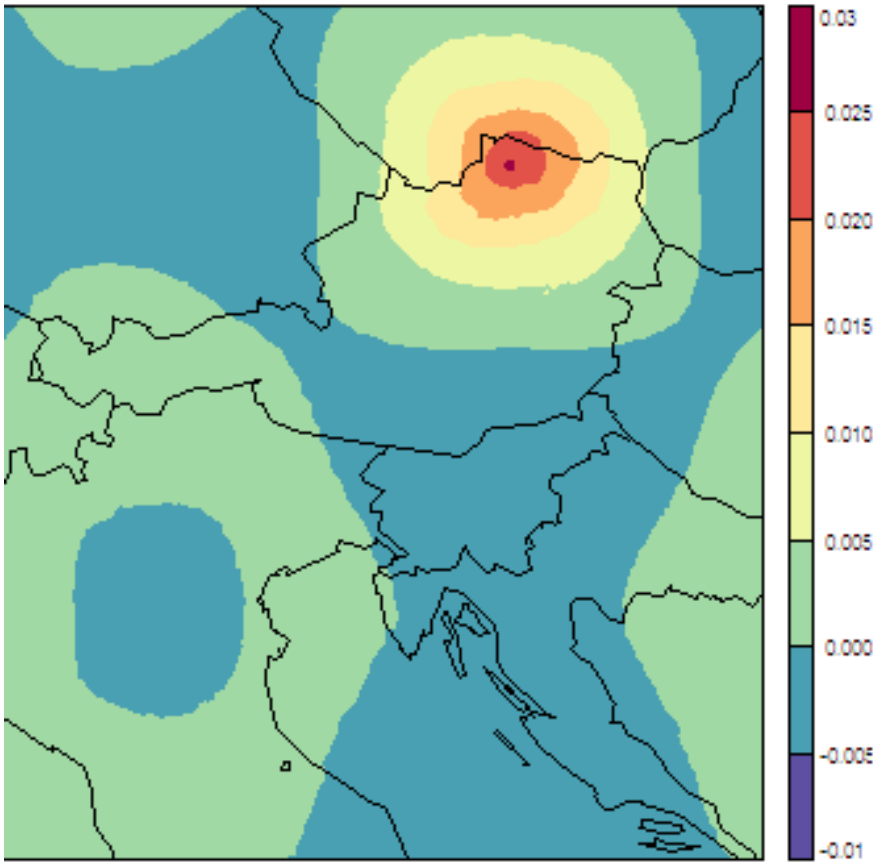

Mehr... (1)
Karte
Satellit
Earth
ALST
MIST
ZIDF
ANDF
LINZ
LEOP
TRAI
AMST
ATPU
BADE
NEUS
WEYE
SALZ
MATT
LIEZ
MURZ
OBER
KIBG
SHLA
JENB
SAAL
SEEF
LEOB
ROET
LAND
MATR
SHEI
GRAZ
SONN
GUES
OCHS
TREI
WOBG
SILL
LEIB
GUMM
KOET
KLAF

Increment

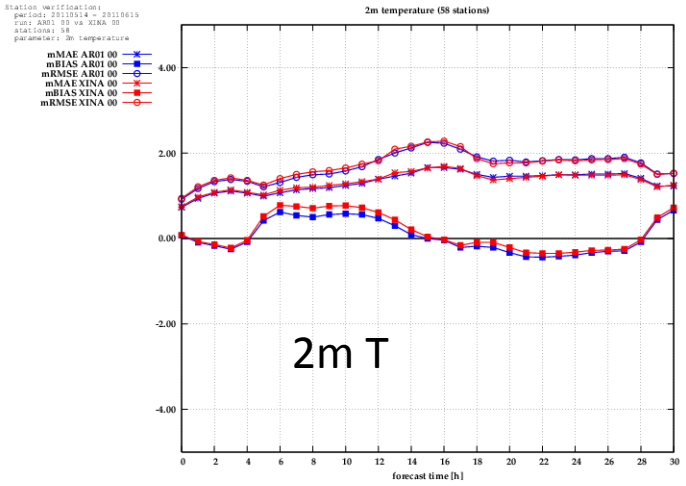
Humidity (0.01g)

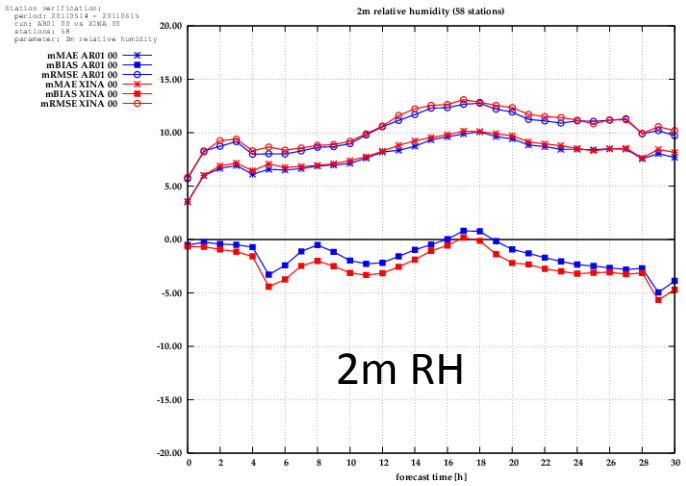


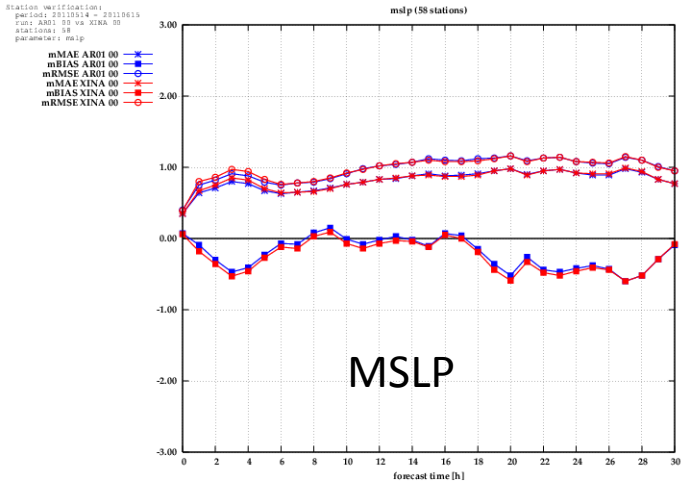
Temperatur(K)

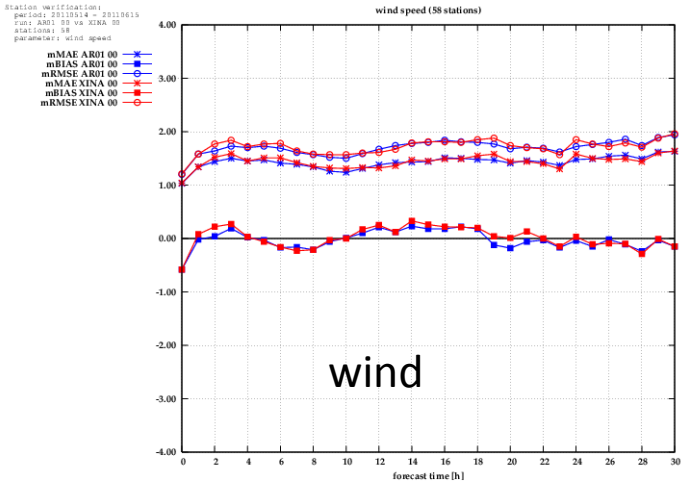


Surface parameter verification



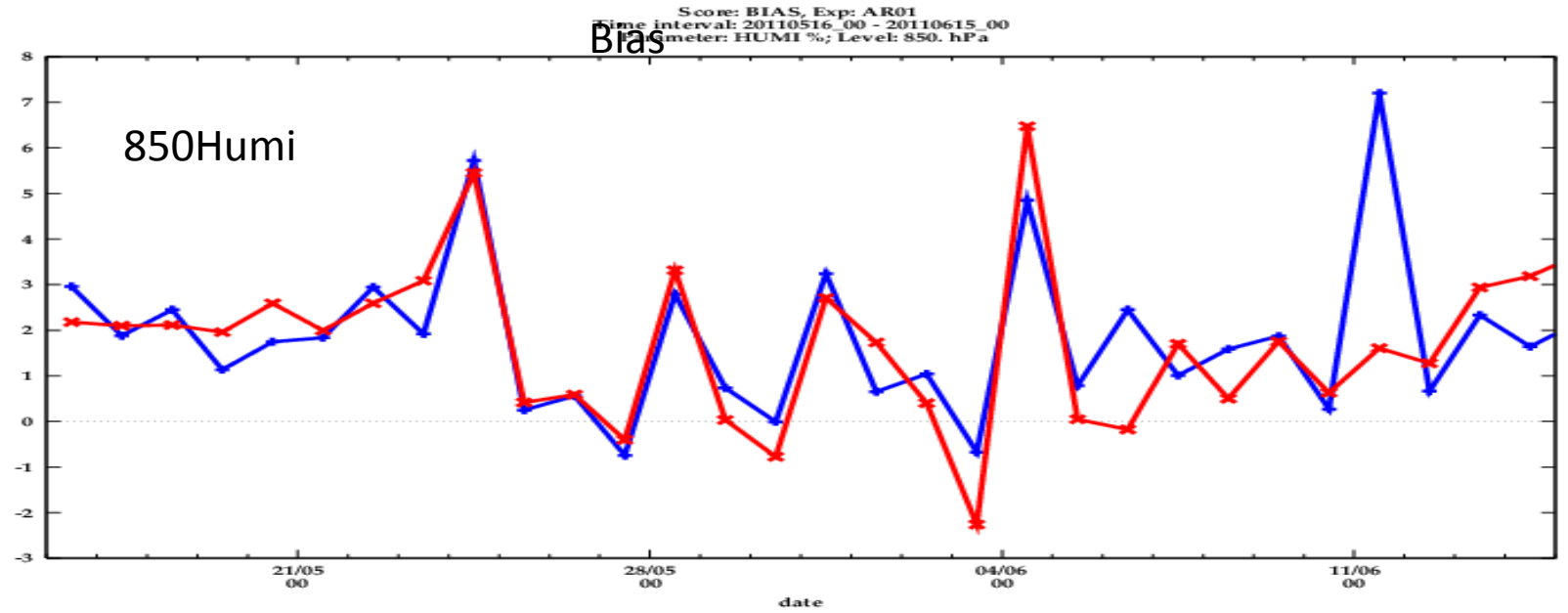


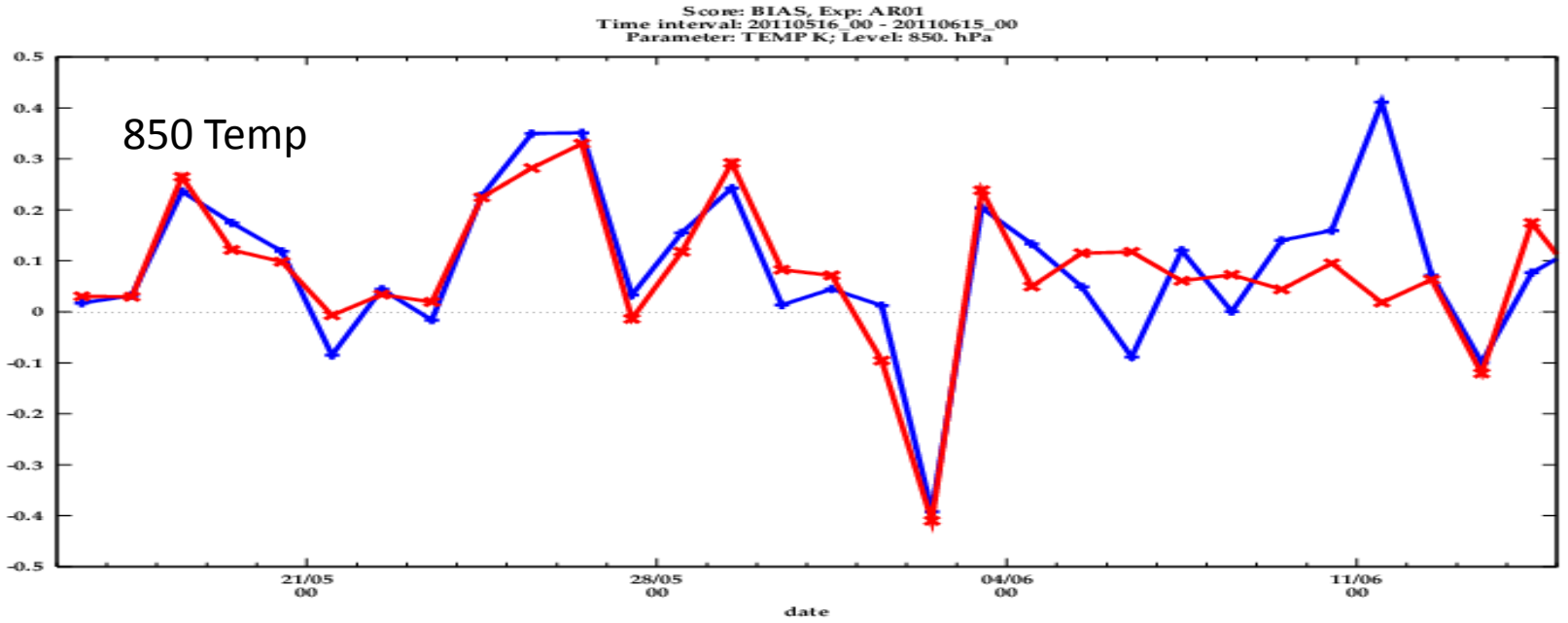




Bias

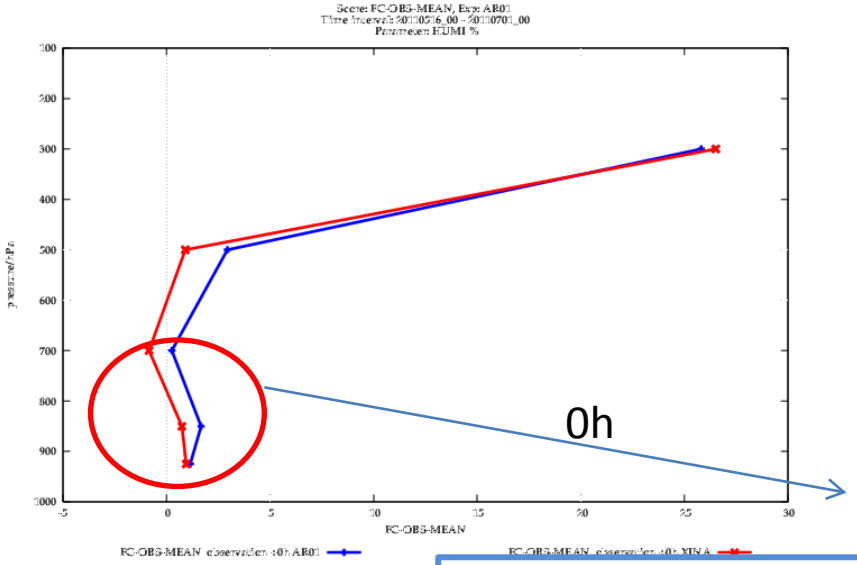
Bias

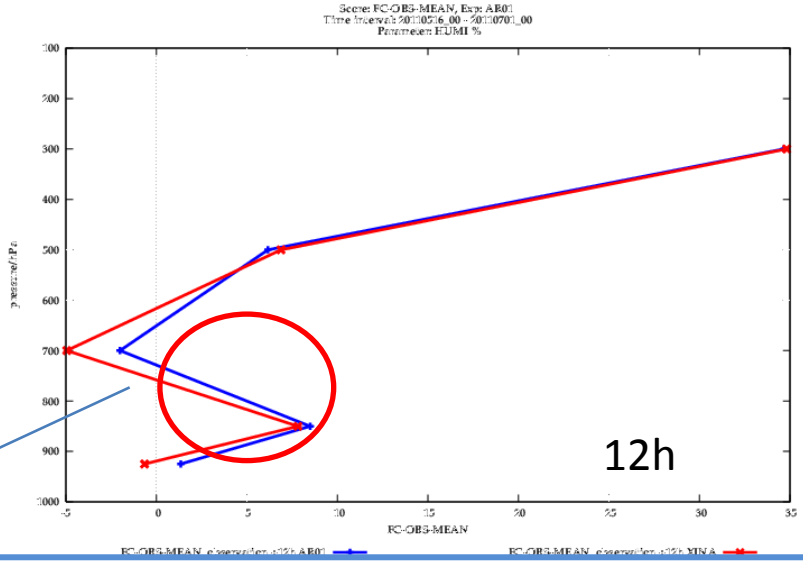

Score: BIAS, Exp: AR01
Time interval: 20110516_00 - 20110615_00
Parameter: HUMI %; Level: 850. hPa
850Humi
8
7
6
5
4
3
2
1
0
-1
-2
-3
21/05
00
28/05
00
04/06
00
11/06
00
date


Score: BIAS, Exp: AR01
Time interval: 20110516_00 - 20110615_00
Parameter: TEMP K; Level: 850. hPa
850 Temp
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
21/05
00
28/05
00
04/06
00
11/06
00
date
BIAS observation +0h AR01
BIAS observation +0h XINA

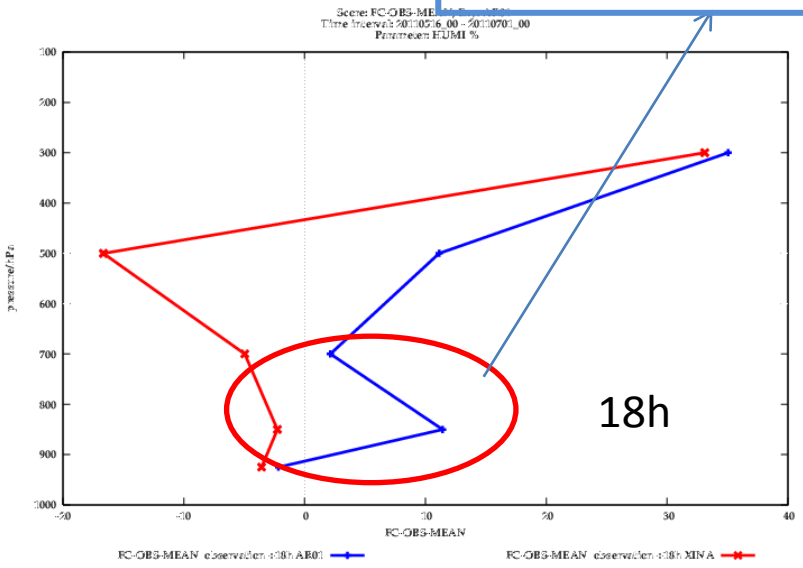
Humidity Bias vertical level

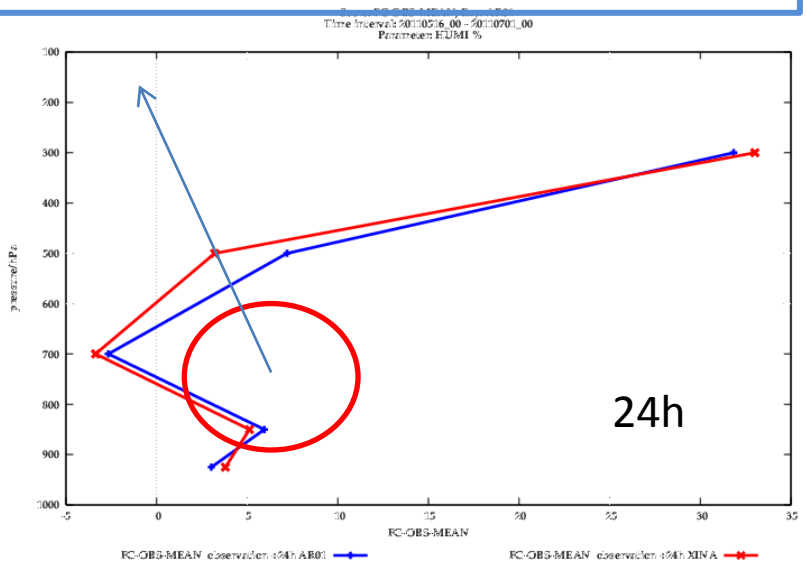
12UTC run Wien Humidity sounding verification





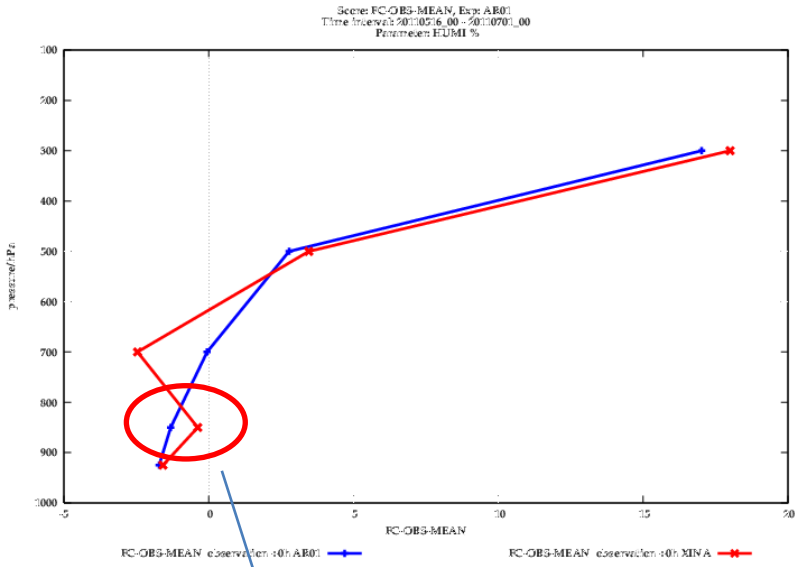
700/850hPa moisture concentrated level improved with GPS



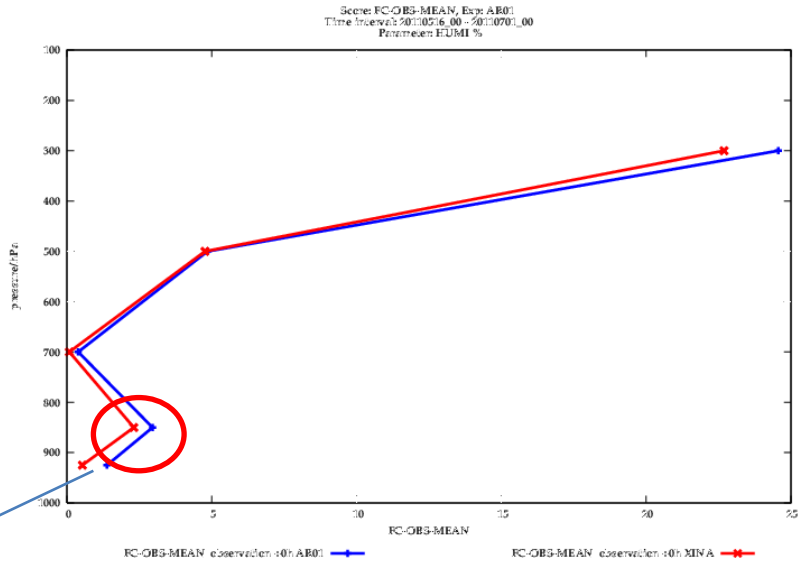


3UTC run Humidity sounding verification

Linz Humidity sounding(nord)

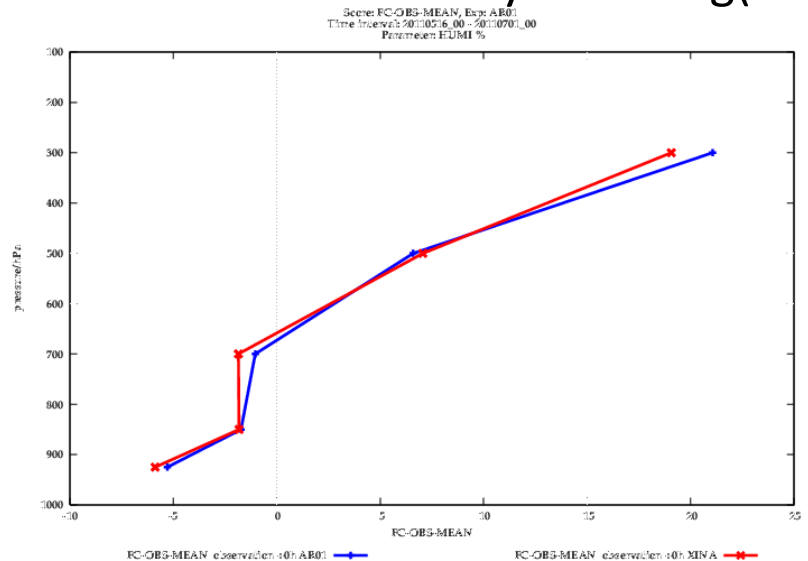


Graz Humidity sounding(sudost)



700/850hPa moisture concentrated level improved with GPS

Innsbruck Humidity sounding(west)



SAL results

Red: GPS

blue: Refrence

 positive impact

 negative impact

Whole austria 06

Southeast 05

Northeast 04

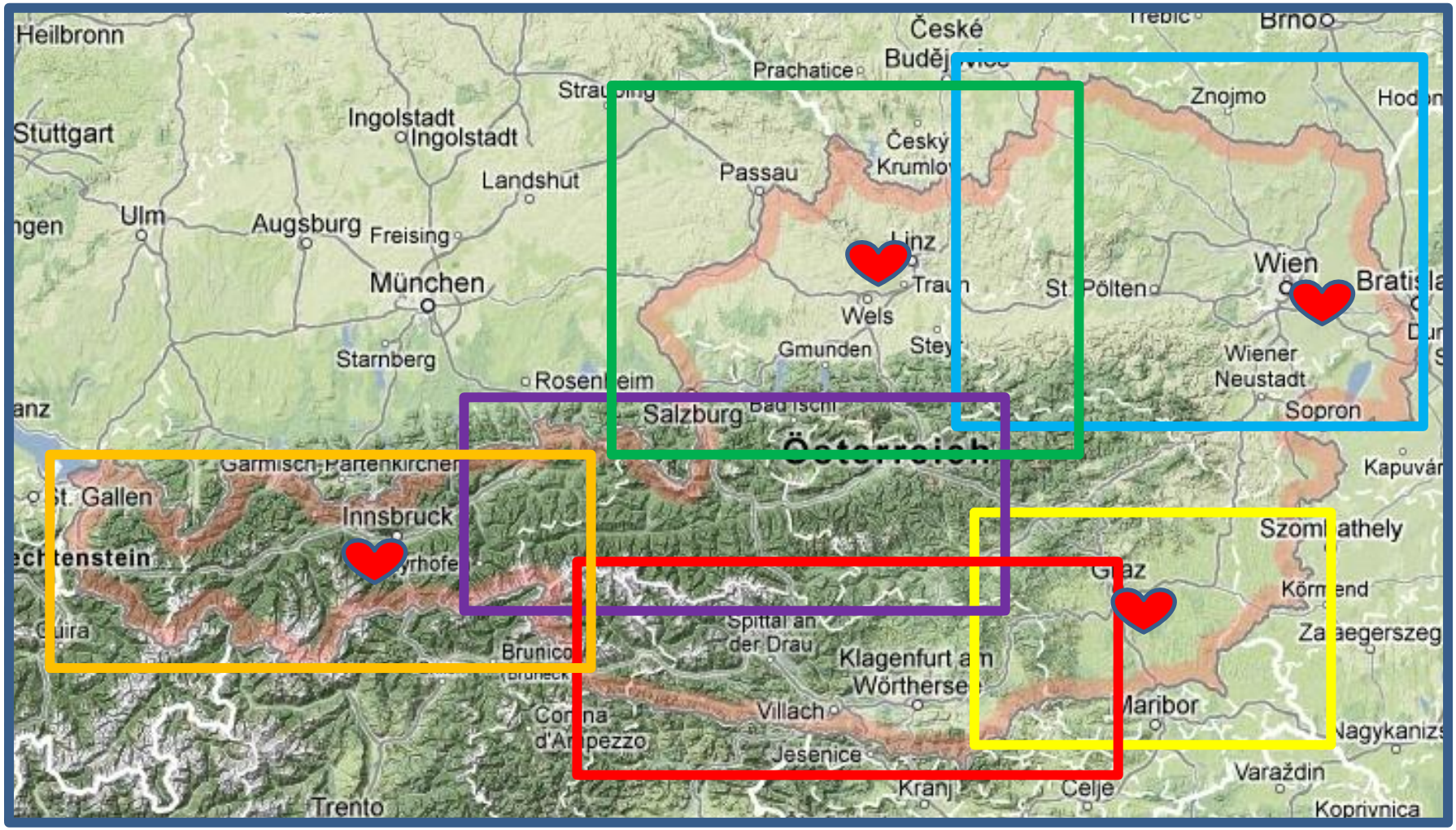
sounding

Middle 03

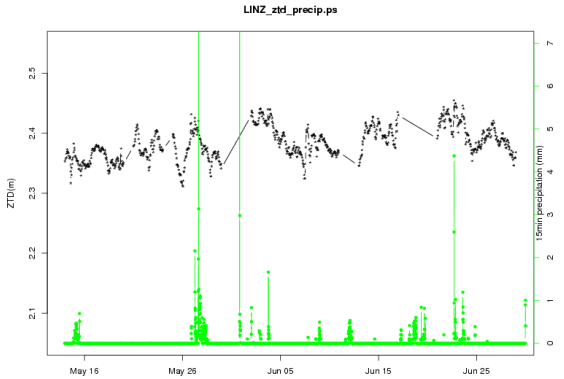
North 02

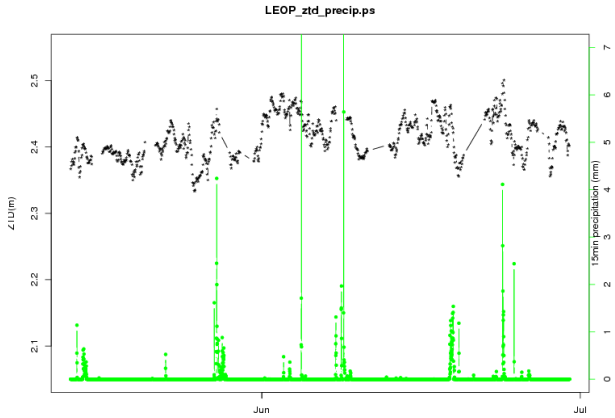
South 01

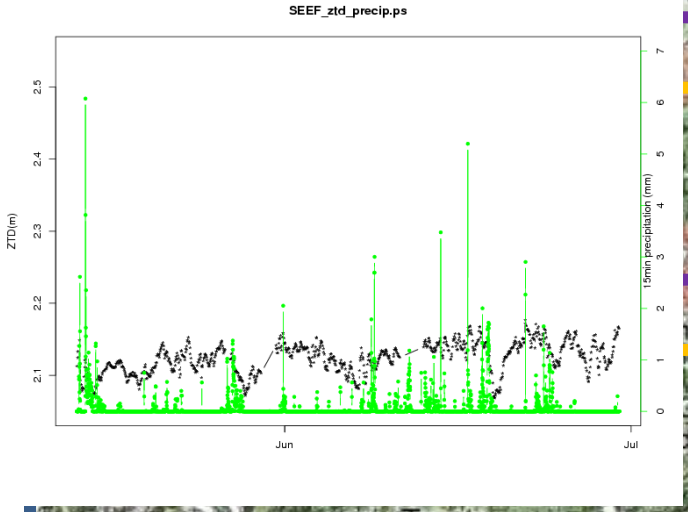
west 00

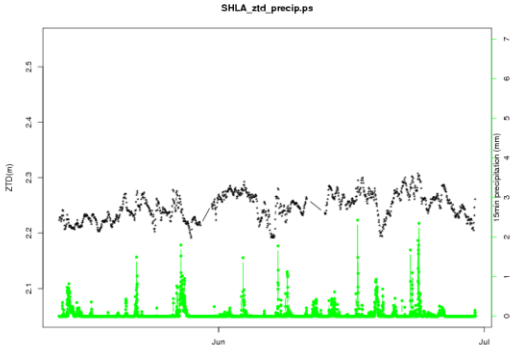


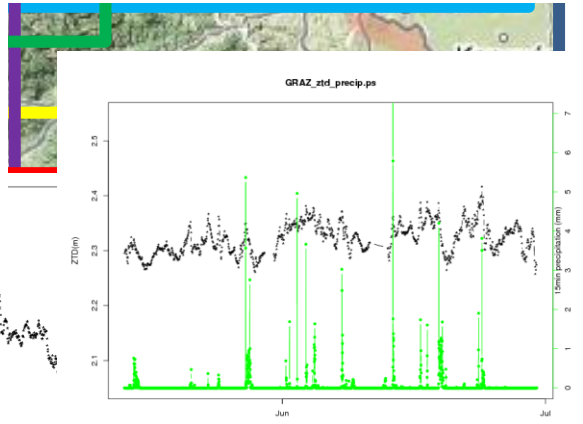
Time series of ZTD(dark line) and rainfall for each subdomain (15min accu) from 5/15-6/30, 2011

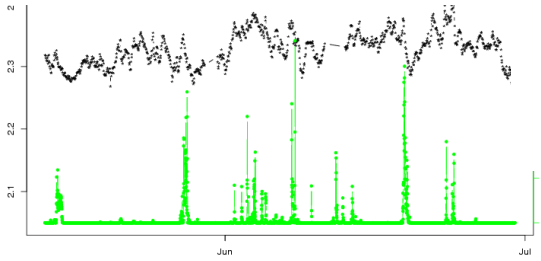


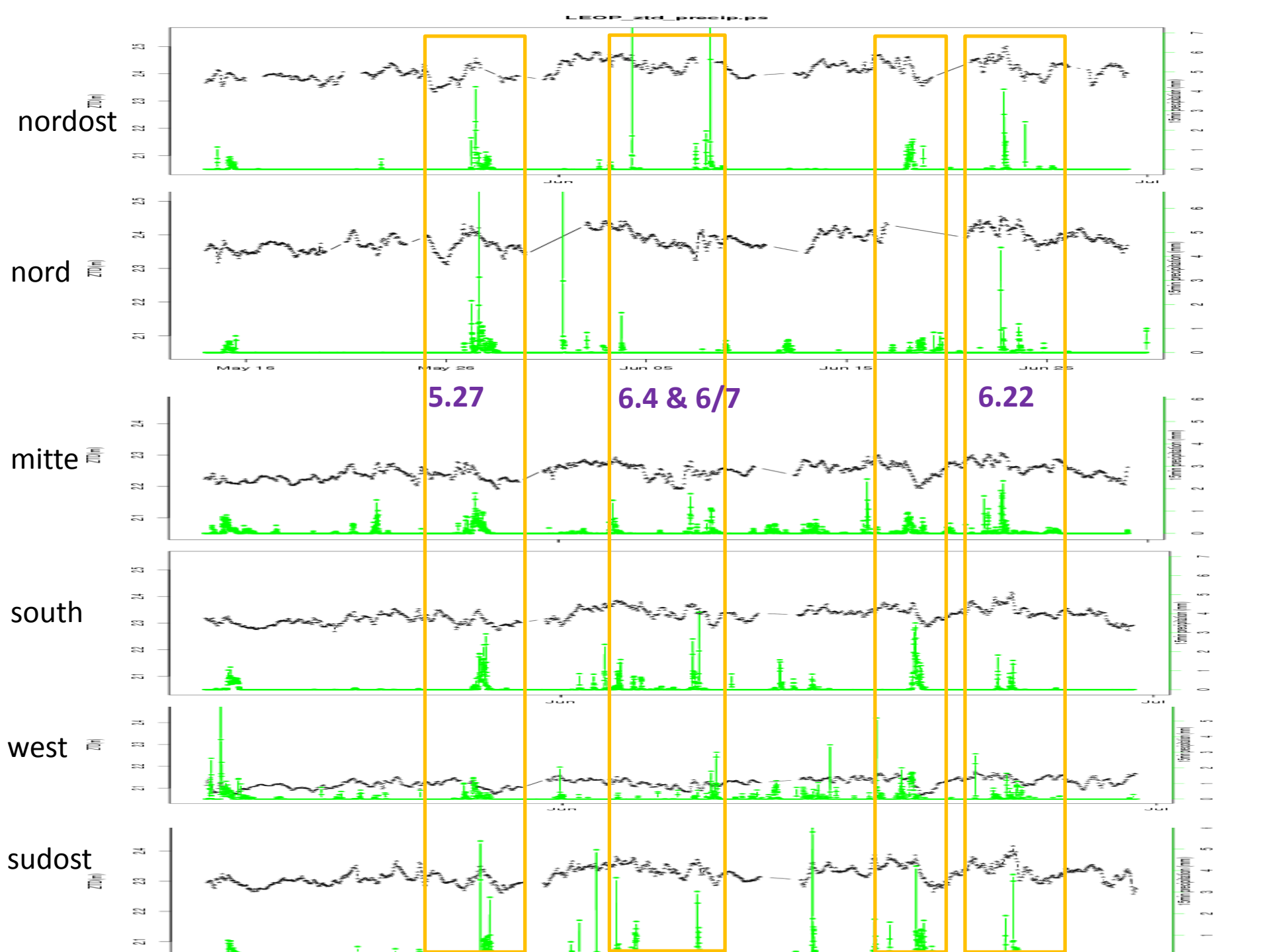




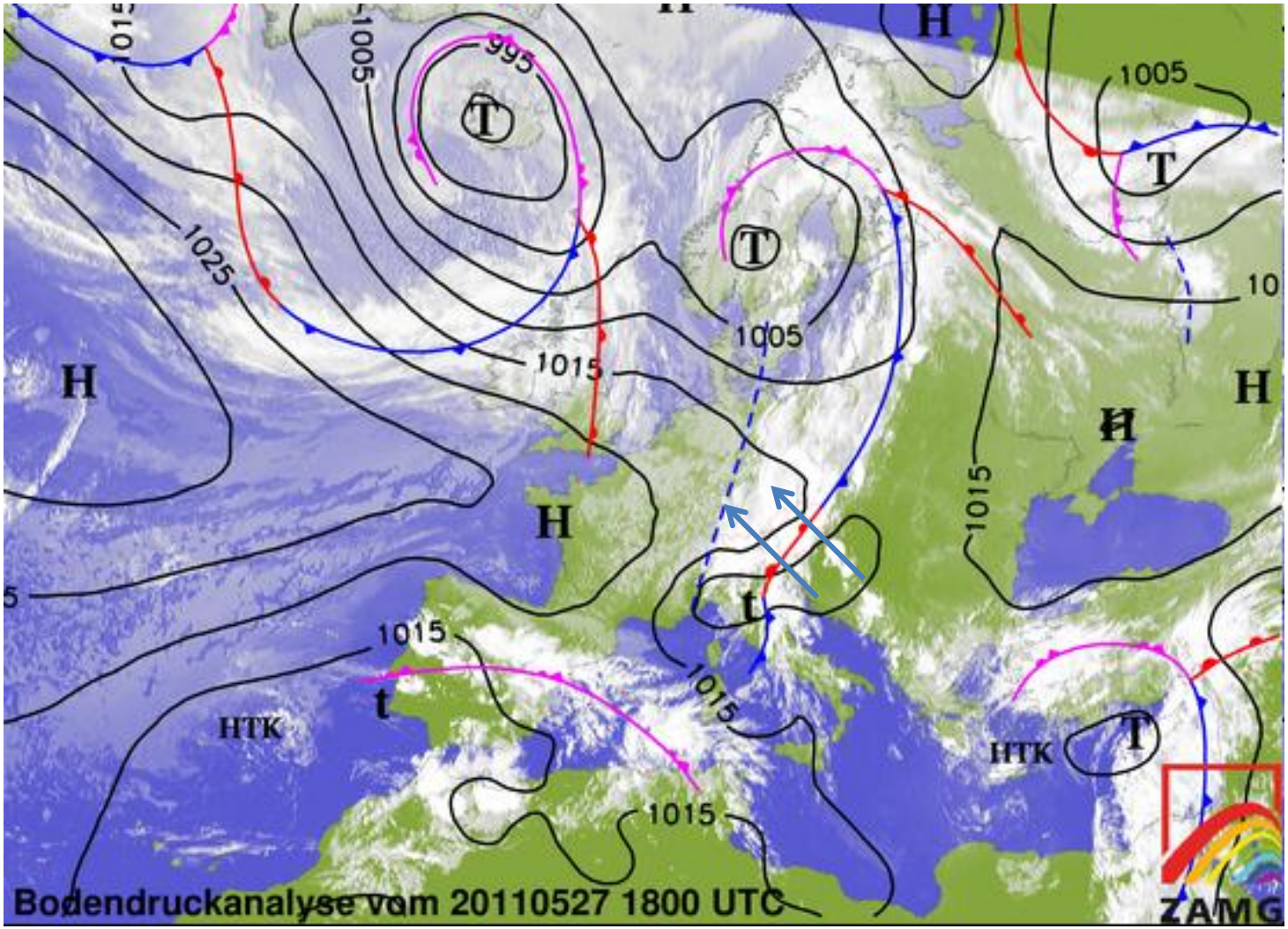




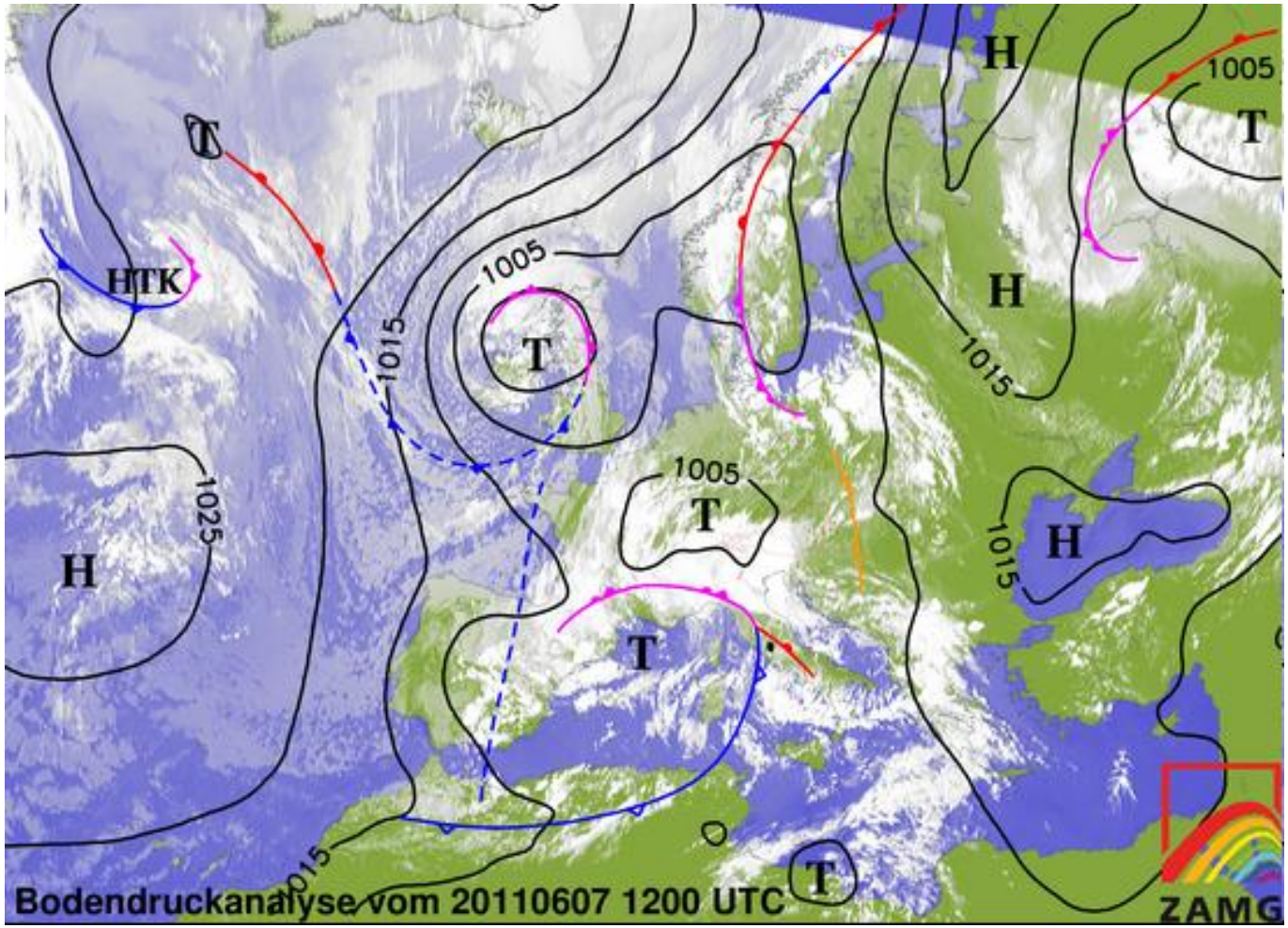



LEOP_ztd_precip.ps
nordost
nord
mitte
south
west
sudost
5.27
6.4 & 6/7
6.22
May 15
May 25
Jun 05
Jun 15
Jun 25
Jun
Jul

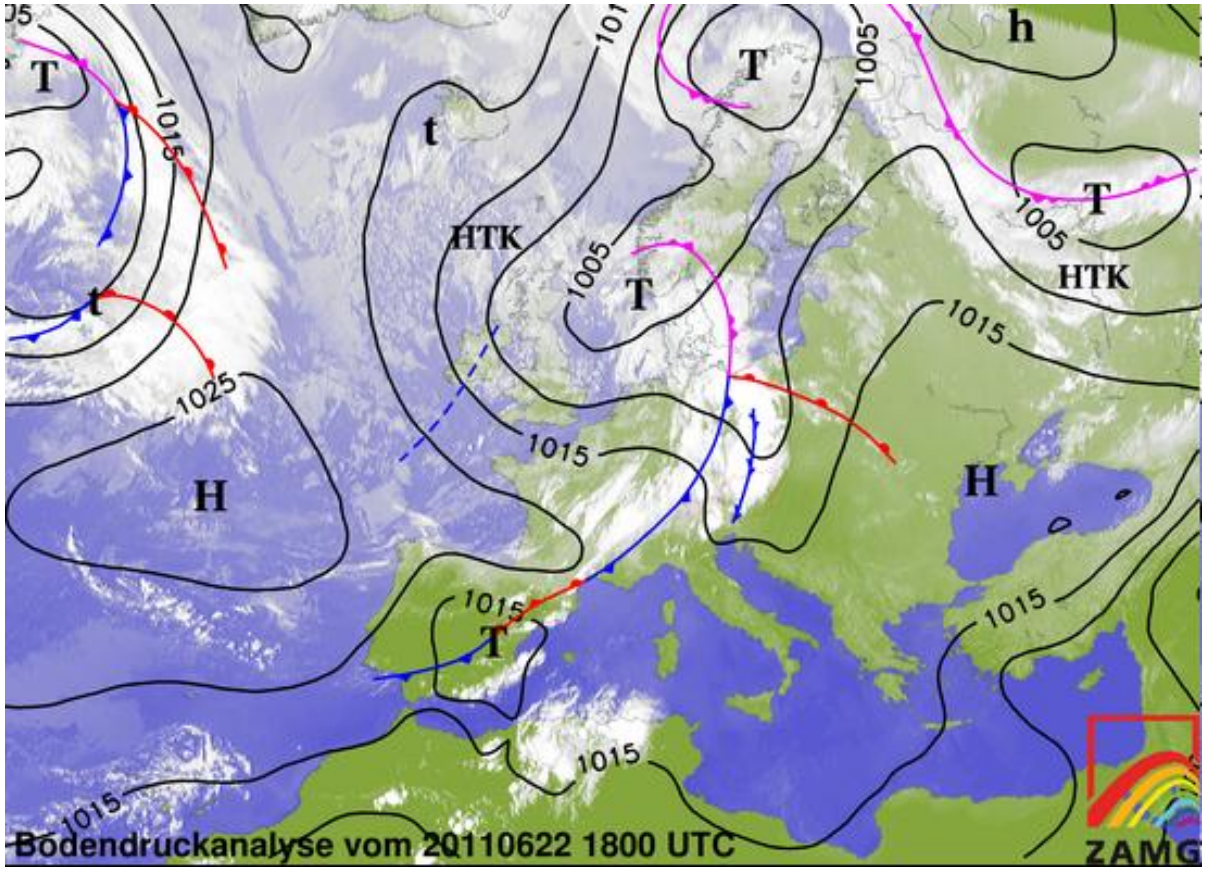
Case study 2011/05/27



Case 2011/06/07



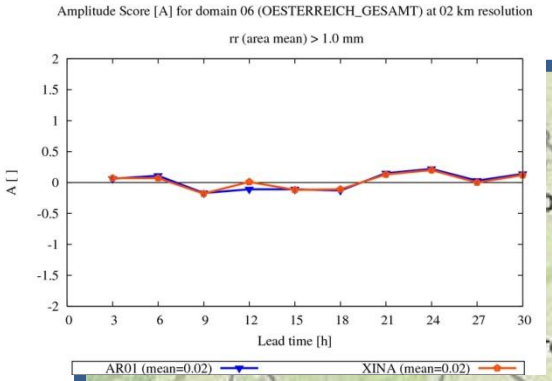
Case 2011/06/22

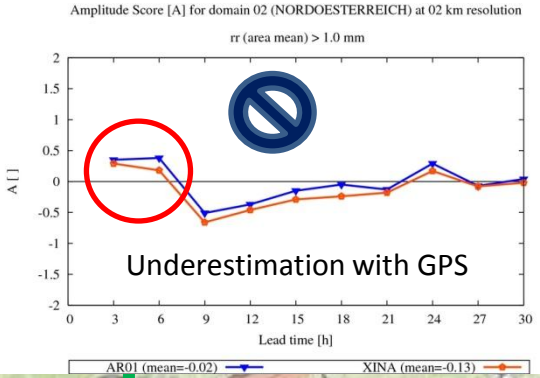


Cold front coming from Germany(from northwest to southeast, crossing austria-german border), lots of precipitation on the alps foot side of germany

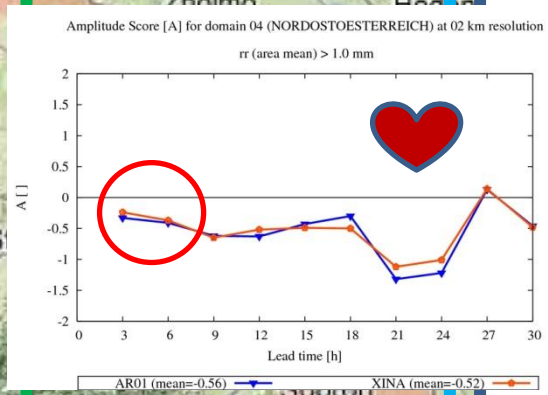
Amplitude score > 1.0mm (0515-0701/2011) 12UTC run

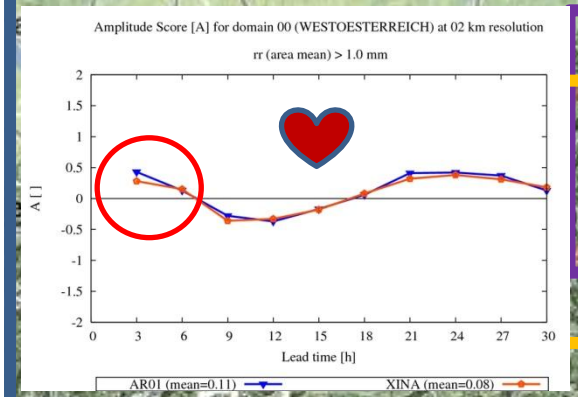
Improvememt on 3-6h forecast for all domain

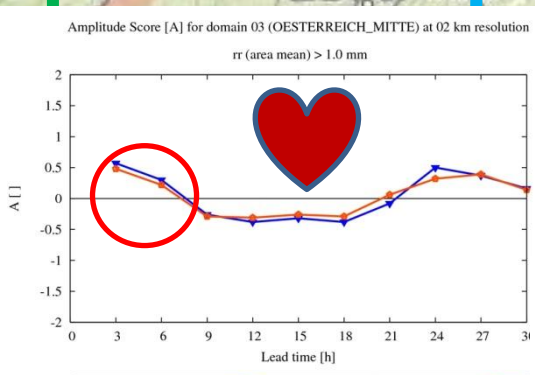


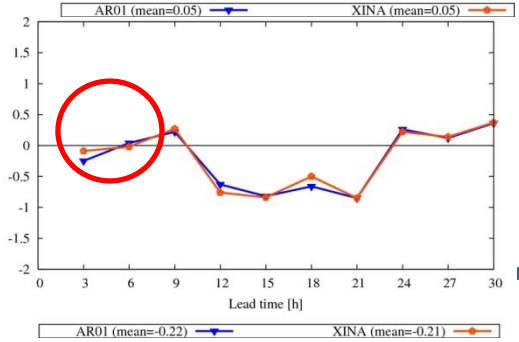


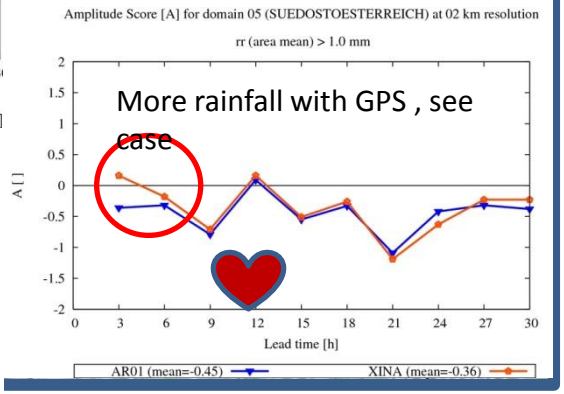
Underestimation with GPS







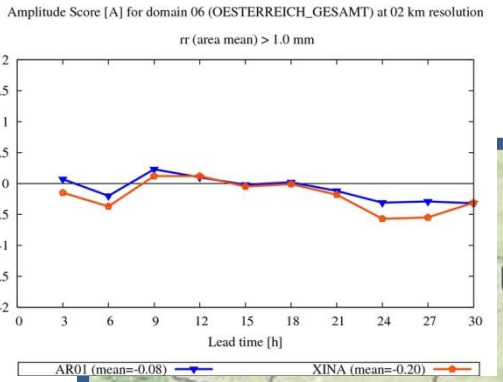


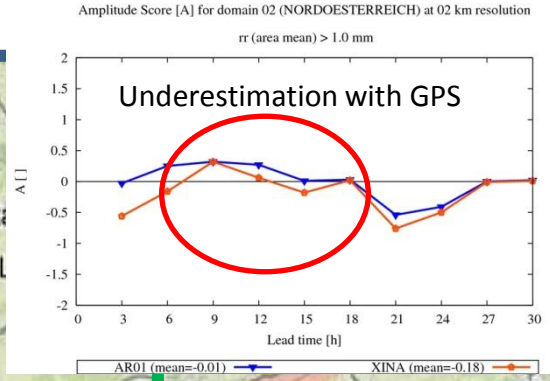


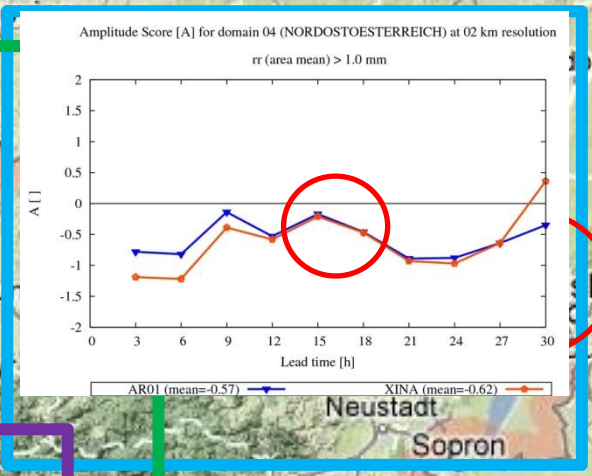
More rainfall with GPS , see case

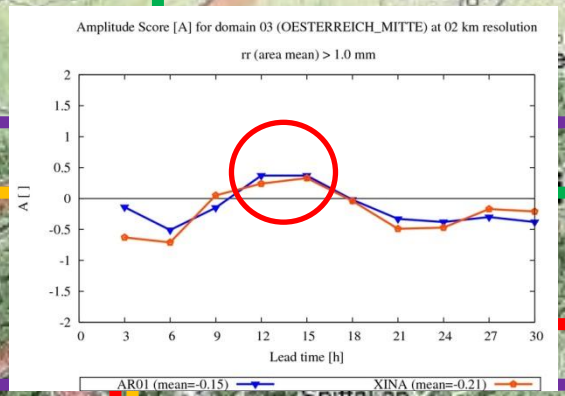
Amplitude score > 1.0mm (0515-0701/2011) 00UTC

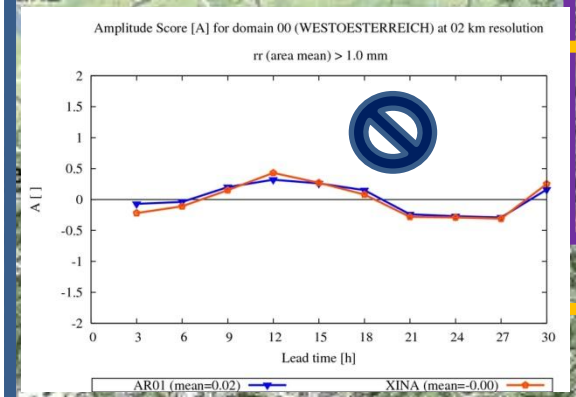
Improvememt on 3-6h forecast for all domain

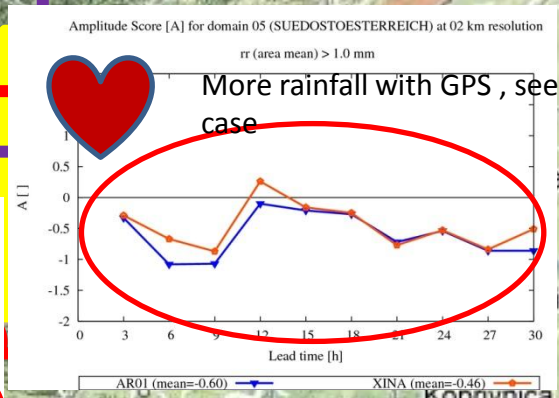


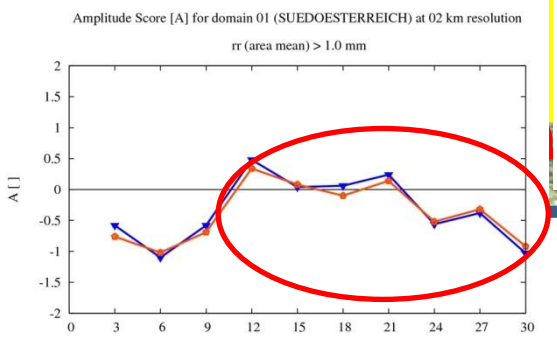


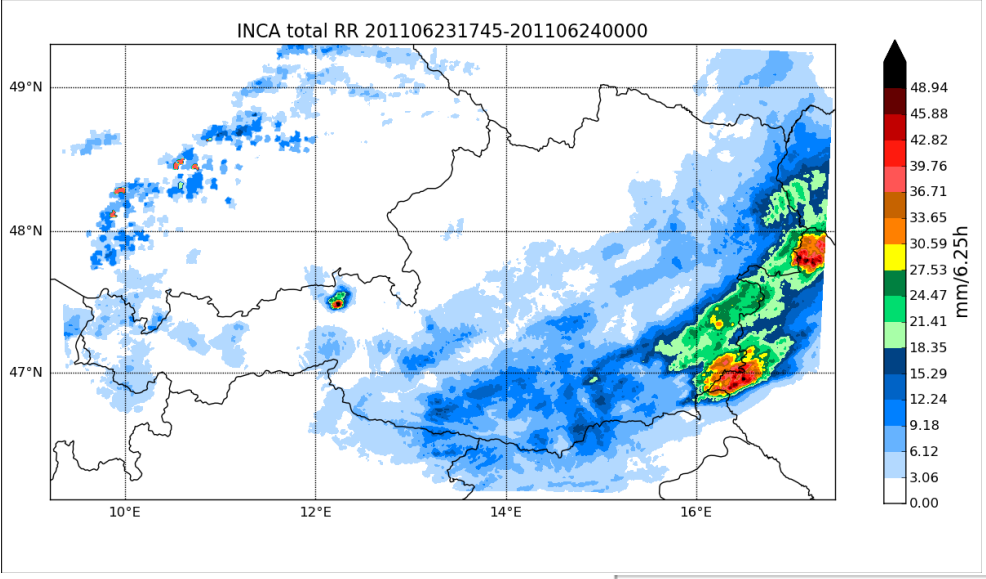






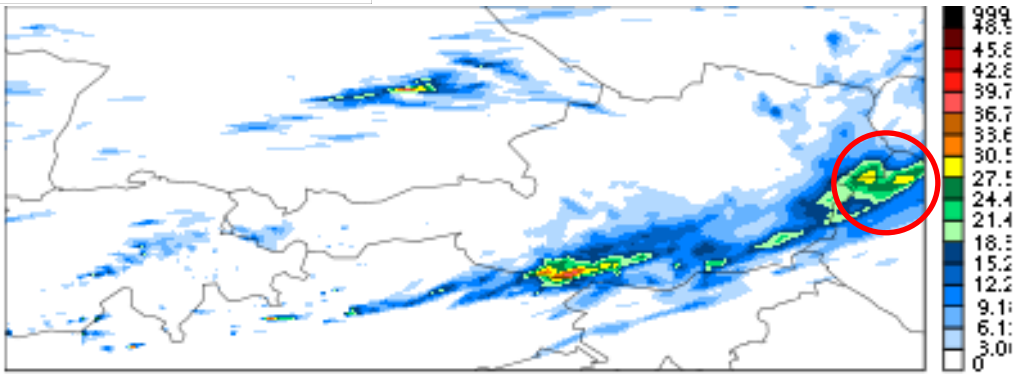




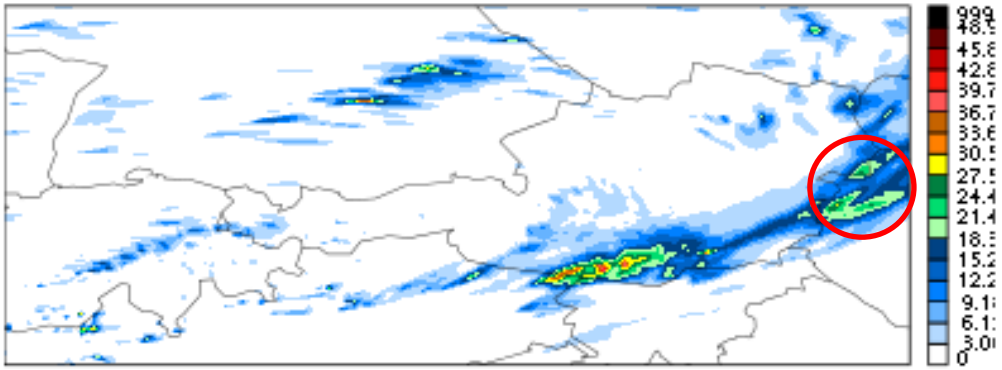


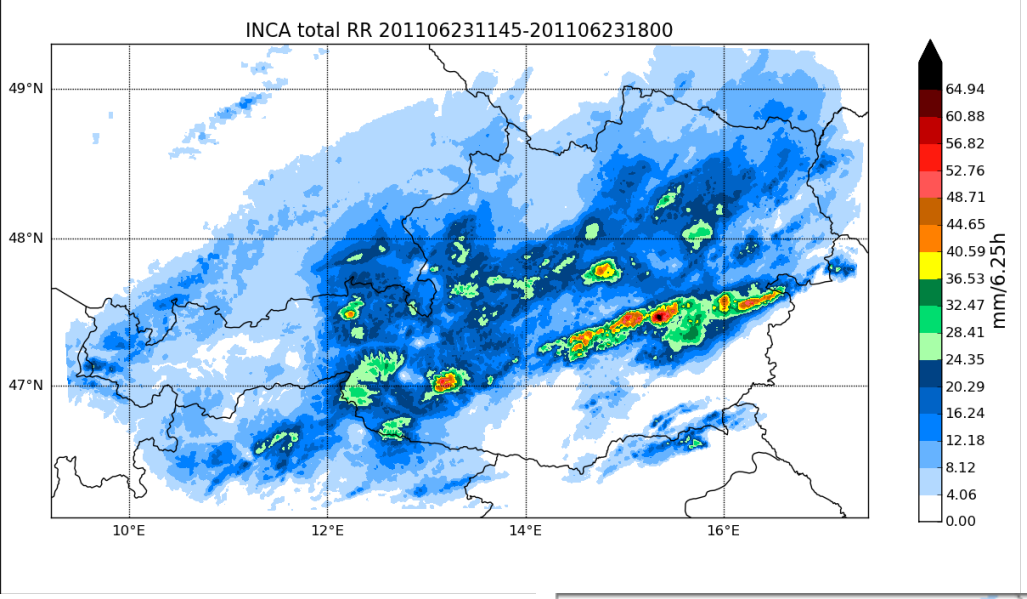
062318-24UTC 6h accumulated rainfall

GPS



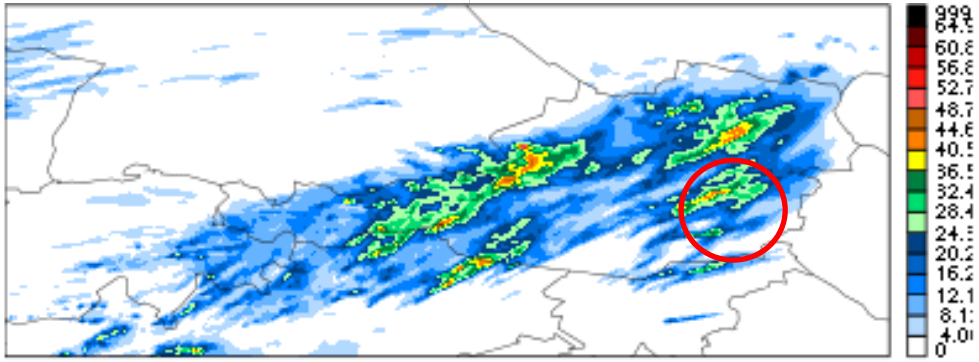
NO GPS



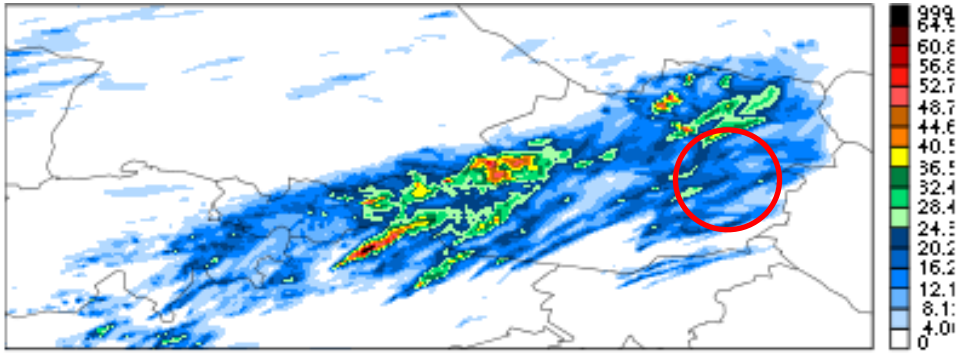


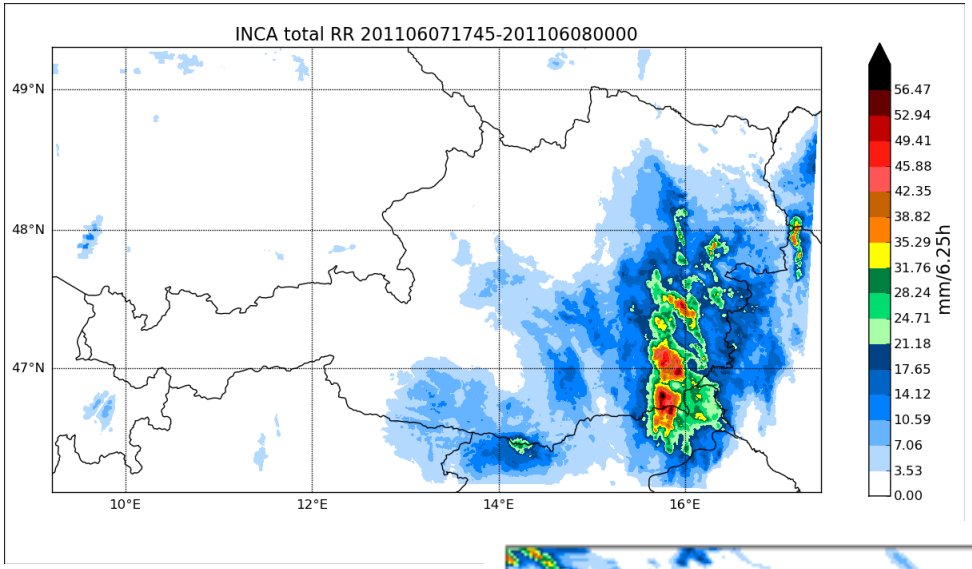
062318-24UTC 6h accumulated rainfall

GPS



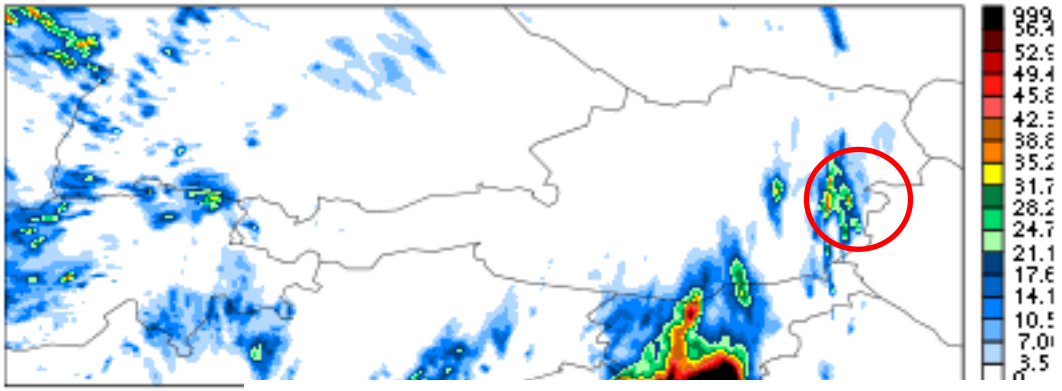
NO GPS





Front passing from south to north 06/07/ 18UTC run 18-24 UTC rainfall

GPS



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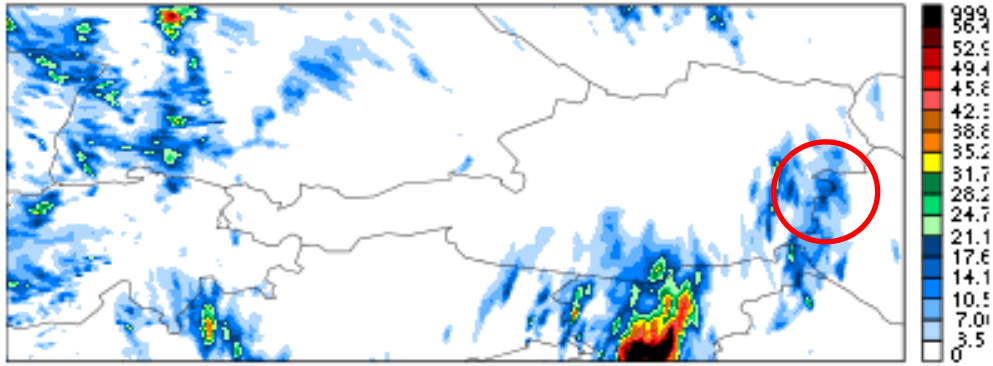
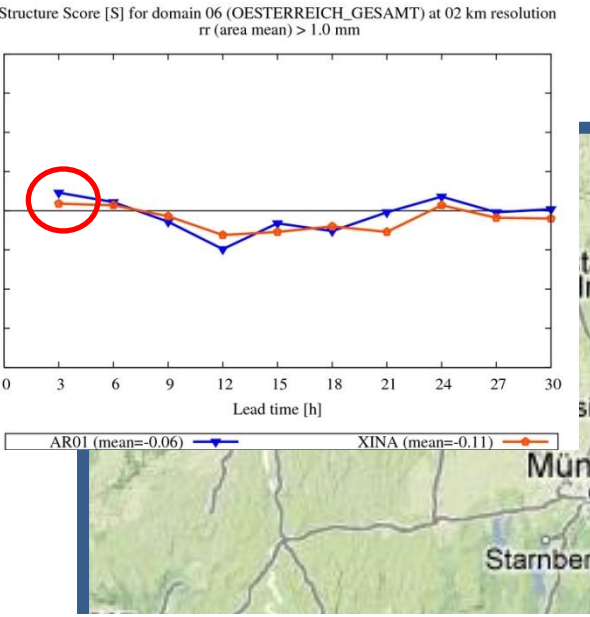
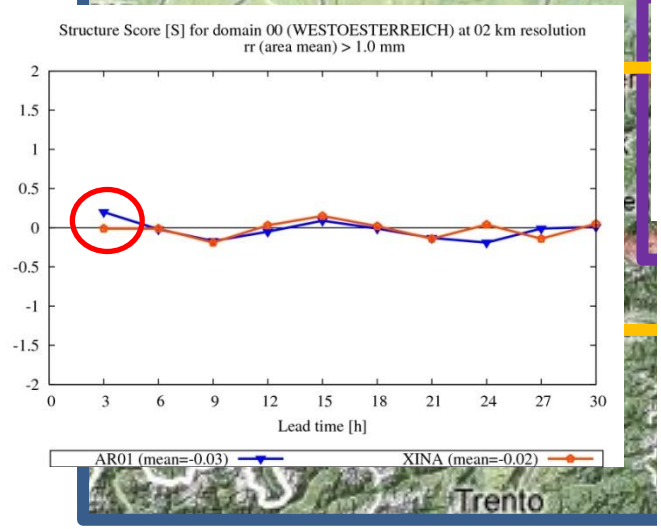
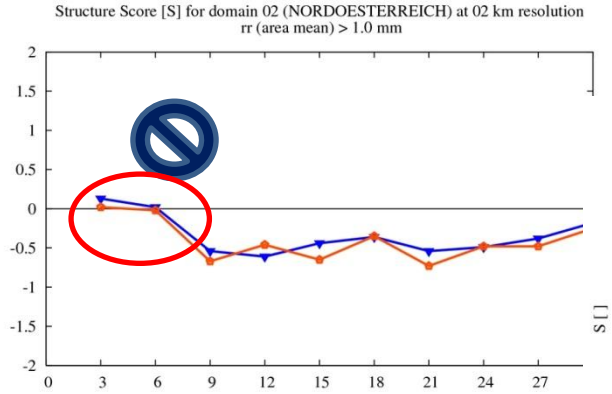


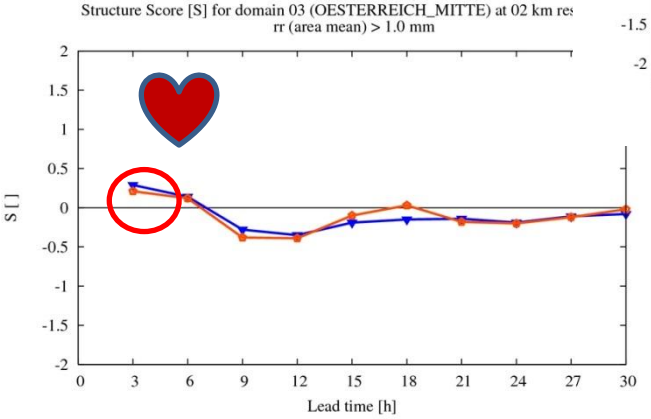
Structure score > 1.0mm (0515-0701/2011) 12run

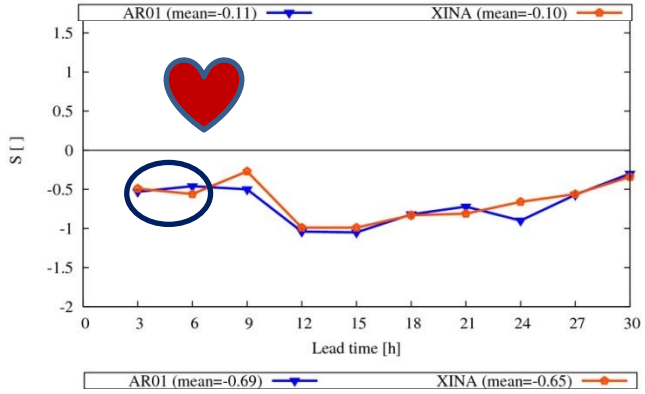
3-6h forecast especially 3h improved

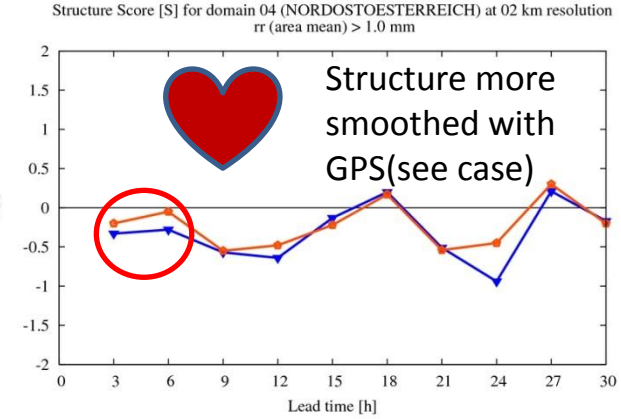


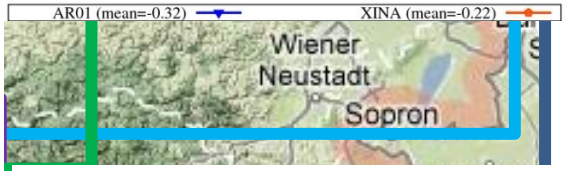


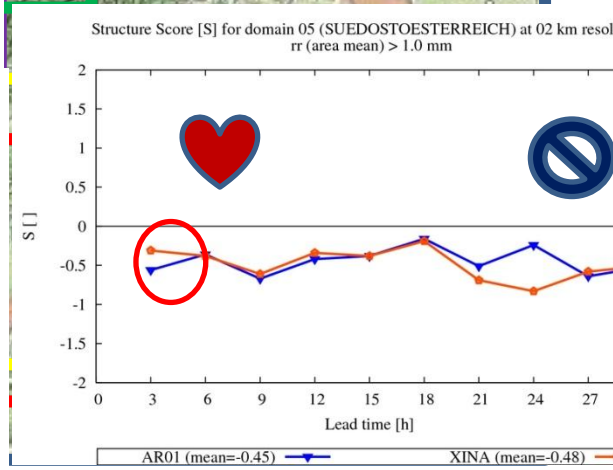






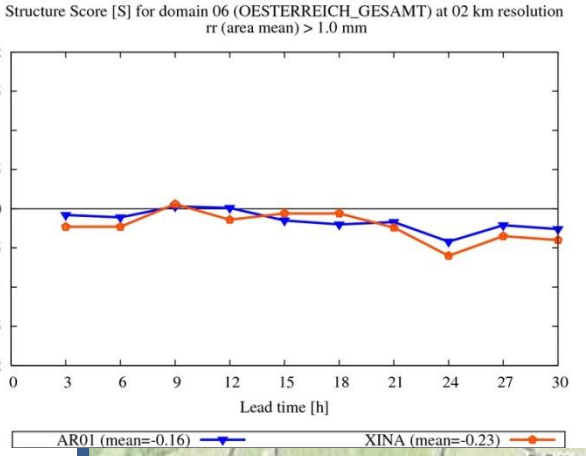


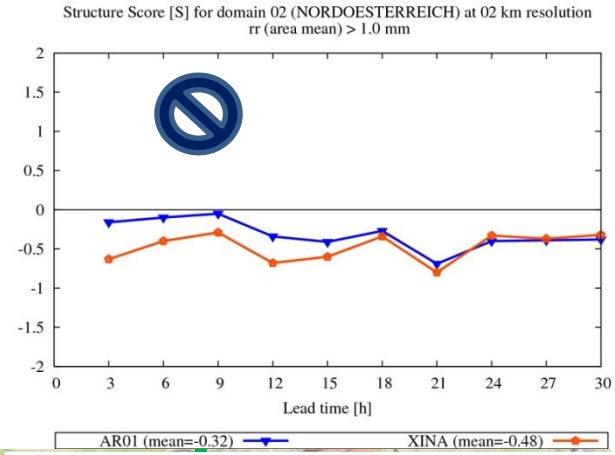


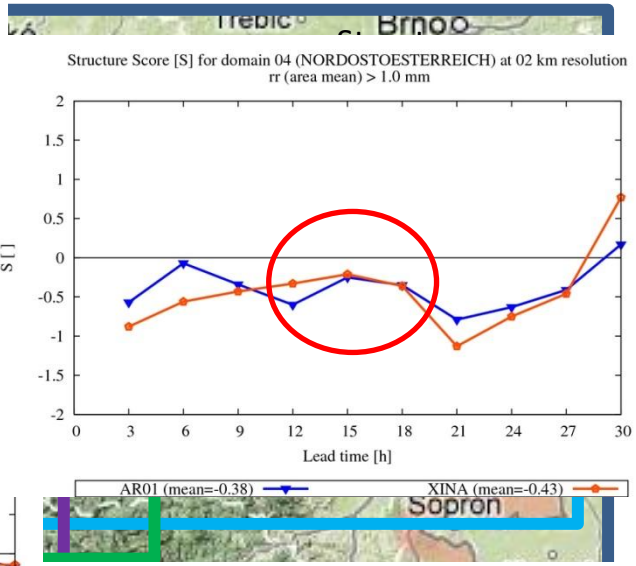


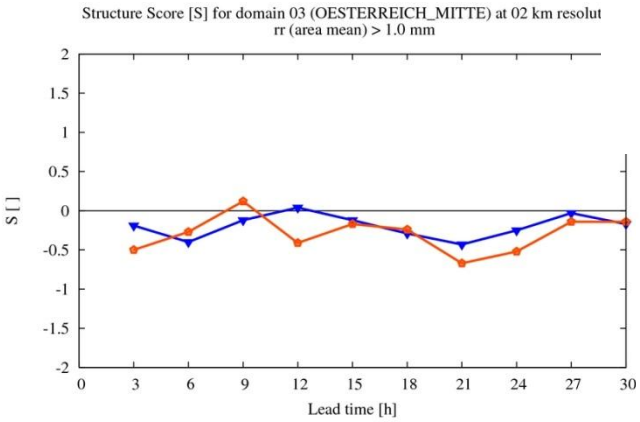
Structure score > 1.0mm (0515-0701/2011) 00run

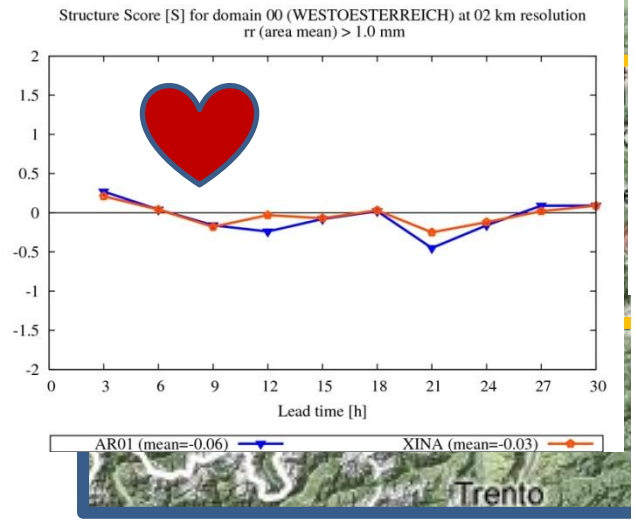
3-6h forecast especially 3h improved

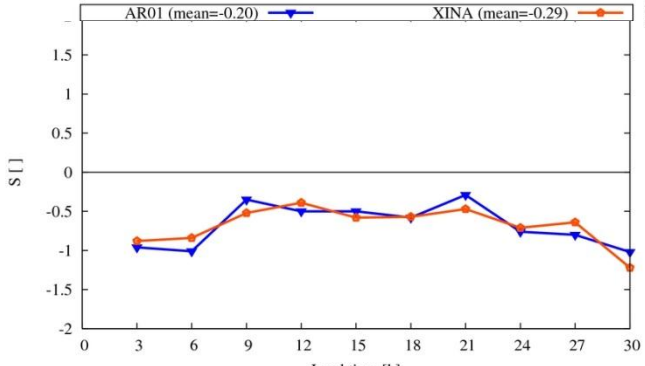


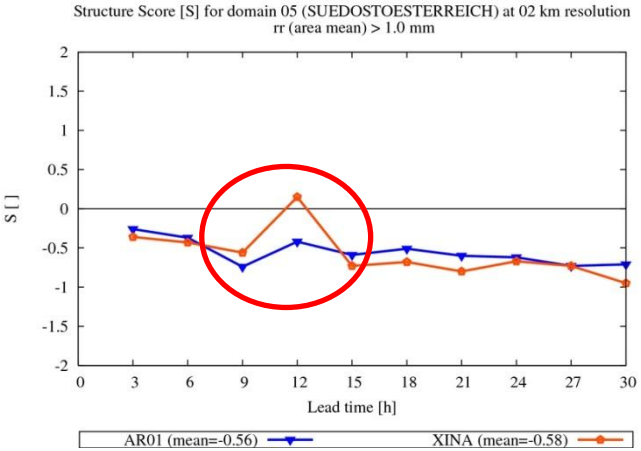


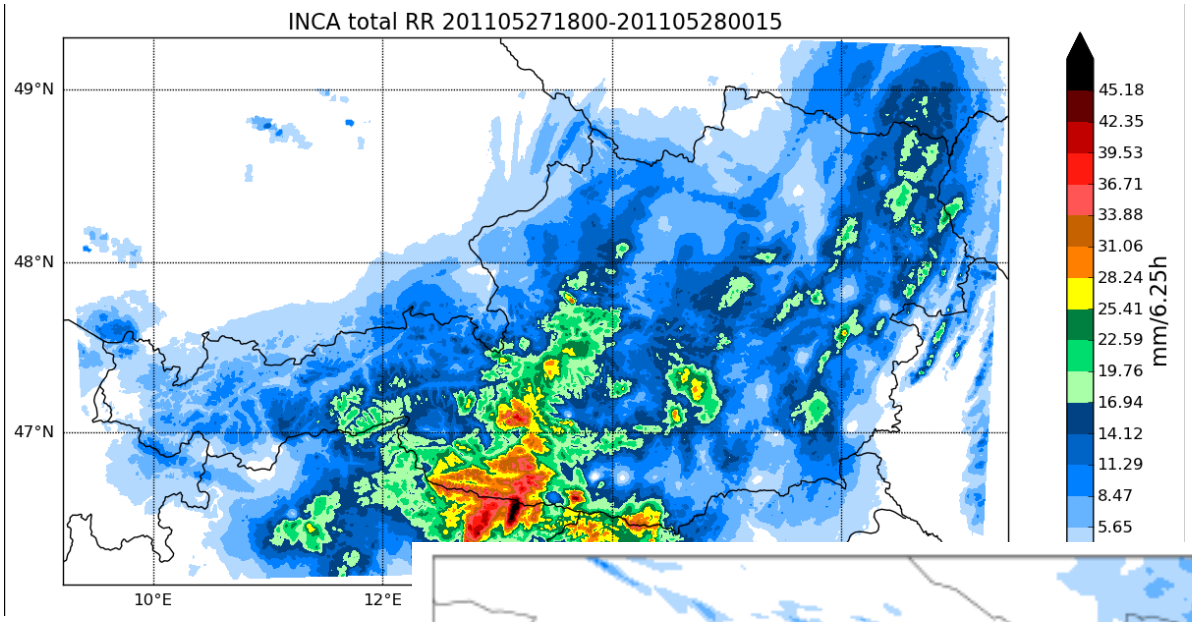




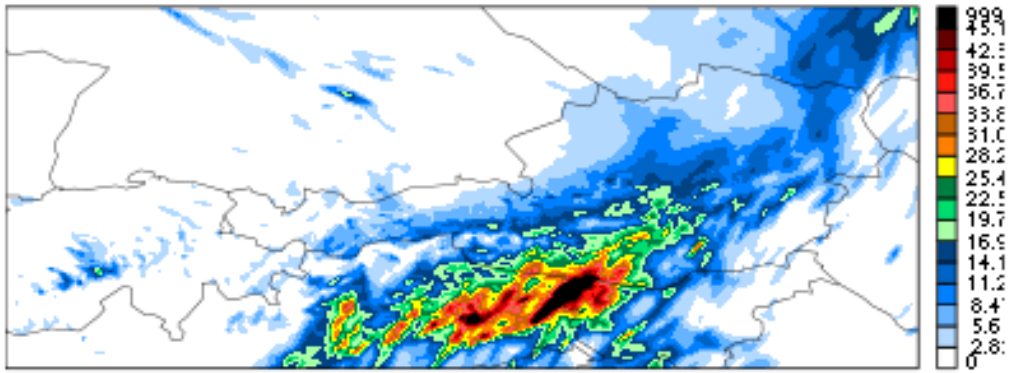




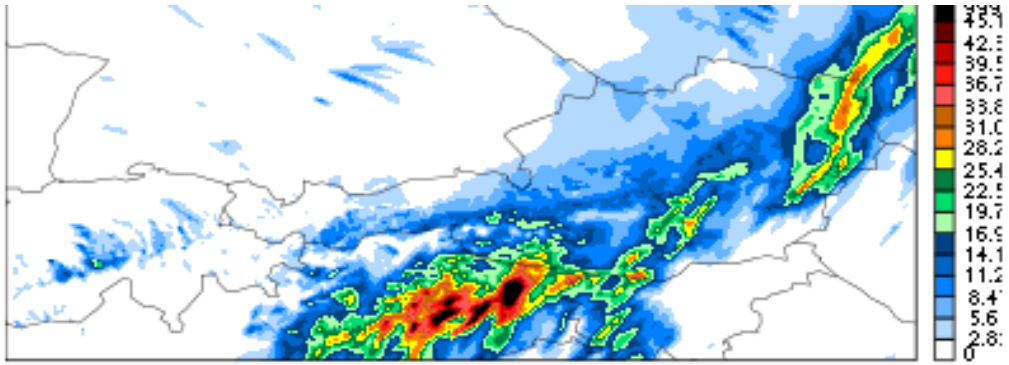




Example structure score:
2011/05/27/18-
05/28/00
6h accumulated rainfall

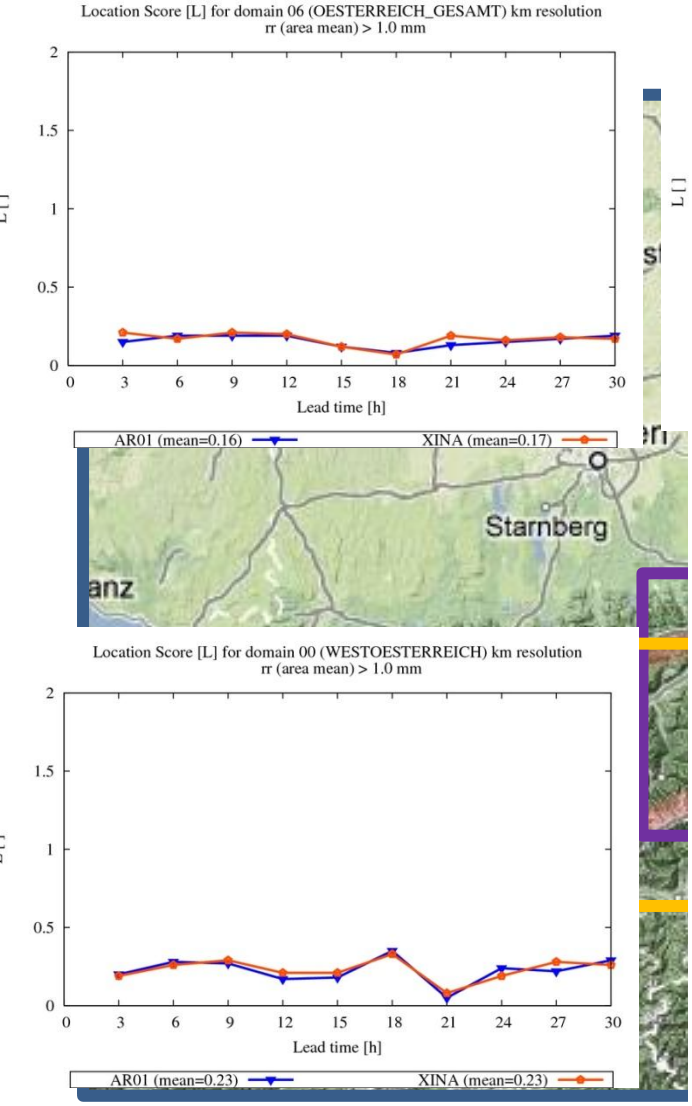


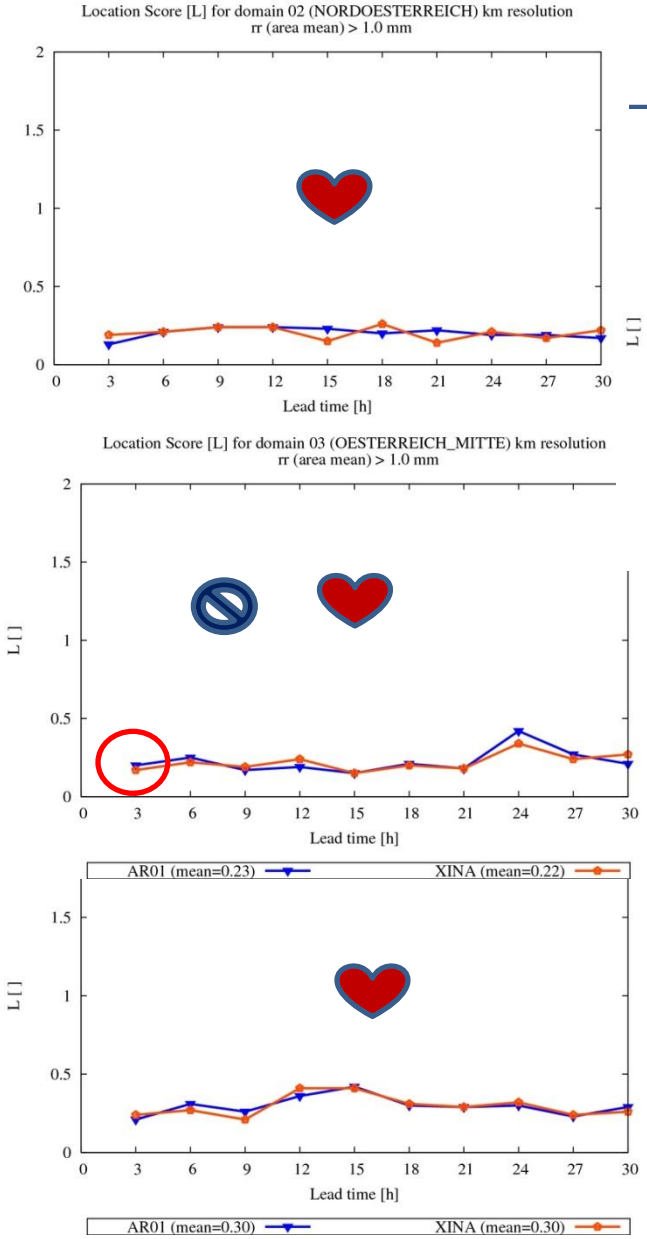
GPS

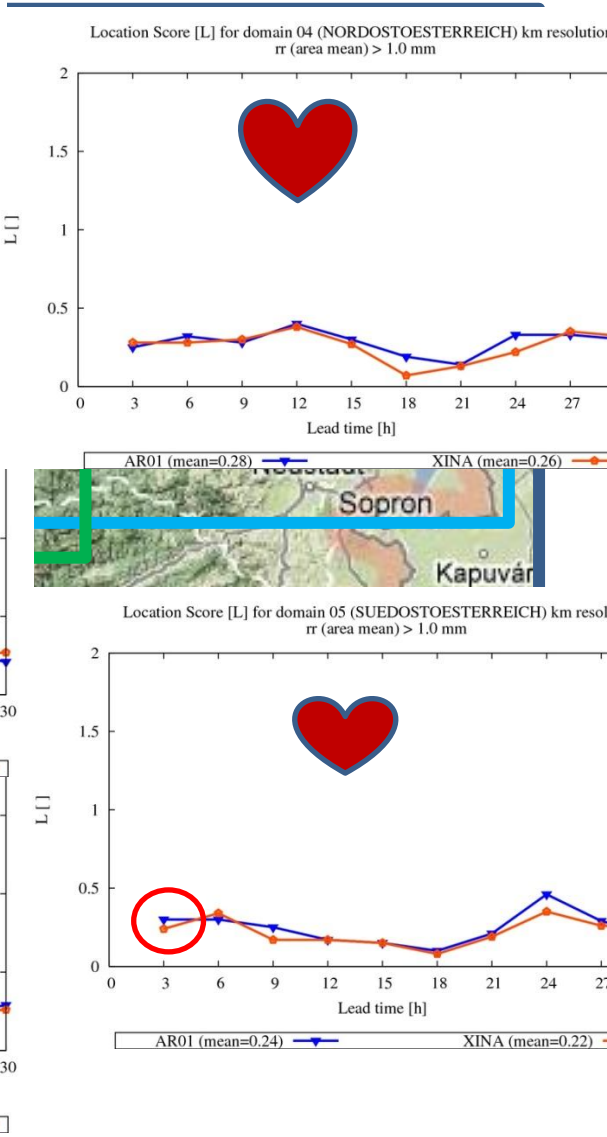


NO GPS

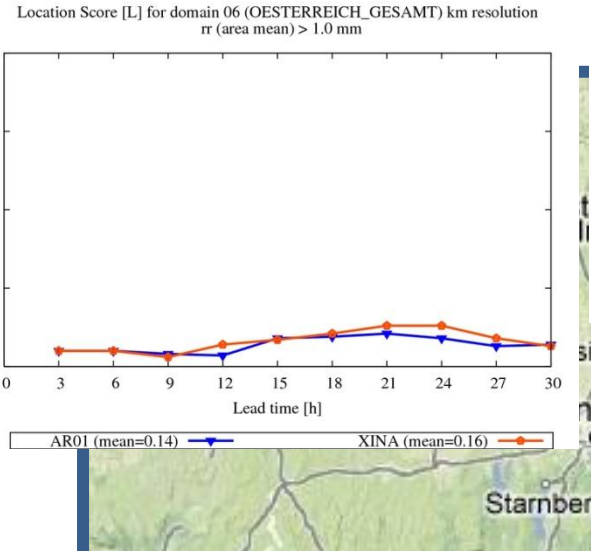
Location score > 1.0mm (0515-0701/2011) 12run

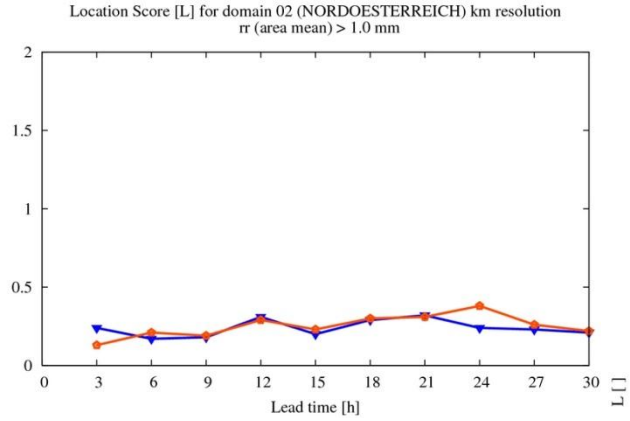


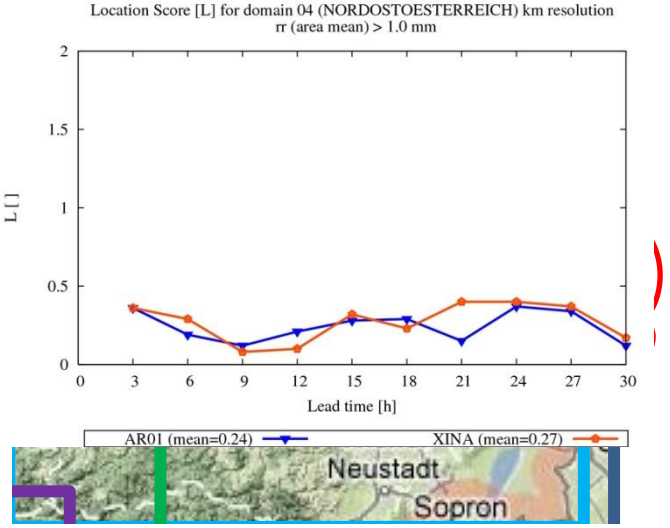


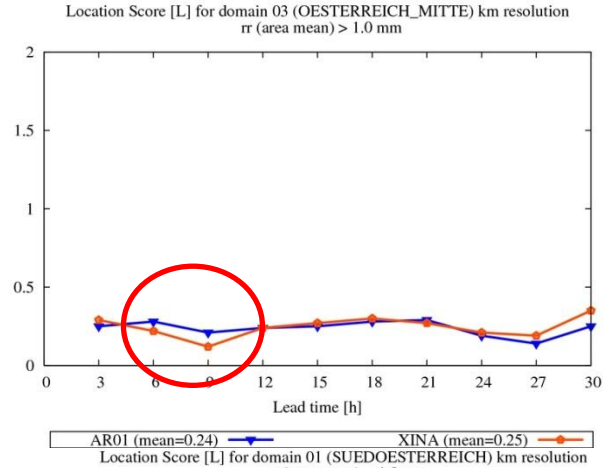


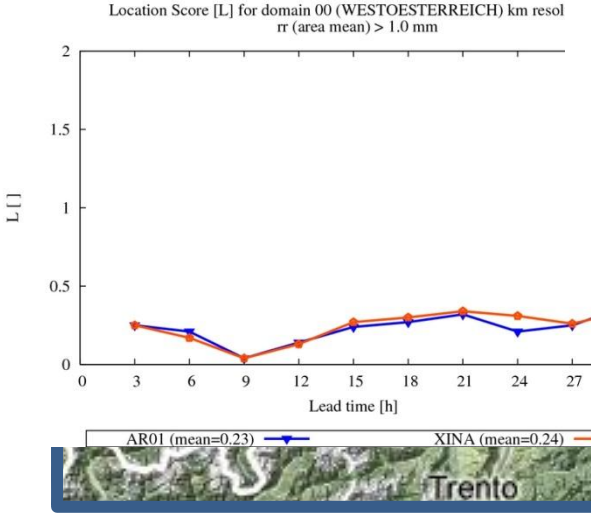
Location score > 1.0mm (0515-0701/2011) 00run

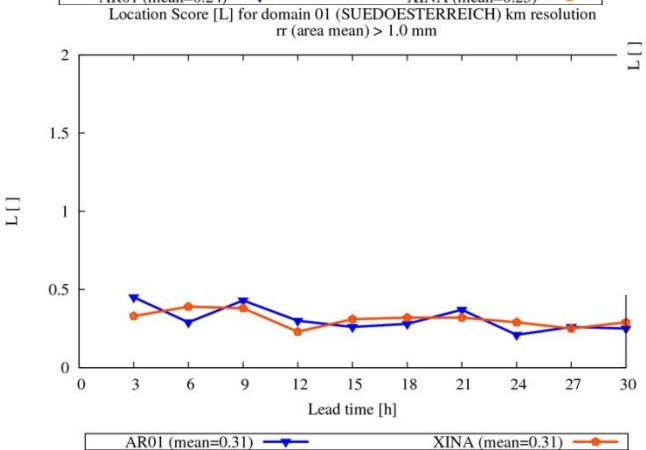


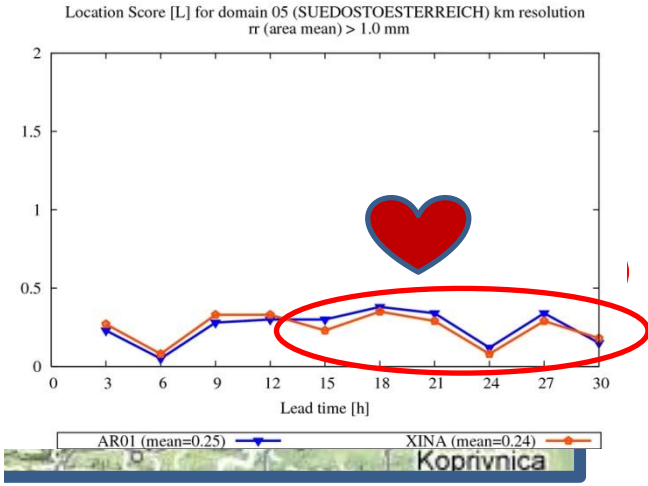


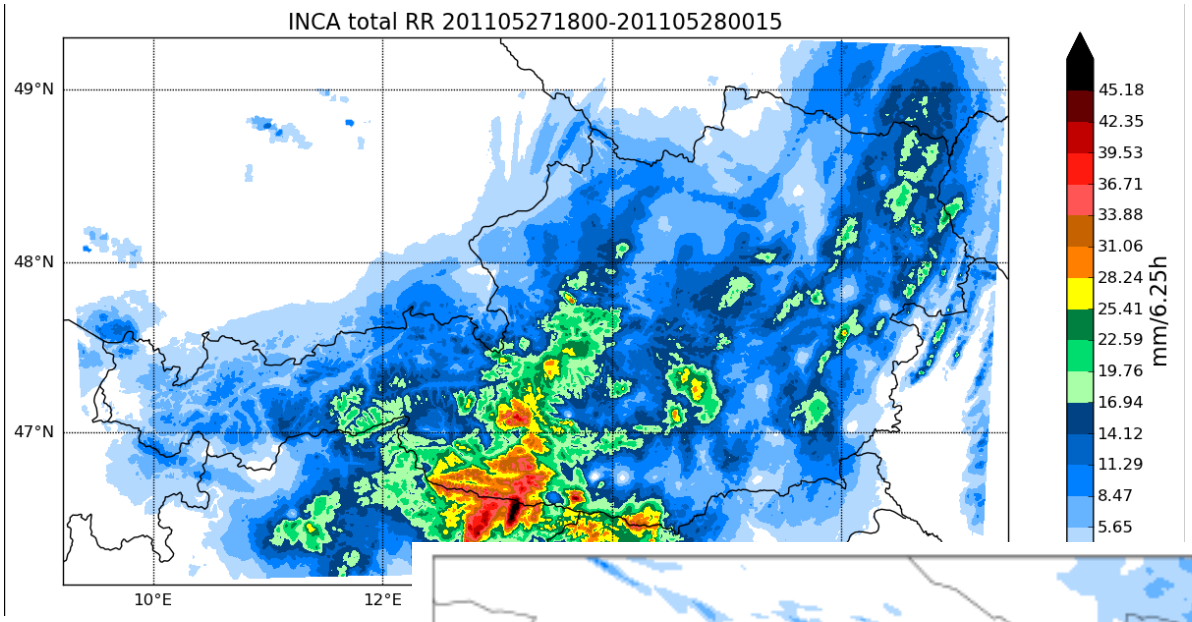




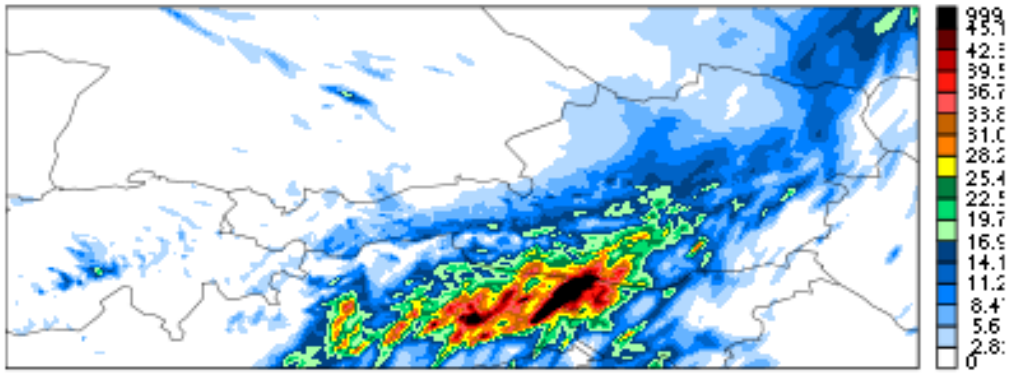




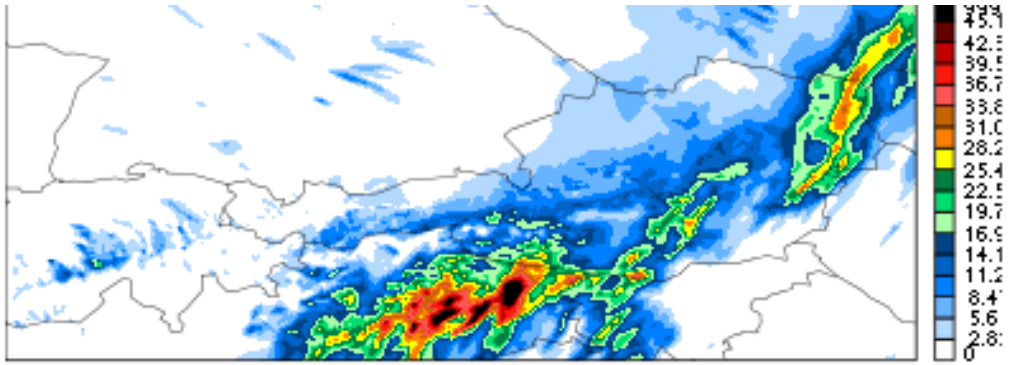




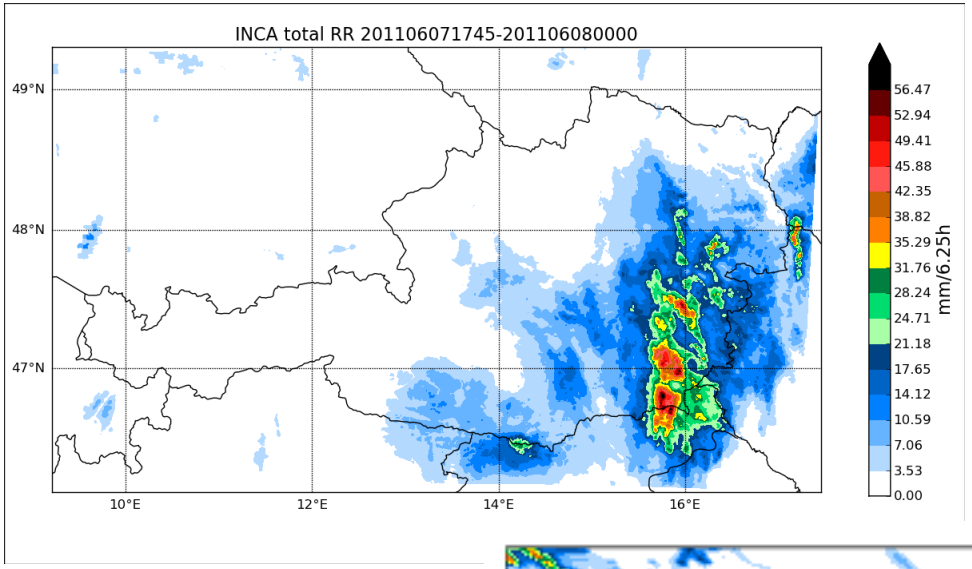
Example location score:
2011/05/27/18-
05/28/00
6h accumulated rainfall



GPS



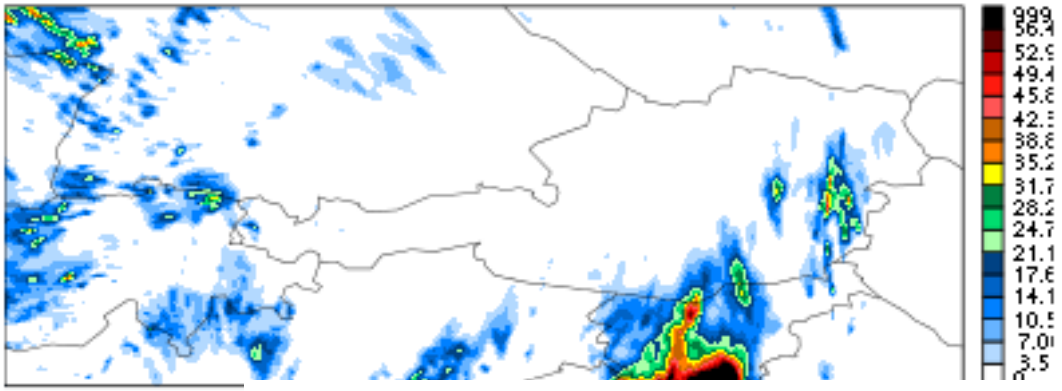
NO GPS



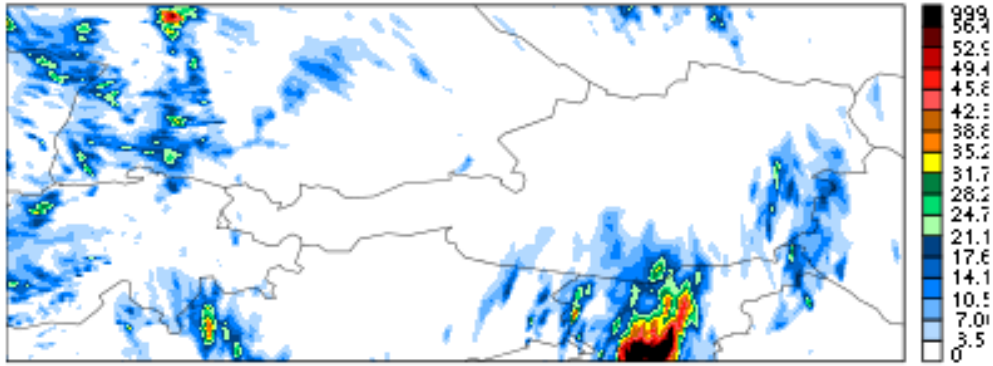
Example location score:
2011/06/07/18-
06/08/00
6h accumulated rainfall

Front passing from south to north

GPS



NO GPS



SAL results summary

- For northeast (wien)/middle part, the A/S/L are generally good, espeically North for 24h accumulated rain, scores all positive.(most precipitation system coming from west/south direction,where there is GPS station on the way before it reaches middle/northeast part).

- For A/S/L/12UTC run score, there is a general trend of improved 3-6h rain forecast. This showed a good forecast in the summer afternoon rainfall(12UTC-18UTC).

- Both 00/12 run showed a positive increase of rainfall in the southeast region and a decrease of rainfall in the north region

- For 12run, location is overall improved while for 00 it is less improved.

- For 00/12, GPS tend to smooth the rainfall structure in the west alps region and peak the rainfall in the north flatland region.

Final conclusion

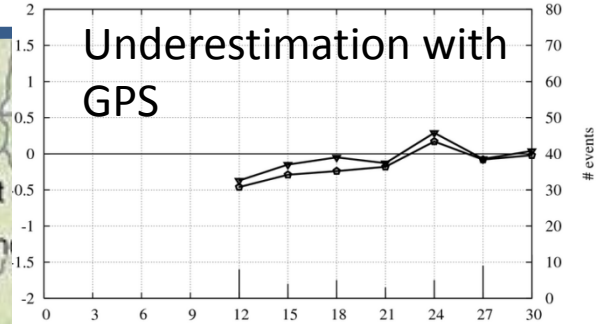
- Mid-lower troposphere moisture -> positive impact
- Surface parameter neutral impact
- Positive impact on rainfall forecasts -> afternoon convective rainfall summer time

Amplitude score > 1.0mm (0515-0701/2011)

Amplitude Score [A] for domain 02 (NORDOESTERREICH) at 02 km resolution

rr (area mean) > 1.0 mm

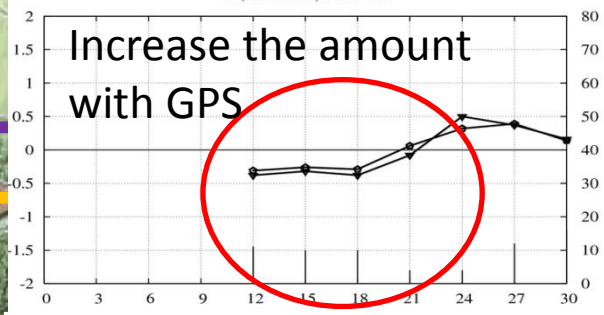
Underestimation with GPS



Amplitude Score [A] for domain 03 (OESTERREICH_MITTE) at 02 km resolution

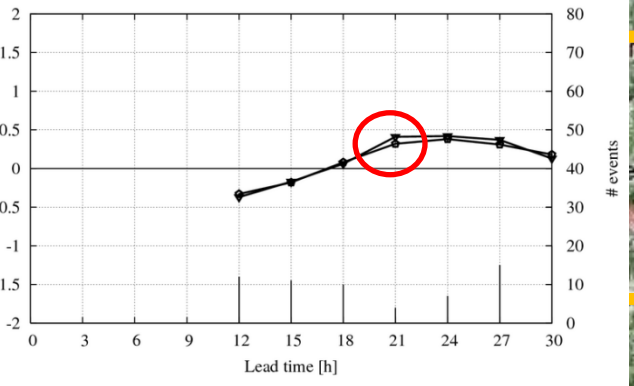
rr (area mean) > 1.0 mm

Increase the amount with GPS



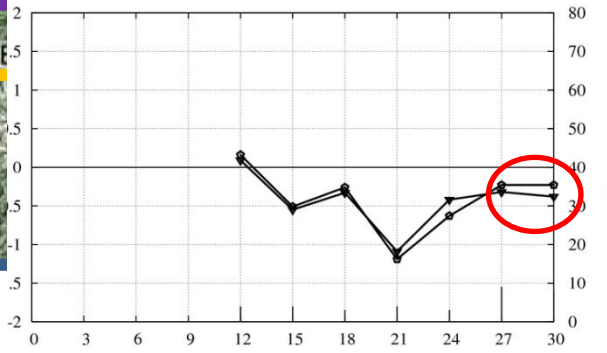
Amplitude Score [A] for domain 00 (WESTOESTERREICH) at 02 km resolution

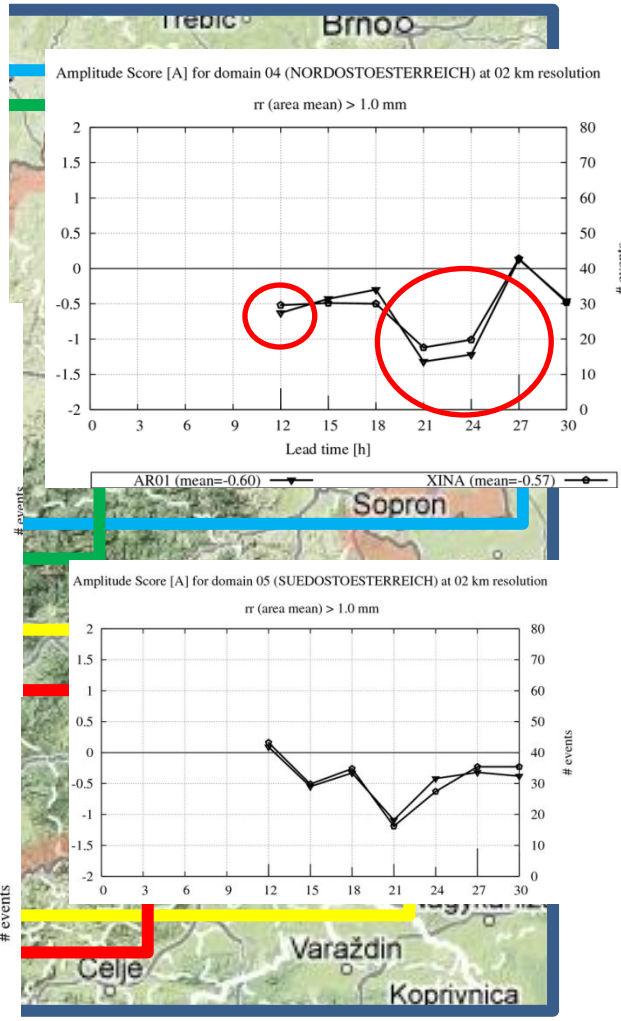
rr (area mean) > 1.0 mm



mplitude Score [A] for domain 05 (SUEDOSTOESTERREICH) at 02 km resolution

rr (area mean) > 1.0 mm





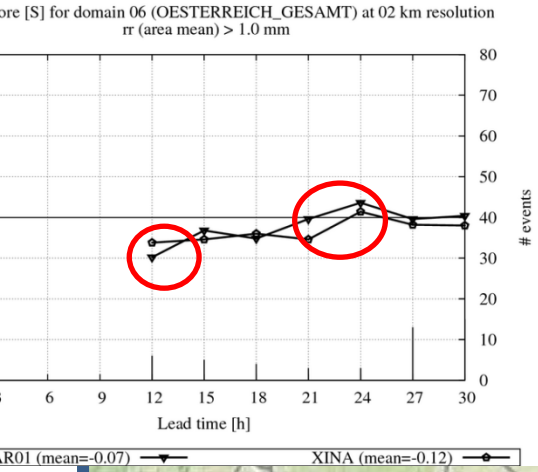
Amplitude Score [A] for domain 04 (NORDOSTOESTERREICH) at 02 km resolution

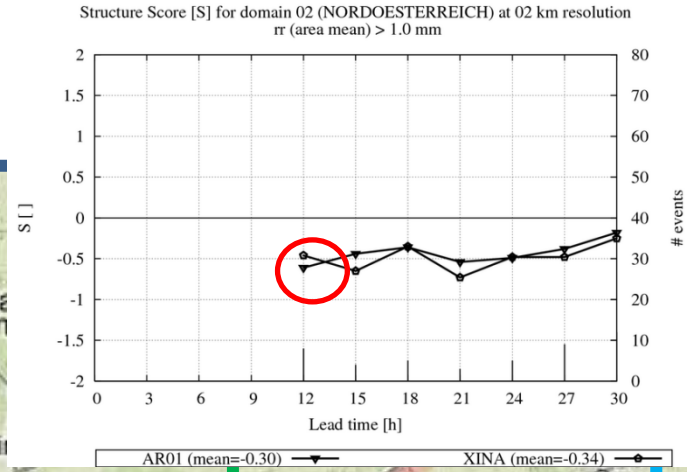
rr (area mean) > 1.0 mm

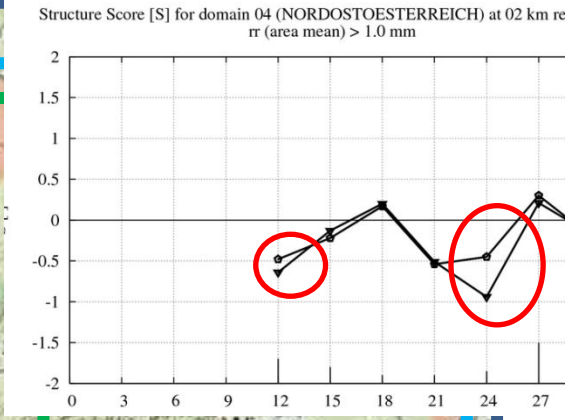
Amplitude Score [A] for domain 05 (SUEDOSTOESTERREICH) at 02 km resolution

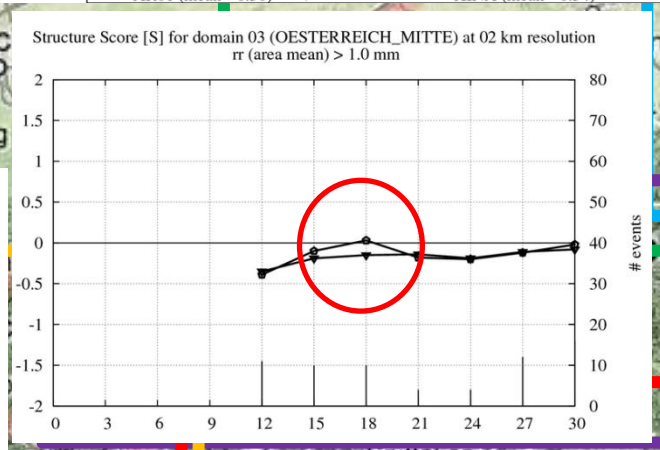
rr (area mean) > 1.0 mm

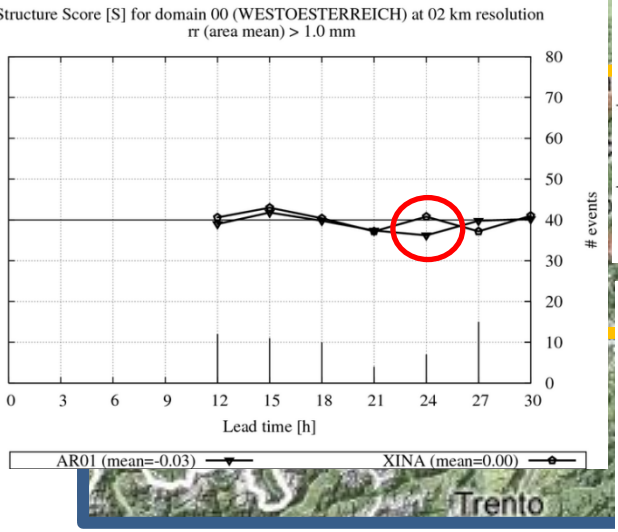
Structure score > 1.0mm (0515-0701/2011)

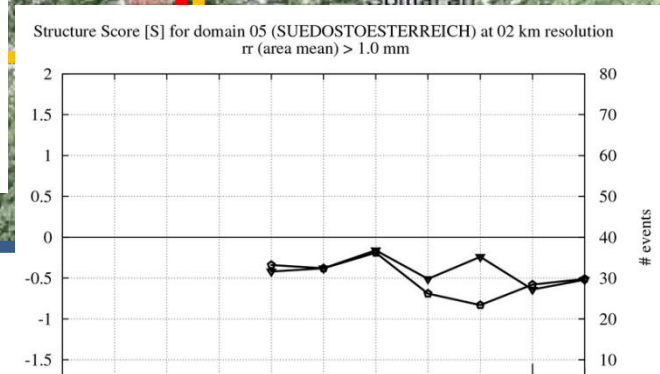


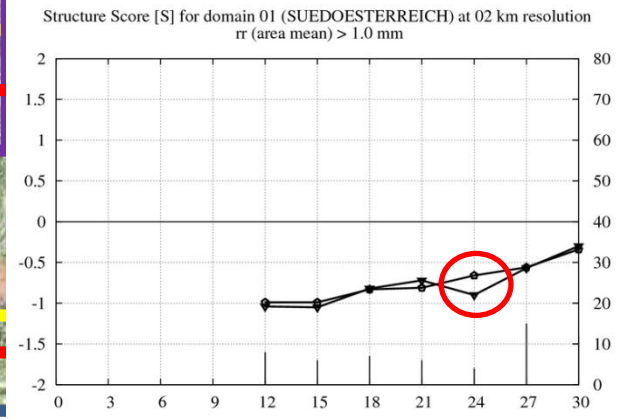












Location score > 1.0mm (0515-0701/2011)