# Assessing impact of SEVIRI water vapour channels in All-Sky conditions in AROME

4th ACCORD All Staff Workshop, Norrköping

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In collaboration with universität wien, imgw Institut für Meteorologie und Geophysik

**Numerical Weather Prediction**
Adhithiyan Neduncheran, Florian Meier,
Christoph Wittmann, Phillip Scheffknecht

18 April 2024

# Why do All-Sky IR Assimilation?

- Increased observation coverage
- Utilize the cloud information otherwise lost in clear sky assimilation
- Cloud detection schemes aren’t needed anymore
- Full disk coverage from geostationary satellite

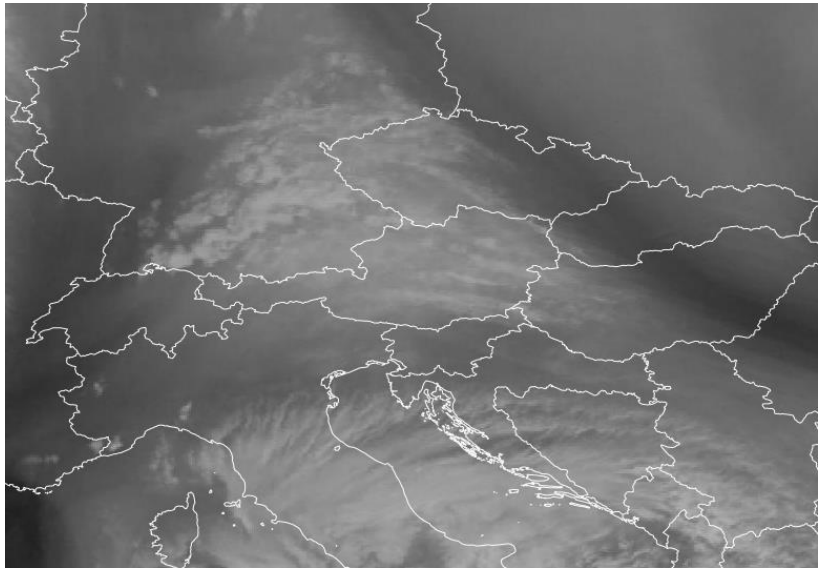


Fig. 1 : MSG-3 SEVIRI WV 6.2µm, 8th May 2023 12 UTC
*Source: EUMETSAT*

# SEVIRI is peaking in the atmosphere at...

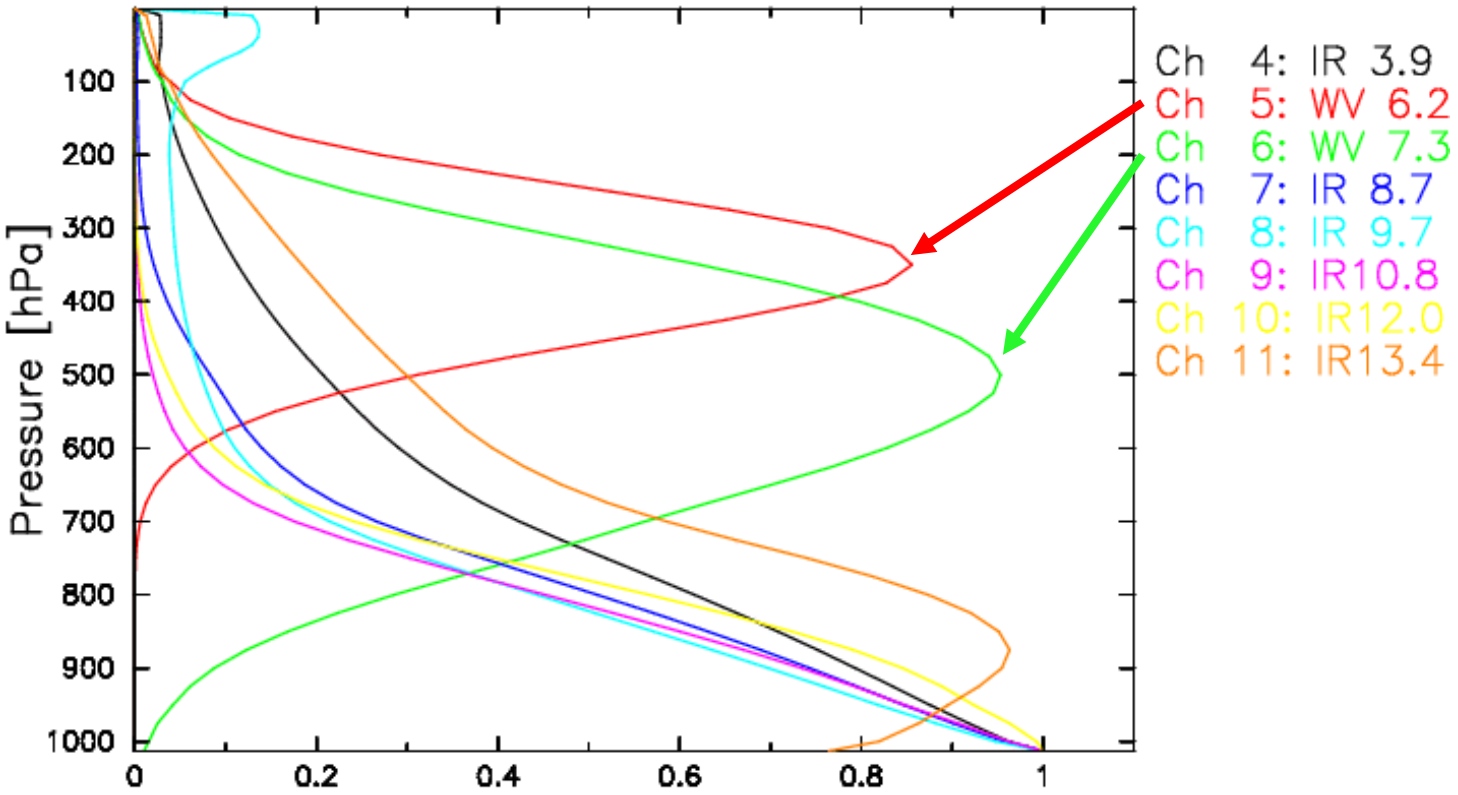



Fig. 2: Normalized weighting function

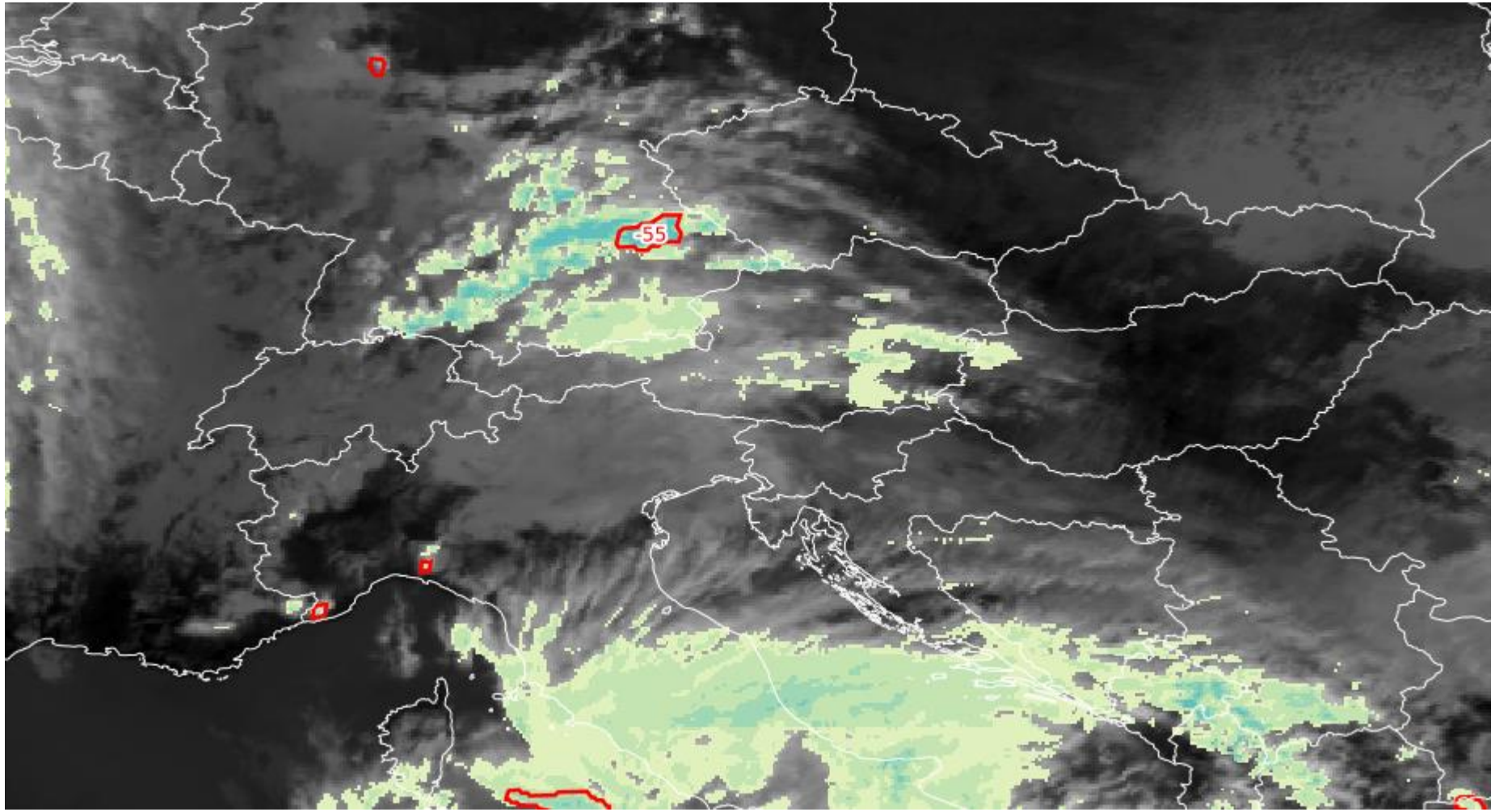



Fig. 3 : SEVIRI WV 6.2 µm+ other products sandwhiched, 8th May 2023, 12:00 UTC. *Source: EUMETSAT*

# AROME-Austria model details

| | Details |
|---|---|
| Model Version | CY48T1op1 |
| Framework | OOPS |
| Resolution | 2.5 km |
| Levels | 90 |
| Assimilation window | -90min - +90min |
| Area / centered over | 600x432 /Alpine region |
| LBC Model | IFS HRES |
| RTTOV (radiative transfer model) | RTTOV v12.2 |

Table 1: AROME-Austria model setup

Please check Austria‘s National poster to know more!

| Experiment | Details |
|---|---|
| CNTL | Conventional observations data assimilation, no satellite radiances |
| CSR | CNTL + Clear Sky Radiances |
| ASR | CNTL + All-Sky Radiances ; thinning distance = 25 km |
| ASR1 | ASR with inflated observation error |
| CSR_EnVar | CSR with 50 ensemble members |
| ASR_EnVar | ASR with 50 ensemble members + hydrometeors |
| ASR1_EnVar | ASR1 with 50 ensemble members + hydrometeors |

Table 2: List of experiments

# Satellite observation into AROME-Austria domain

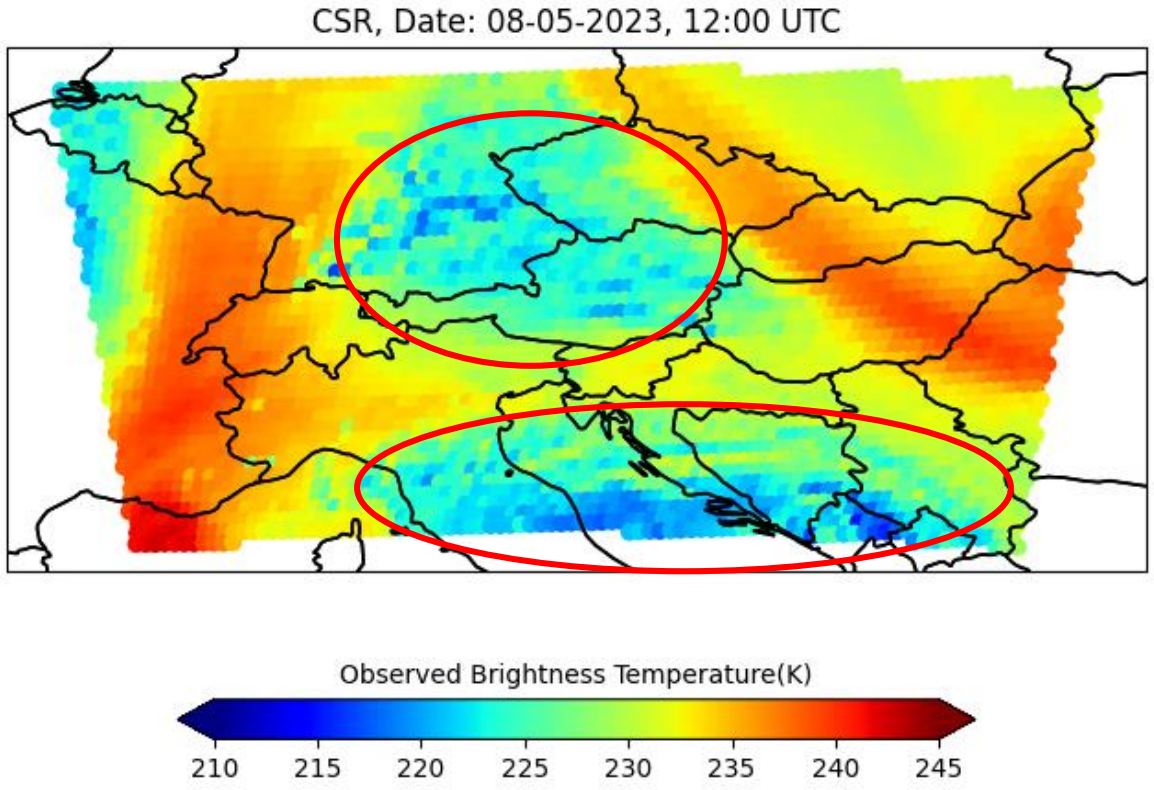



Fig. 4. SEVIRI WV 6.2 µm Observations in AROME-Austria domain

# In the end of minimization

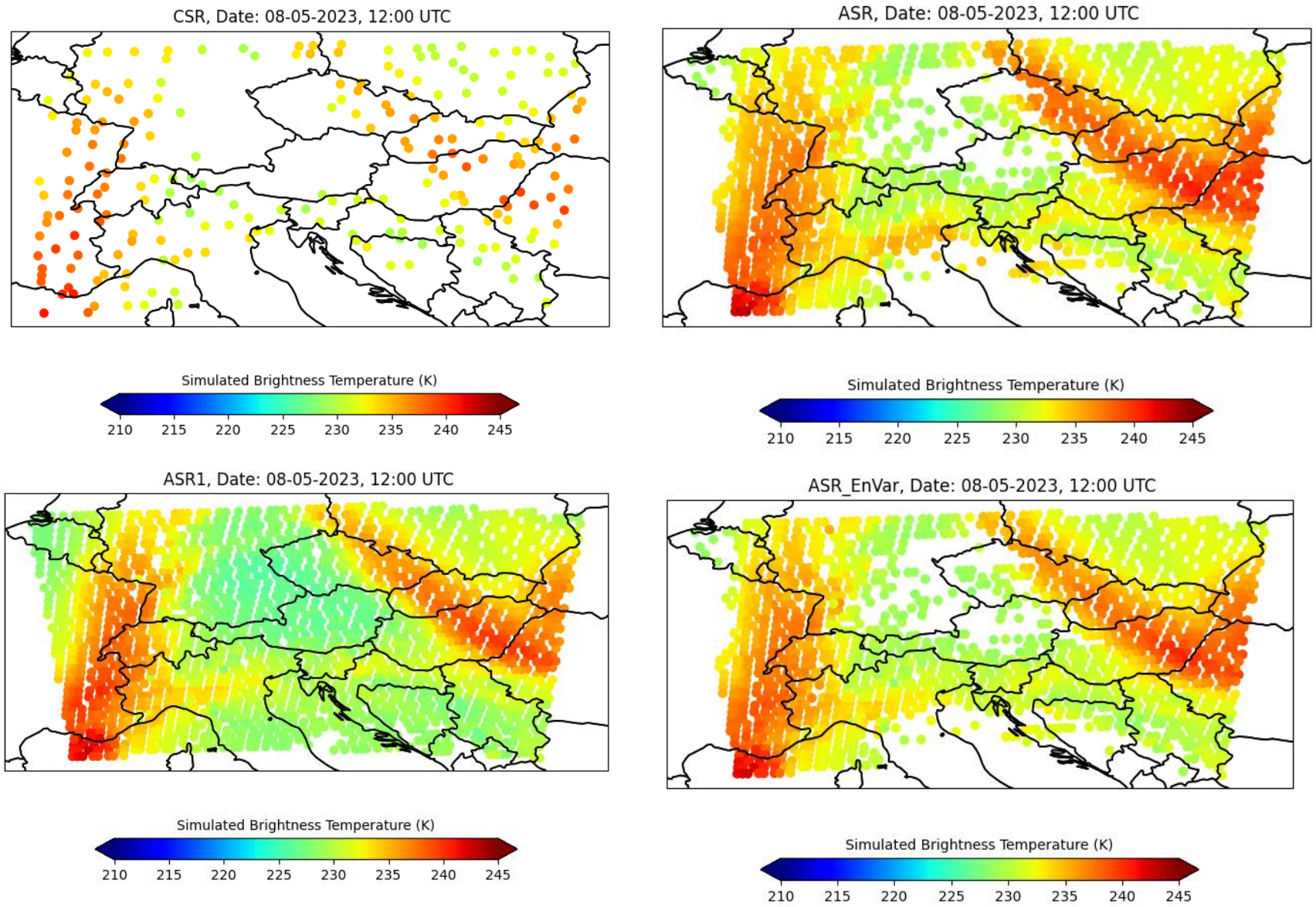



Fig. 5: Simulated brightness temperature(s) in four different experiments

| Experiment | Data count |
|---|---|
| CSR | 410 |
| ASR | 3026 |
| ASR1 | 3849 |
| ASR_EnVar | 3026 |

Table 3a: Observation statistics

# In the end of minimization

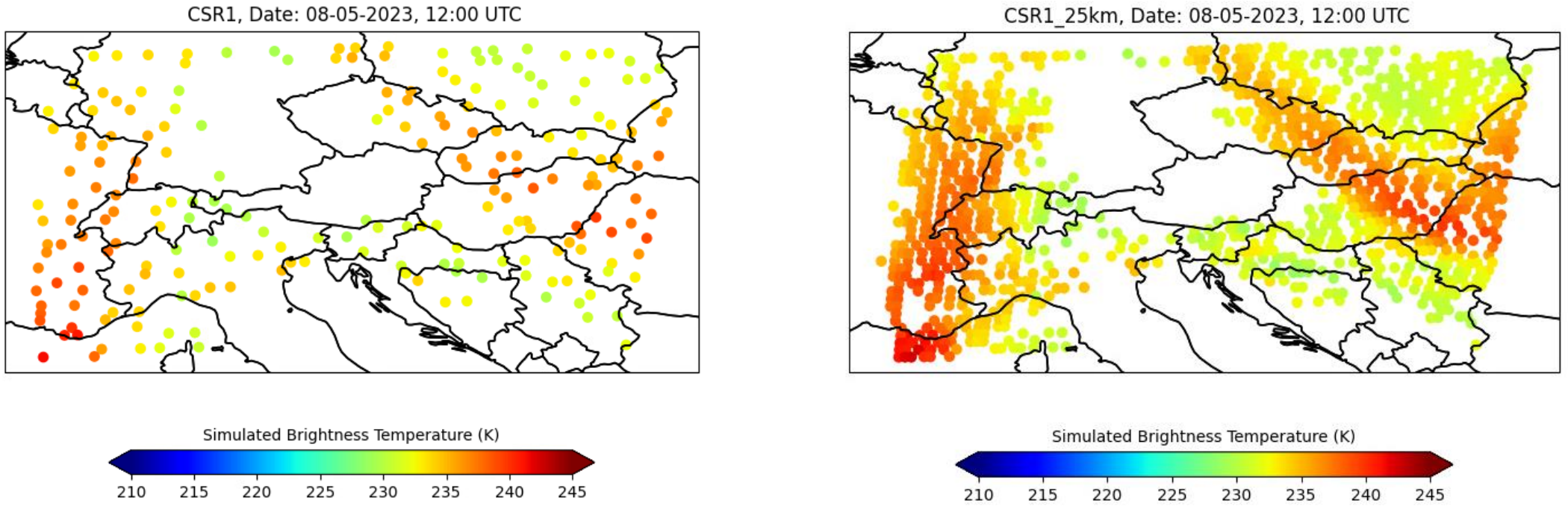



Fig. 6: Simulated brightness temperature(s) in four different experiments

| Experiment | Data count |
|---|---|
| CSR | 410 |
| ASR | 3026 |
| ASR1 | 3849 |
| ASR_EnVar | 3026 |
| CSR1 | 422 |
| CSR1_25km | 2035 |

Table 3b: Observation statistics

# Departures

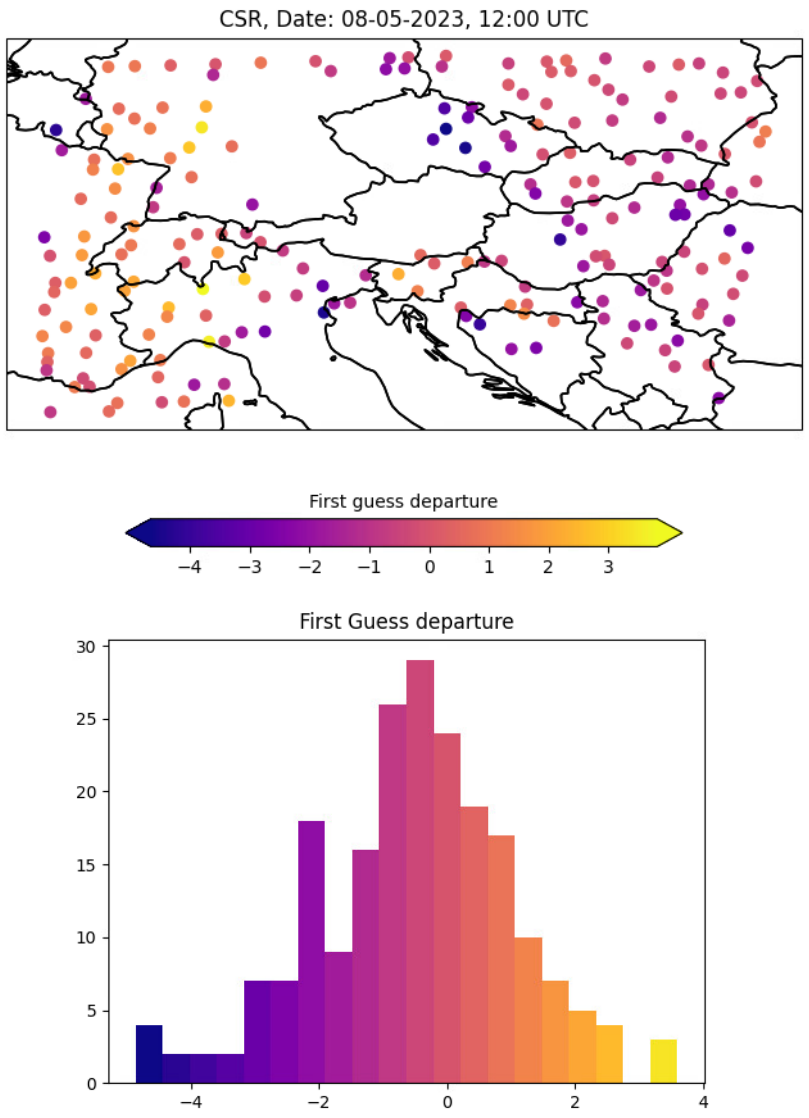



Fig. 6a: FG departure & it‘s histogram

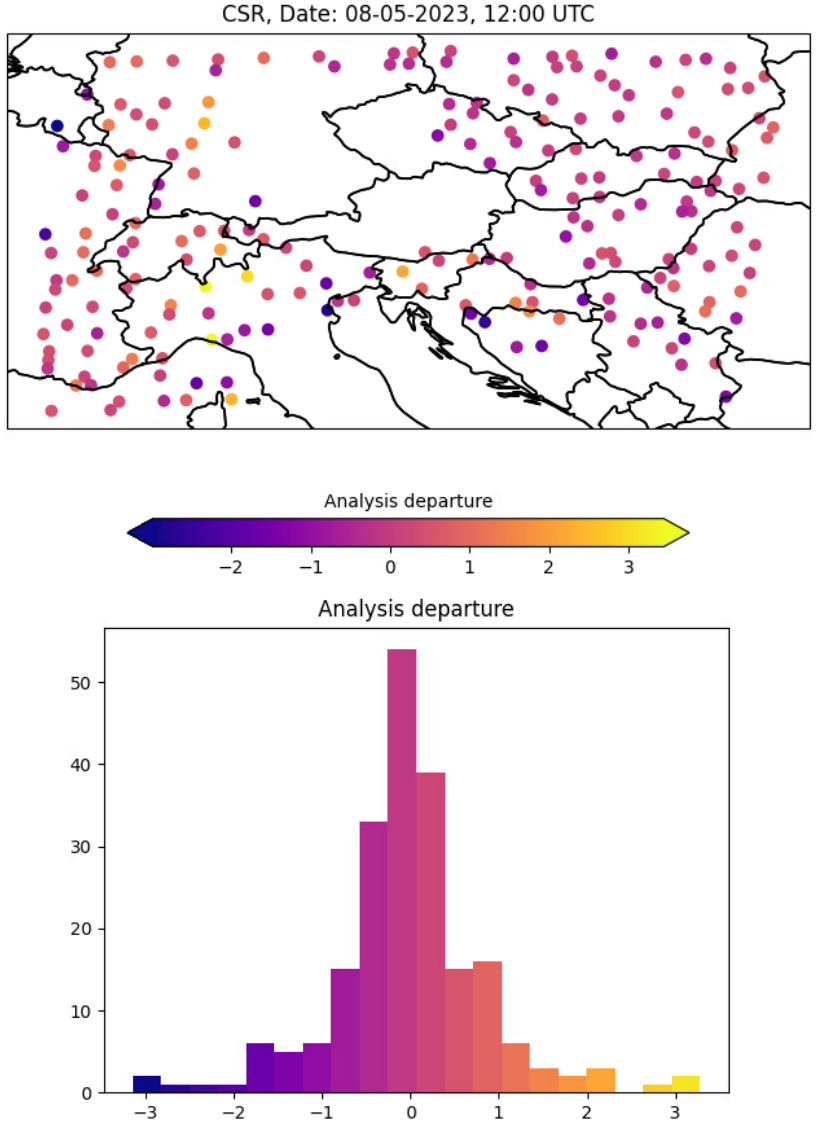



Fig. 6b: Analysis departure & it‘s histogram

# Departures

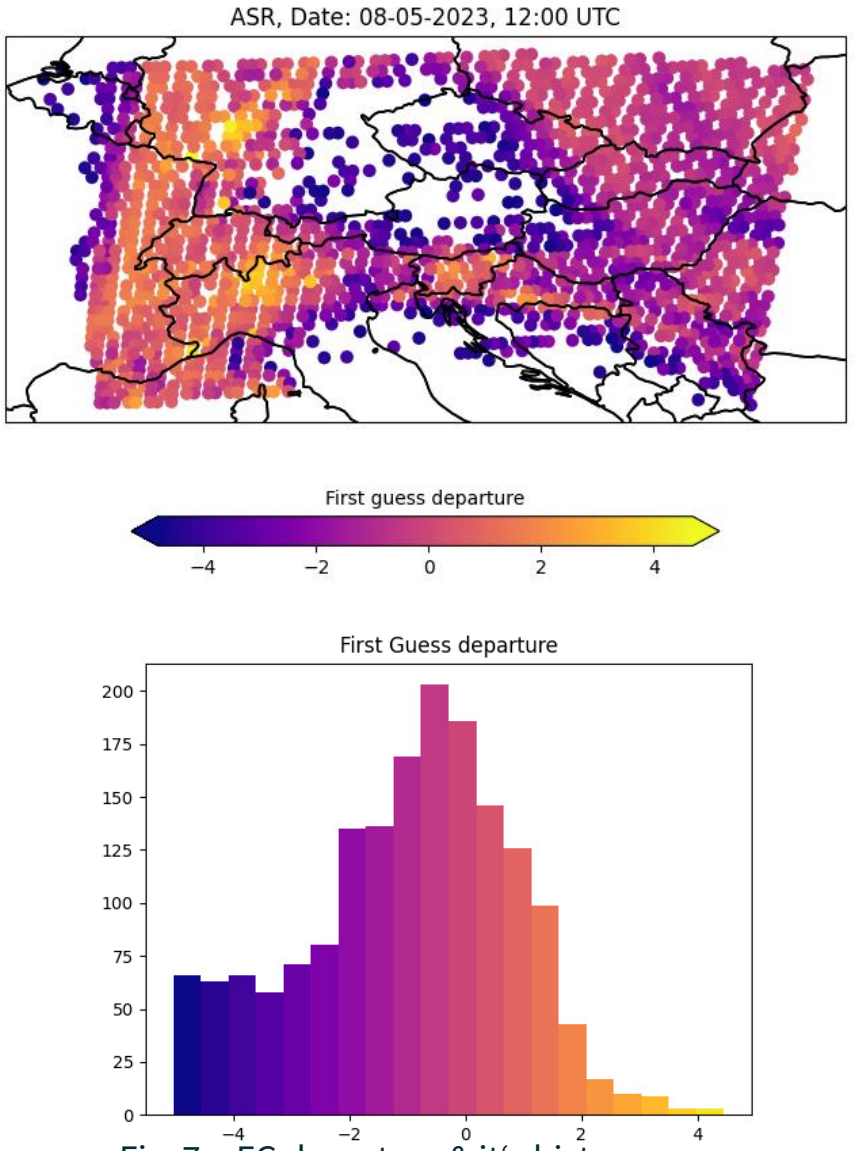



Fig. 7a: FG departure & it‘s histogram

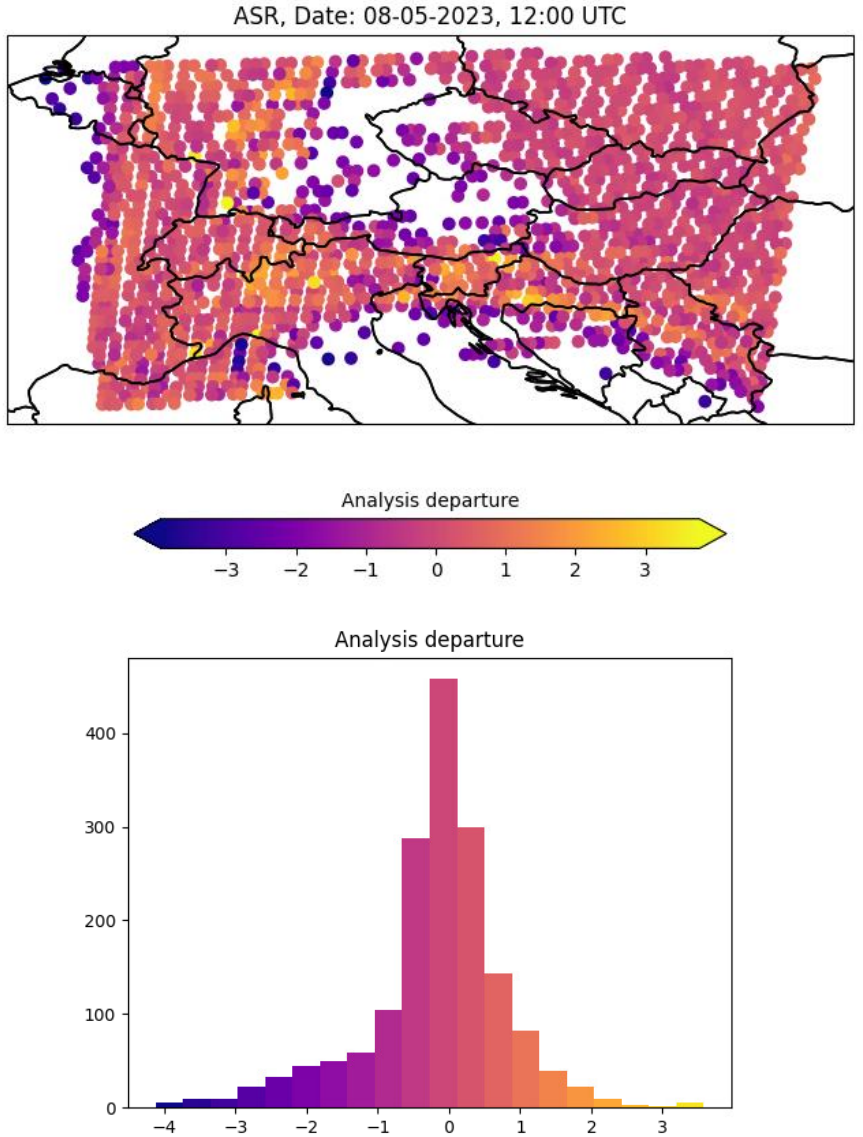



Fig. 7b: Analysis departure & it‘s histogram

# Departures

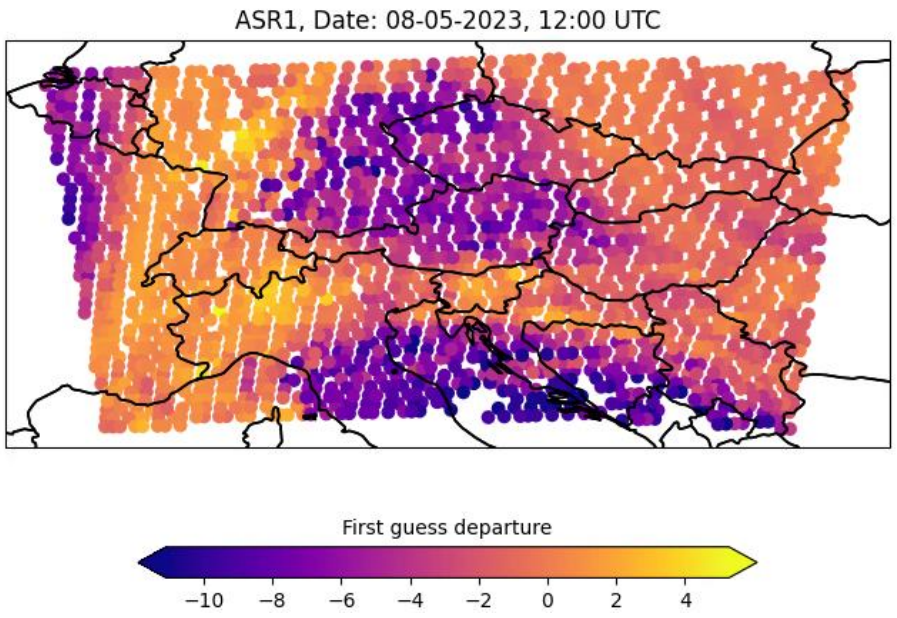



Fig. 8a: FG departure & it‘s histogram

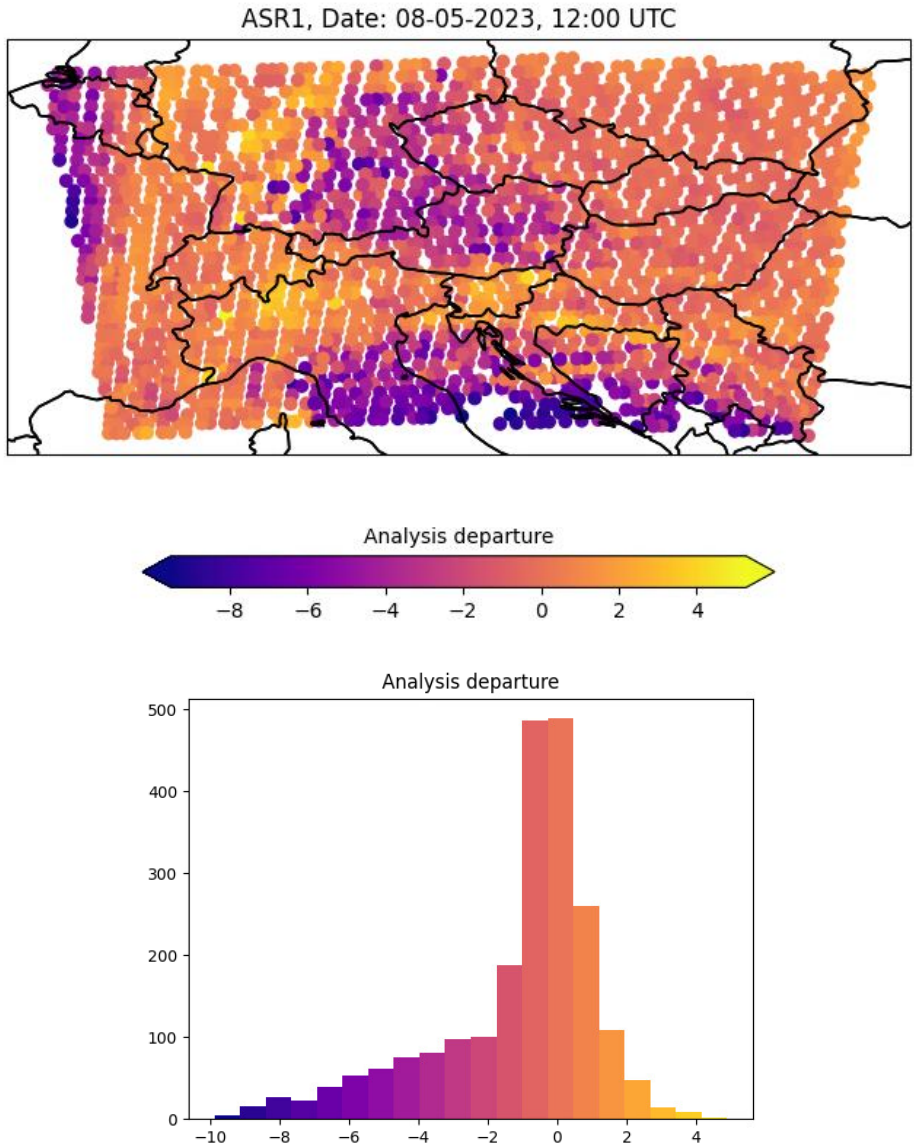



Fig. 8b: Analysis departure & it‘s histogram

# Observation error model

the cloud property itself. We developed a new parameter called the cloud effect average ($C_A$):

$$C_A = (|C_M| + |C_O|)/2,$$

where $C_M$ and $C_O$ are cloud effect on model and observation, respectively, written by

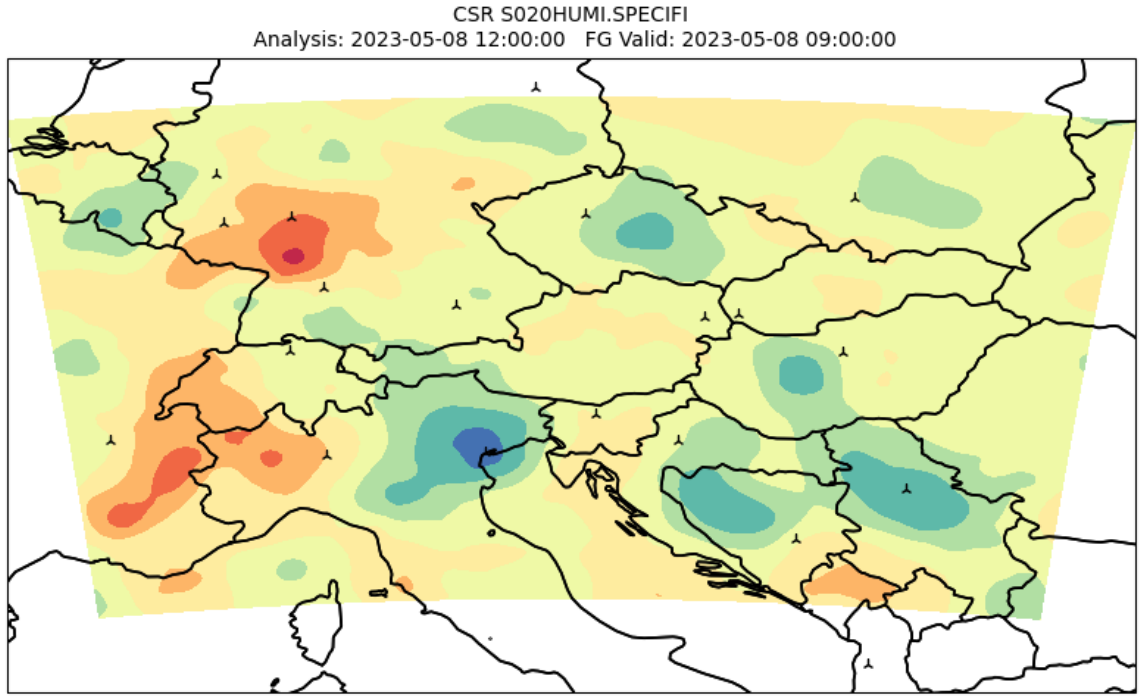
$$C_M = B - B_{clr},$$
$$C_O = O - B_{clr},$$

$O$ and $B$ are observed and simulated BTs, respectively. $B_{clr}$ is clear-sky background BT when the cloud-scattering calculation is switched off in RTTOV. $C_A$ increases as observation and all-sky

(Grabbed from *Okamato et al.*2013)

Thus if errors are treated correctly, all-sky observations can be assimilated successfully under the assumption of Gaussianity on which assimilation systems are based.

# Increment in specific humidity ~350hPa (Analysis – First guess)



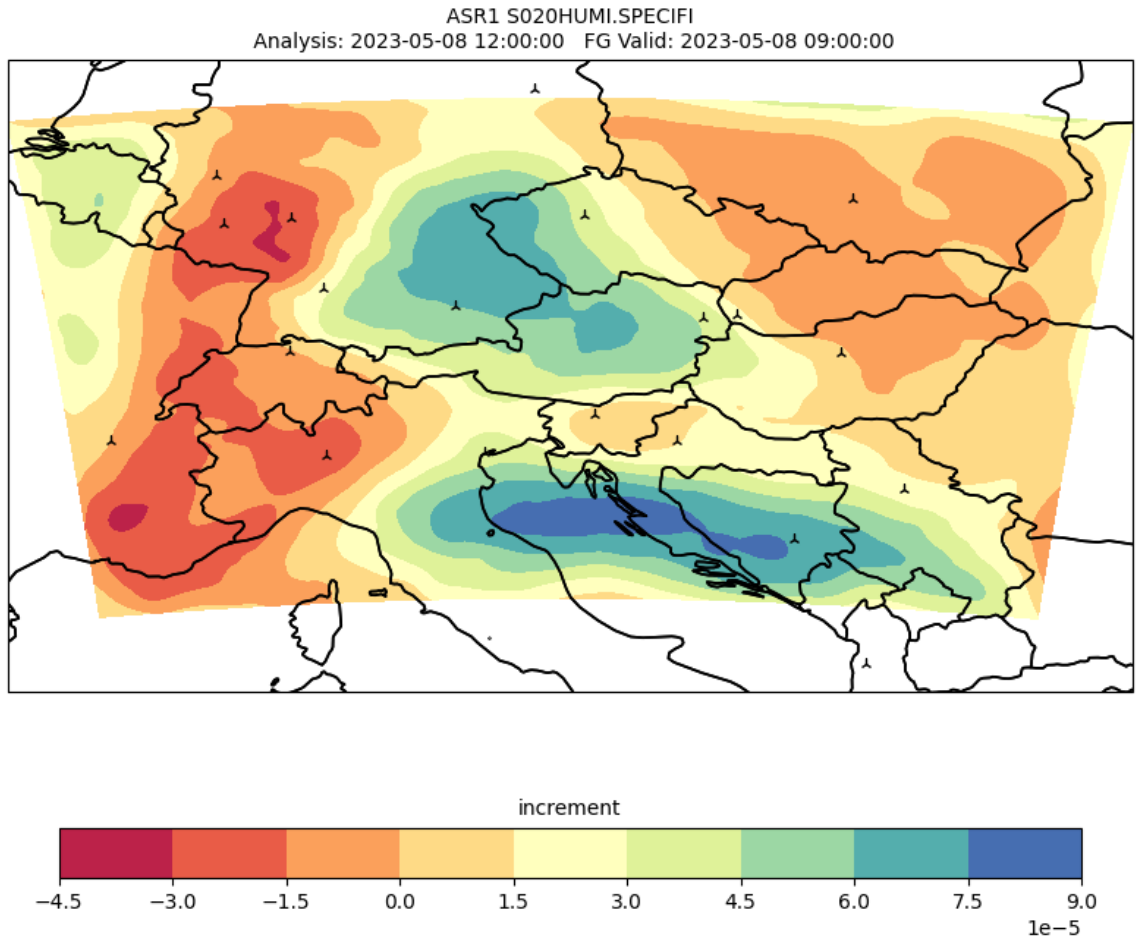
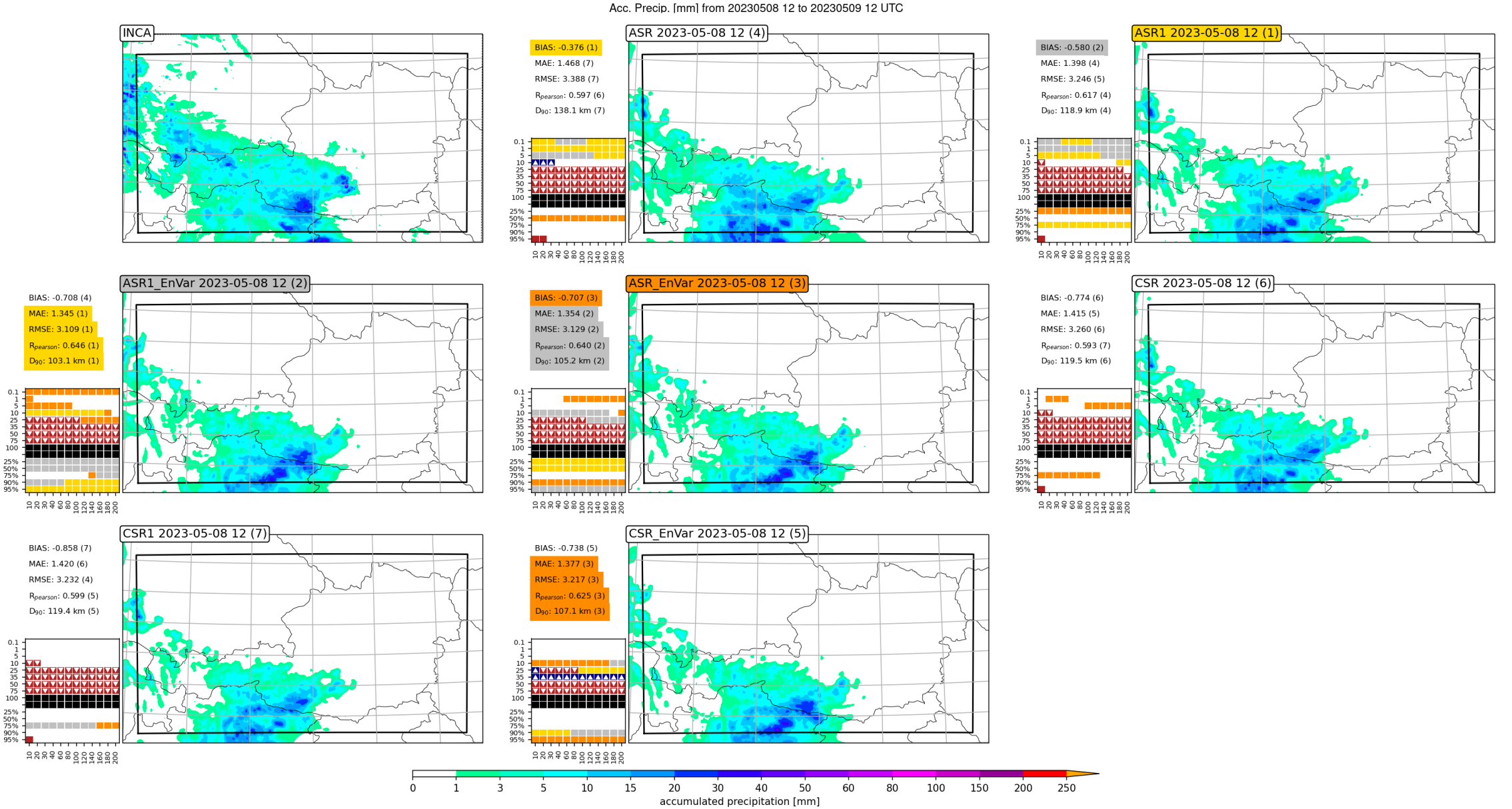
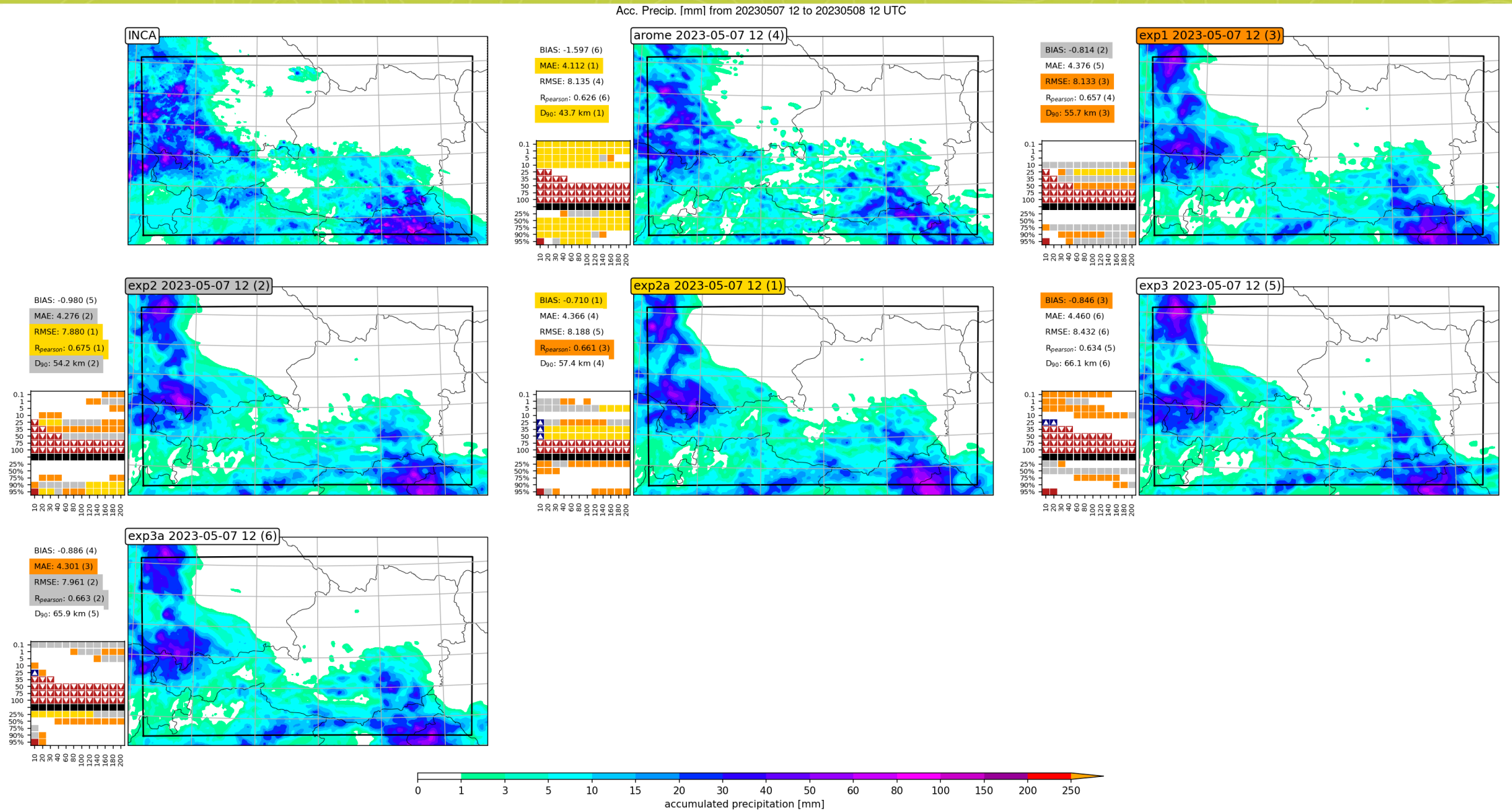




Fig. 9: Increment(s) in specific humidity in CSR and ASR1

# Forecast verification using panelification



# Forecast verification using panelification



# It’s work in progress…

# next sTOP…

Assimilation of SEVIRI VIS0.6 in AROME-Austria

GeoSphere Austria

# DANKE

**Numerical Weather Prediction**
Adhithiyan Neduncheran
adhithiyan.neduncheran@geosphere.at

# HARP verification (Clear-Sky case)

## HARP spatial verification

**SQLite file:**

/ment_arch2/aneduncheran/HARP/harpSpatial_example/SQLITE_VERI | OK

**Period**

Custom

**Date range:**

2023-05-07 to 2023-05-07

**Parameter**

AccPrec3h

**Lead time**

3

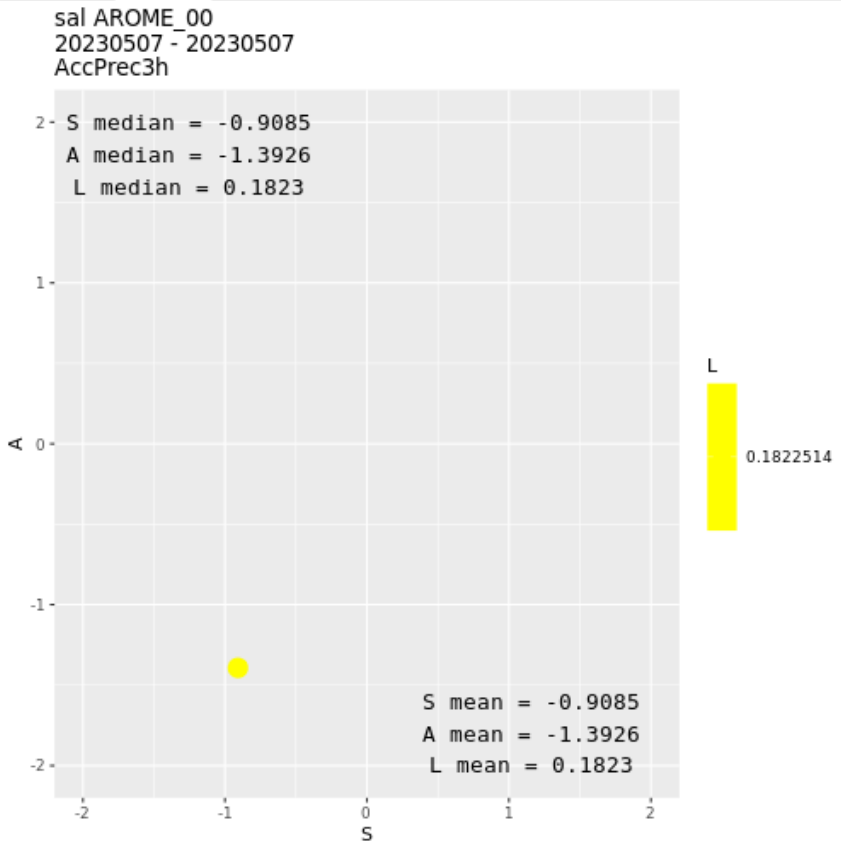
**Model**

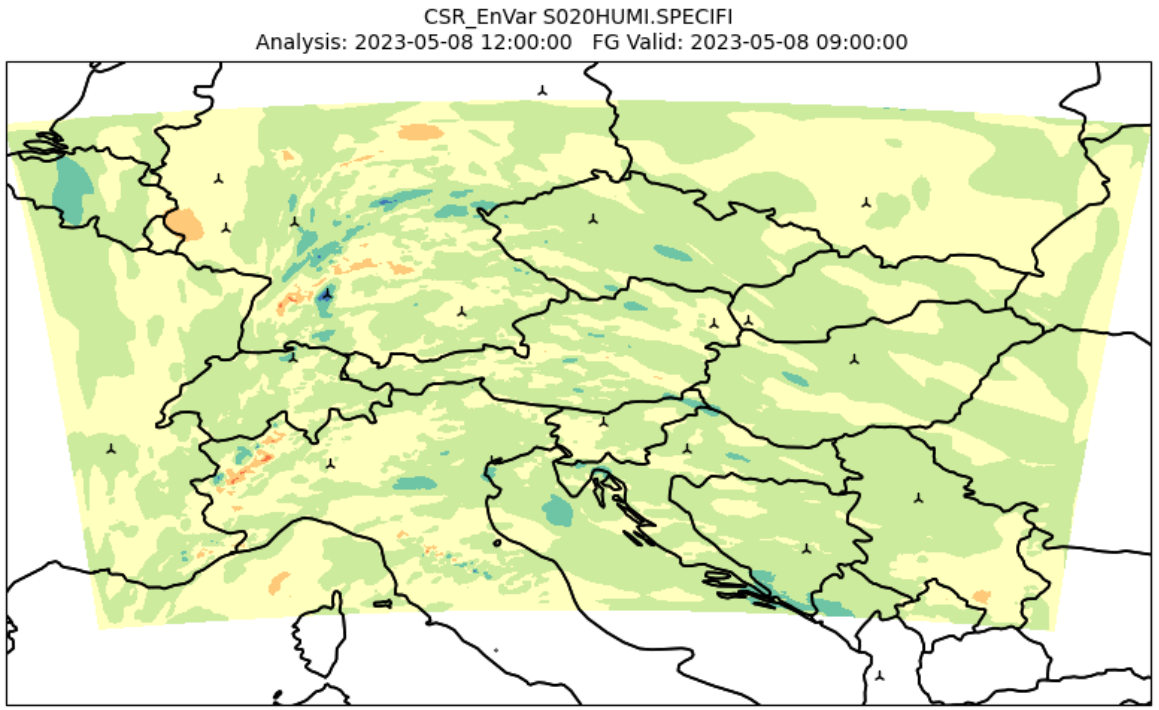
AROME_00

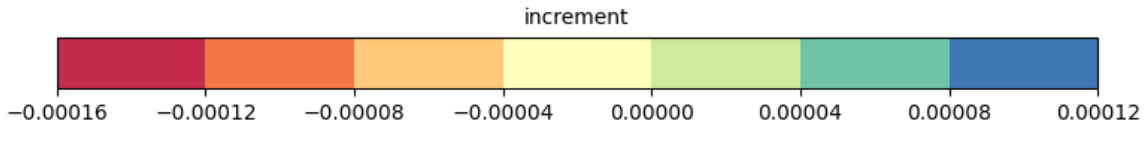
**Fcst time**

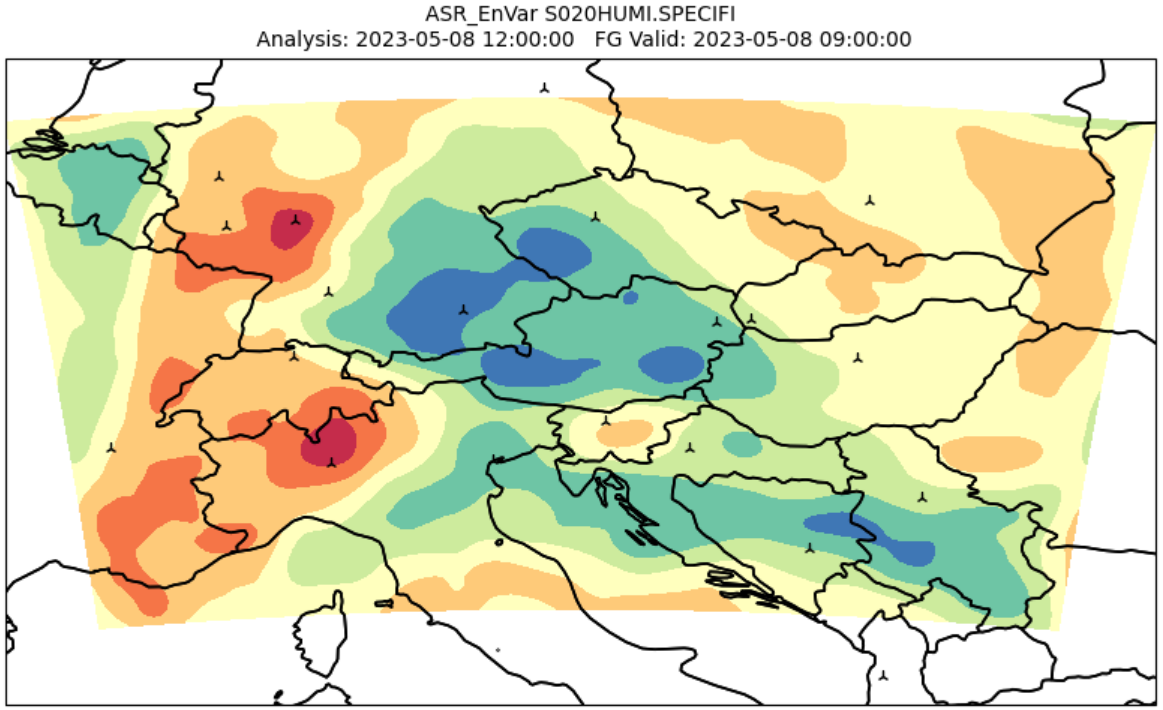
12

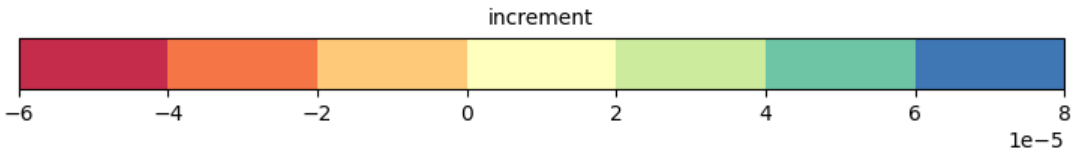
fuzzy | SAL



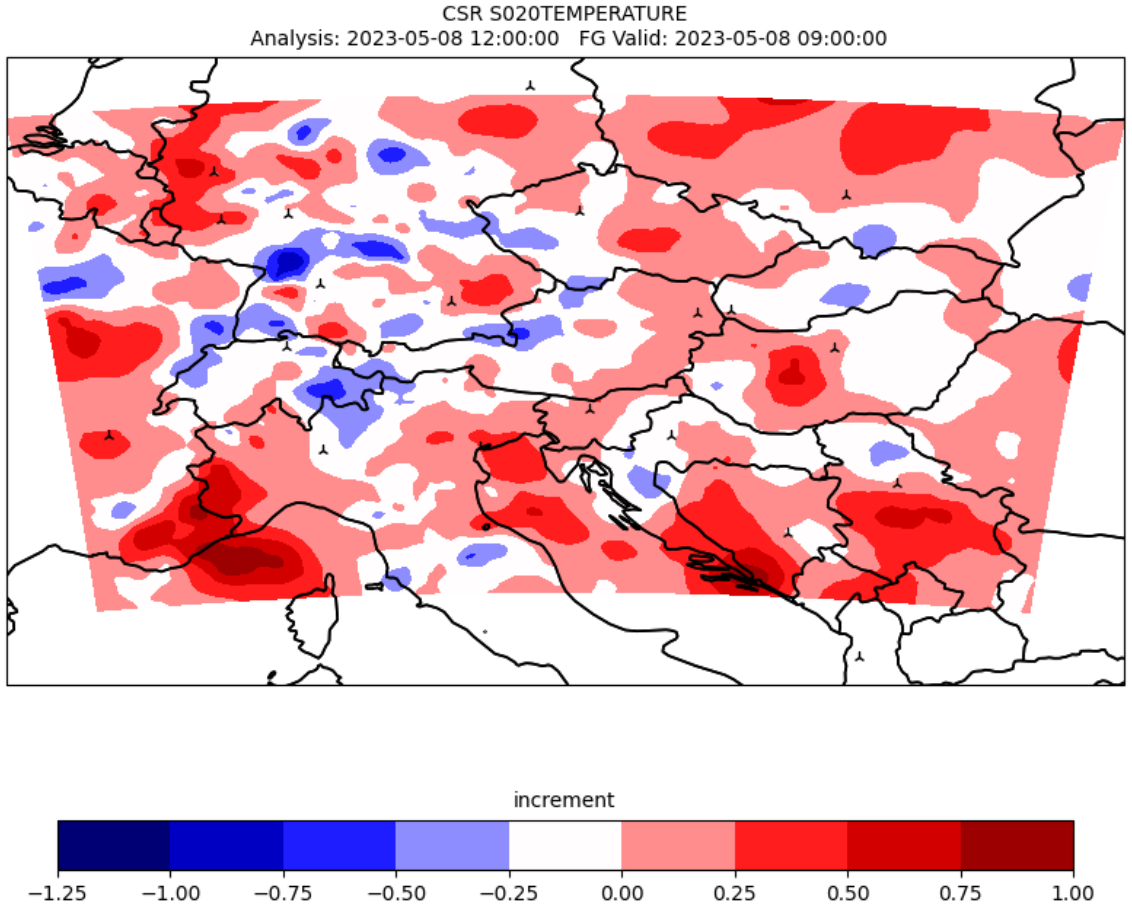

CSR_EnVar S020HUMI.SPECIFI
Analysis: 2023-05-08 12:00:00 FG Valid: 2023-05-08 09:00:00

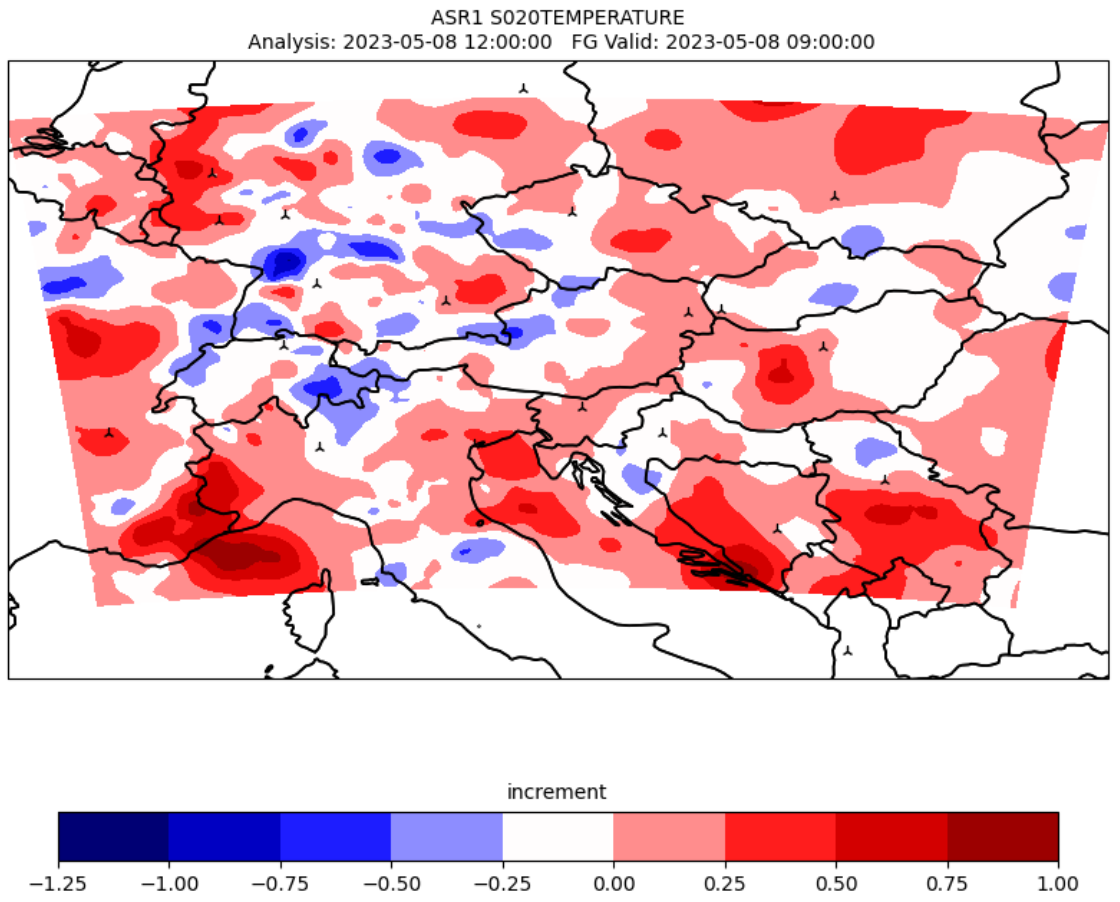

increment
−0.00016
−0.00012
−0.00008
−0.00004
0.00000
0.00004
0.00008
0.00012


ASR_EnVar S020HUMI.SPECIFI
Analysis: 2023-05-08 12:00:00 FG Valid: 2023-05-08 09:00:00

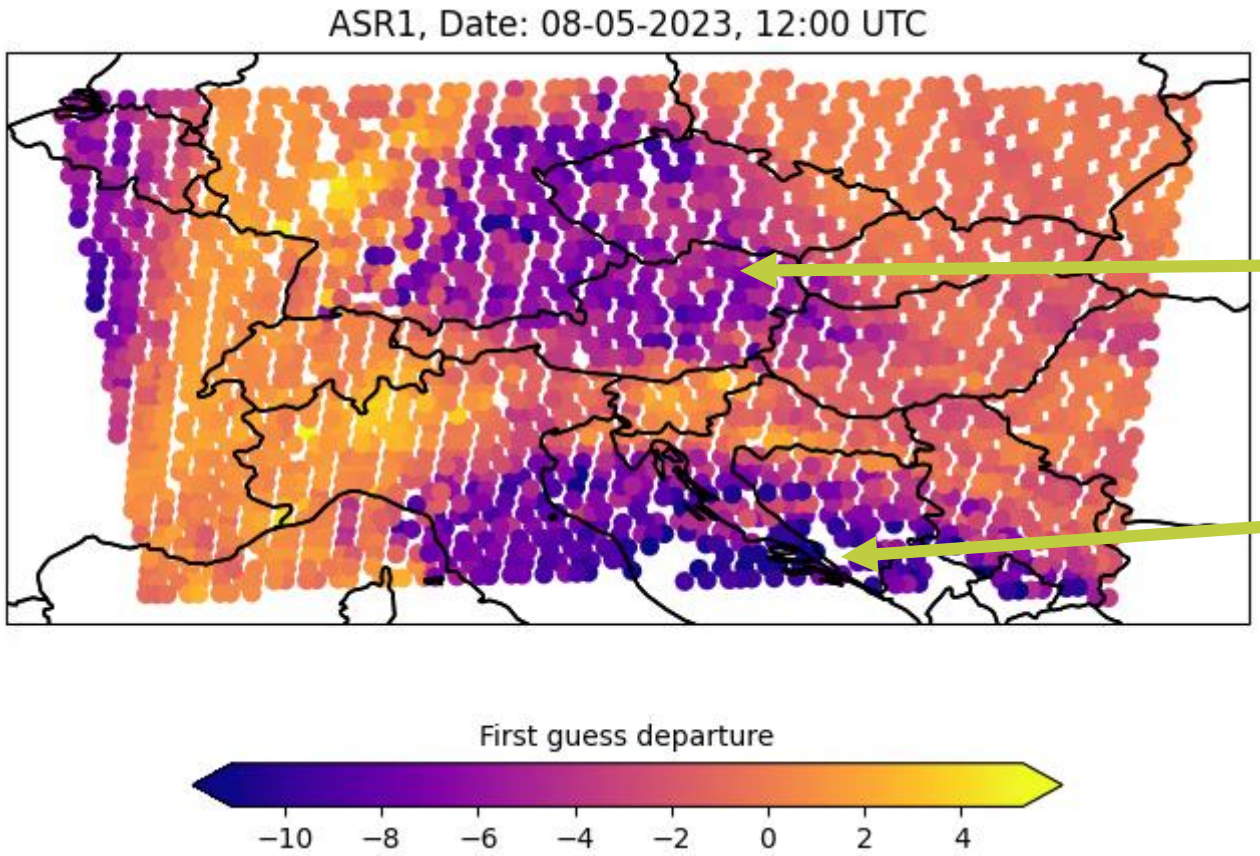

increment
−6
−4
−2
0
2
4
6
8
1e−5

# Increment in temperature ~350hPa (Analysis – First guess)



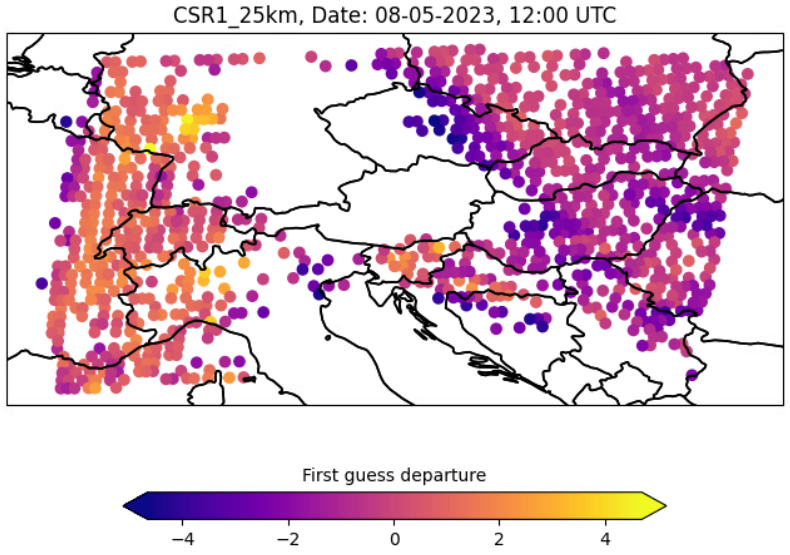



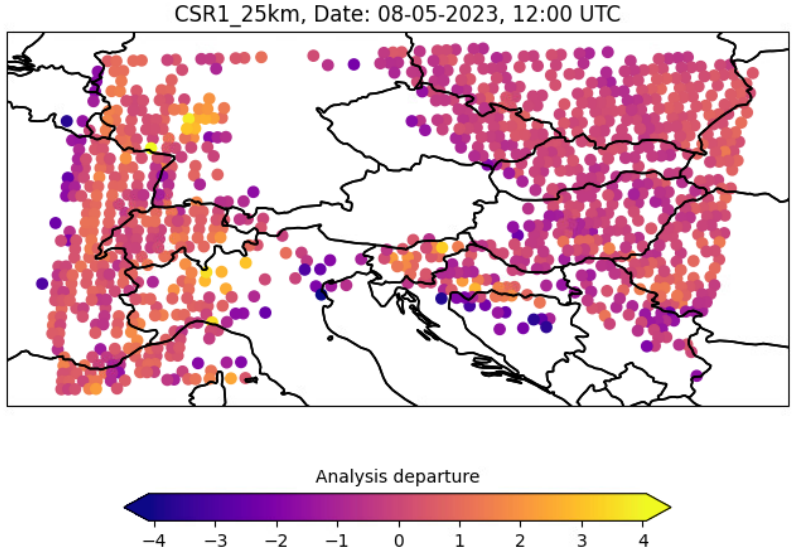
# Properties of All-Sky background departures

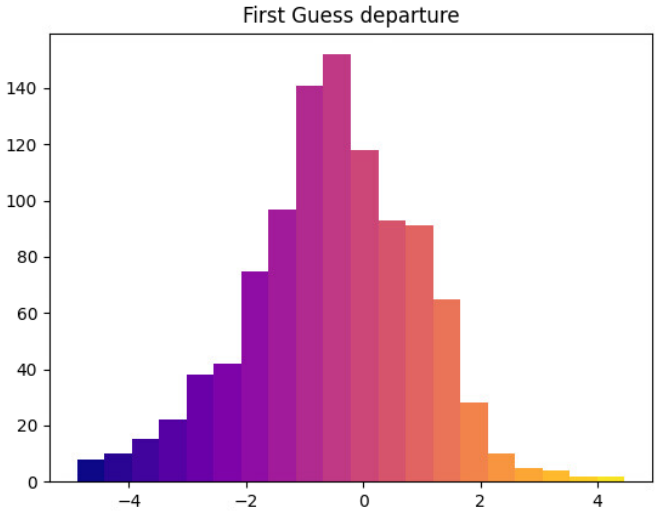


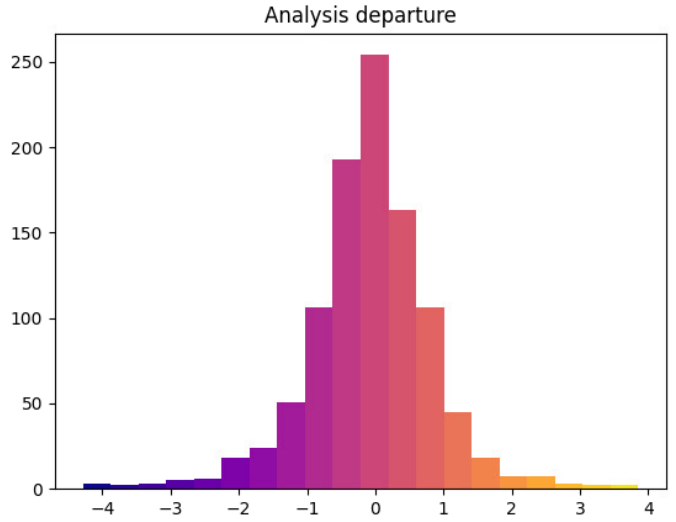

Spatially correlated

Much bigger in presence of clouds than in clear sky


CSR1_25km, Date: 08-05-2023, 12:00 UTC
First guess departure
−4
−2
0
2
4


CSR1_25km, Date: 08-05-2023, 12:00 UTC
Analysis departure
−4
−3
−2
−1
0
1
2
3
4


First Guess departure
140
120
100
80
60
40
20
0
−4
−2
0
2
4


Analysis departure
250
200
150
100
50
0
−4
−3
−2
−1
0
1
2
3
4