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Convective precipitation in AROME

- **Introduction**
- **Model and data**
- **Case studies**

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HIRLAM/ALADIN All-Staff Meeting
met.no, Oslo, Norway
23 - 26 April 2007

Introduction

- FMI, SMHI and DMI have been running daily high-resolution AROME/ALADIN models.

- The quality of results have been monitored by using monthly verification statistics.

  → As good as other models (e.g. HIRLAM).

- Where do we expect to get the added value? Precipitation? Winds?

  → How does the AROME perform in convective conditions?

Models

- AROME at FMI is based on **CY30T1.**
- **2.5 km** horizontal resolution, **40** vertical levels.
- **Time step = 60 s.**
- **24 hour forecast,** twice a day (00 and 12 UTC).

- Controlled by **SMS**.

- **No deep convection parameterization. No data assimilation.**

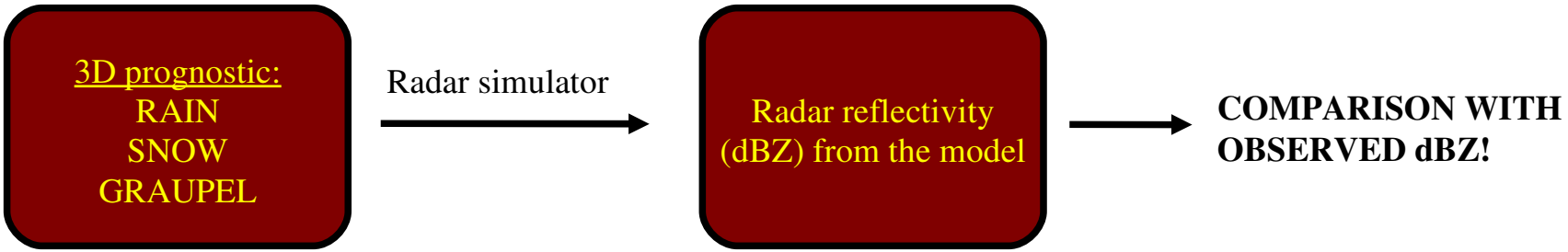
Case studies

1. Meso-scale convective systems (MCS) and frontal rain band, 10 July 2006.

2. Small-scale convection with little meso-scale organisation, 26 August 2006

→ Both qualitative and quantitative evaluation.

- Comparison with radar reflectivity!



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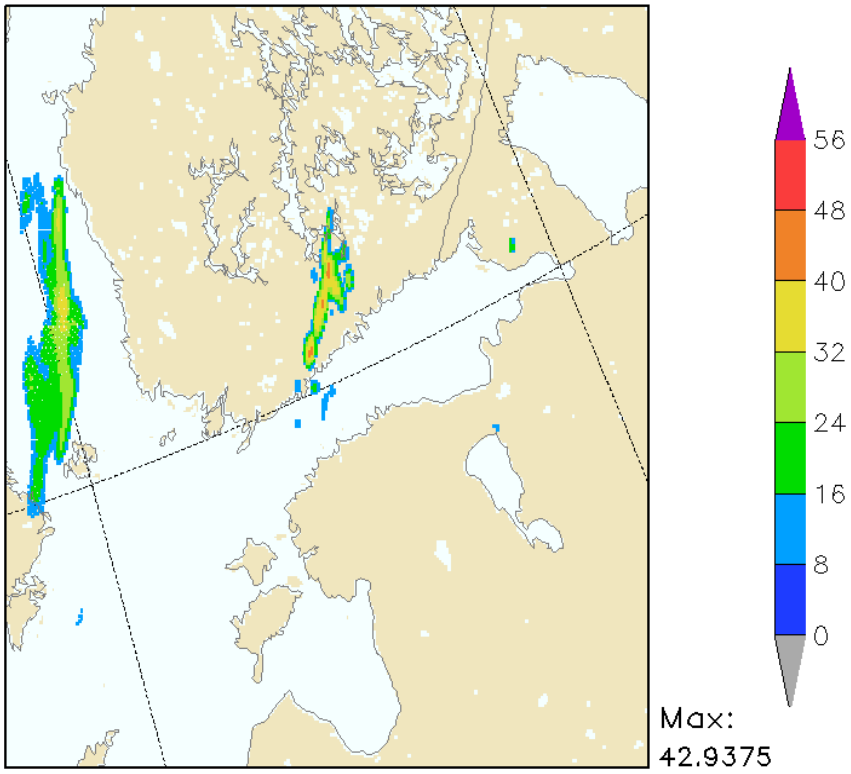
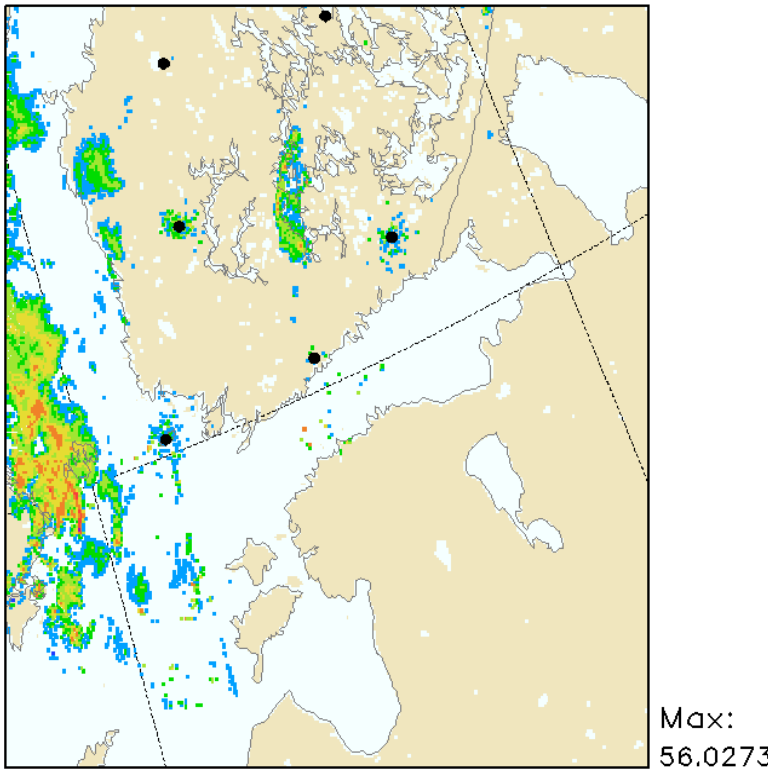
10 July 2006 – Qualitative evaluation

AROME 10JUL2006 00 UTC Forecast. Radar reflectivity [dBZ]
10JUL2006 09:00 UTC (ARO,2.5km).



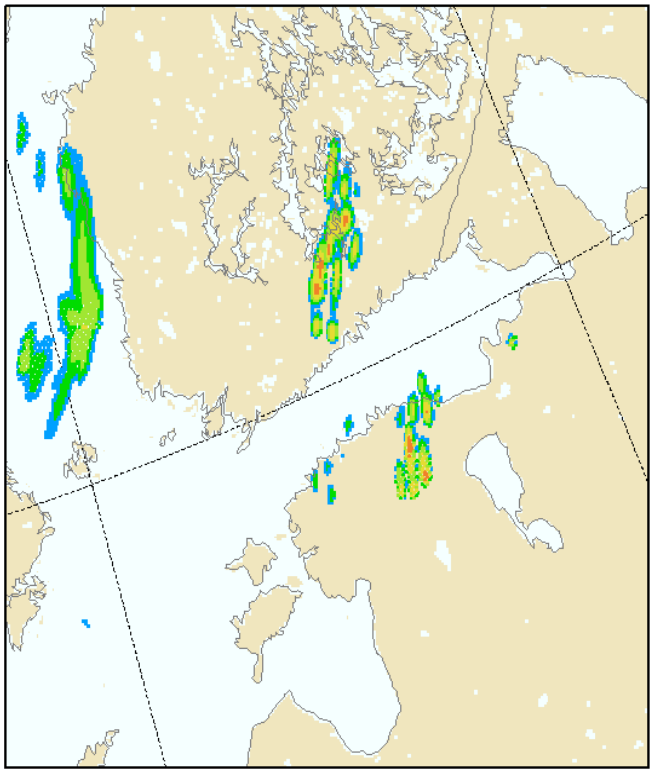
Observed radar reflectivity [dBZ].
10JUL2006 09:00 UTC.

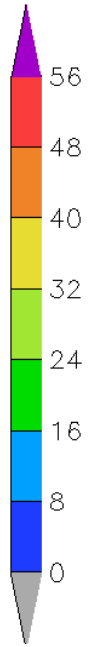


AROME **+ 9 h** **OBSERVATIONS**

10 July 2006 – Qualitative evaluation

AROME 10JUL2006 00 UTC Forecast. Radar reflectivity [dBZ]
10JUL2006 10:00 UTC (ARO,2.5km).

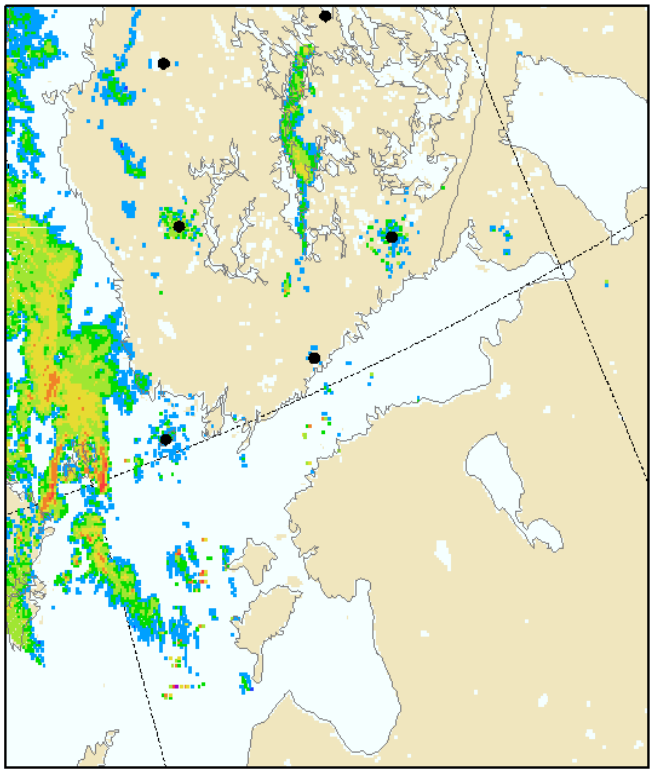




Max:
45.1211

Radars:VAN,IKA,ANJ,KOR,KUO,VIM
Antenna=0.6°

Observed radar reflectivity [dBZ].
10JUL2006 10:00 UTC.

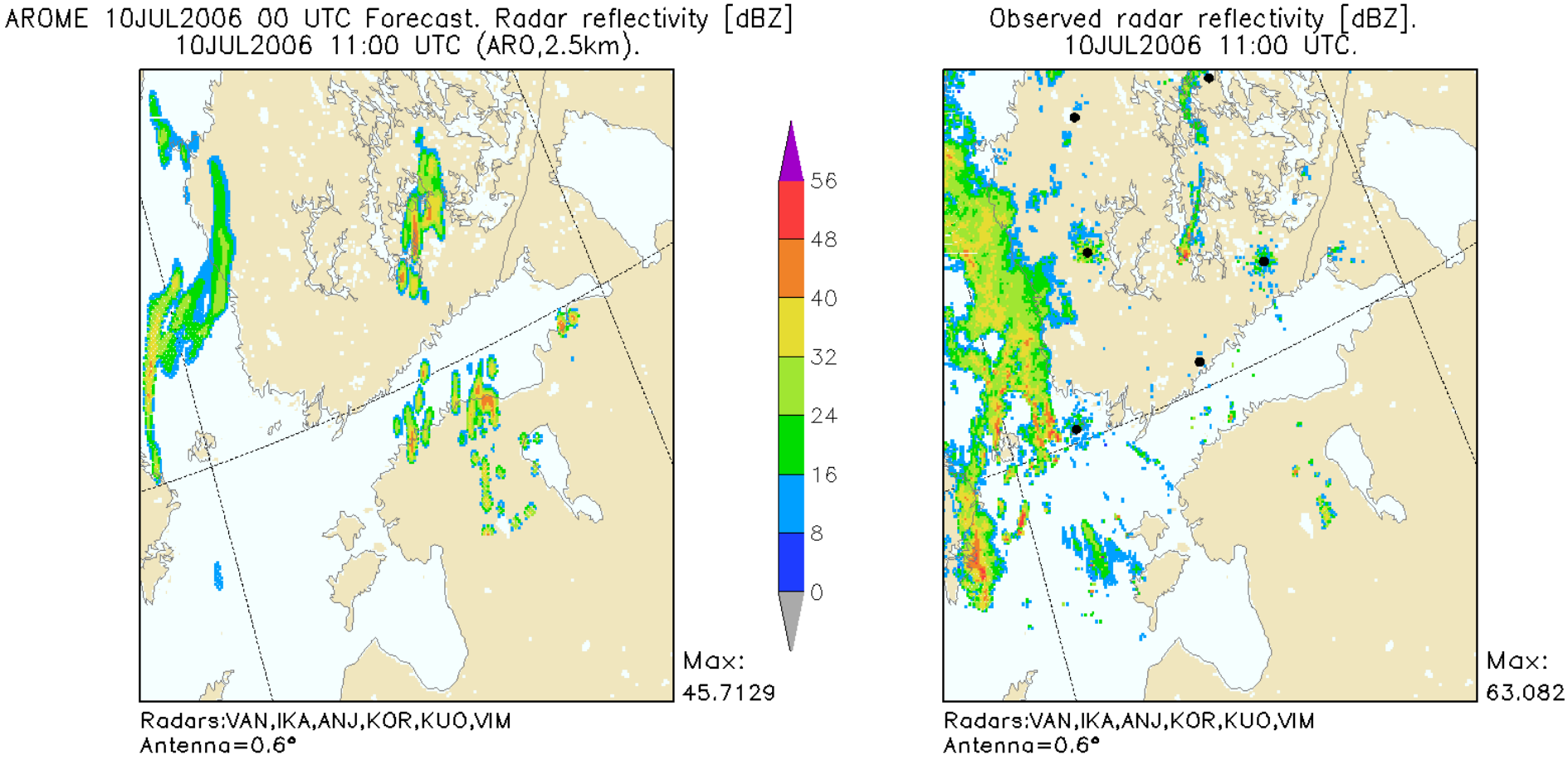


Max:
56.002

Radars:VAN,IKA,ANJ,KOR,KUO,VIM
Antenna=0.6°

AROME **+ 10 h** **OBSERVATIONS**

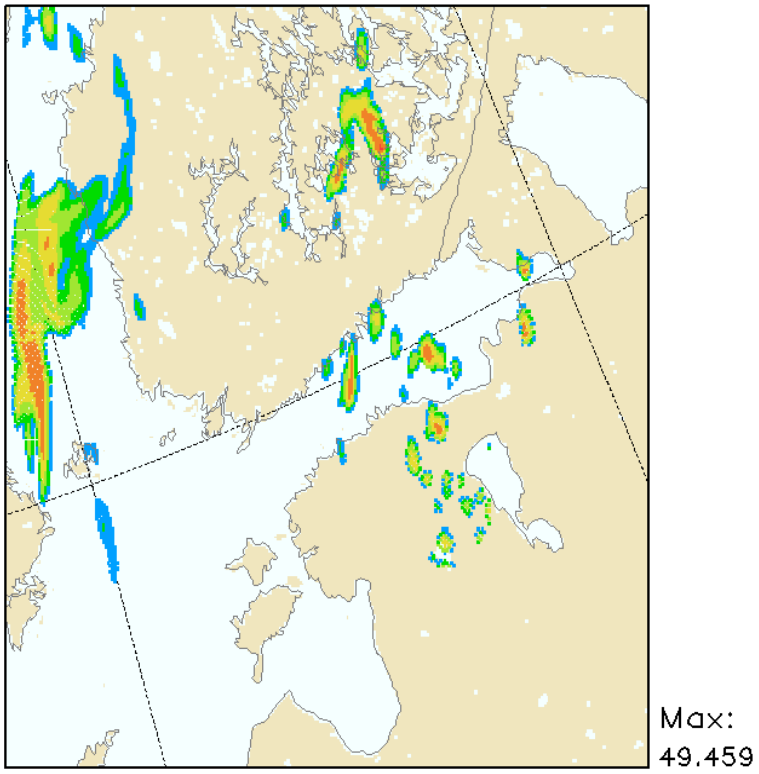
10 July 2006 – Qualitative evaluation



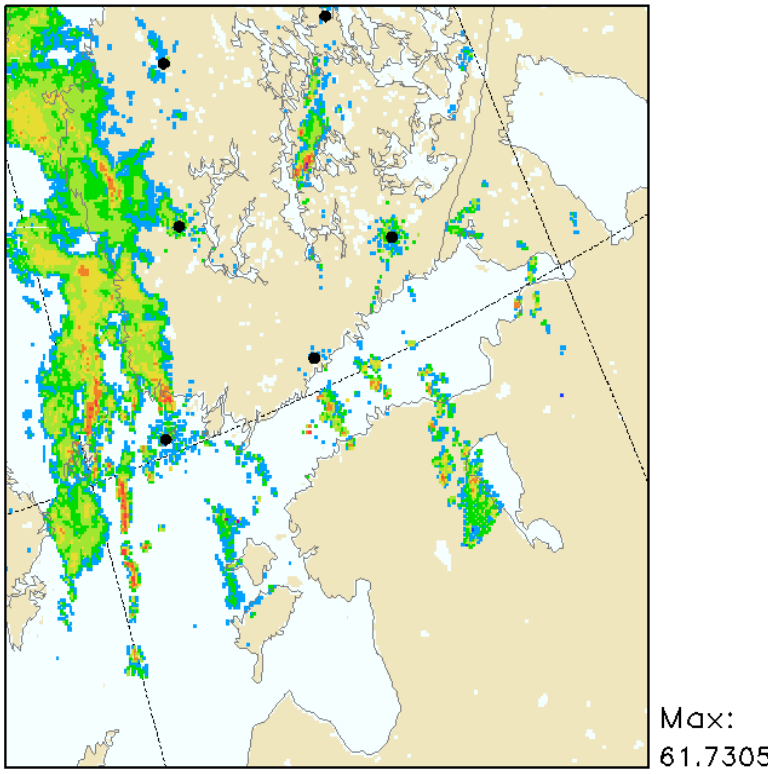
AROME **+ 11 h** **OBSERVATIONS**

10 July 2006 – Qualitative evaluation

AROME 10JUL2006 00 UTC Forecast. Radar reflectivity [dBZ]
10JUL2006 12:00 UTC (ARO,2.5km).

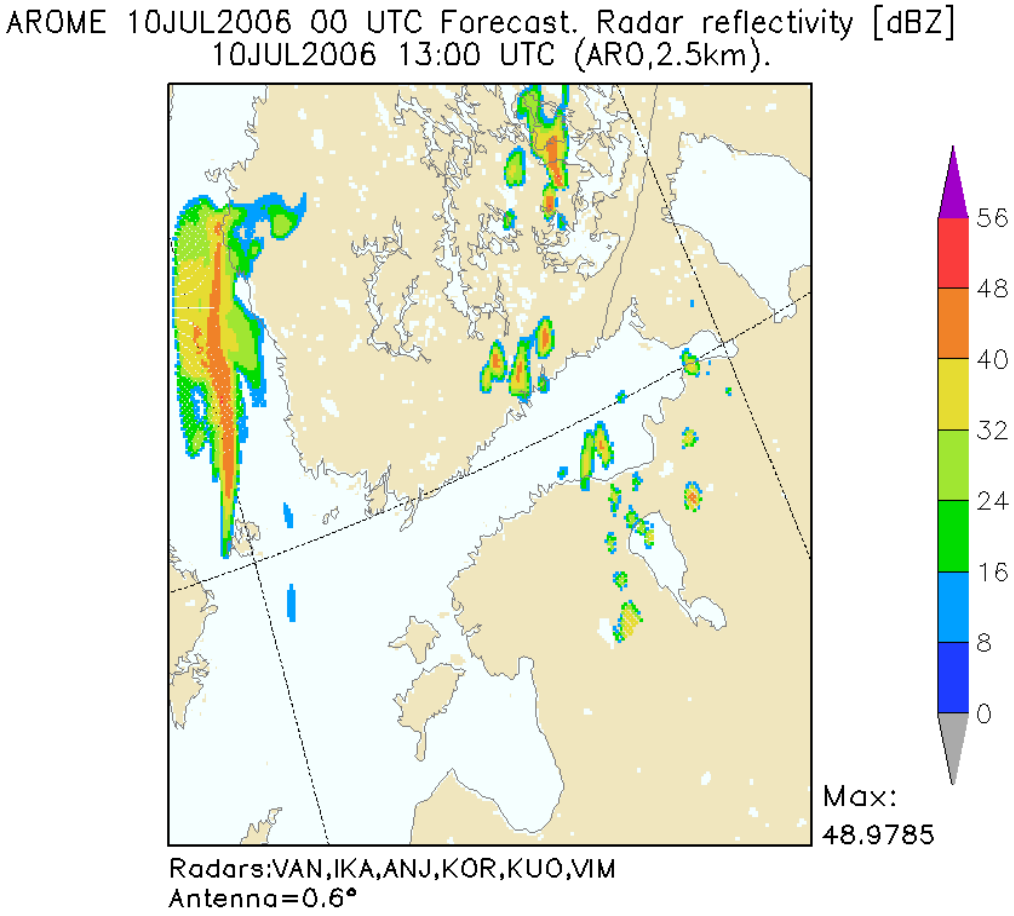


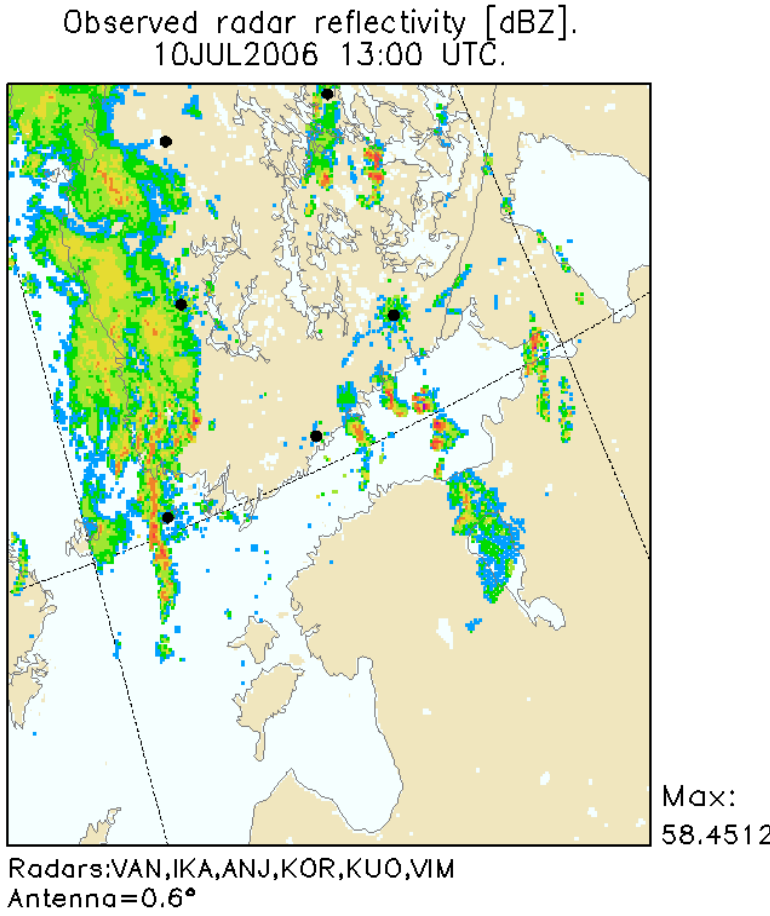
Observed radar reflectivity [dBZ].
10JUL2006 12:00 UTC.



AROME **+ 12 h** **OBSERVATIONS**

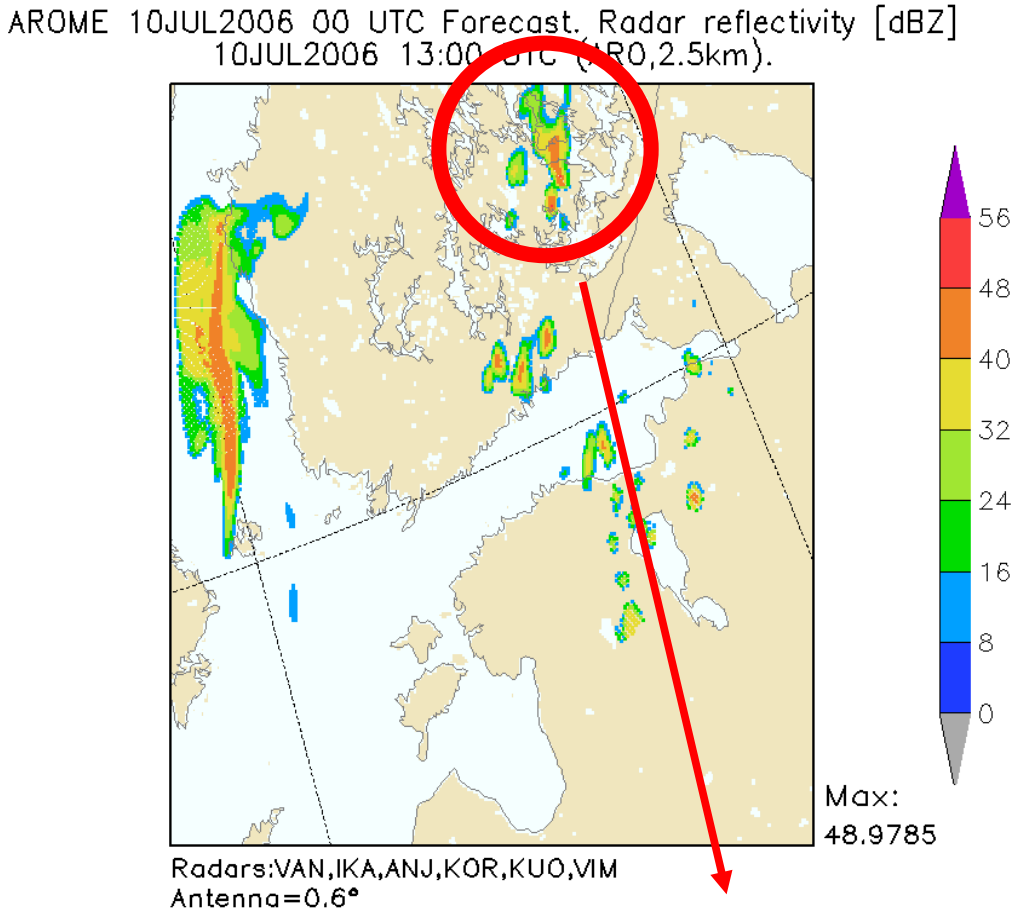
10 July 2006 – Qualitative evaluation

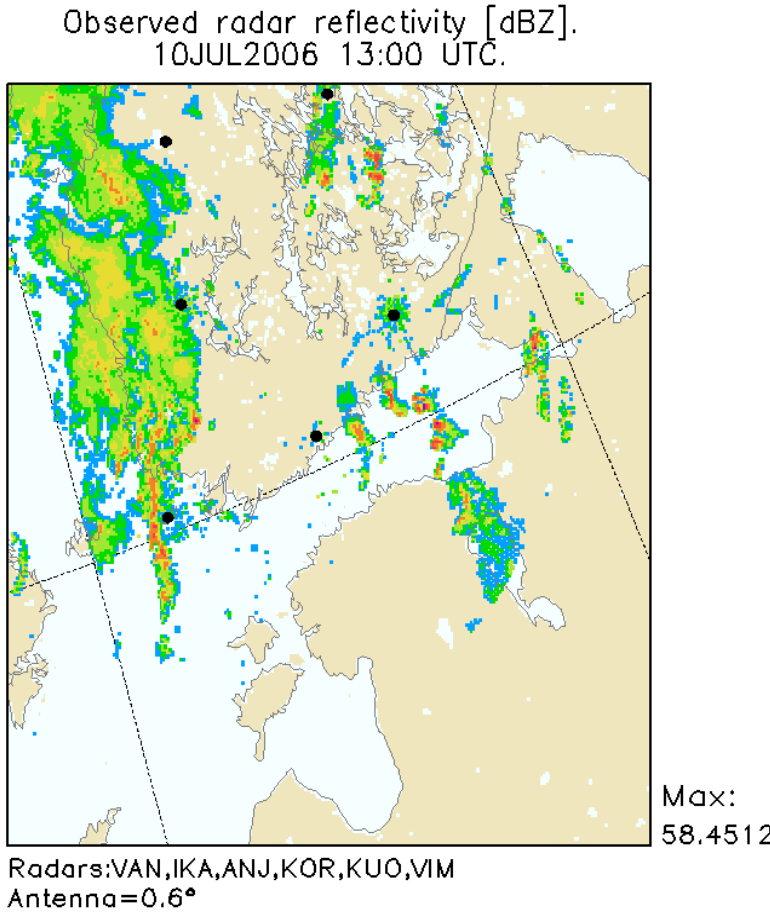




AROME **+ 13 h** **OBSERVATIONS**

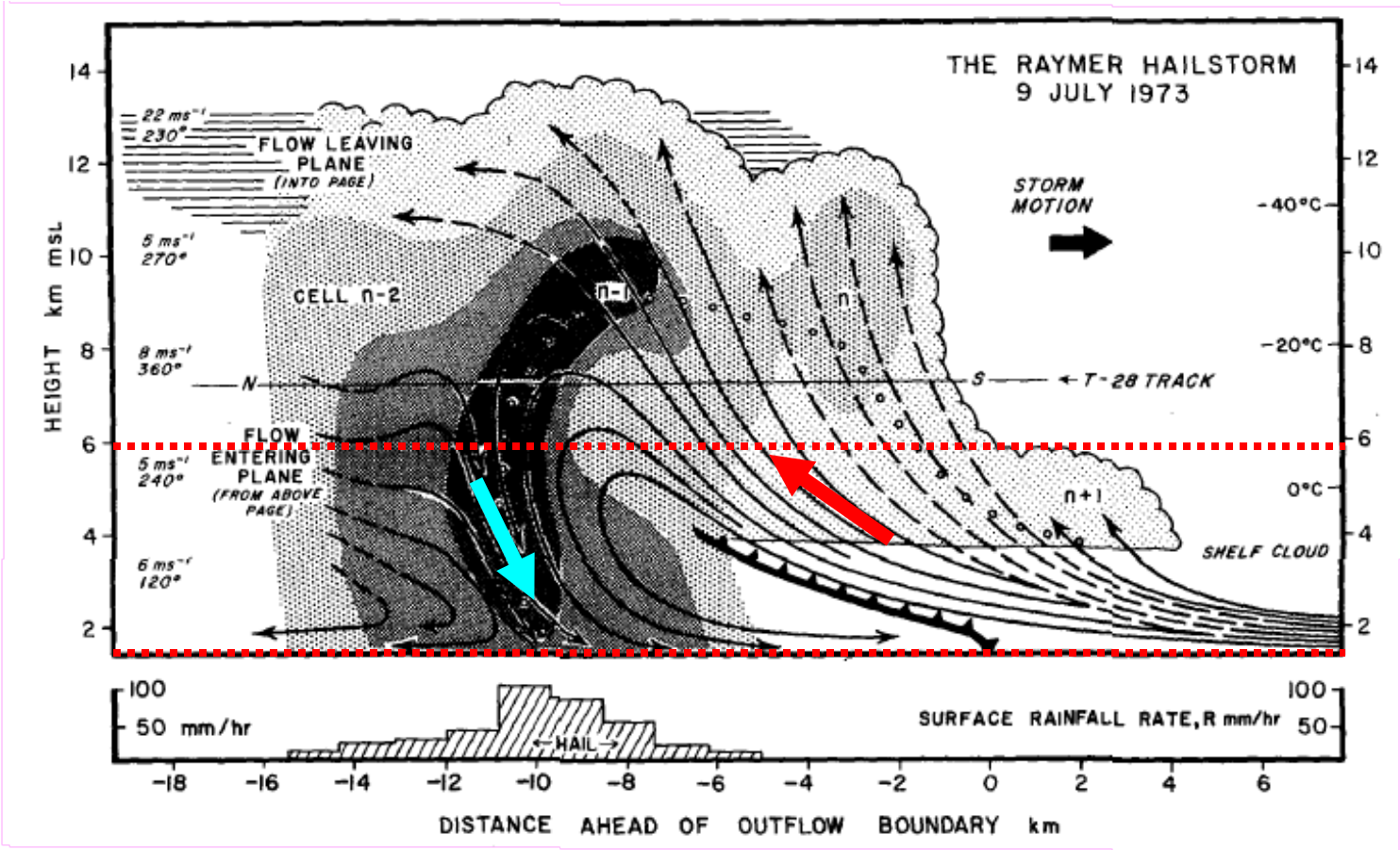
10 July 2006 – Qualitative evaluation





What kind of MCS structure we should expect?

Classical MCS structure



Browning *et al.* (1976), MWR

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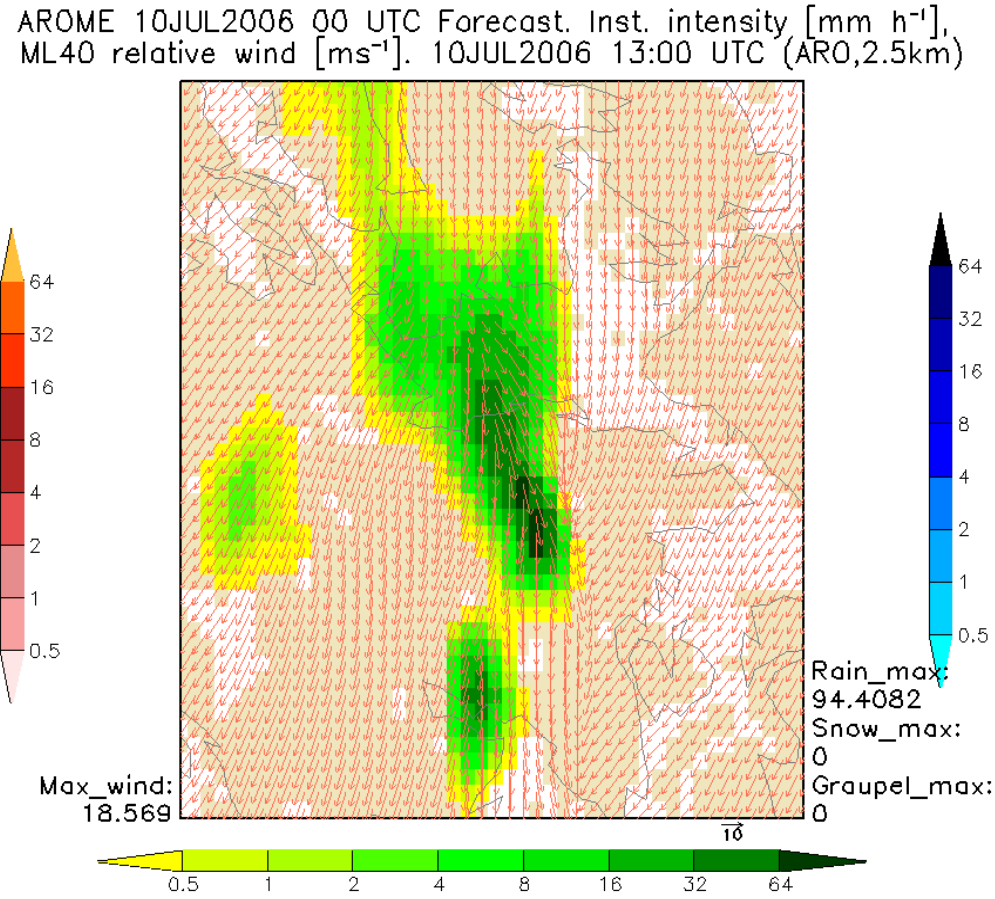
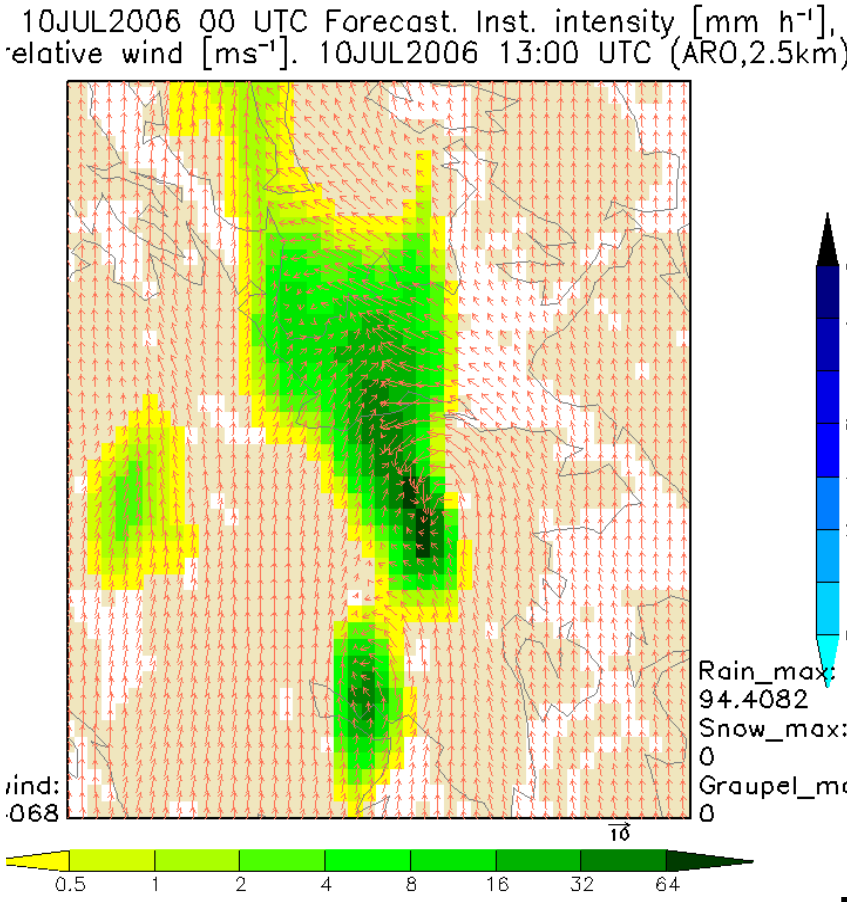
Relative wind and precipitation intensity

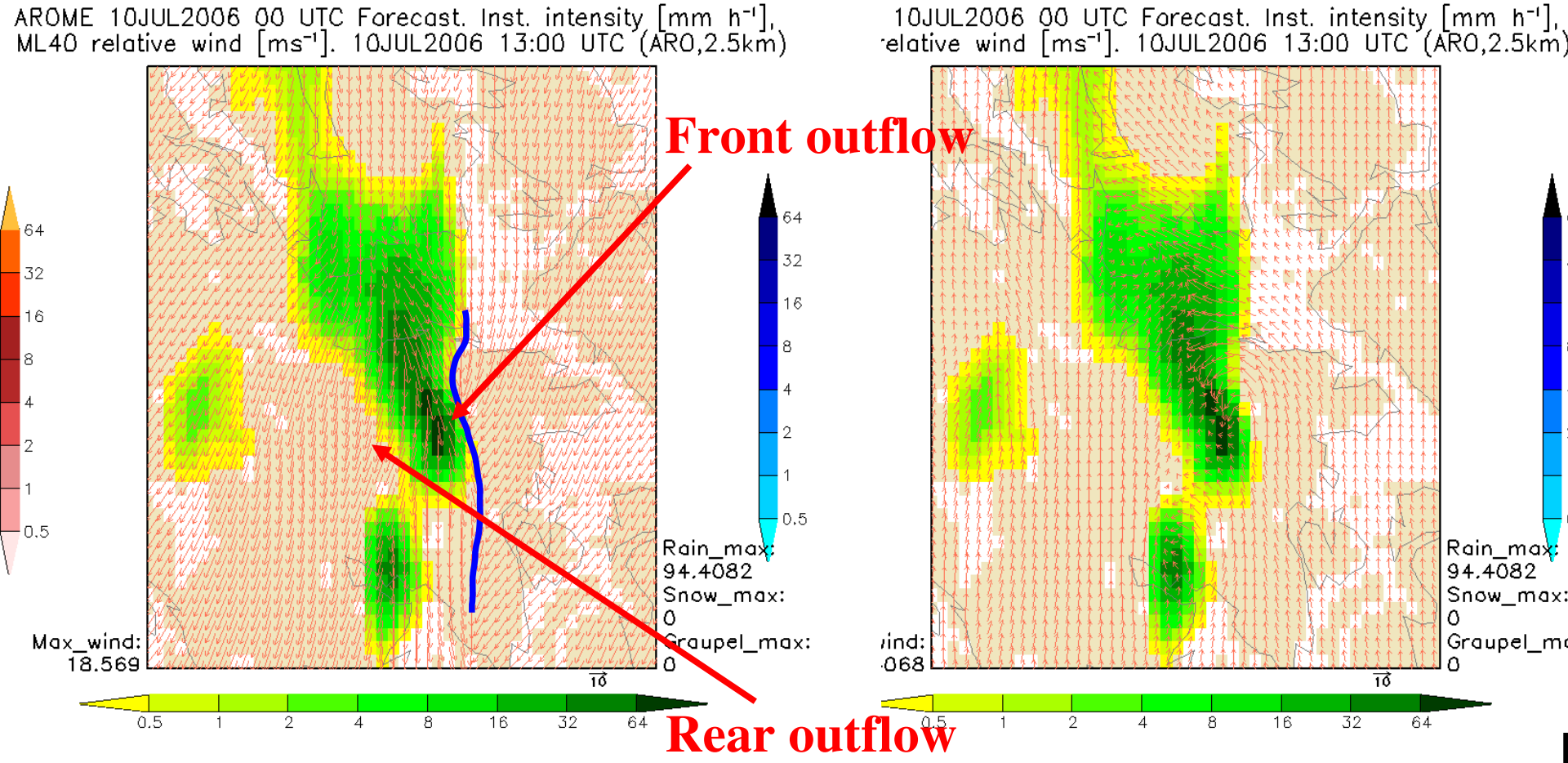


30 m



3000 m

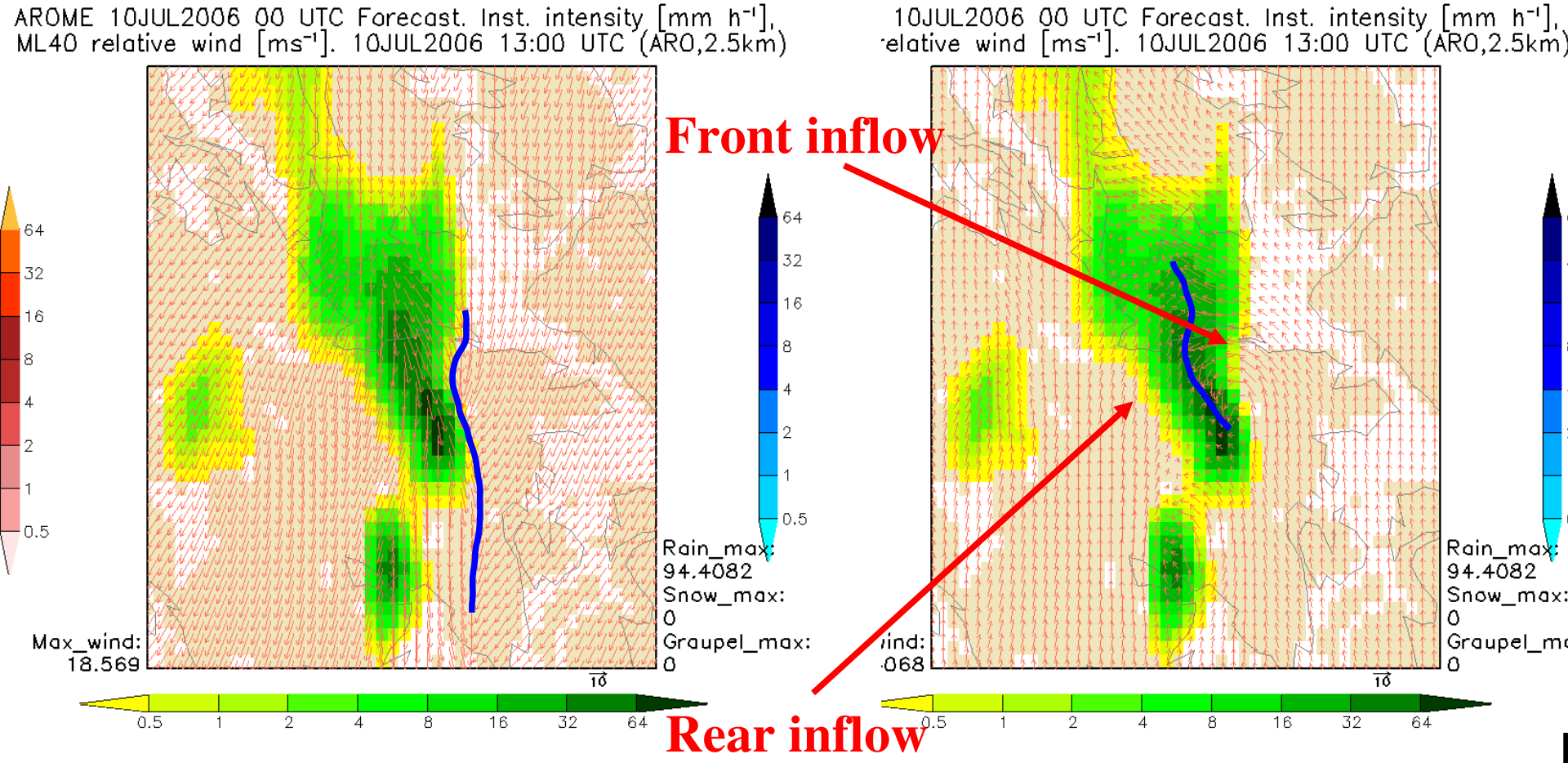
Relative wind and precipitation intensity



30 m

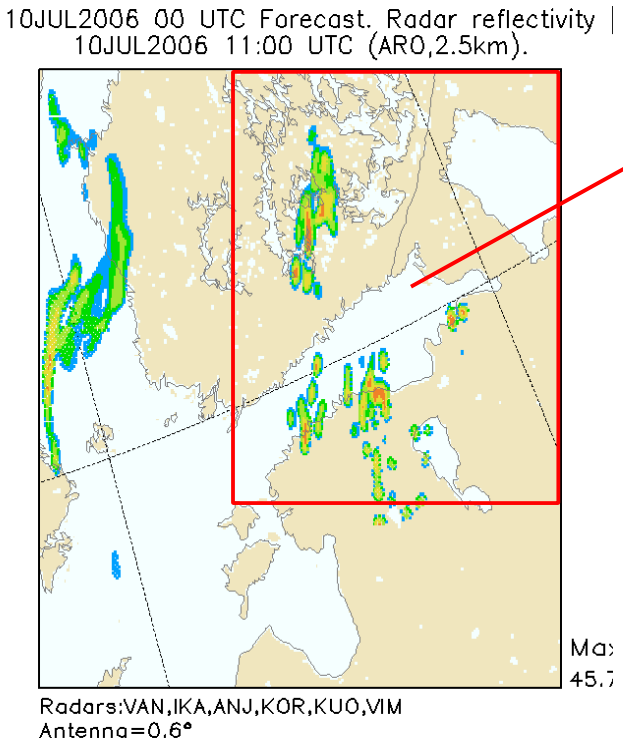
3000 m

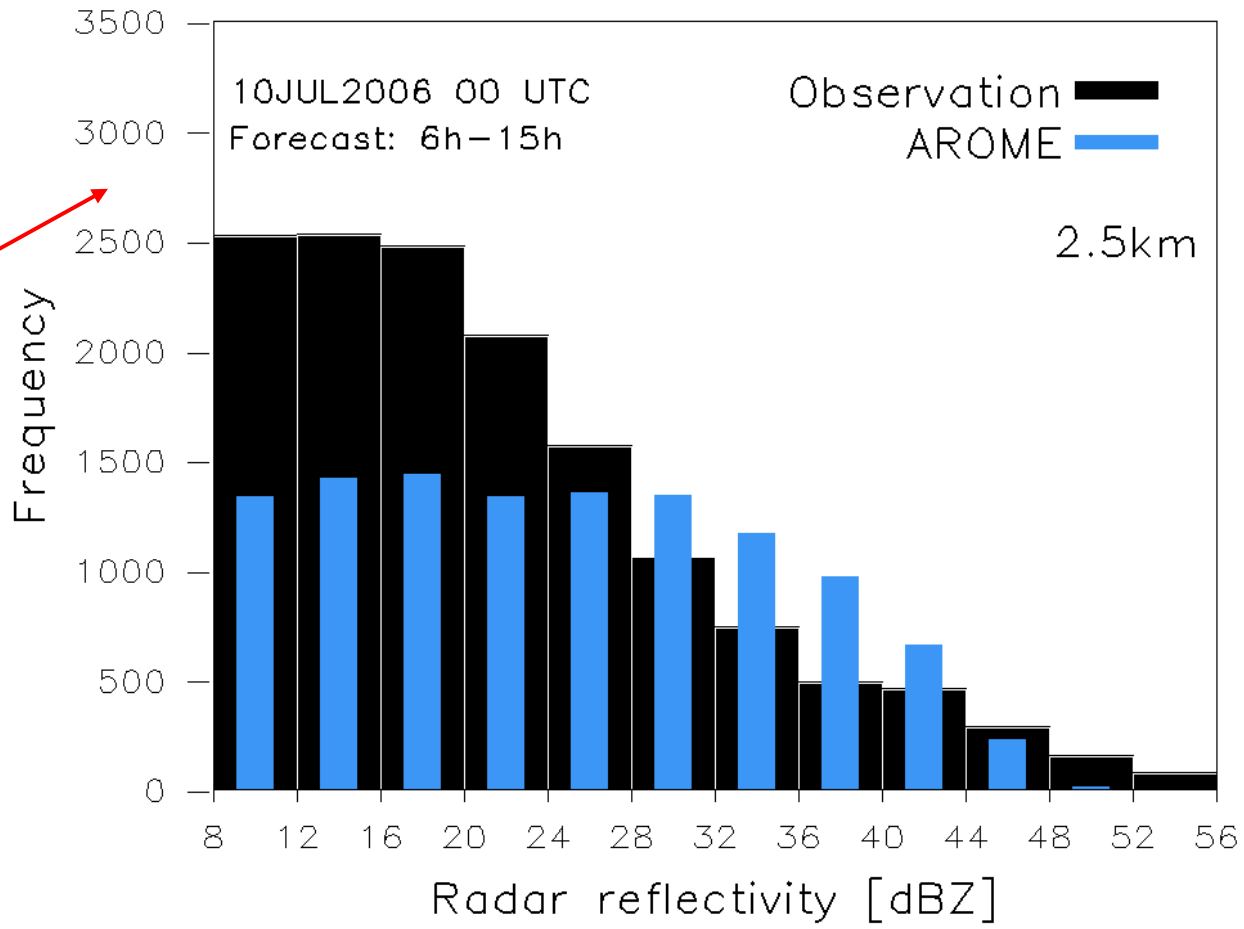
Relative wind and precipitation intensity



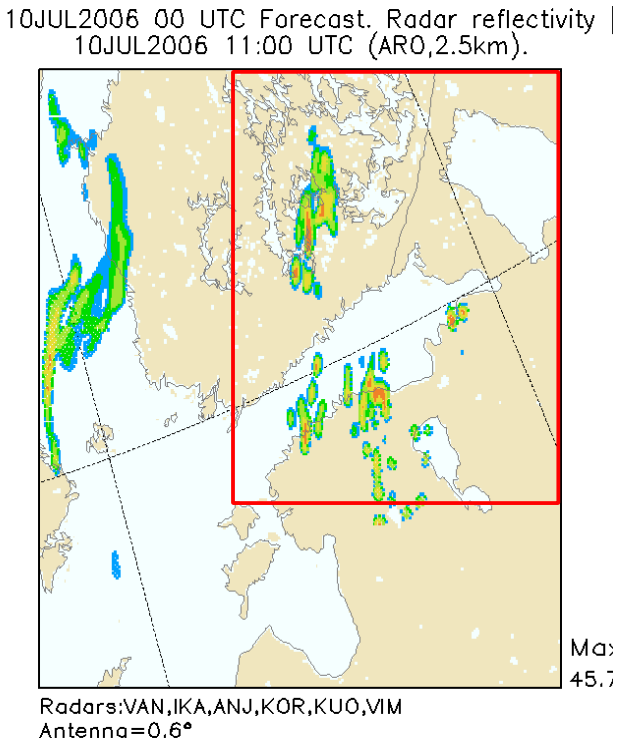
30 m **Qualitatively OK, but how about quantitatively?** **3000 m**

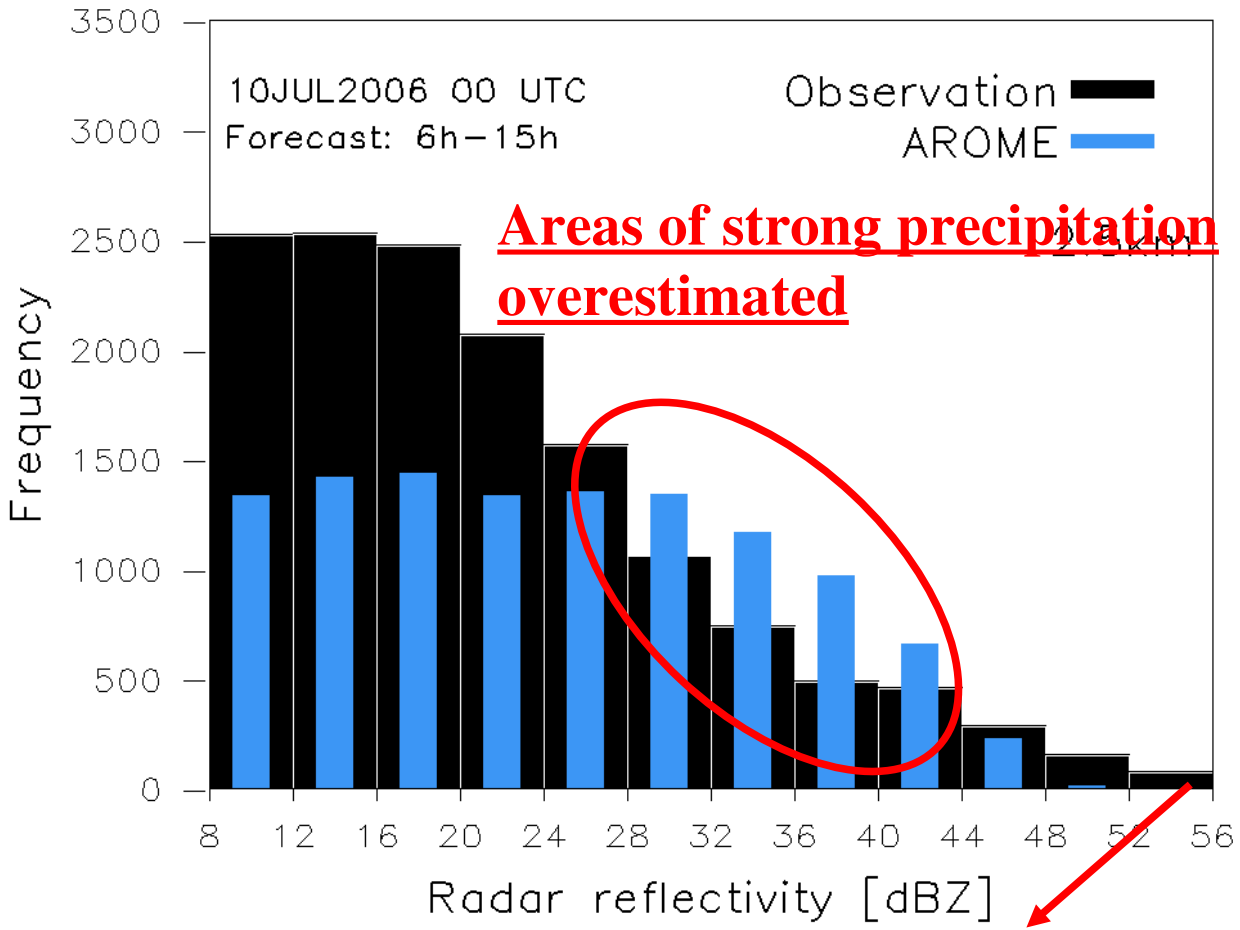
10 July 2006: reflectivity frequency distribution



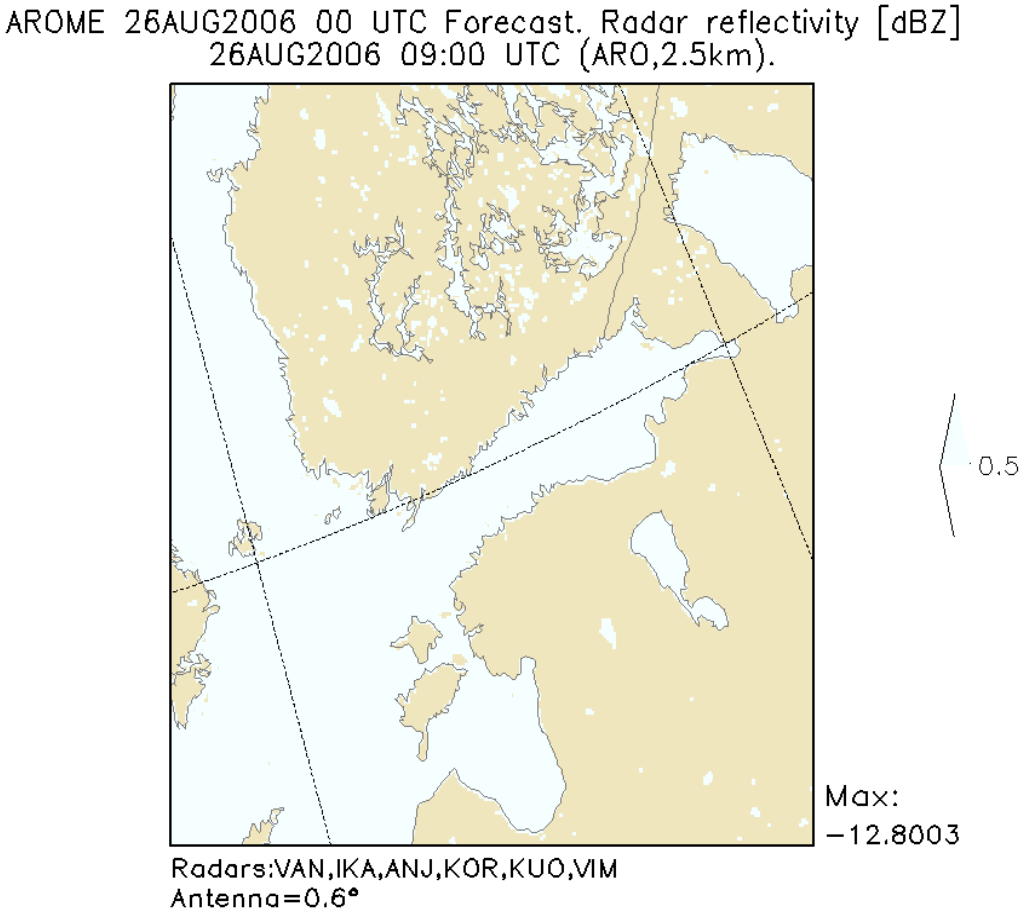


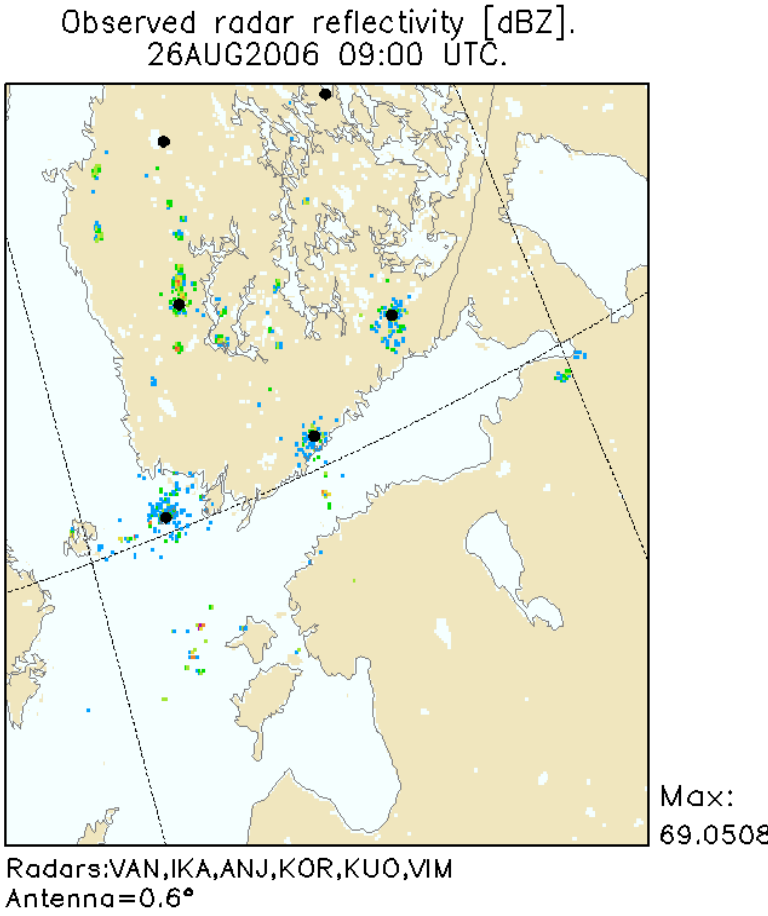
10 July 2006: reflectivity frequency distribution





26 August 2006 – Qualitative evaluation





AROME **+ 9 h** **OBSERVATIONS**

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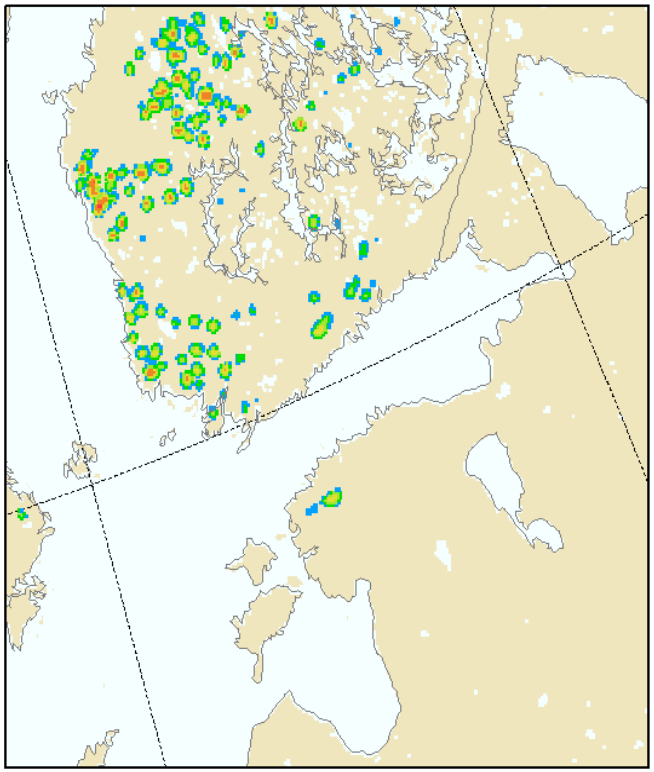
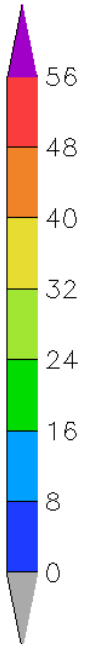
26 August 2006 – Qualitative evaluation

AROME 26AUG2006 00 UTC Forecast. Radar reflectivity [dBZ]
26AUG2006 12:00 UTC (ARO,2.5km).

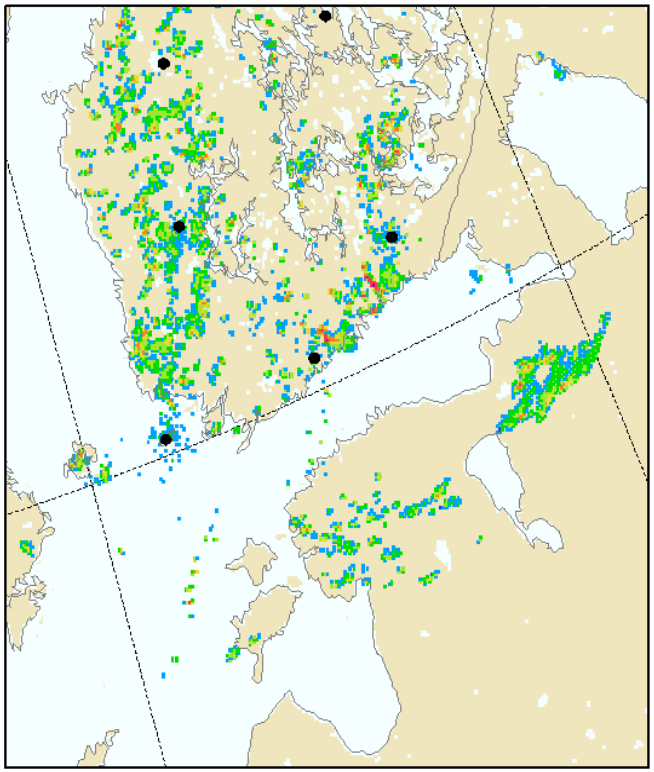




Max:
49.0371

Radars:VAN,IKA,ANJ,KOR,KUO,VIM
Antenna=0.6°

Observed radar reflectivity [dBZ].
26AUG2006 12:00 UTC.

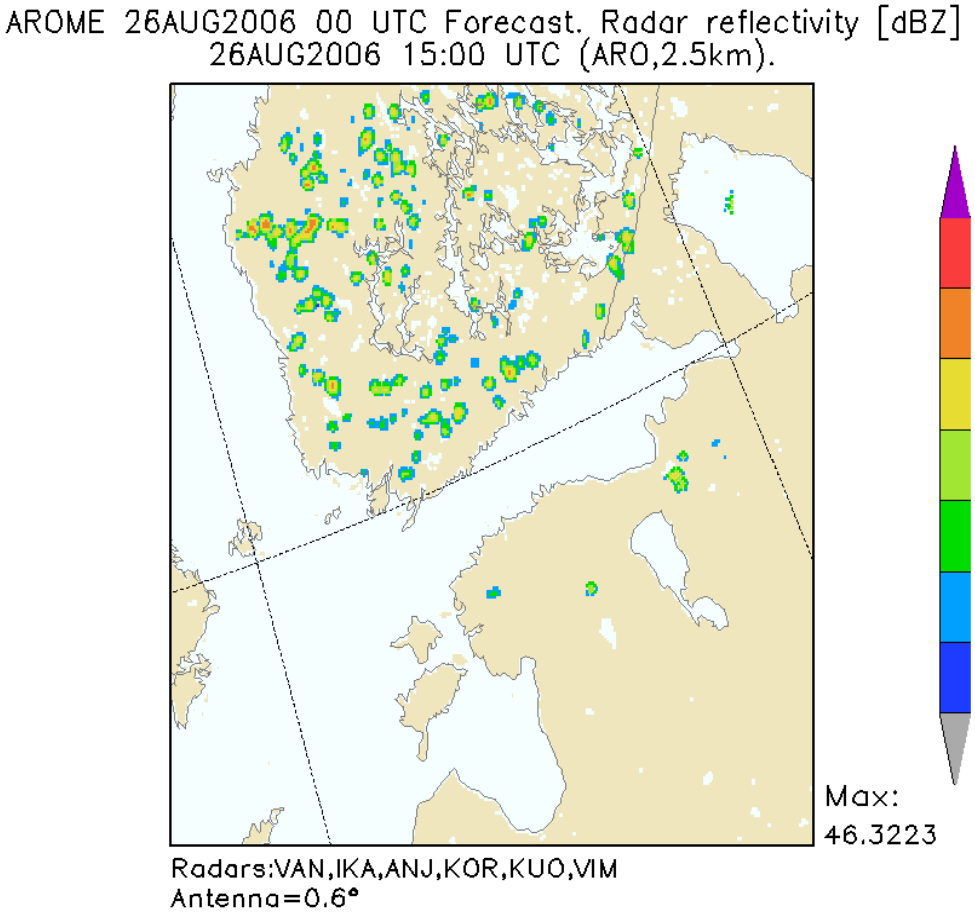


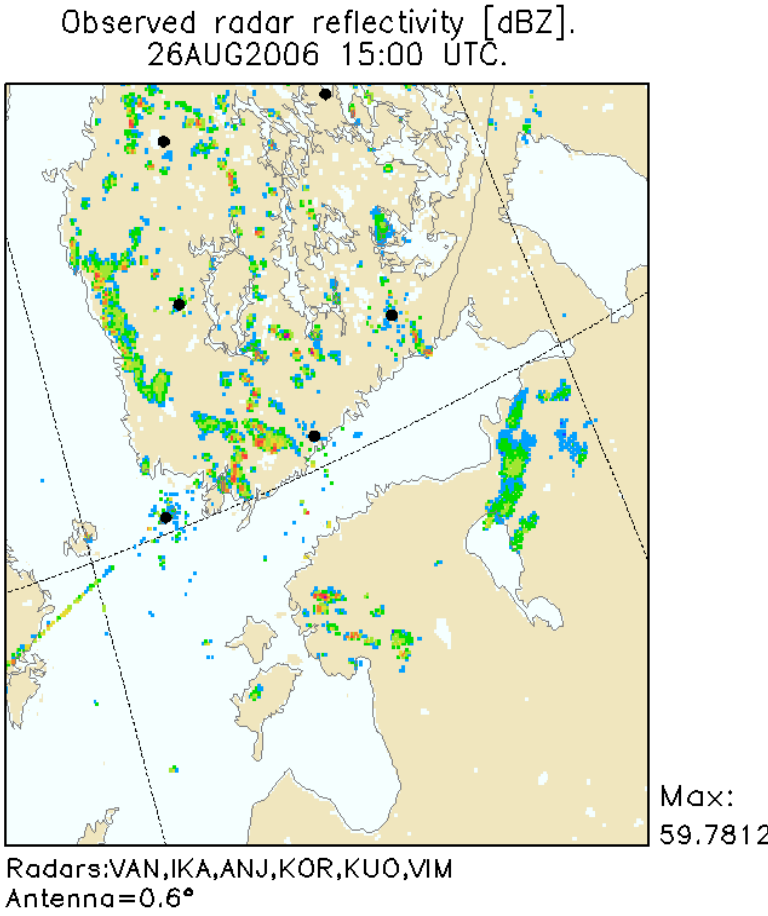
Max:
60.3926

Radars:VAN,IKA,ANJ,KOR,KUO,VIM
Antenna=0.6°

AROME **+ 12 h** **OBSERVATIONS**

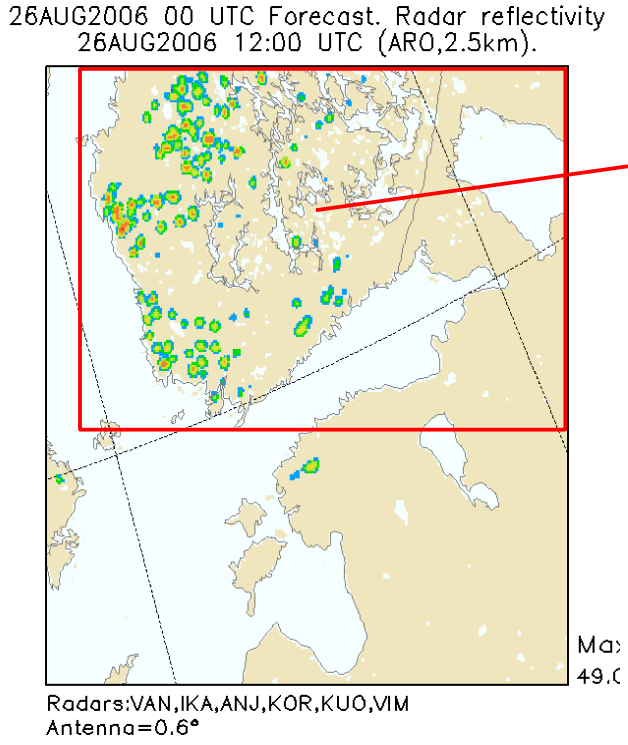
26 August 2006 – Qualitative evaluation

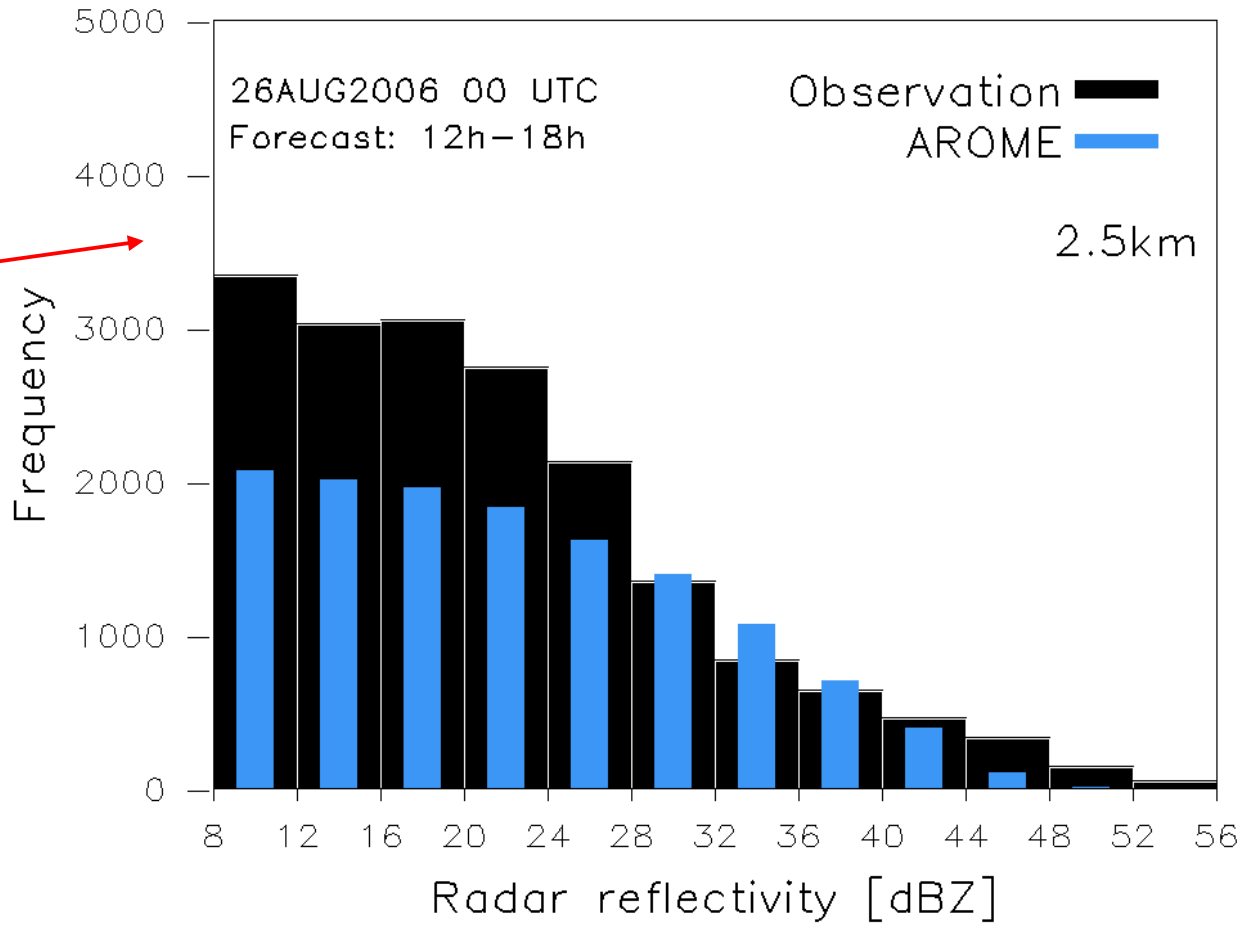




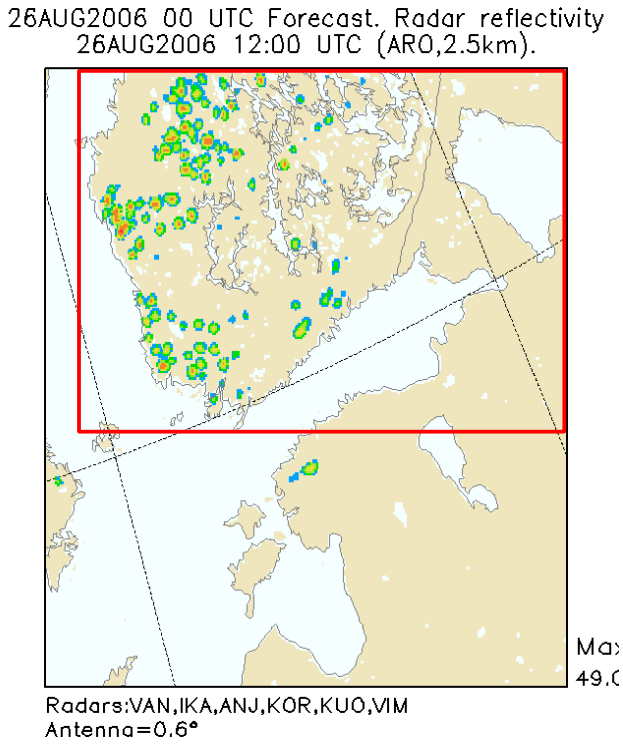
AROME **+ 15 h** **OBSERVATIONS**

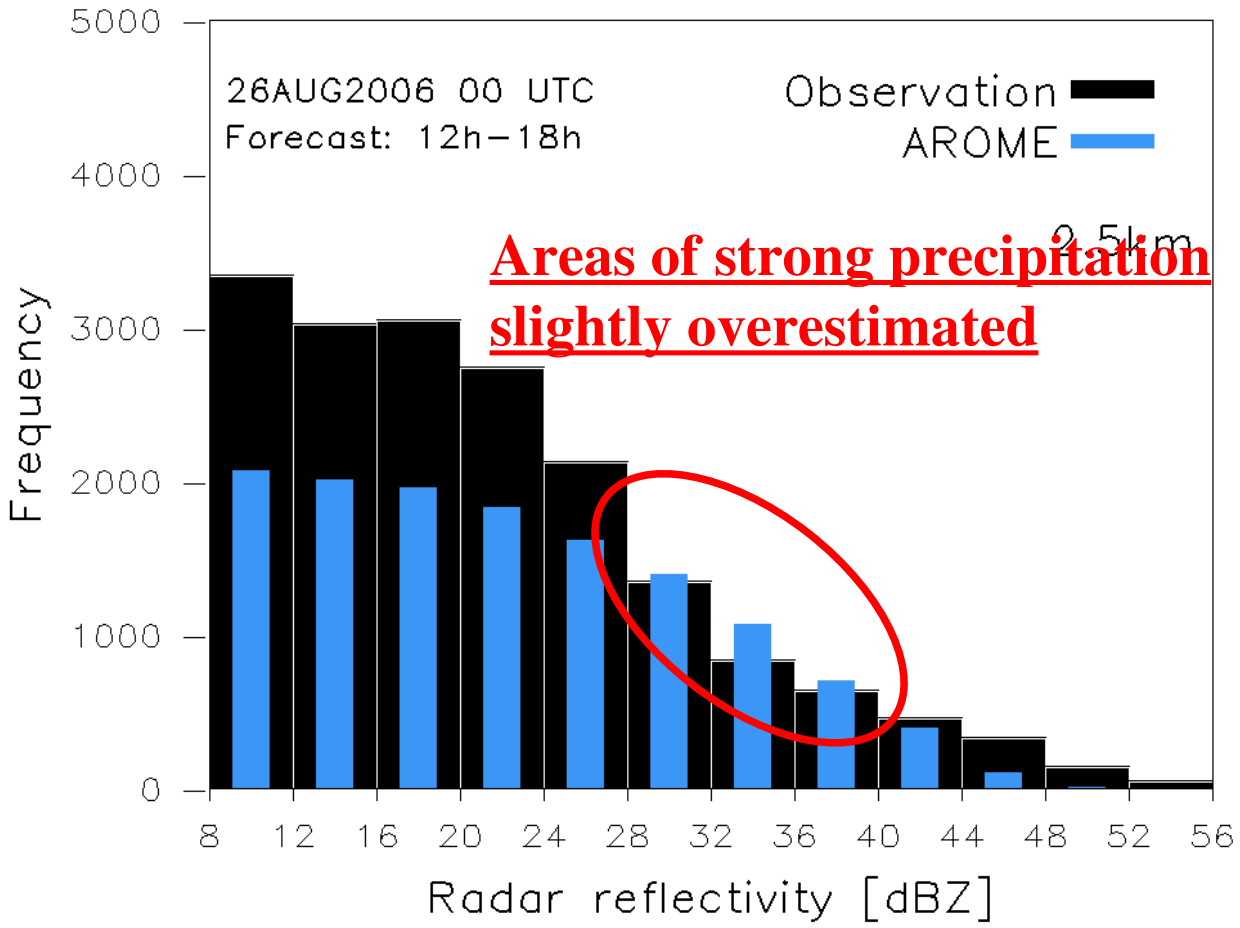
26 August 2006: reflectivity frequency distribution





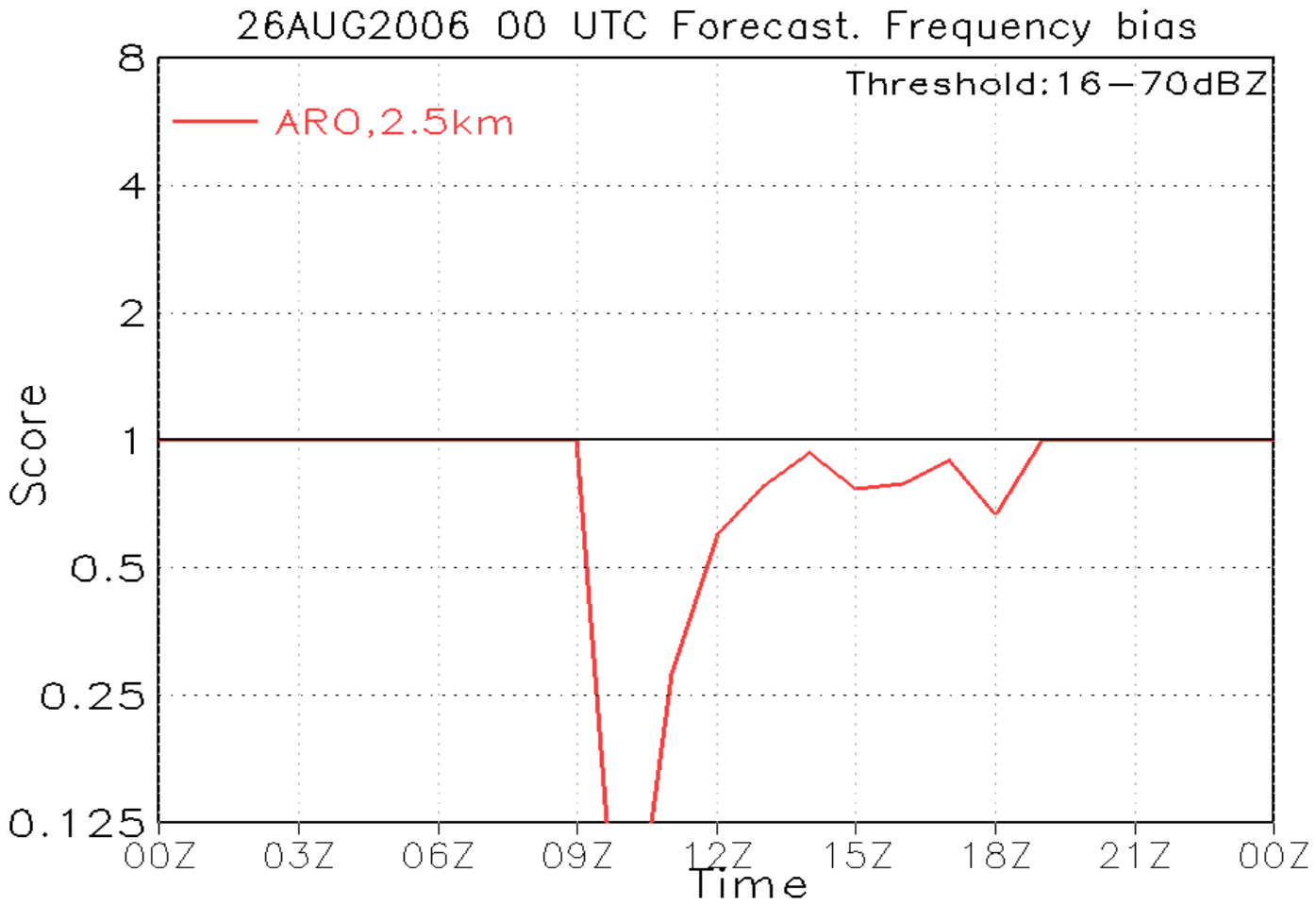
26 August 2006: reflectivity frequency distribution





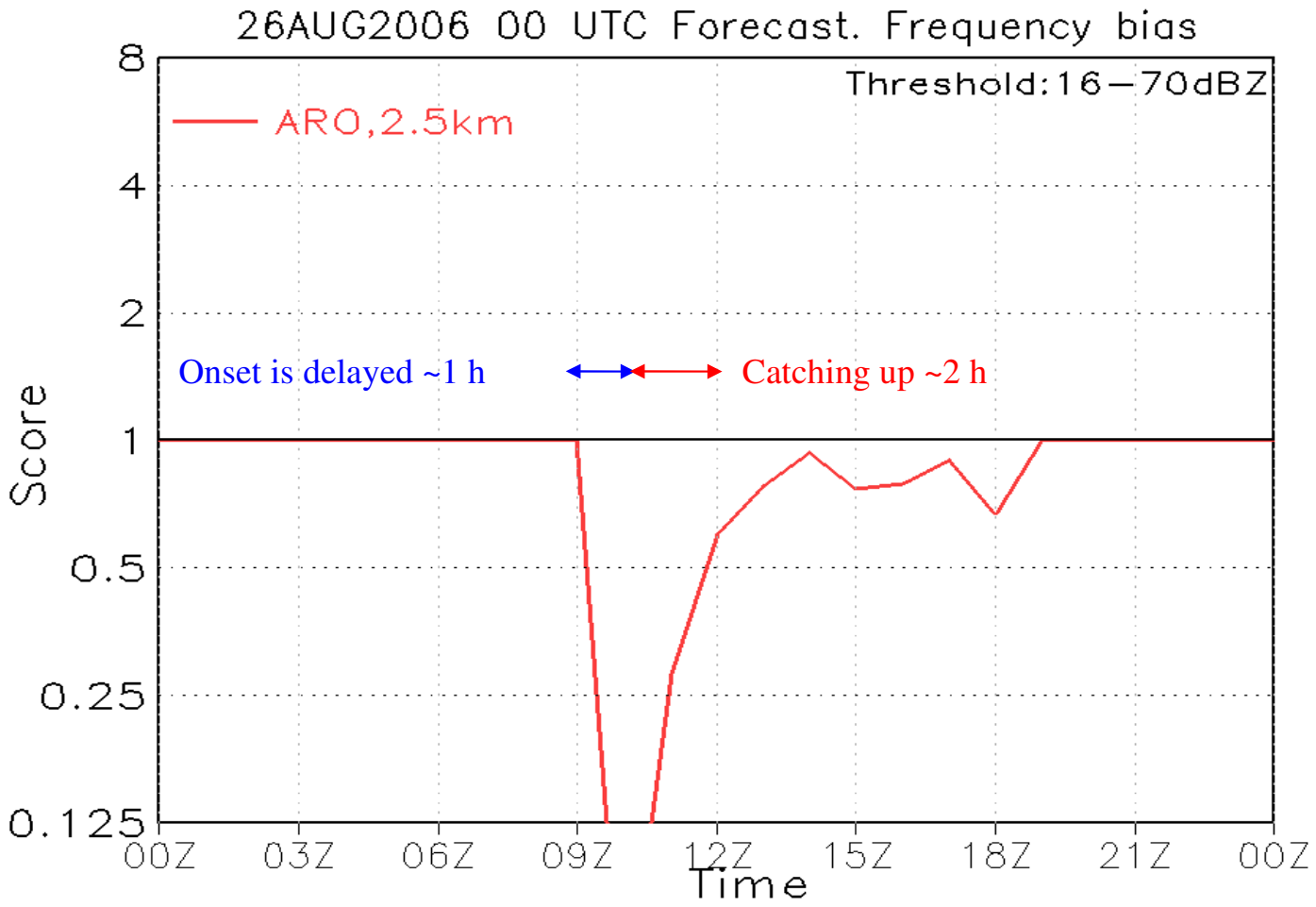
26 August 2006: Timing of the precipitation

FREQUENCY BIAS INDEX



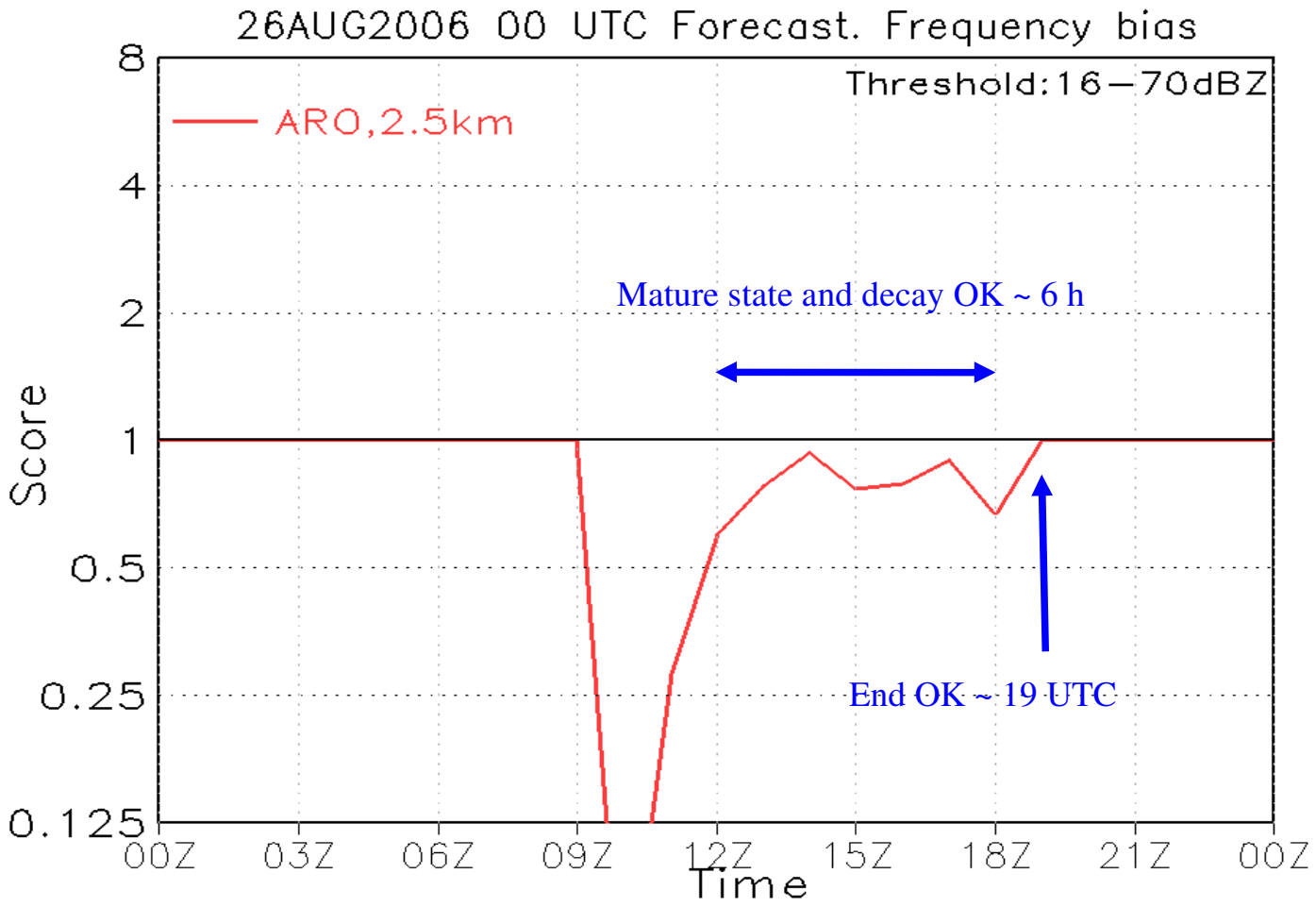
26 August 2006: Timing of the precipitation

FREQUENCY BIAS INDEX



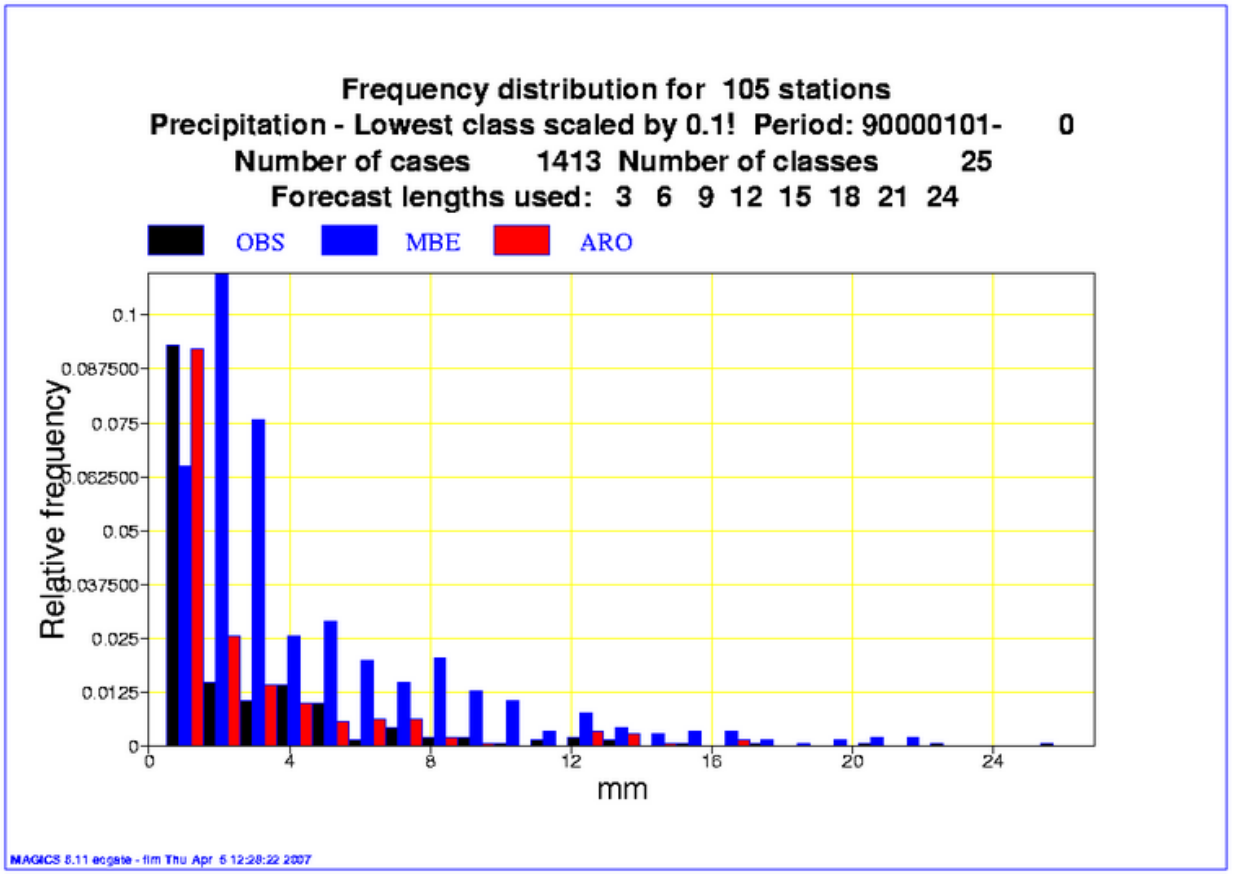
26 August 2006: Timing of the precipitation

FREQUENCY BIAS INDEX



25 August 2006 – Precipitation (mm/3h)

Helsinki Testbed observations
25. - 27.8 2006



Observations

AROME – 2.5 km

HIRLAM – 9 km

Conclusions

- Qualitatively, AROME is able to produce realistic MCS structures and weakly forced convective cells.

  - Some indication that strong reflectivities are overestimated.
  - In the model, convection is forced to occur in too large scale.

- In the weakly forced case, the onset of convection is delayed ~ 1h.

- In case of the small scale convection, the km-scale AROME produces better precipitation distribution than coarser resolution HIRLAM (9km).