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Winter-time convection – a heavy snowfall case in Southern Finland

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FMI

HIRLAM ASM / ALADIN WS 2012
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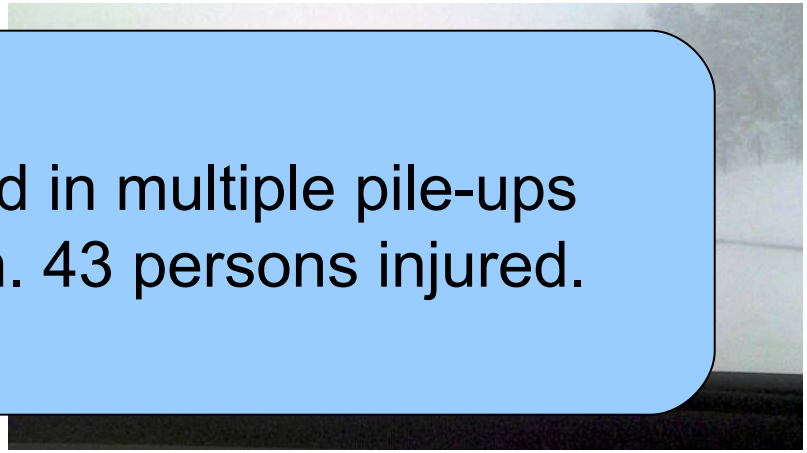
Outline

- Presentation of the case
  - Convective episode over Gulf of Finland: 1 – 5 Feb 2012
  - Heavy snowfall event in Helsinki: 3 Feb 2012
- How did the mesoscale NWP model Harmonie perform?
  - Comparison with radar and satellite data.

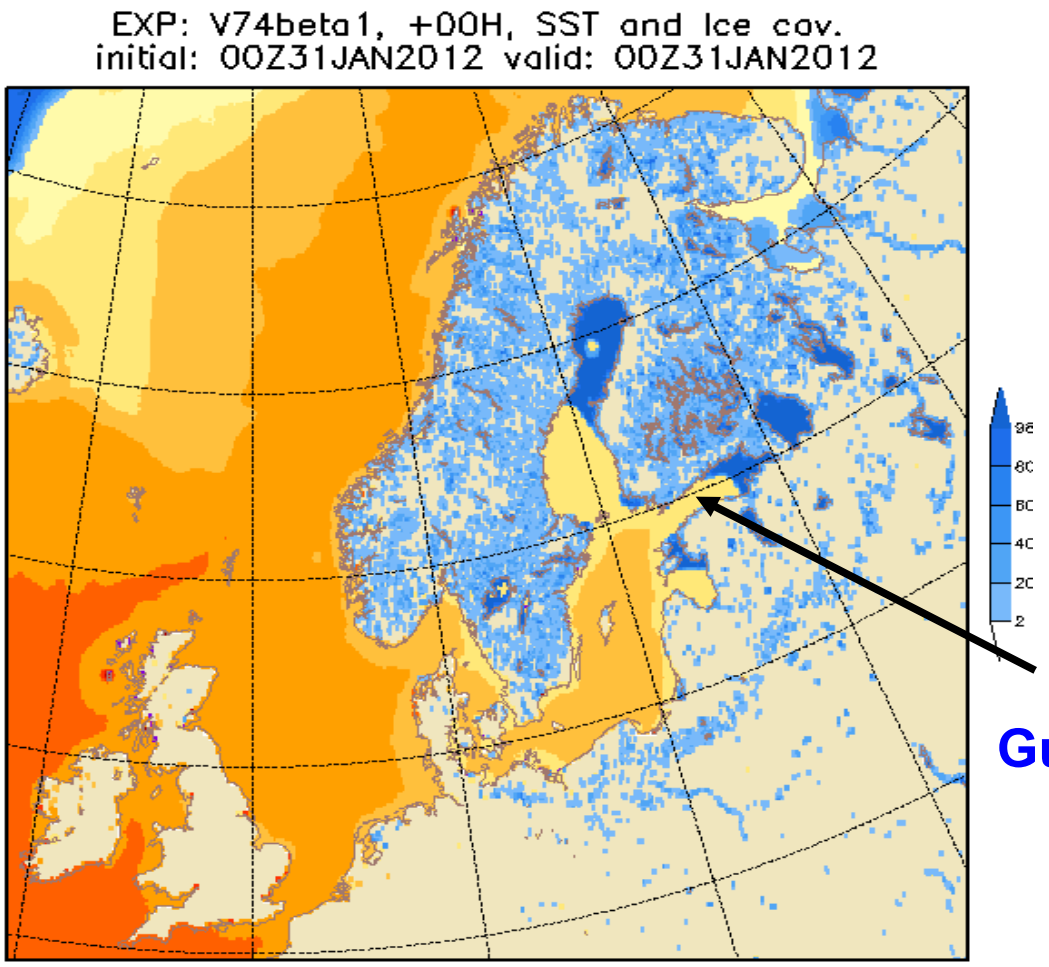
3 Feb 2012 – Impact of snowfall

3 Feb 2012 – Impact of snowfall

Up to 300 cars involved in multiple pile-ups around Helsinki region. 43 persons injured.



Sea ice over Baltic – 31 Jan 2012

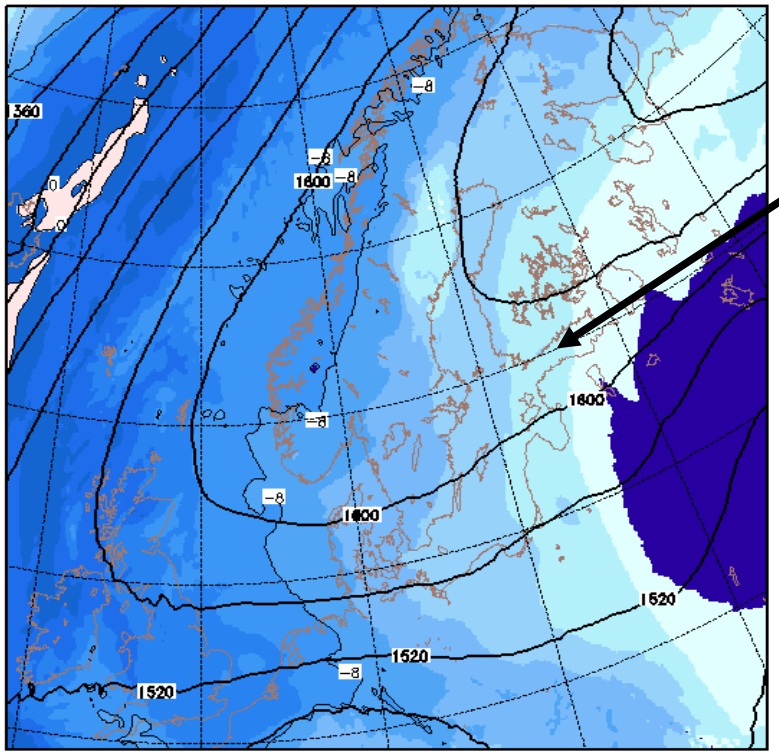


Ice free

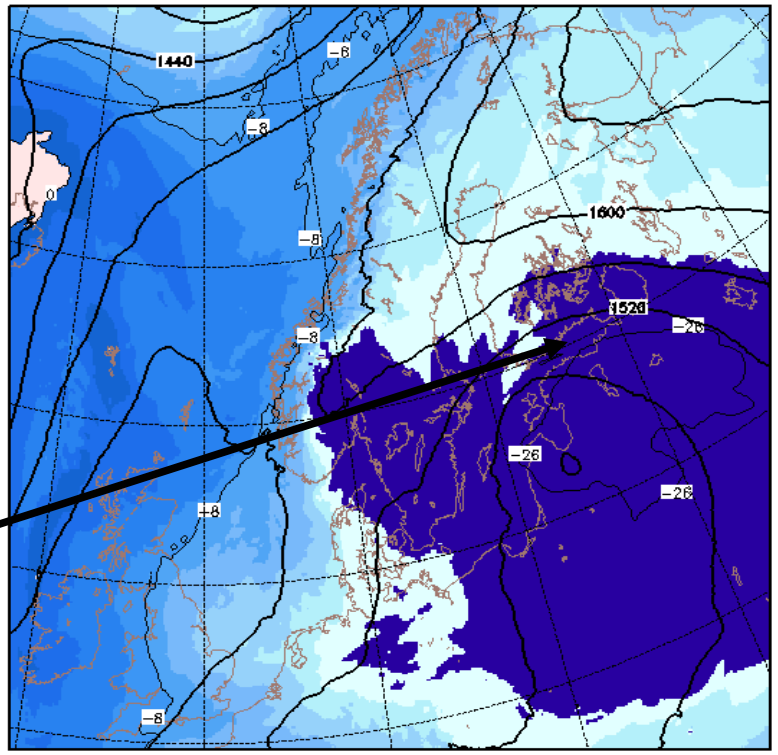
Gulf of Finland

Temperature – 850 hPa

1 Feb 2012



3 Feb 2012

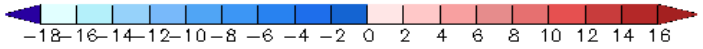


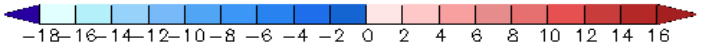
– 16 ºC

– 25 ºC

Max(T_s – T_{850}) ~ 16 ºC

Max(T_s – T_{850}) ~ 25 ºC





"Rule of thumb" for Lake Effect Snow episodes

by Markowski and Richardson (2010), T_s – T_{850} ~ 13 ºC

Key ingredients

- Ice free Gulf of Finland
- Very cold air mass
- Mean flow direction
  - 1 – 2 Feb, easterly (parallel to gulf)
  - 3 – 4 Feb, southeasterly
  - 5 Feb, weak winds

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→ 5-day lake effect snow episode, radar animation

- 1 – 2 Feb, a single snow band parallel to gulf
- **3 – 4 Feb, snow bands perpendicular to gulf**
- *5 Feb, mesoscale vortex.*

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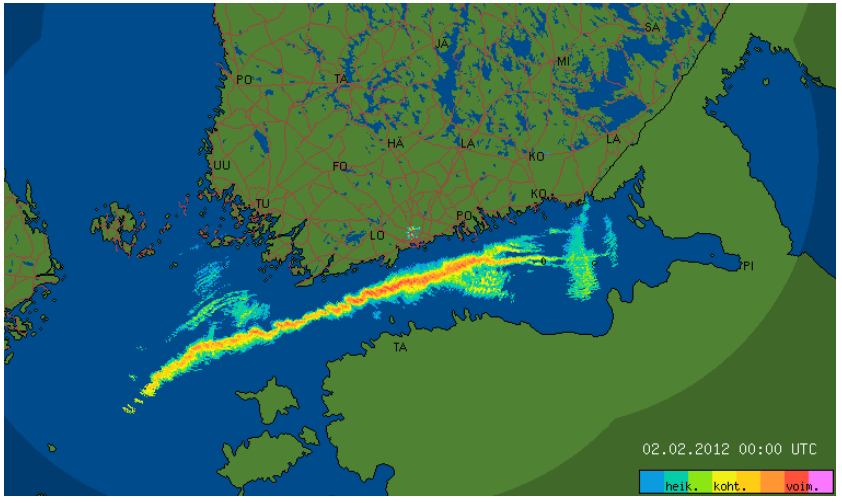
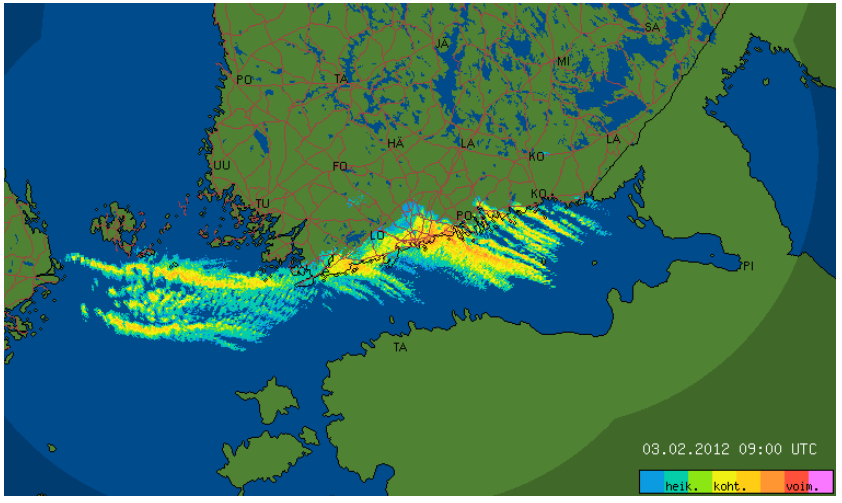
Radar data, 1 – 5 Feb 2012

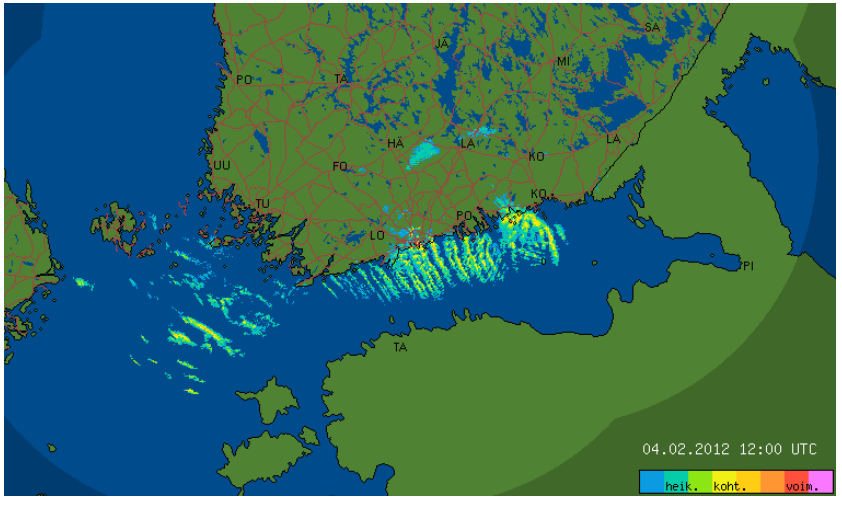
2 Feb, 00 UTC



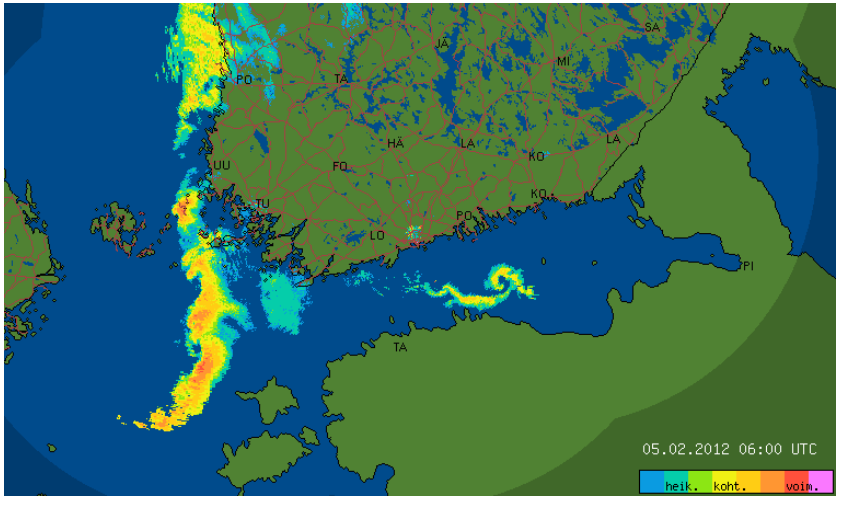
3 Feb, 09 UTC



4 Feb, 12 UTC



5 Feb, 06 UTC

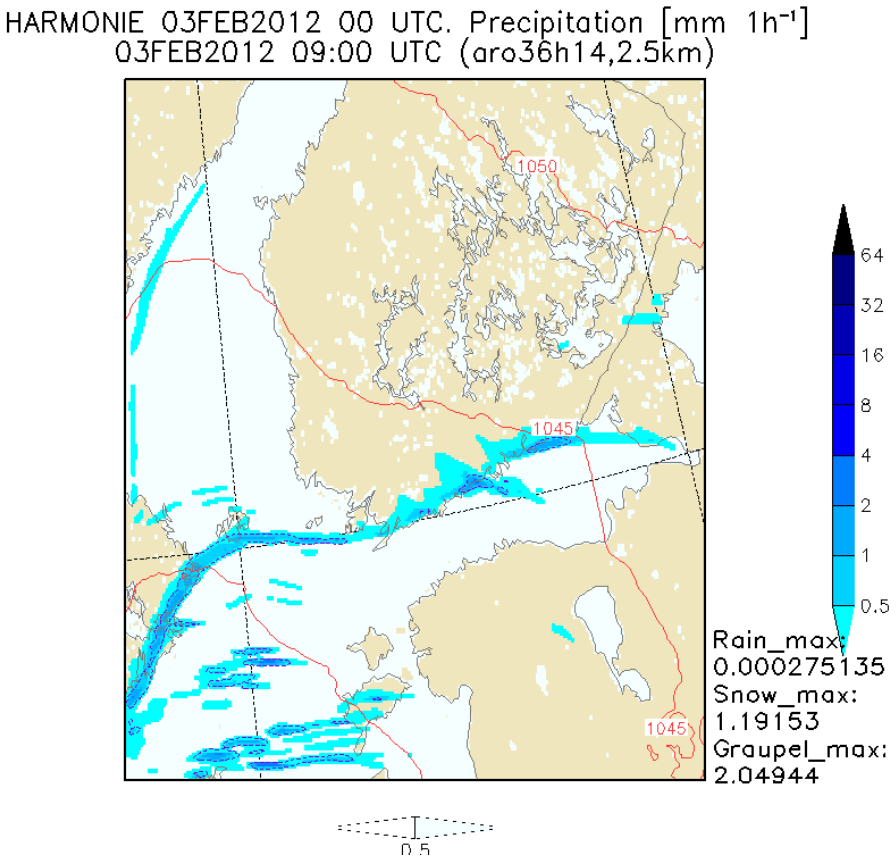


Harmonie mesoscale NWP

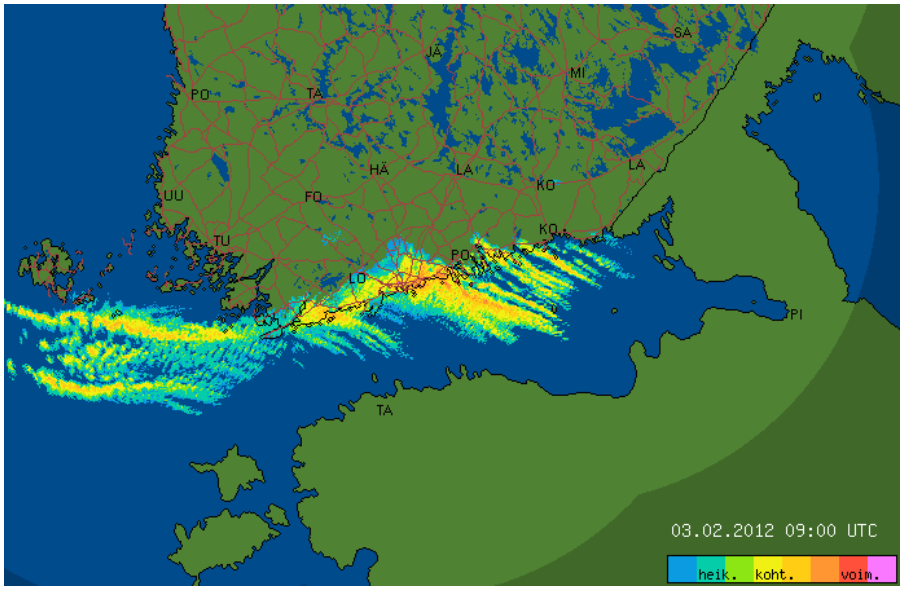
- Non-hydrostatic, Euler equation model
- Physical parameterizations (*AROME-physics*):
  - ECMWF radiation scheme
  - Tiled surface scheme (SURFEX)
  - TKE-based turbulence (Cuxart et al., 2000)
  - ICE3-microphysics with prognostic Cw, Ci, Rain, Snow, Graupel
  - EDMFm shallow convection (Siebesma et al., 2007; Neggers et al. 2009)
  - No deep convection parameterization used
- FMI – setup (cy36h1.4)
  - 2.5 km grid size covering Finland
  - 65 levels in vertical (20 in lowest 1 km).
  - Data assimilation: 3D-Var for upper air, OI for surface
  - +36h forecast, 4 times/day.

Harmonie vs. Radar

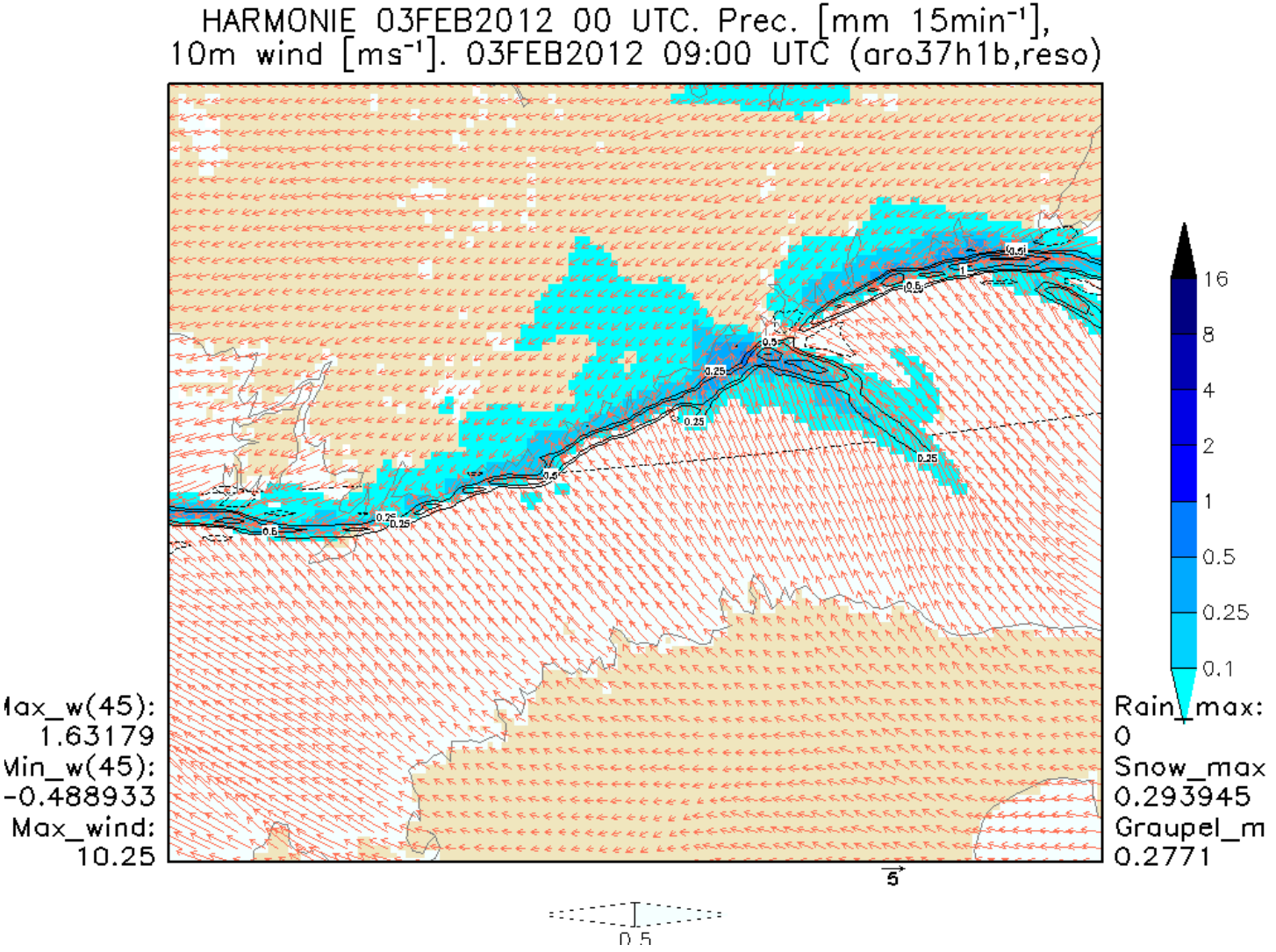
1h-prec [mm] , 00UTC +9h



Reflectivity [dBZ], 3 Feb, 09 UTC

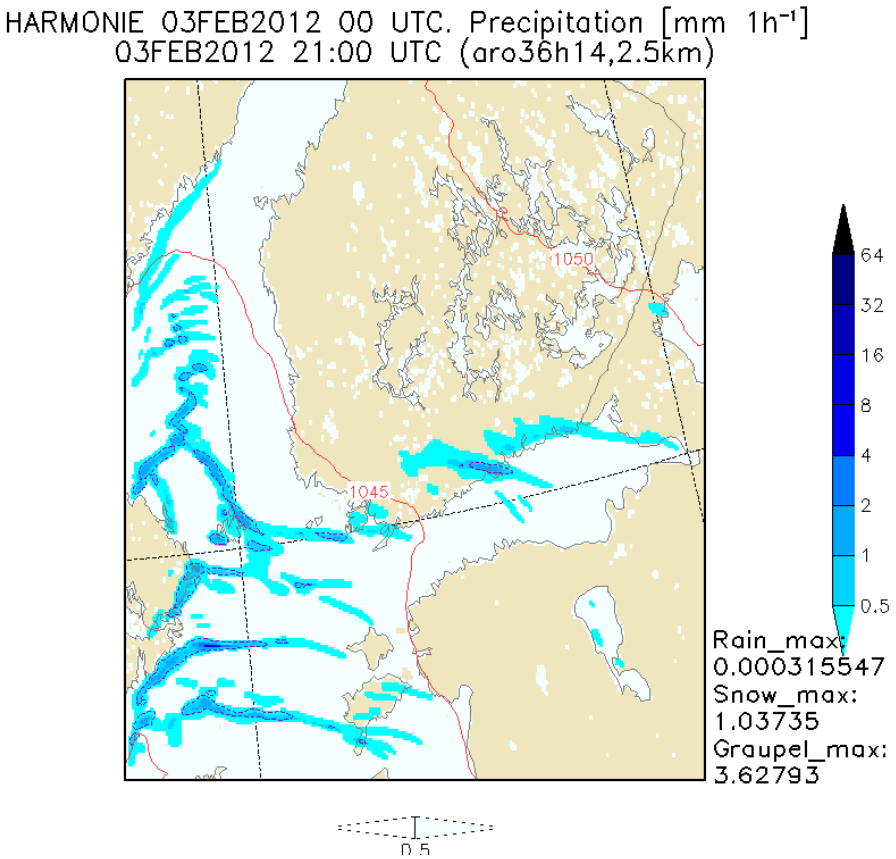


Harmonie – precipitation, 10m-wind, w

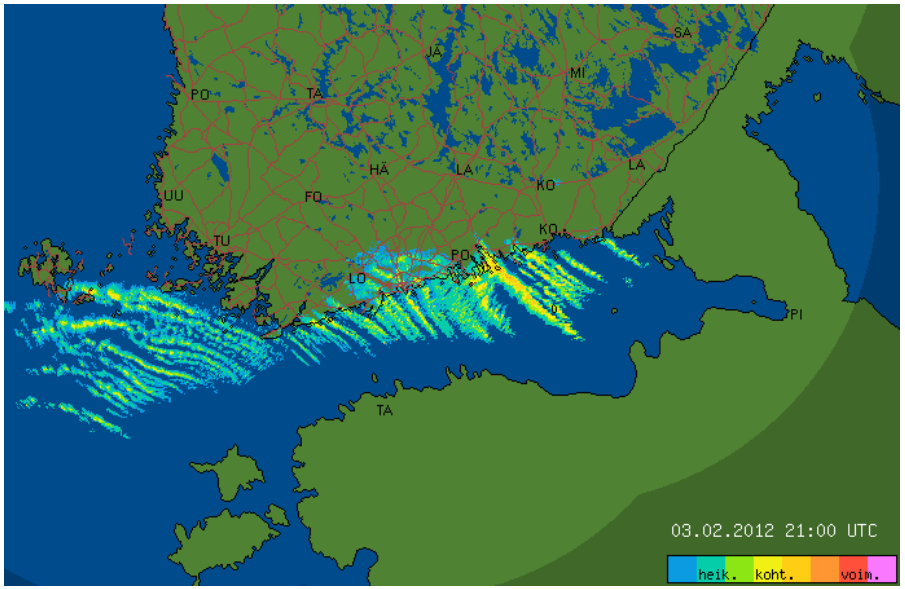


Harmonie vs. Radar

1h-prec [mm] , 00UTC +21h

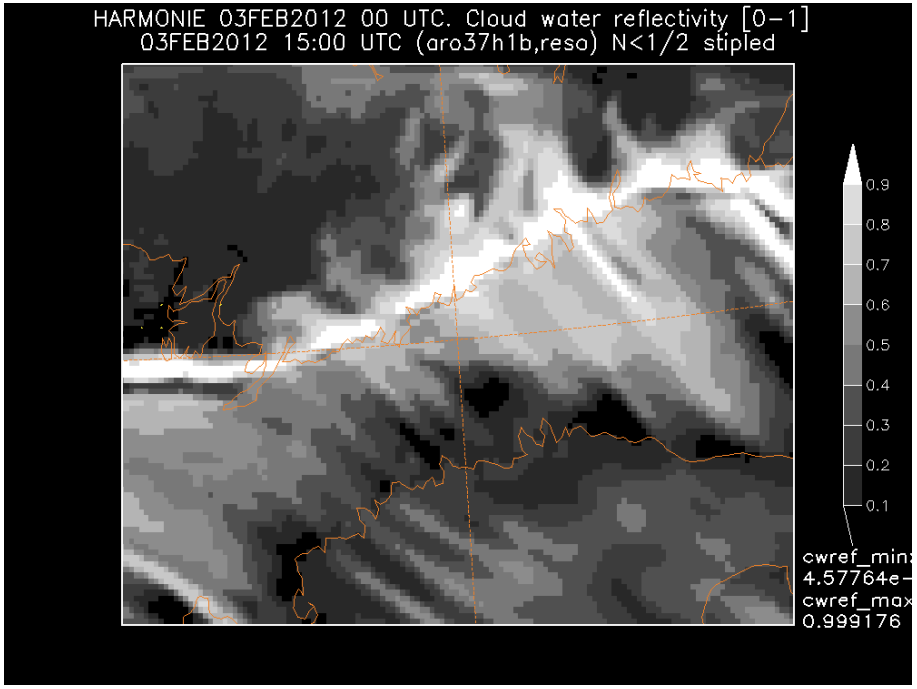


Reflectivity [dBZ], 3 Feb, 21 UTC

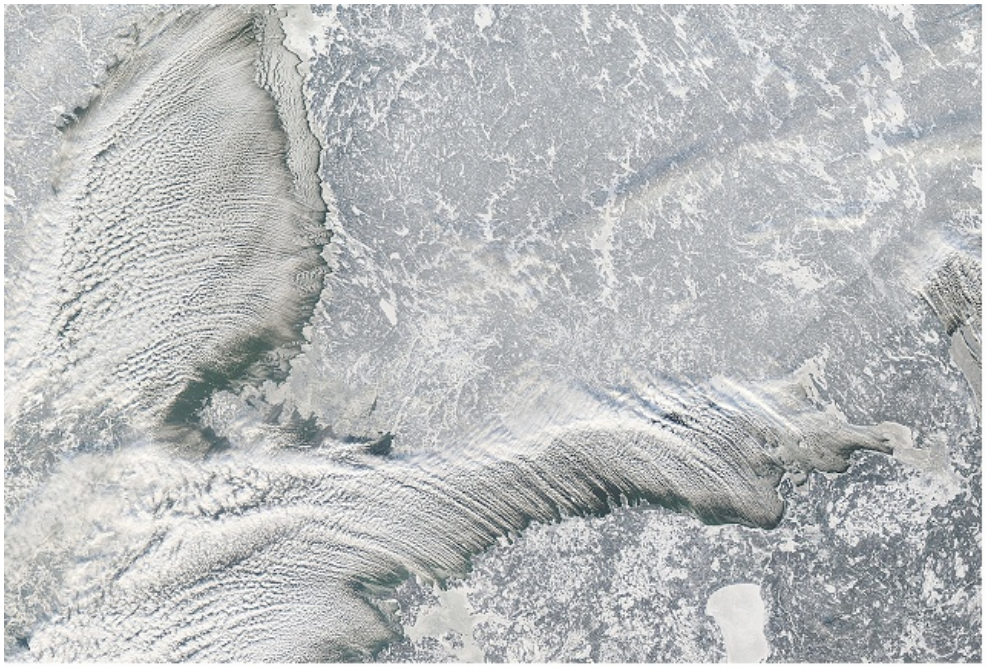


Harmonie vs. MODIS

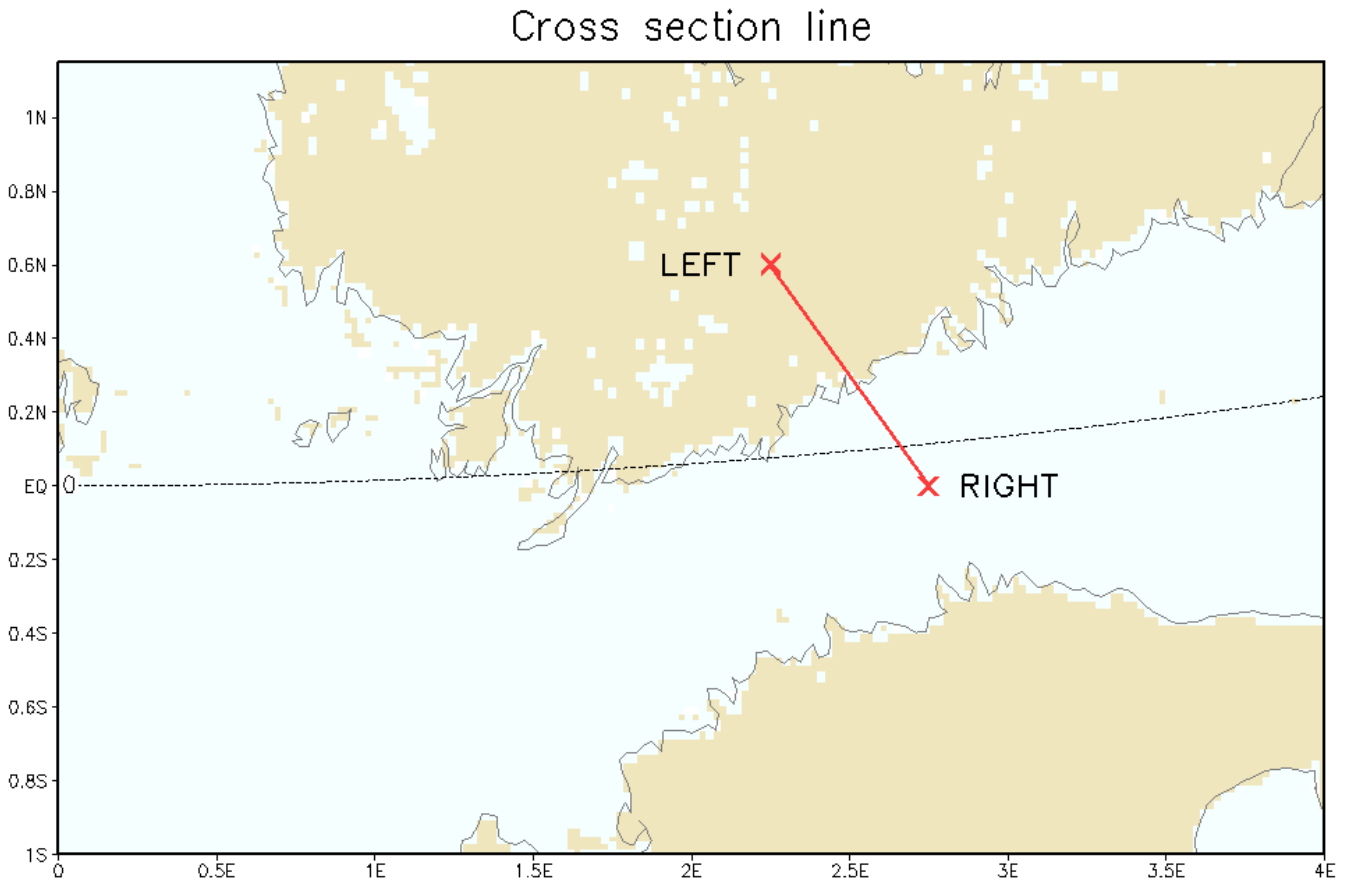
Cloud reflectivity , 00UTC +15h



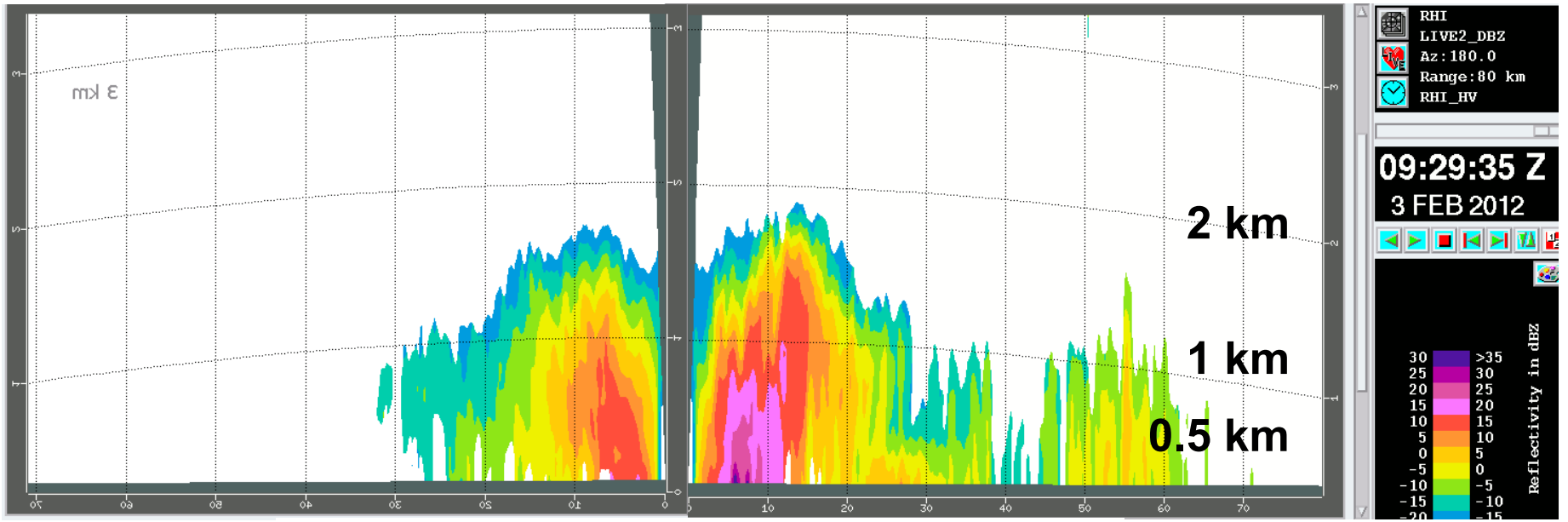
MODIS, 3 Feb, afternoon

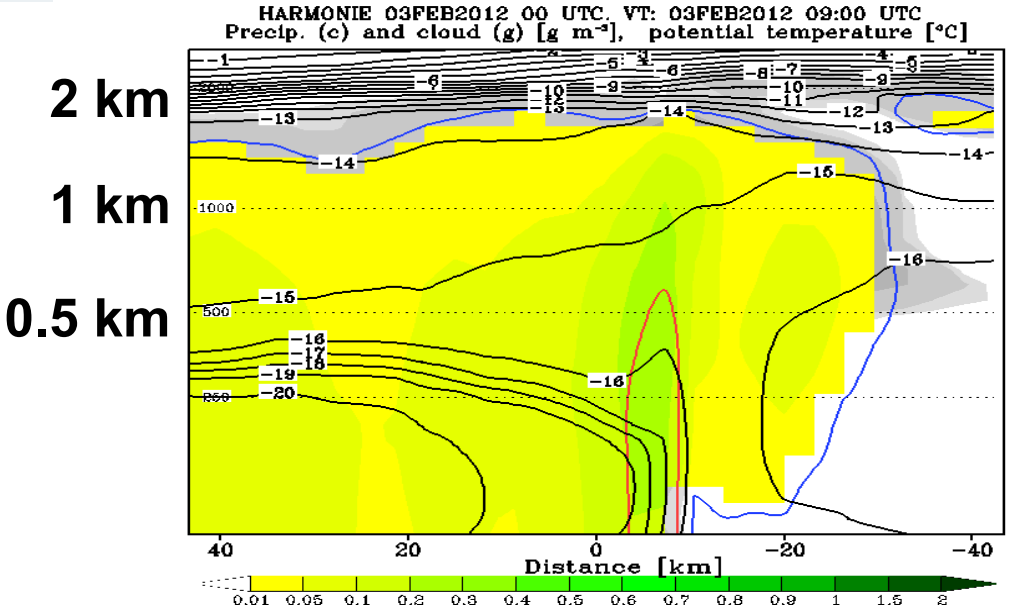


Vertical structure

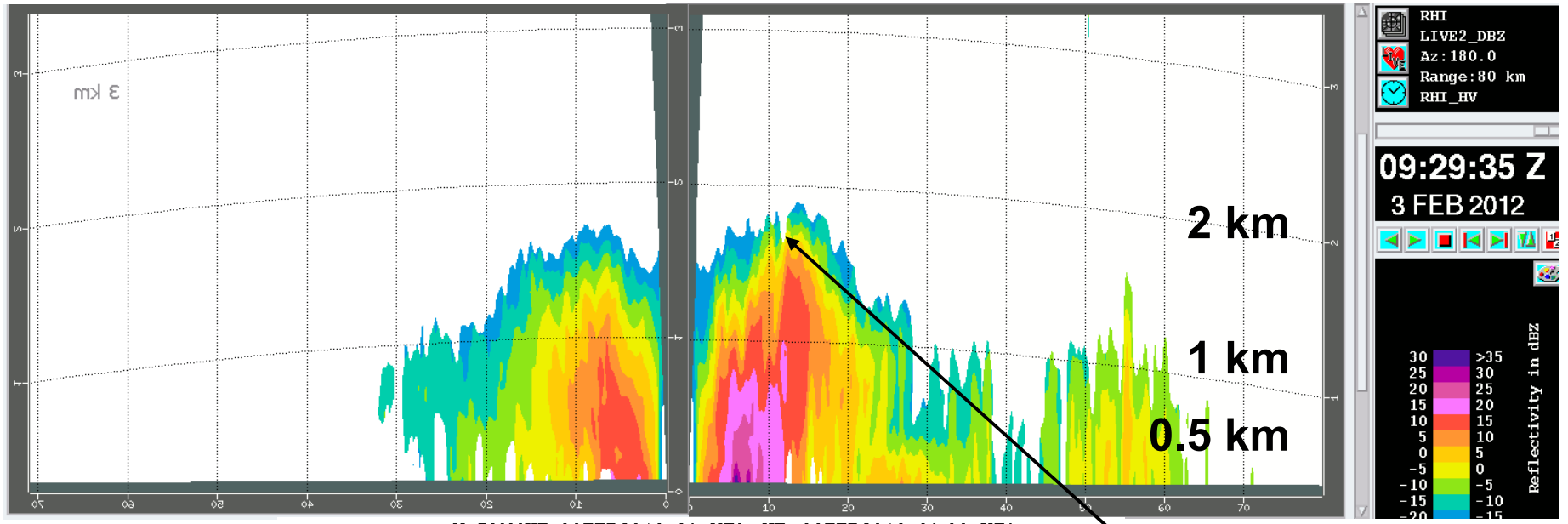


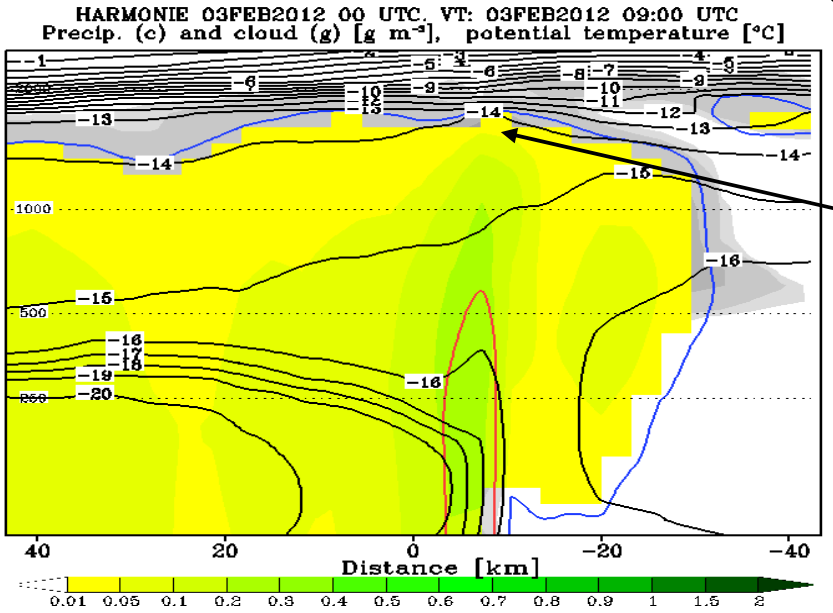
Vertical structure





Vertical structure





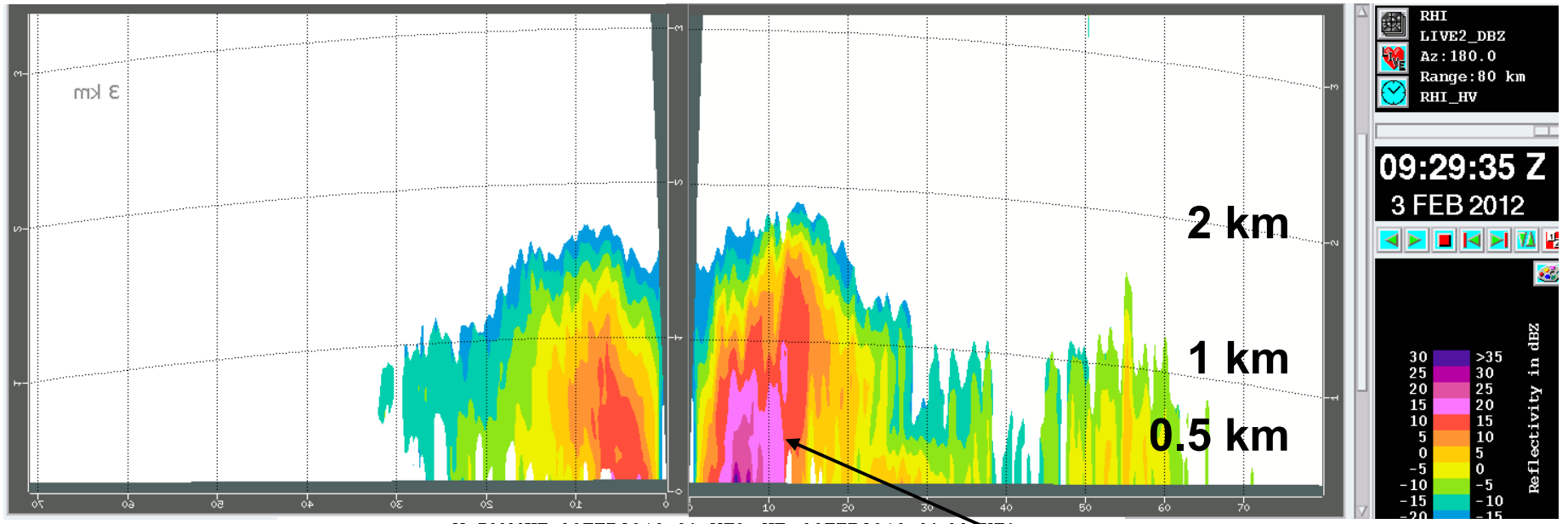
2 km

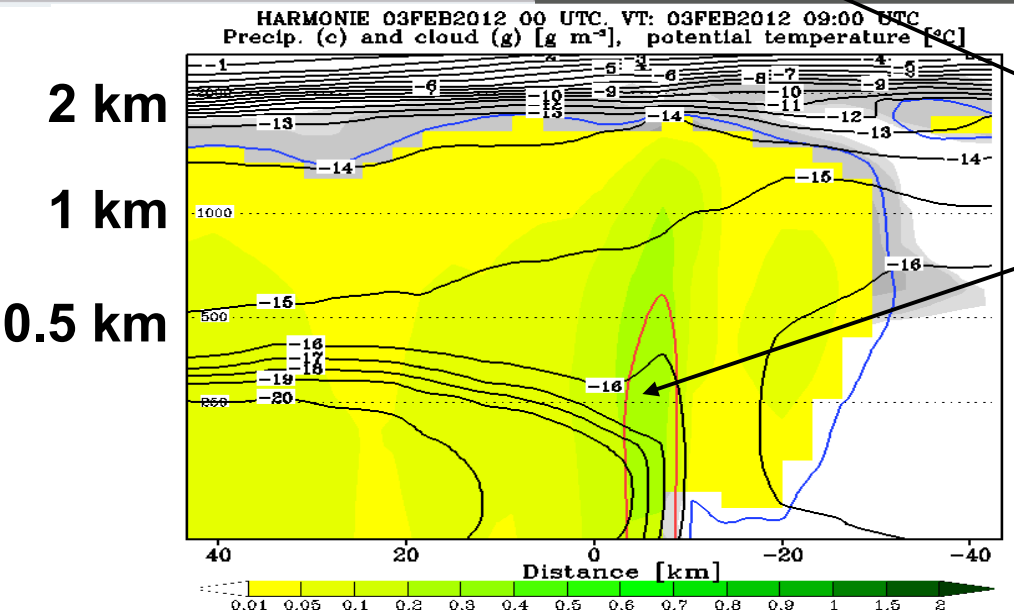
1 km

0.5 km

Top between 1.5 – 2 km

Vertical structure





Mesoscale vortex over Gulf of Finland, 5 Feb 2012, 06 UTC

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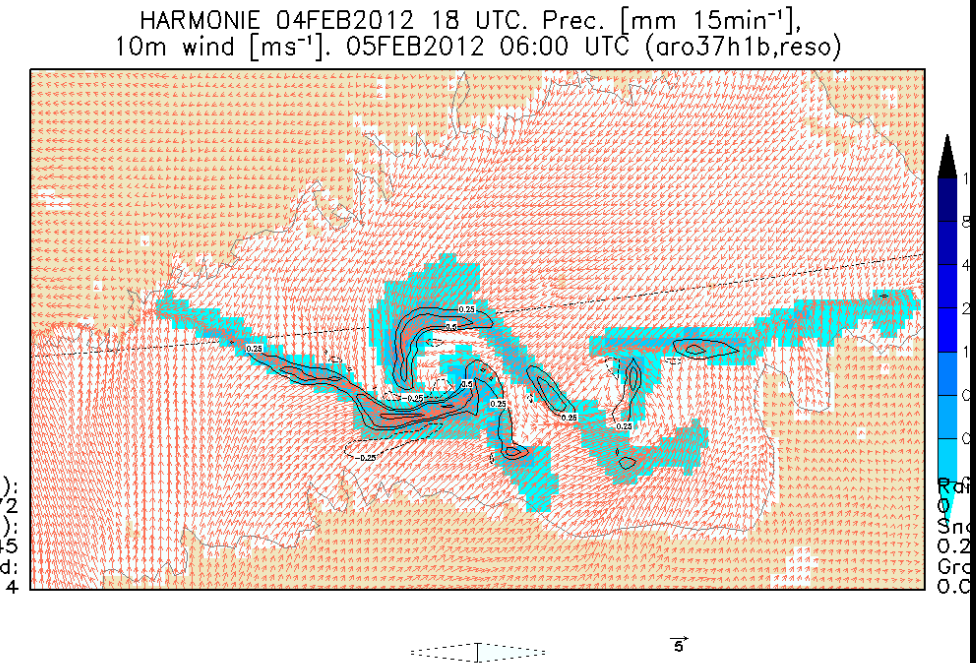
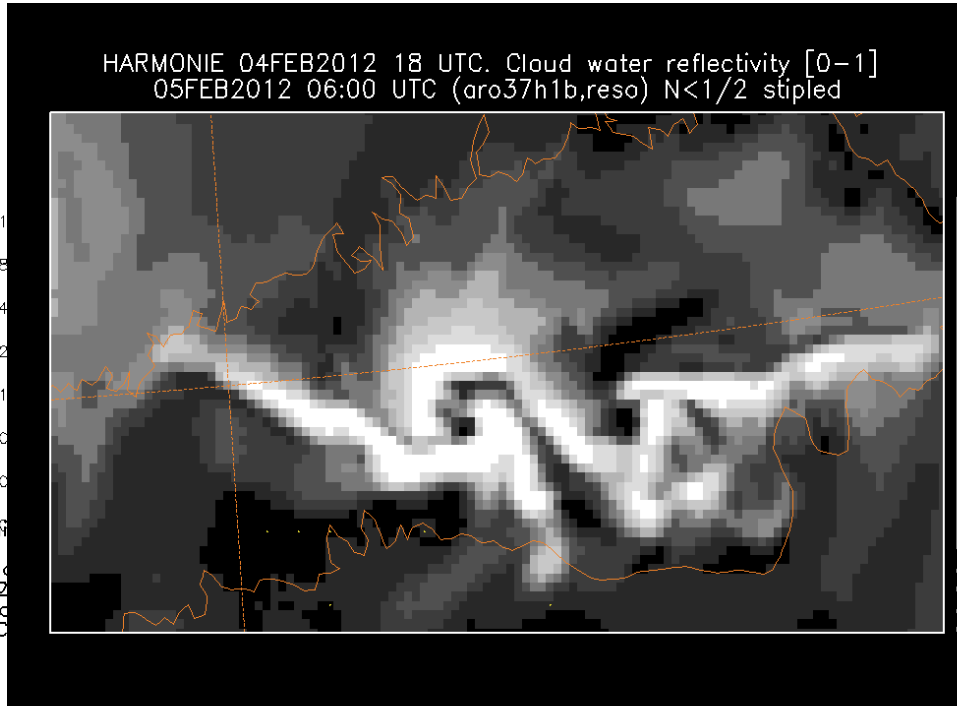




Summary

• Winter convection case causing multiple pile-ups in Southern Finland, 3 Feb 2012 → Part of the 5-day “lake effect snow” episode

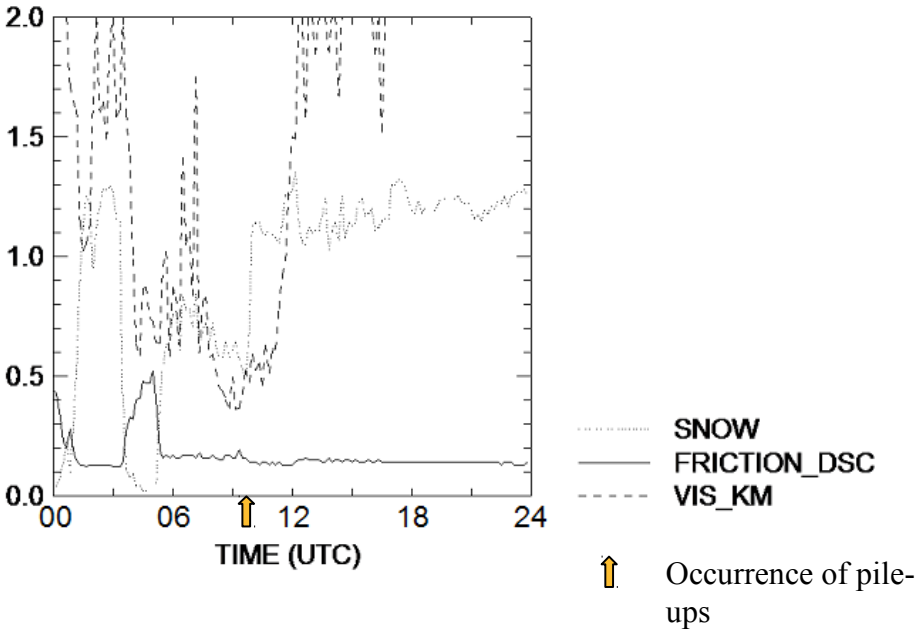
• Harmonie was able to form the convective snow band parallel to the Gulf of Finland and mesoscale vortex

• The vertical structure of the main snow band was well captured by Harmonie

• Harmonie struggled in forming the narrow precipitating snow bands perpendicular the coast line

THANK YOU

Jakomäki RWS observations: Snow in equivalent mm and friction (scale 0.1-0.82) by optical DSC111 device, visibility (km)



Radar based 12h precipitation, 3 Feb 2012, 06 – 18 UTC