Läänemere põhjaosas toimunud järveefektist põhjustatud ekstreemsete lumesadude analüüs

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1 – Tartu Ülikool
2 – Tallinna Tehnikaülikool
3 – Soome Meteoroloogia Instituut
4 – Eesti Keskkonnaagentuur
5 – Eesti Keskkonnauuringute Keskus

Eesti kaugseirepäev Tõraveres 27. okt 2016

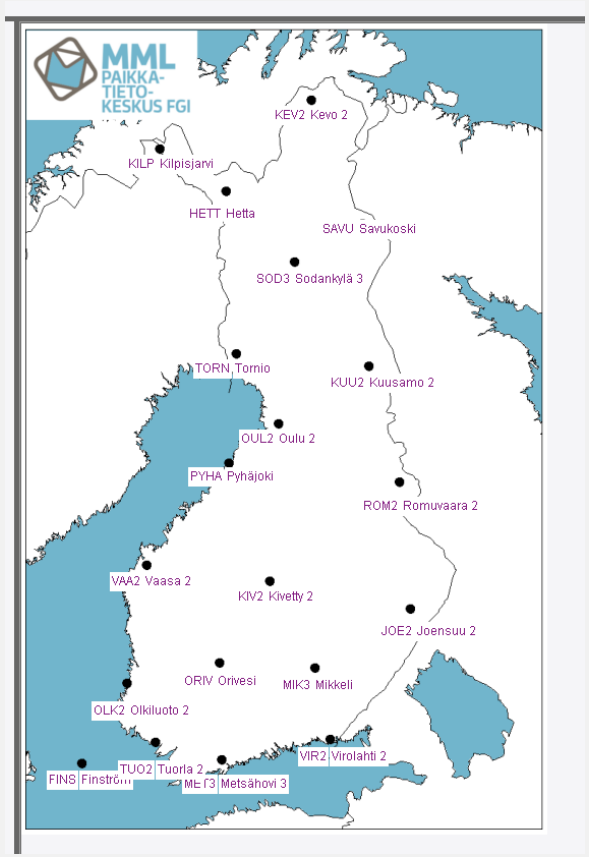
Väga tugev lumesadu Soomes
8. jaanuaril 2016, Merikarvia - 73 cm 24 tunniga

Alates 2. jaanuarist tugevad lumesajud Soome lahe kohal ning Eesti põhja- ja Soome lõunarannikul

Kas GNSS IPW võiks anda mingi lisandväärtuse sellise ekstreemse lumesaju täpsemaks ennustamiseks Läänemere põhjaosas?

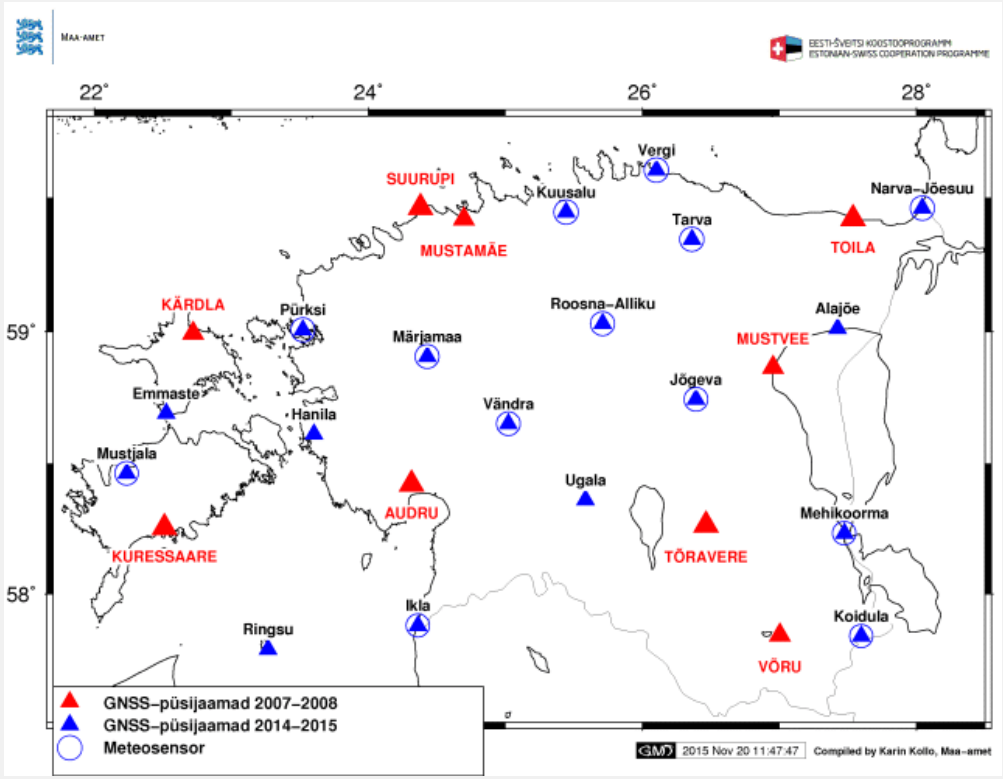
GNSS - global navigation satellite system
IPW – Integrated Precipitable Water

Tehnilised võimalused (GNSS jaamad)



+ sites from EUREF, IGS and Russia
(data provided by CAO and IGA)

+ ESTPOS



http://euref-fin.fgi.fi/fgi/en/positioning-service/finnref-stations

http://geoportaal.maaamet.ee/est/Andmed-ja-kaardid/Geodeetilised-andmed/Geodeetilised-vorgud/GNSS-pusijaamad-p288.html
Data provided by Estonian Land Board:
https://www.maaamet.ee/index.php?lang_id=2&page_id=52&menu_id=51&no_cache=1457254753

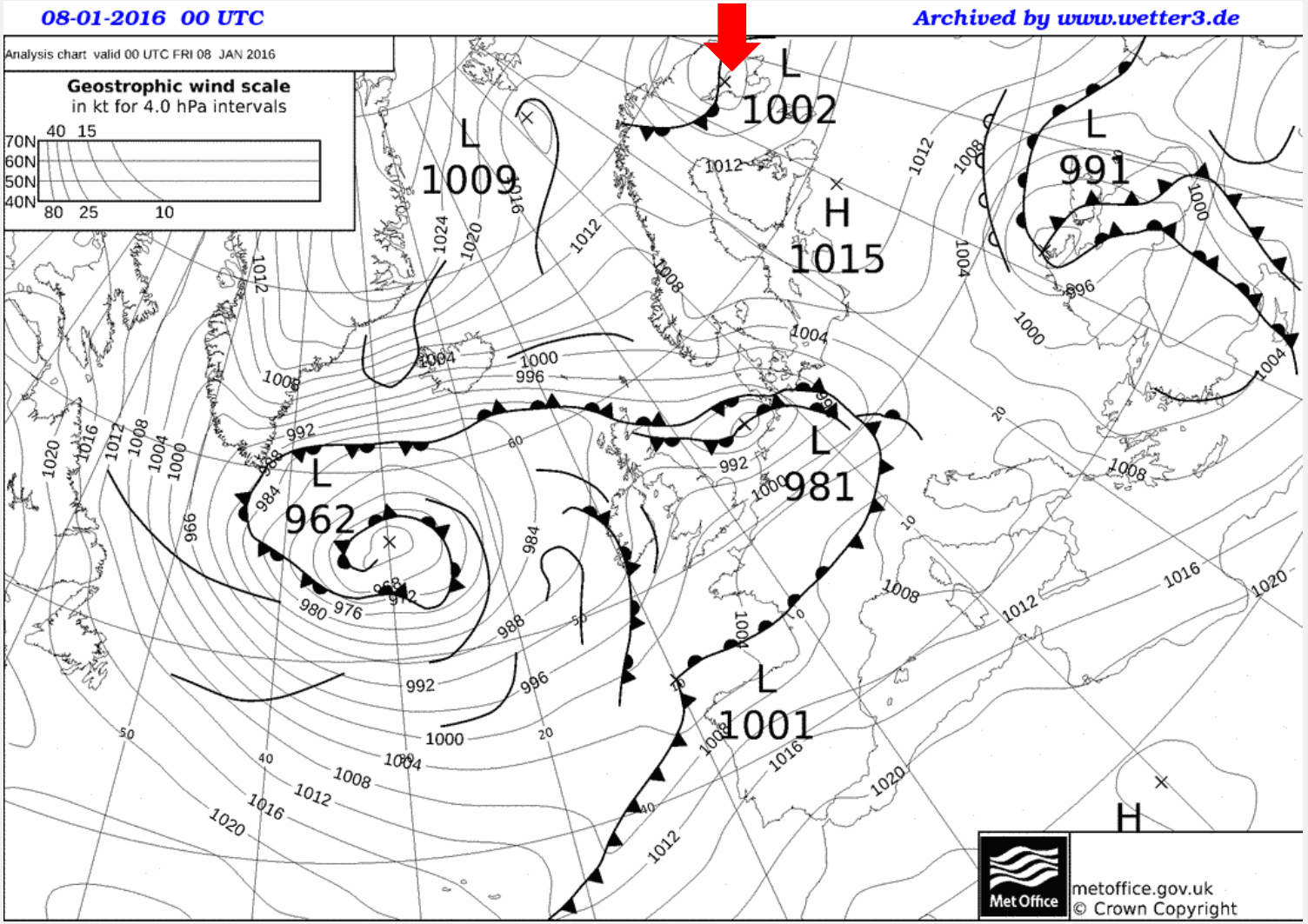
Data

GNSS sites (42 in this experiment) from ESTPOS, EUREF, IGS, FinnRef and Russia (data provided by CAO and IGA)

GNSS-data processed by GAMIT/GLOBK software.

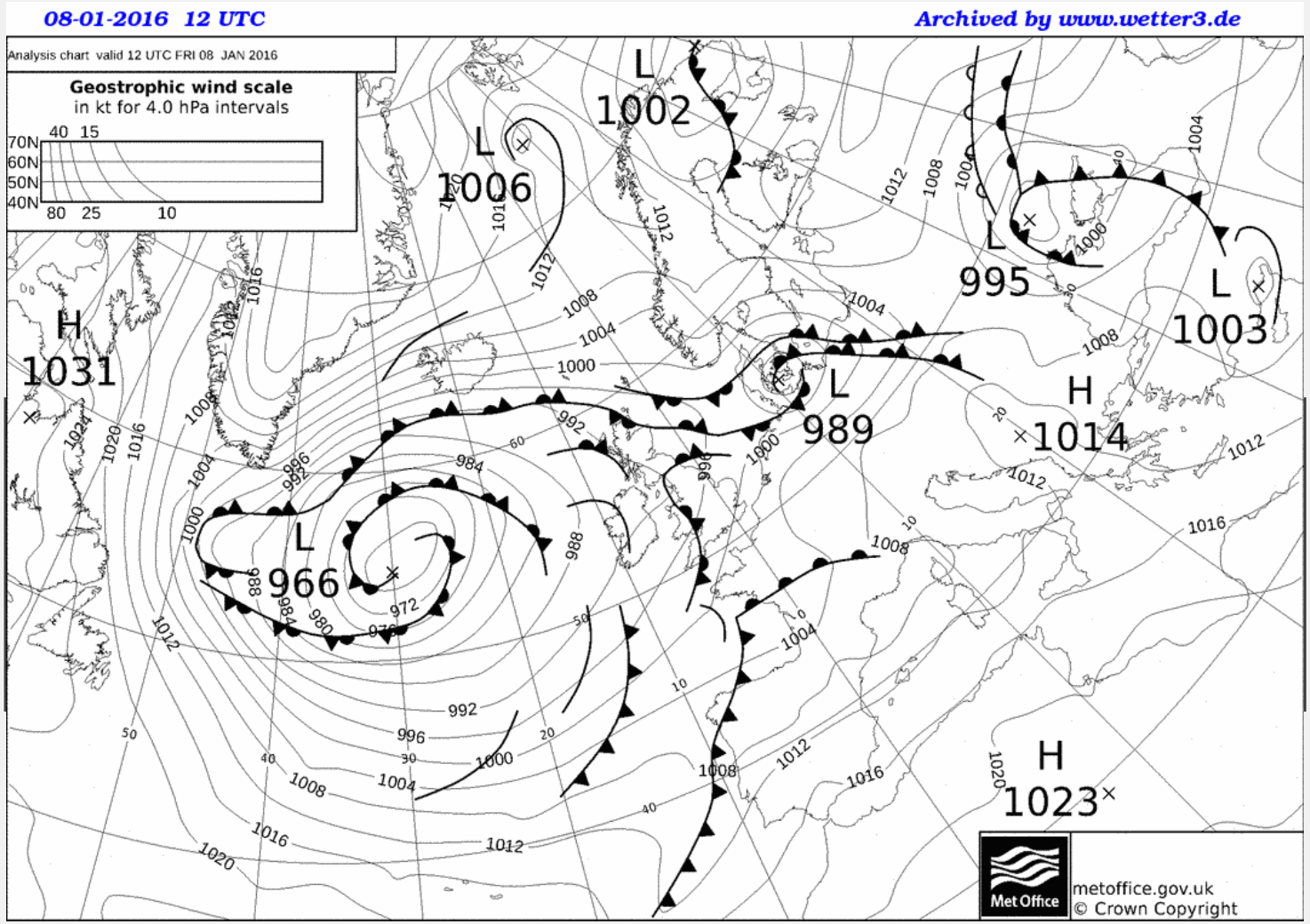
Meteorological data from FMI, Estonian Environmental Agency (EEA), CAO (Russia)


animatsioon



UK Metoffice weather map for 8 Jan 00 UTC

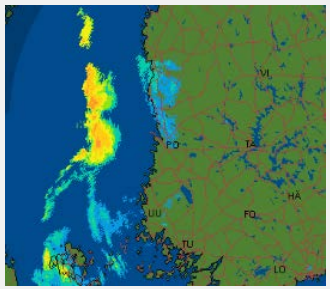
After long time of high pressure, a cyclone is approaching from NE
Difference in the sea surface temperature and air temperature >20 K



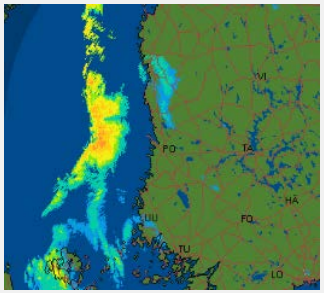
UK Metoffice weather map for 8 Jan 12 UTC

Merikarvia 2016: By Finnish radar – start 8. Jan. 00:00 – end: 8.Jan. 11:00

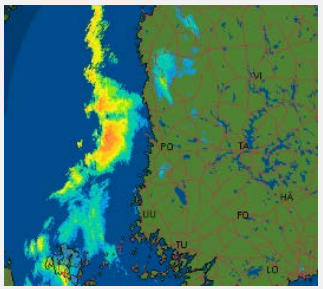
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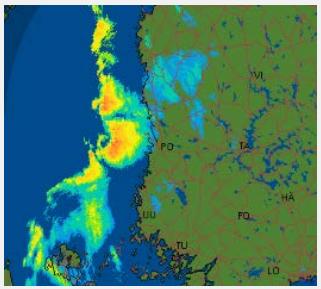
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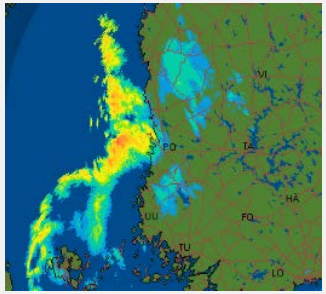
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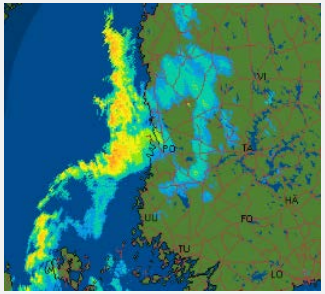
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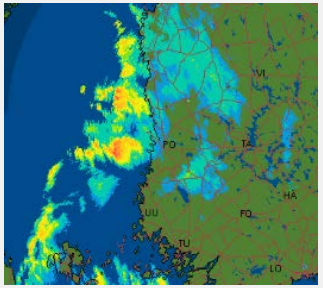
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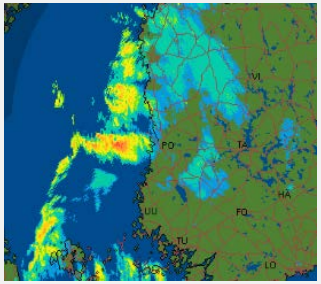
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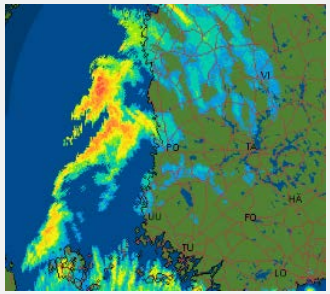
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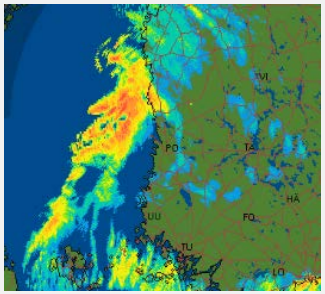
07:00



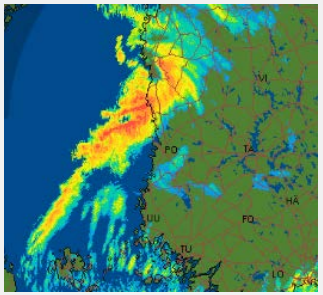
08:00 *)



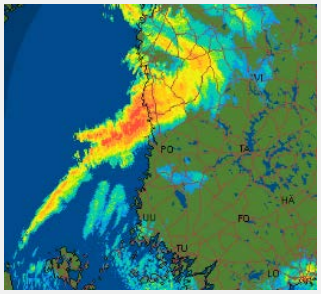
09:00



10:00

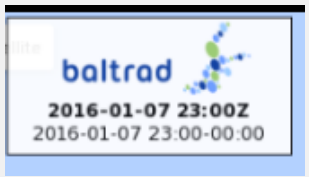


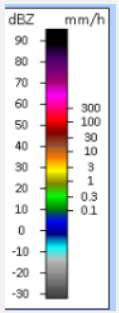
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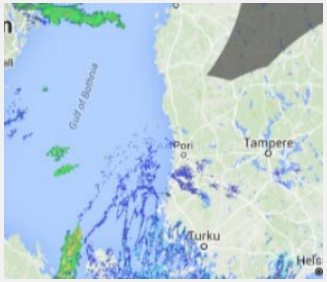
*) 8:00 snowing starts at the coast

Merikarvia 2016: By radar – start: 8. Jan. 10:00 – end: 9. Jan. 01:00

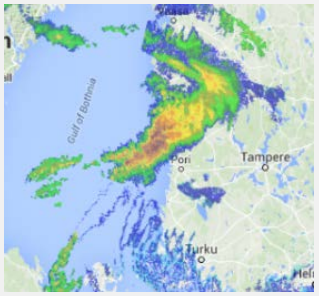




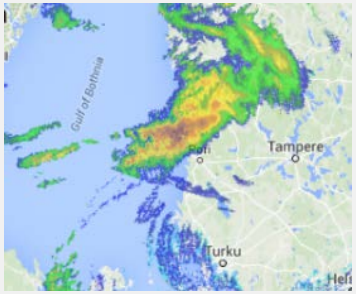
10:00 *)



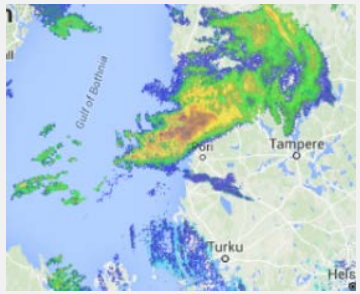
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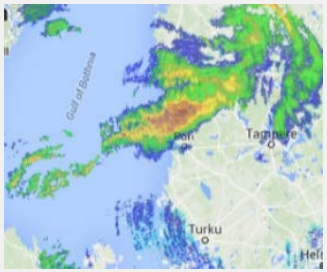
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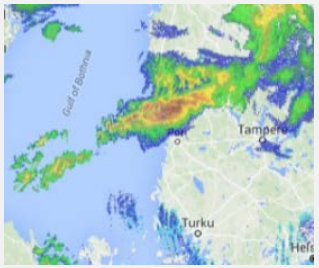
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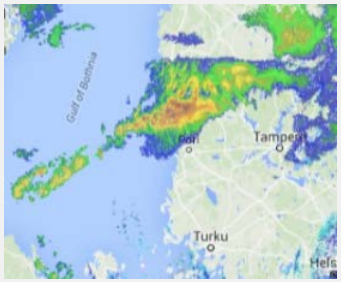
14:00



15:00



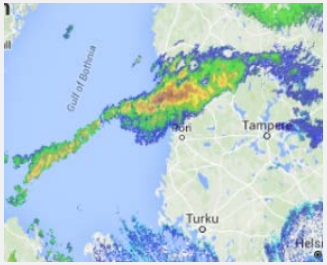
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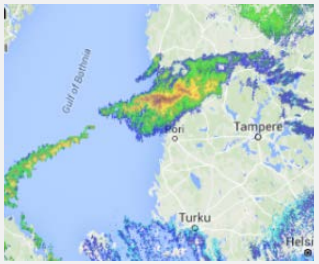
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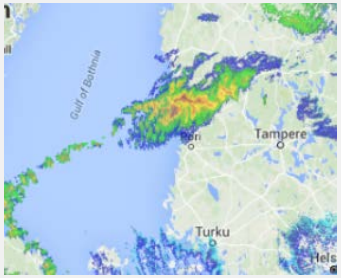
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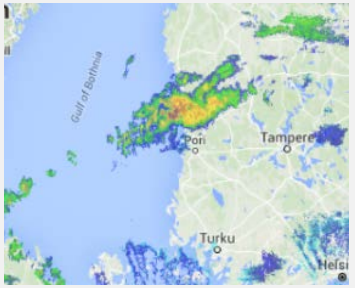
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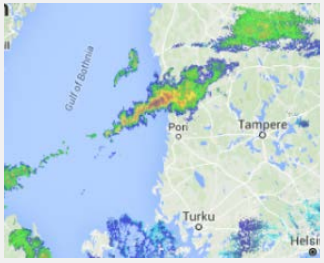
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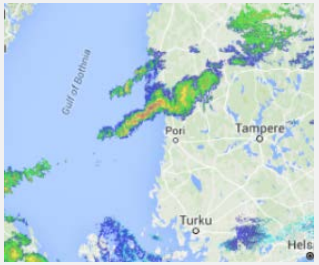
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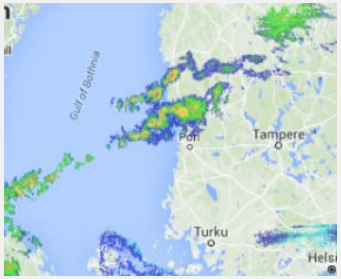
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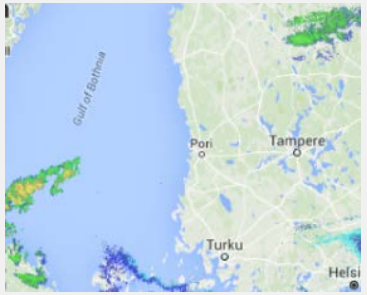
23:00



19. Jan. 00:00



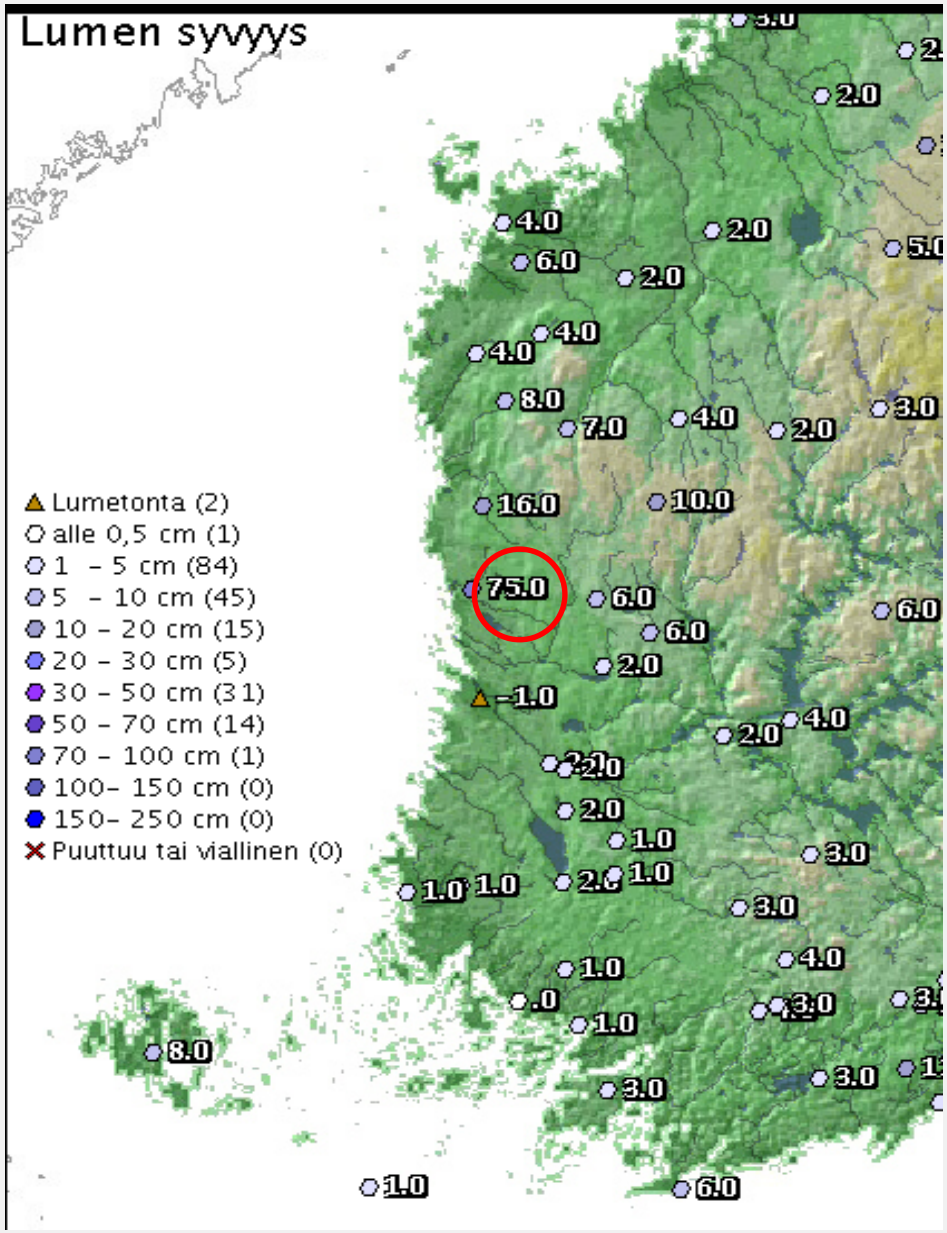
19. Jan. 01:00



*) Data missing from Baltrad

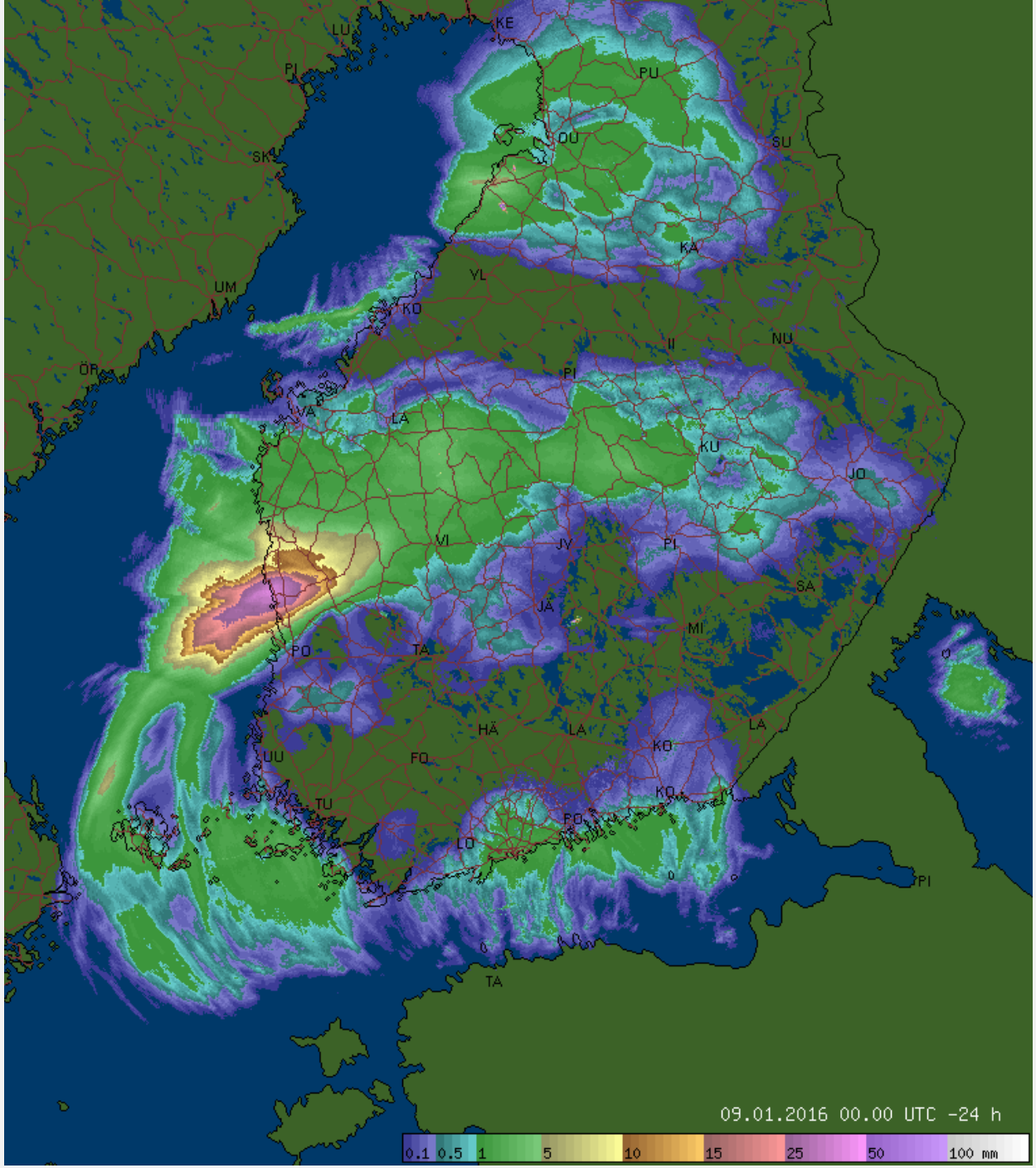
How it looked like:

http://yle.fi/uutiset/talta_nayttaa_merikarvian_lumi-ihme_mittaustulos_73_cm/8582081



… and on the map of snow depth

Intensive snowfall was detected at the sea area. Relatively a small area around Merikarvia has enjoyed the snow-wonder. The surrounding points show only a few centimeters of snow depth.

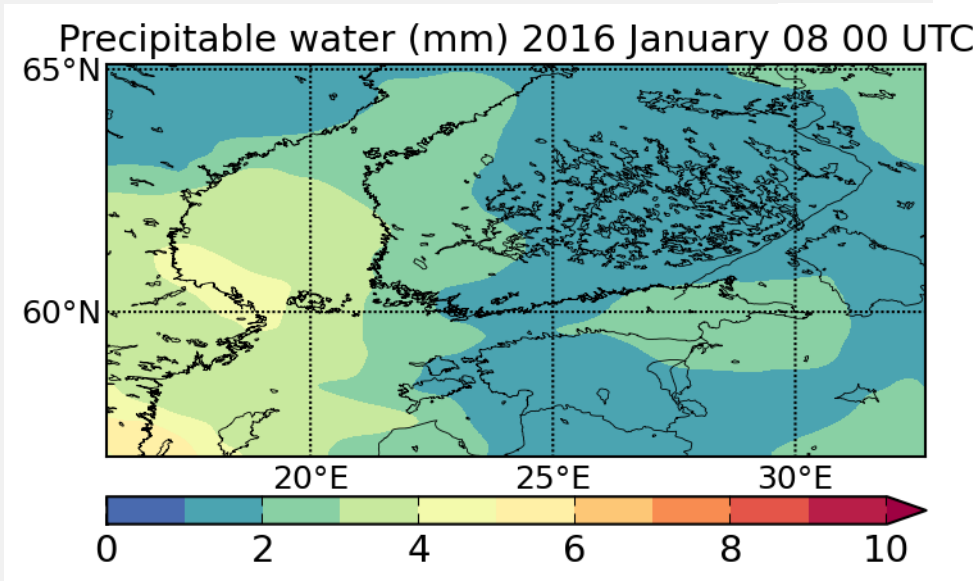


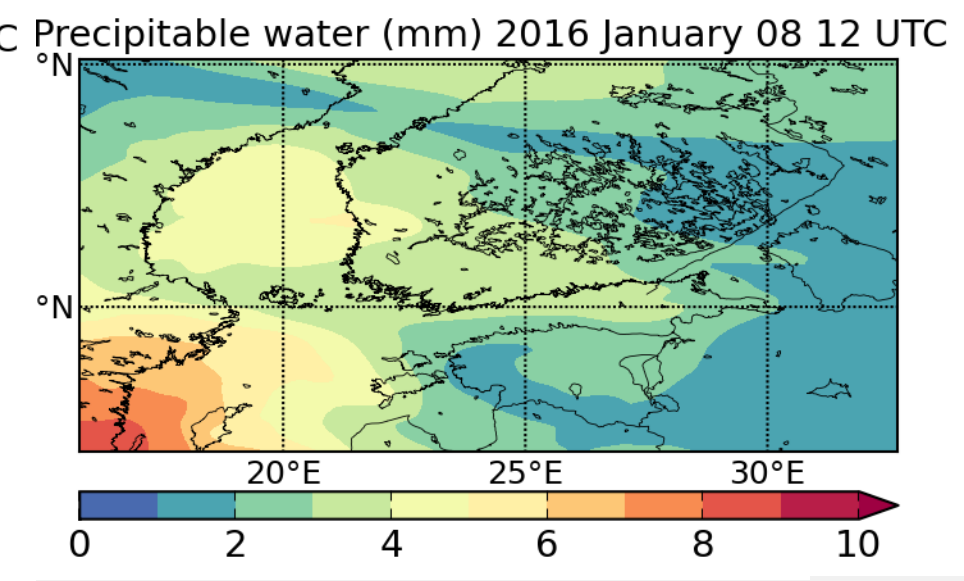
Soome radarite 24 h akumulatsioon

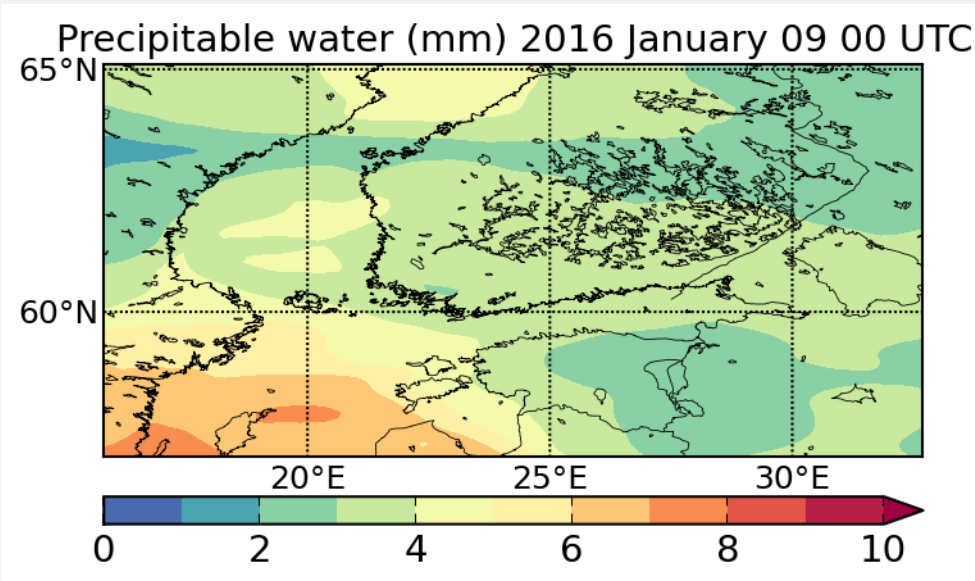
Merikarvia umbes

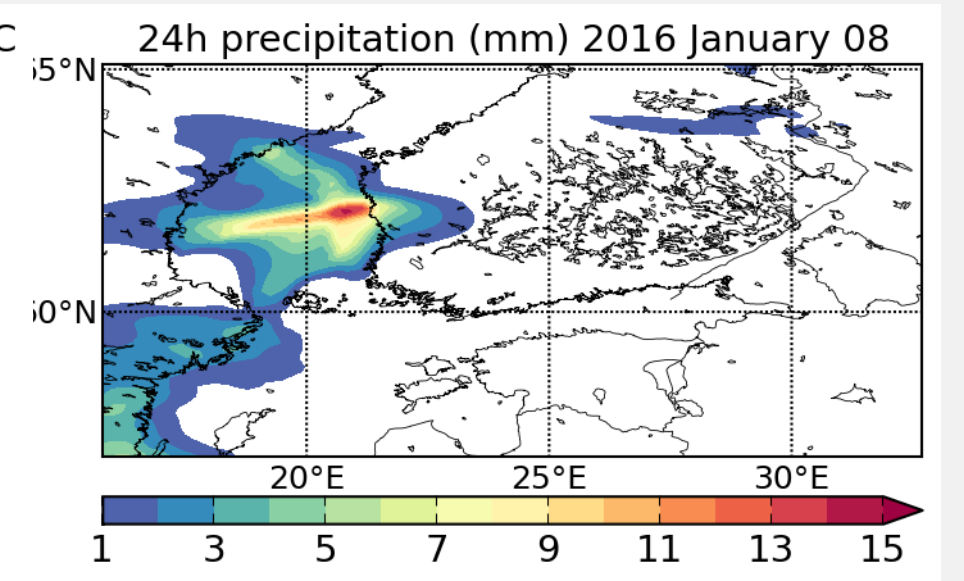
25 mm

Model IPW and precipitation (EEA HIRLAM)

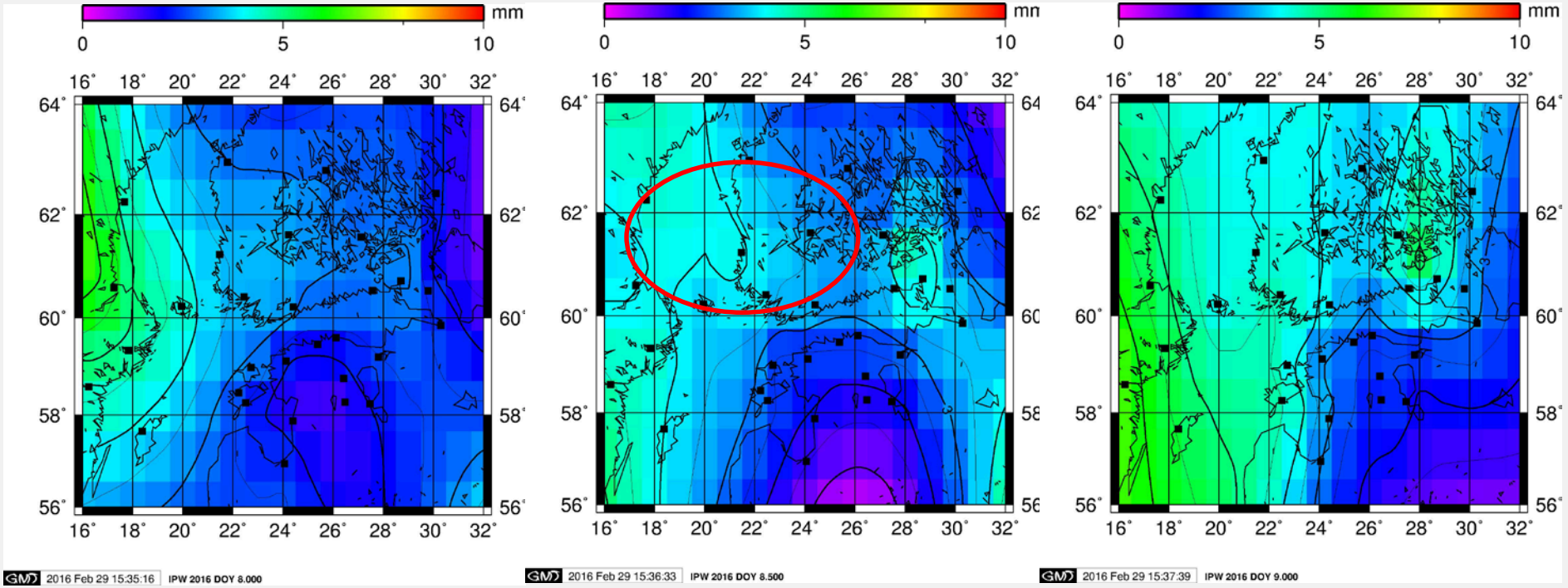


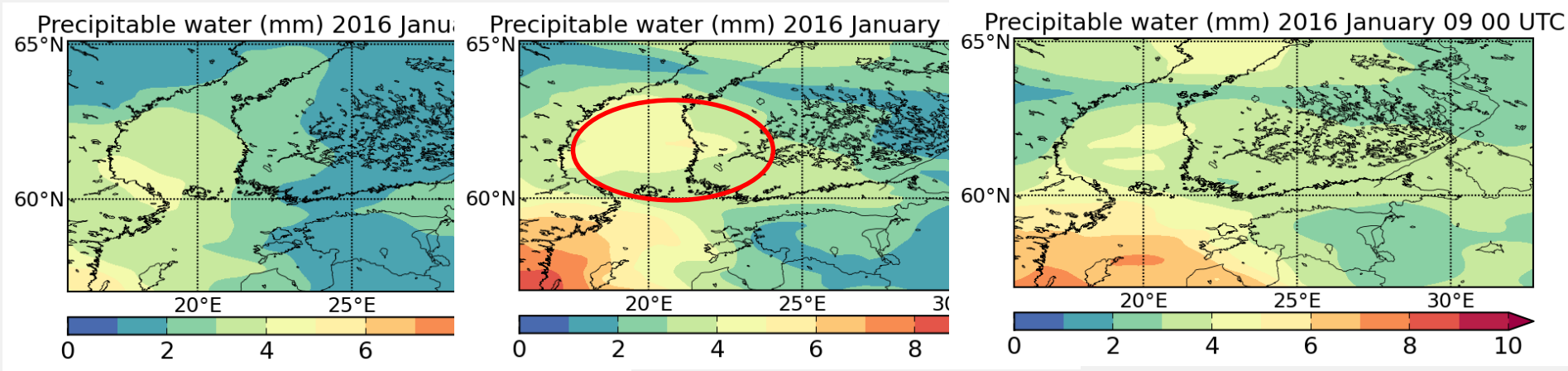




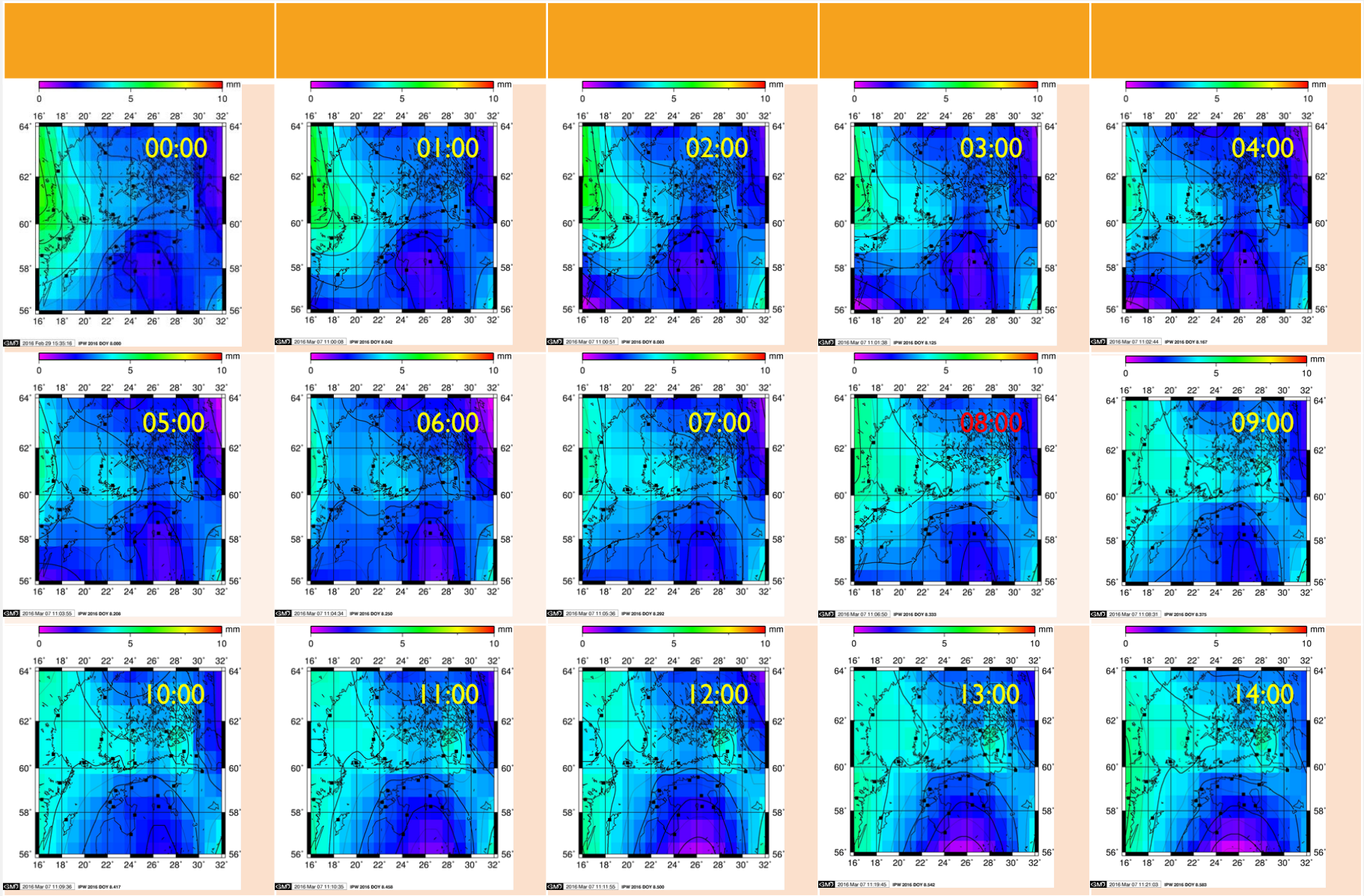


Model IPW and GNSS-IPW (8-9 Jan)

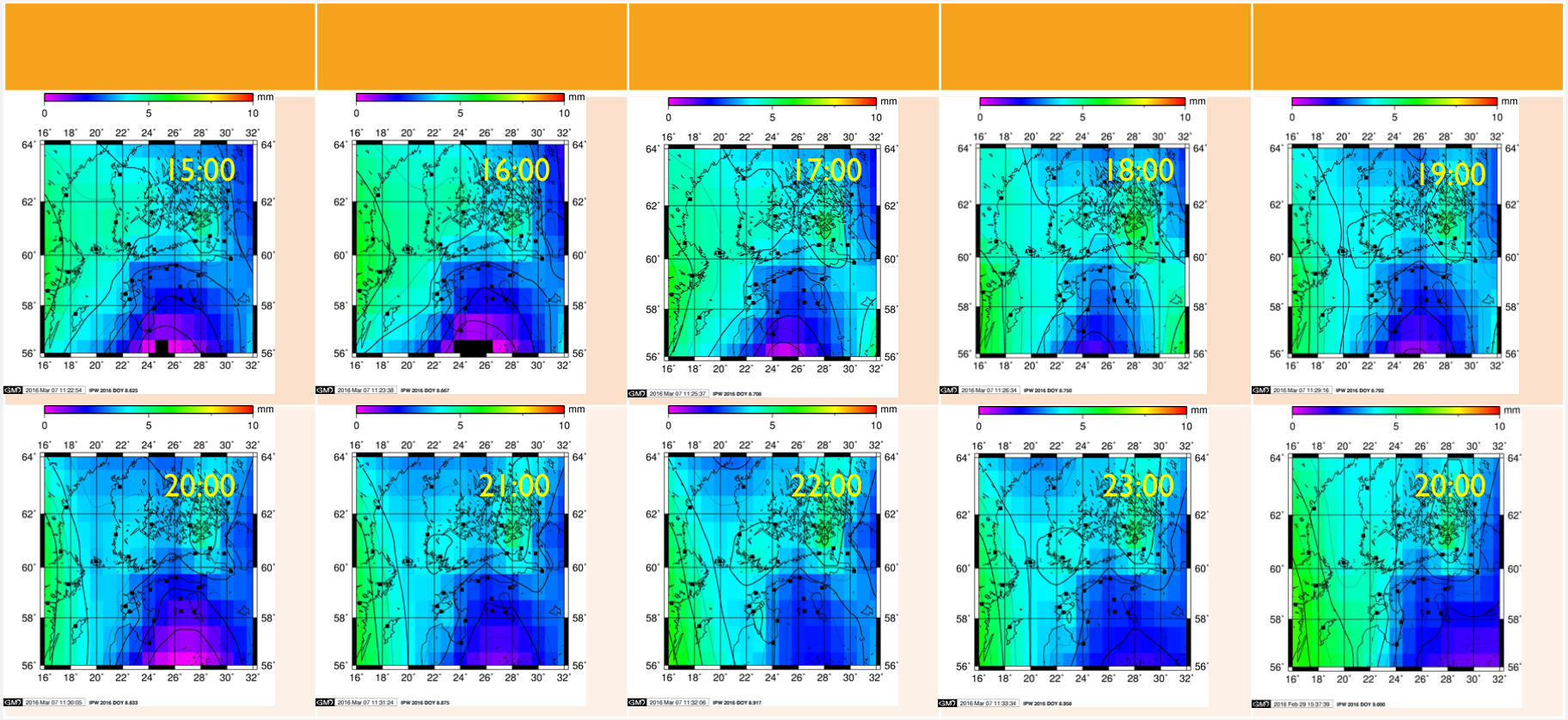




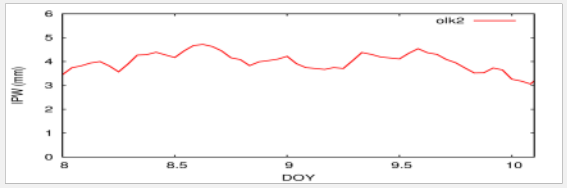
GNSS-IPW 1h steps (8. Jan)

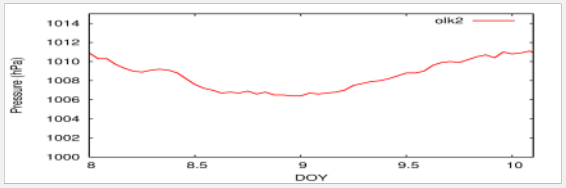


GNSS-IPW 1h steps (8. Jan)



IPW and Pressure at Olkiluoto (OLK2) – the closest GNSS site to Merikarvia (8.-9. Jan)





Comparing GNSS-Radiosonde-HIRLAM

	Radiosonde* -IPW	GNSS-IPW	HIRLAM
SUR4 (Harku)	2016 01 08 00:00 1.60 2016 01 08 12:00 2016 01 09 00:00 3.51 2016 01 09 12:00	2.08 +/- 0.6 2.86 +/- 0.6	1.86 2.29 3.53 3.85
OLK2	2016 01 08 00:00 2016 01 08 12:00 2016 01 09 00:00 2016 01 09 12:00	3.45 +/- 0.75 4.17 +/- 0.45 4.22 +/- 0.74 4.11 +/- 0.45	3.00 4.52 3.46 3.14
TUO2	2016 01 08 00:00 2016 01 08 12:00 2016 01 09 00:00 2016 01 09 12:00	3.32 +/- 0.72 4.07 +/- 0.44 4.62 +/- 0.74 3.43 +/- 0.45	2.14 3.51 3.02 3.51
FINS	2016 01 08 00:00 2016 01 08 12:00 2016 01 09 00:00 2016 01 09 12:00	4.38 +/- 0.68 3.61 +/- 0.41 4.16 +/- 0.68 3.53 +/- 0.41	3.72 3.69 3.87 4.33
VAA2	2016 01 08 00:00 2016 01 08 12:00 2016 01 09 00:00 2016 01 09 12:00	3.00 +/- 0.74 3.49 +/- 0.45 4.05 +/- 0.73 4.10 +/- 0.44	2.27 3.50 3.02 3.37

*) Jokioinen RS not included due to missing surf. met. data from nearby GNSS.

Conclusions

- Merikarvia “snow-event” can be characterized as very local. The intensive precipitation area at the coast does not extend more than 25-30 km. The nearest GNSS-site is located at Olkiluoto (OLK2) – 50-60 km from Merikarvia.

- The GNSS-network is not dense enough to detect accurately this event (no sites in the sea and the coastal sites are located relatively far).

- However, the overall tendencies at the sites and the wide-area distribution of IPW is detected reliably. Comparing the IPW values with radiosonde (Suurupi/Harku) and HIRLAM and radar images, the results confirm well with what is got from GNSS.

- For high latitude winter extreme precipitation cases other data of water vapour are even less sensitive.

Future works and plans

- Continuing with refined study of Merikarvia event (by adding available GNSS-sites not included thus far and adding verified meteorological data to GNSS-IPW processing

- Finding possibilities to assimilate GNSS-data to HIRLAM (HARMONY) and to check whether it could improve the forecast

- Continuing with similar case-studies around the Gulf of Finland for getting better knowledge and developing a capability to predict intensive local snowfalls affecting both land- and air transport (airports).

Acknowledgements

Thanks to

- CAO and IGA from Russia for providing GNSS and meteorological data
- Estonian Land Board for GNSS and meteorological data from ESTPOS RTK network
- FMI for radar images and meteorological data,
- EEA for radar and meteorological data, model output

COST Action ES1206:
Advanced Global Navigation Satellite Systems tropospheric products for monitoring severe weather events and climate (GNSS4SWEC)

Baltic Sea - SST Analysis
sea surface foundation temperature
Date: 2016-01-08 00:00 UTC

