Nowcasting on Yr
Opportunities and challenges

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MET Norway

WeADL 2021 Workshop

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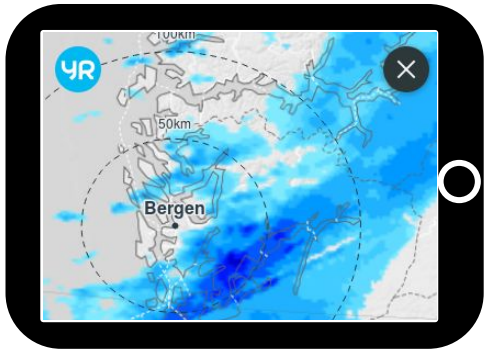
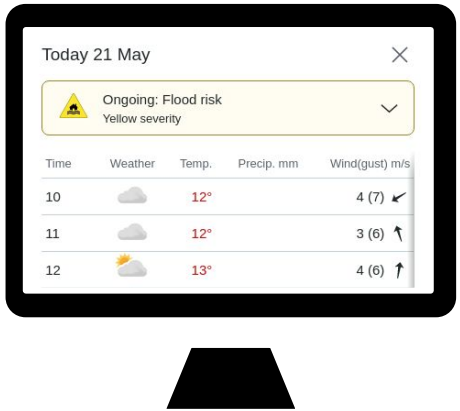
Overview of presentation

1) Introduction to Yr
2) How does the precipitation nowcast on Yr work?
3) Current developments on the Yr nowcast
4) Future perspectives

Introduction to Yr (www.yr.no)





- MET Norway's official weather forecasts
- Data provided by MET, visualization by NRK
- Global coverage with a Nordic focus
- 10 million weekly users
- Fully automated forecasting pipeline since 2014 (except weather warnings)

Introduction to Yr (www.yr.no)

Yr relies on a wide variety of weather data and updates forecasts continually

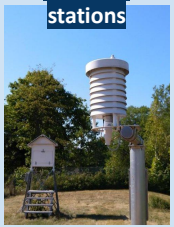
Observations

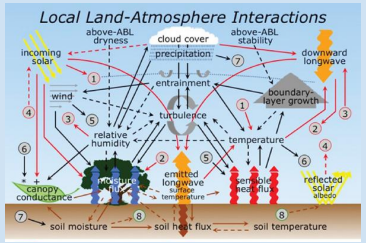
Physical models

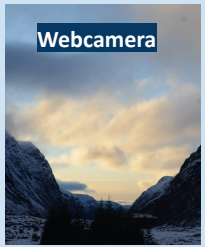
Conventional

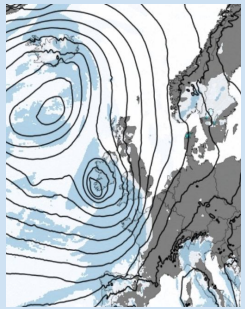
Crowdsourced

Weather stations





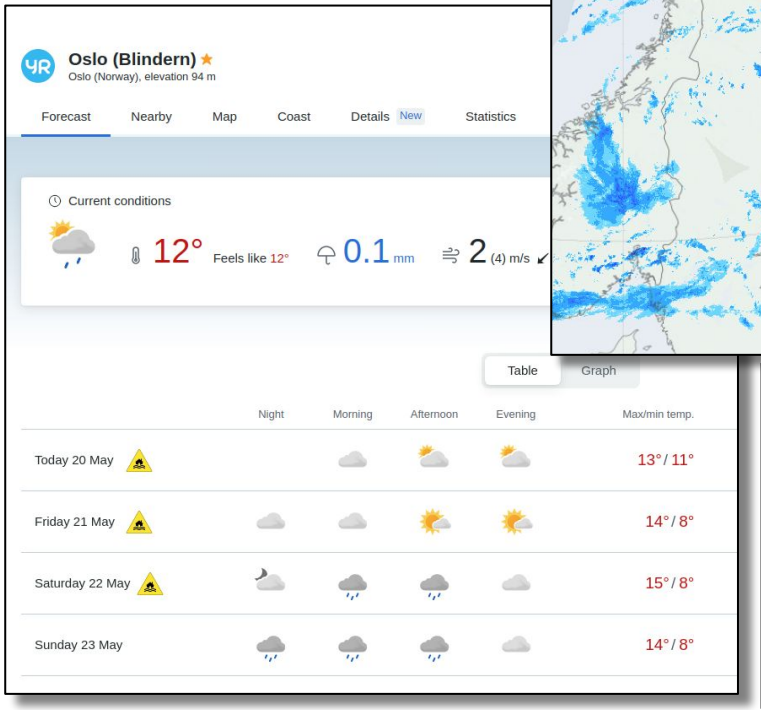


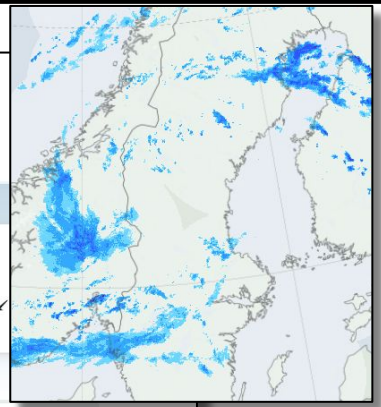


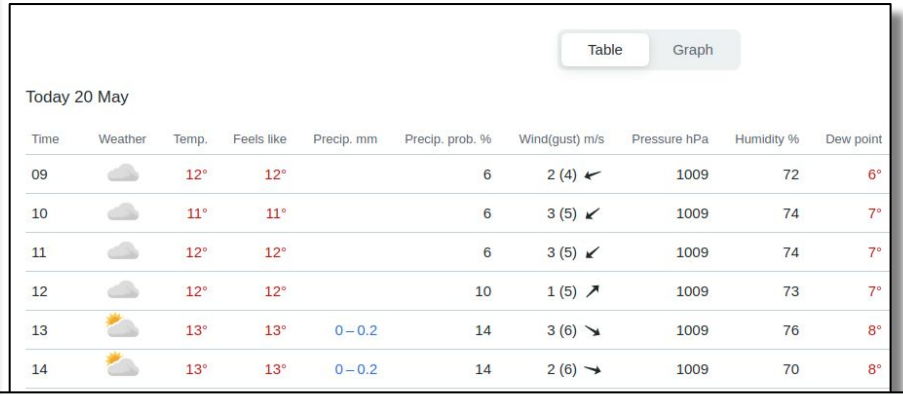
Near real-time integration

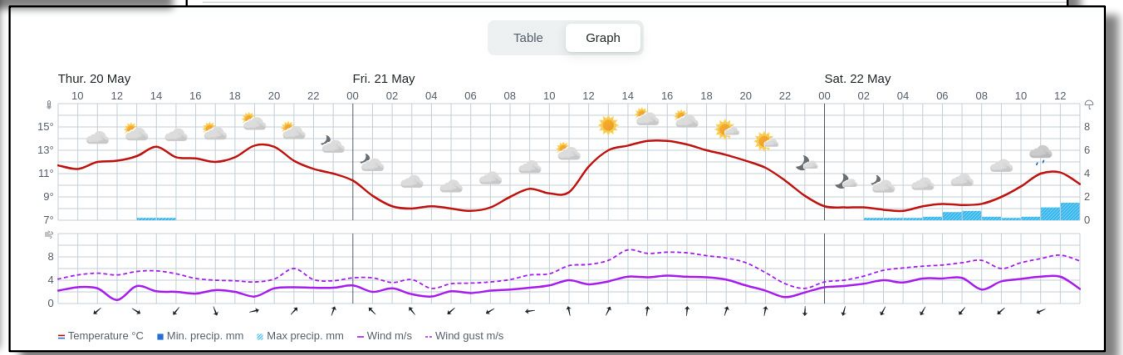
Introduction to Yr (www.yr.no)

Forecast provided at nowcasting to long-range (10d) time scales in a variety of presentation modes





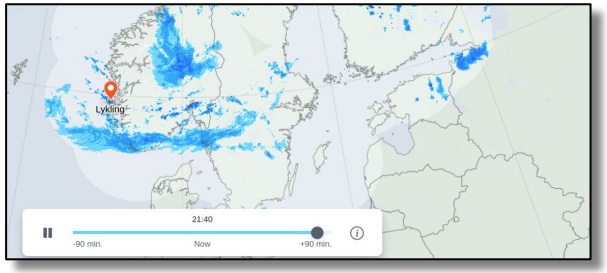




How does the precipitation nowcast work?

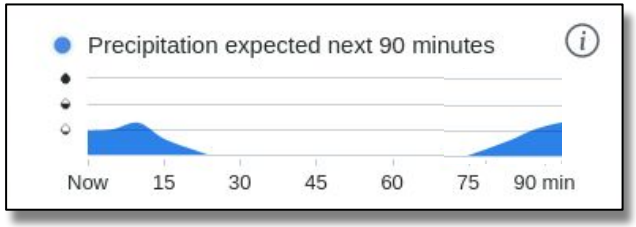
- Launched 2016
- 90 minute forecast
- Based on recent radar images
- Updated every 5 minutes
- 5 minute temporal resolution
- 1 km spatial resolution

Map format



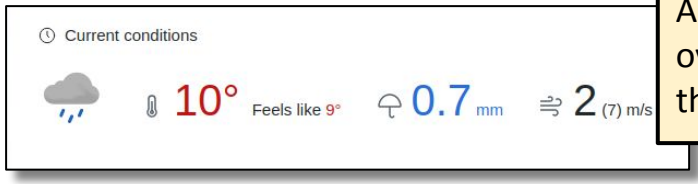
Understanding the situation

Timeseries for a point



Supporting time-sensitive decision making

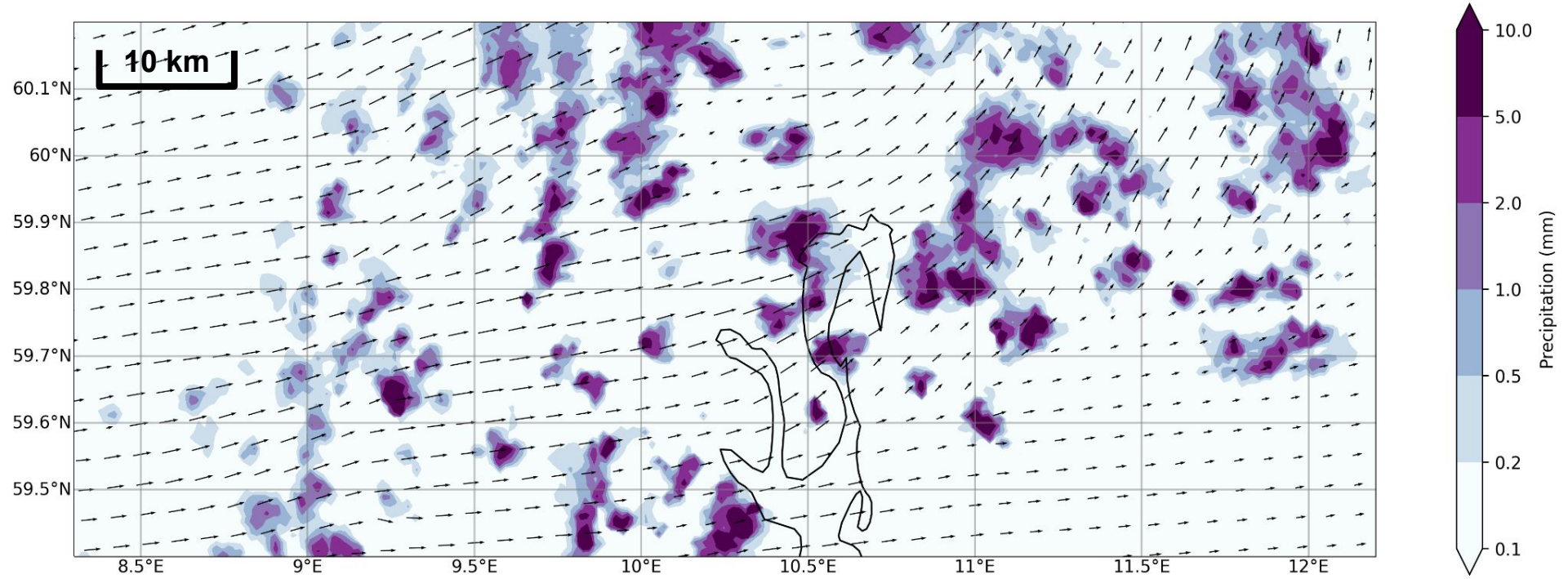
1h hour aggregation at point



Assessing the overall severity of the situation

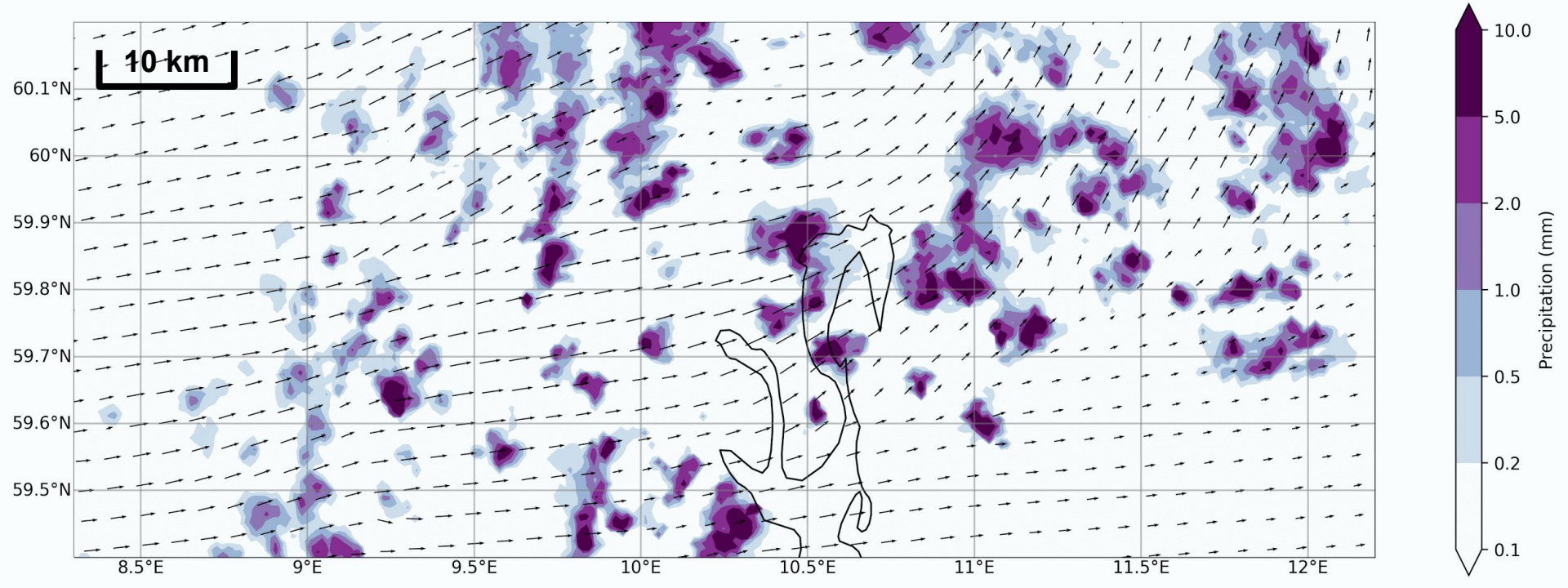
How does the precipitation nowcast work?

Motion is detected from two recent images (optical flow)



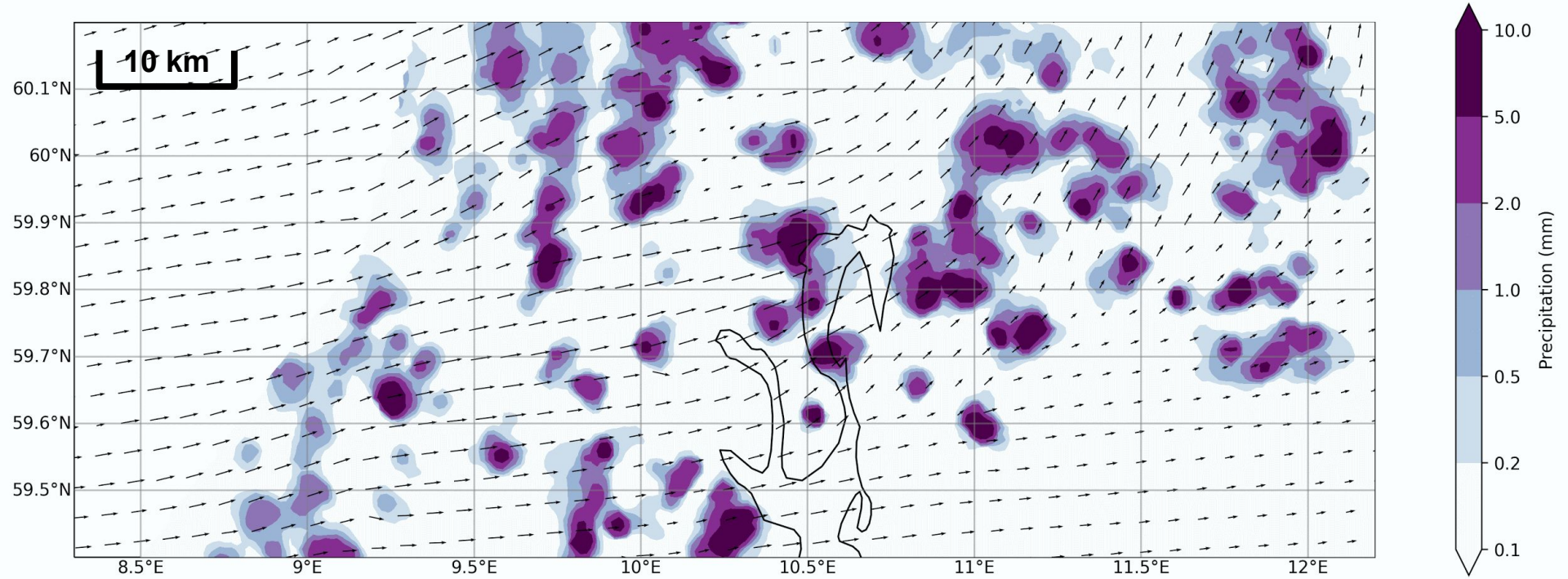
How does the precipitation nowcast work?

The field is advected along the streamlines



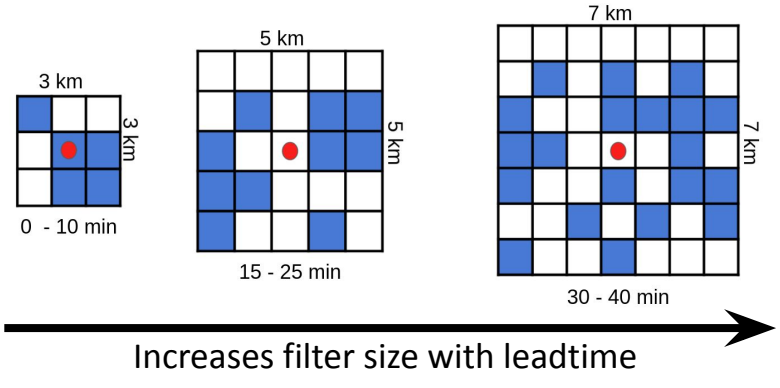
How does the precipitation nowcast work?

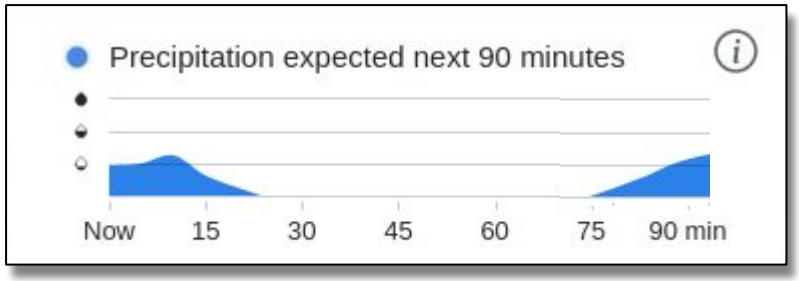
Spatial smoothing applied to optimize the use in a timeseries

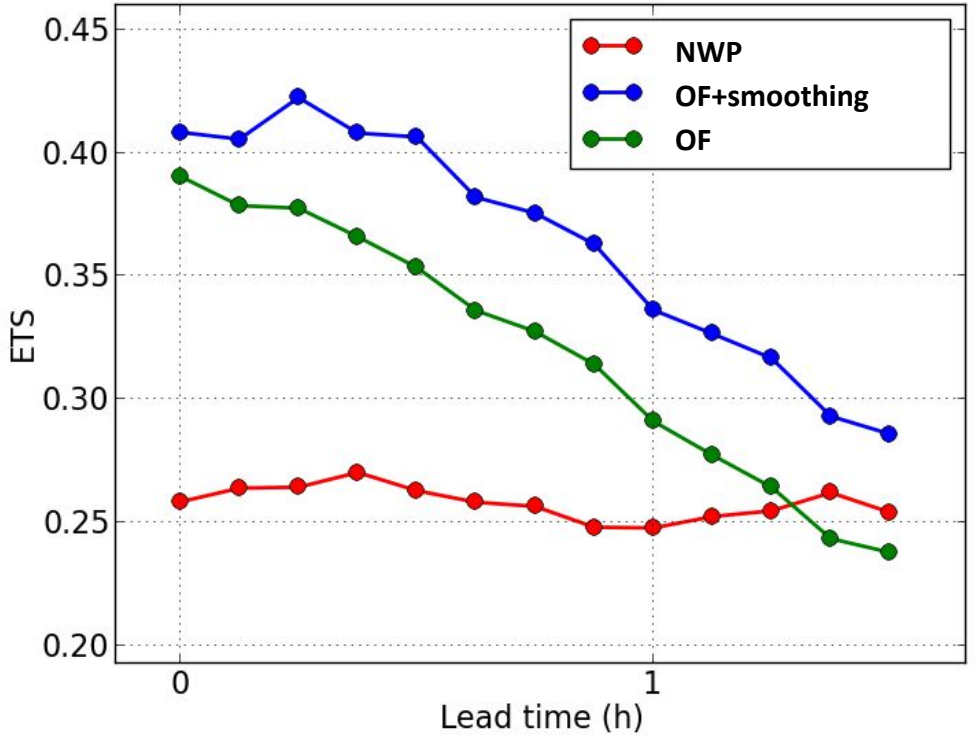


How does the precipitation nowcast work?

Spatial filter reduces jumpiness and increases usability in timeseries form

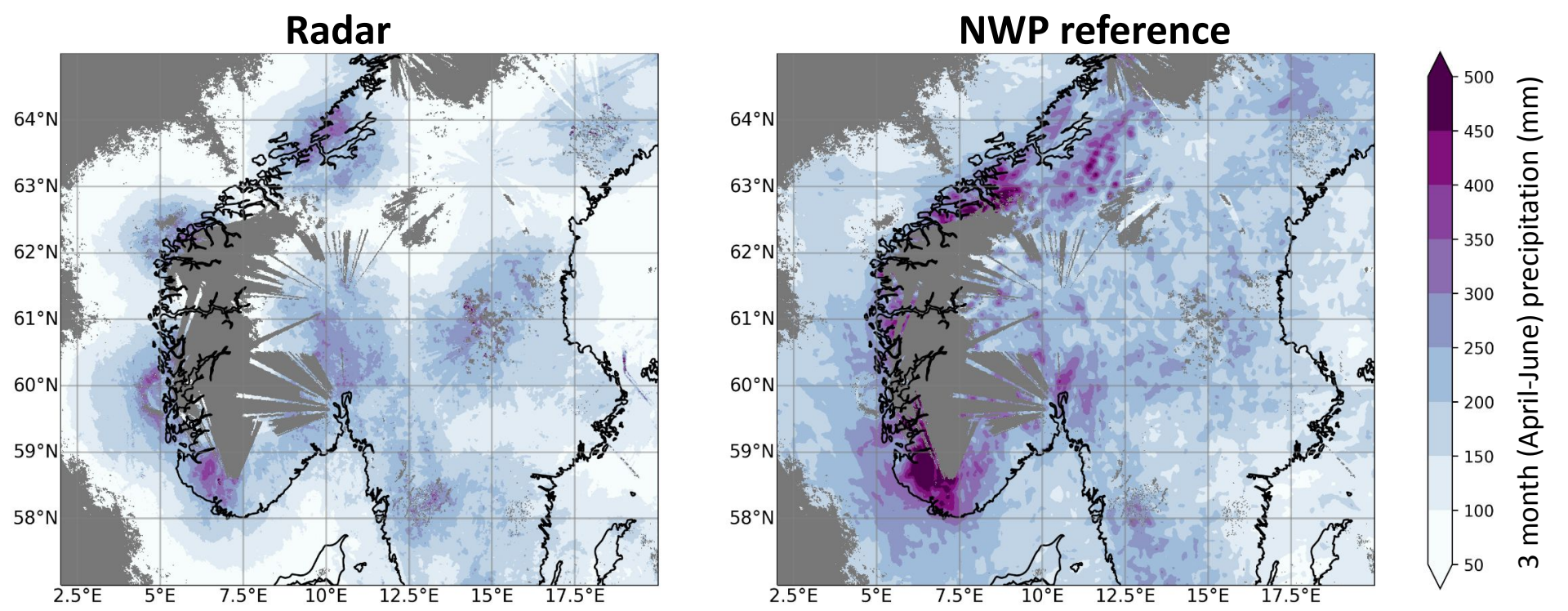






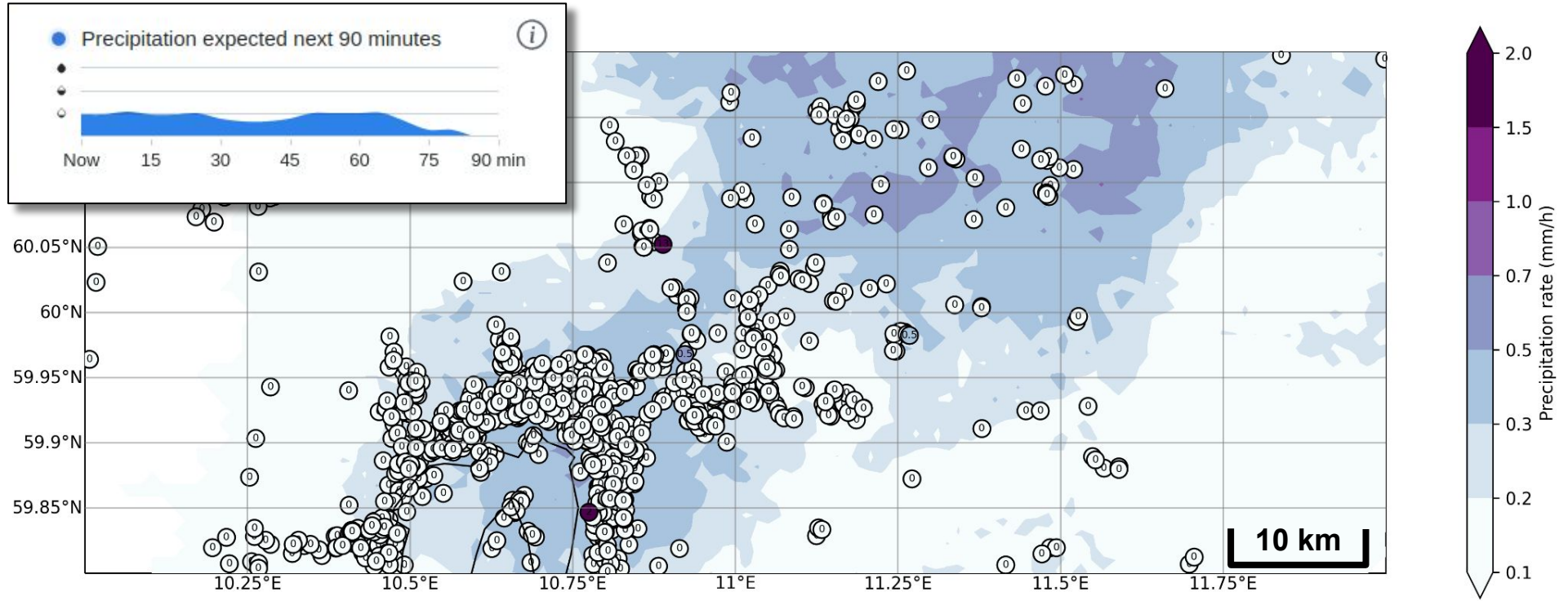
Challenges: Systematic errors

Non-homogeneous coverage with spatially varying biases

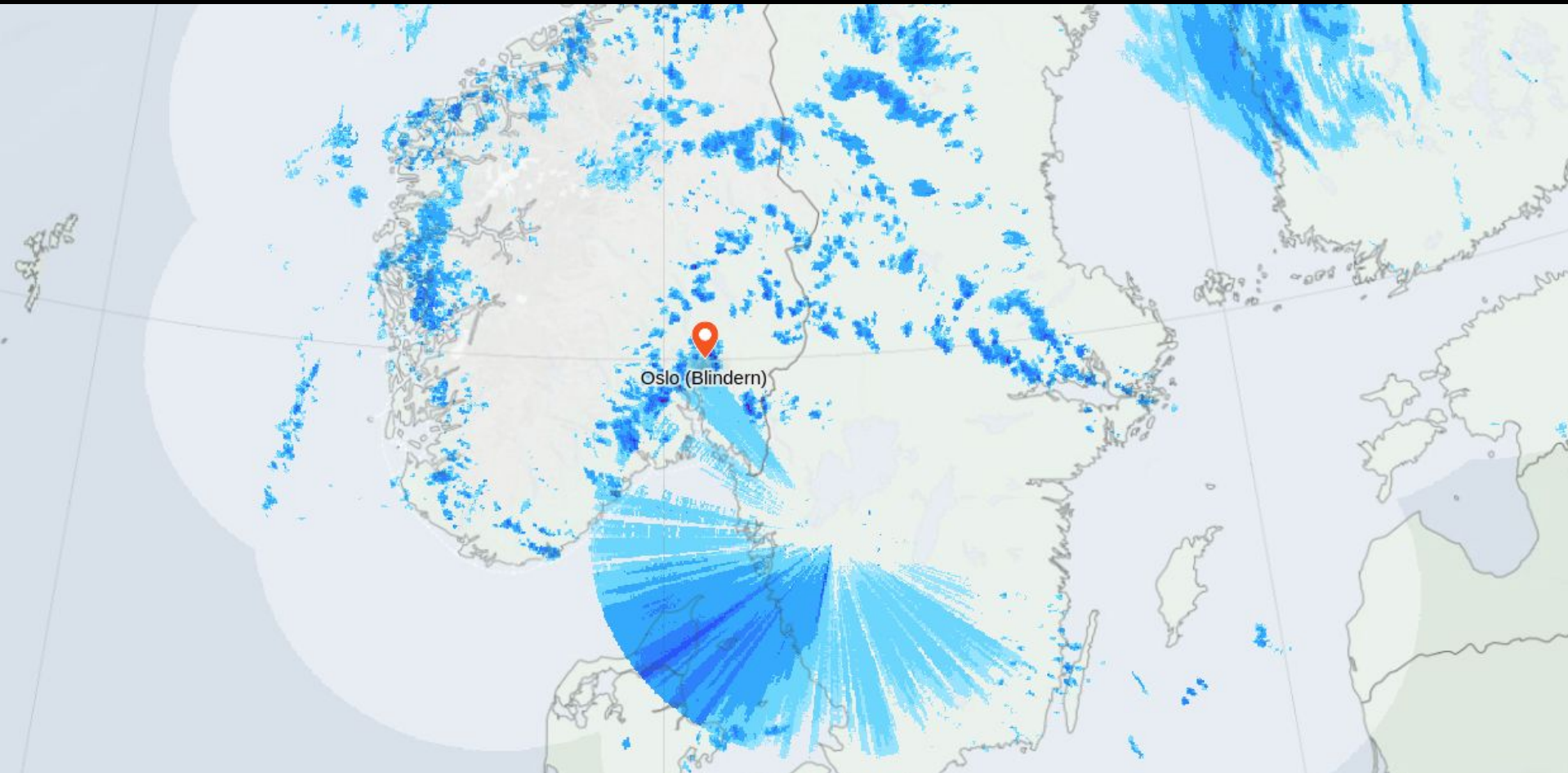


Challenges: Precipitation not reaching ground

Rain not detected by ground stations. Generates false alarms.

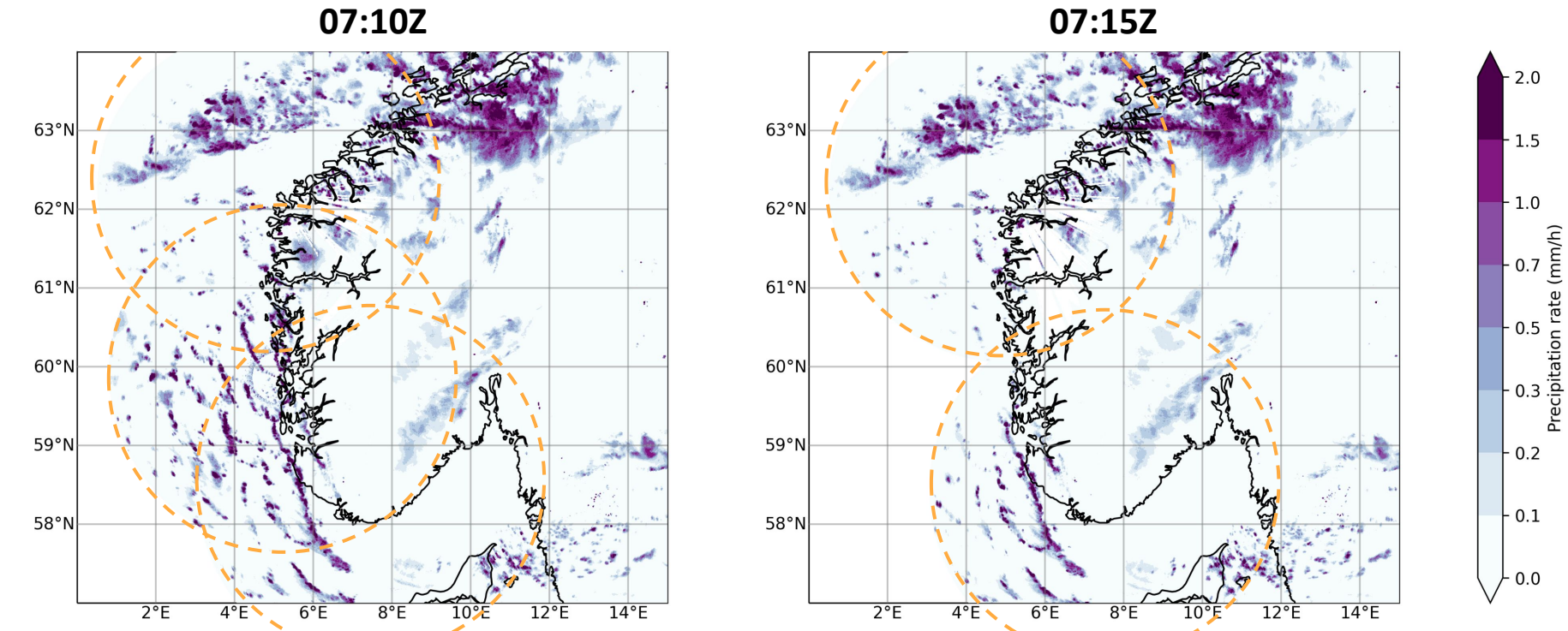


Challenges: Malfunctioning equipment



Challenges: Unavailable radar

Radars occasionally go down for planned or unplanned maintenance



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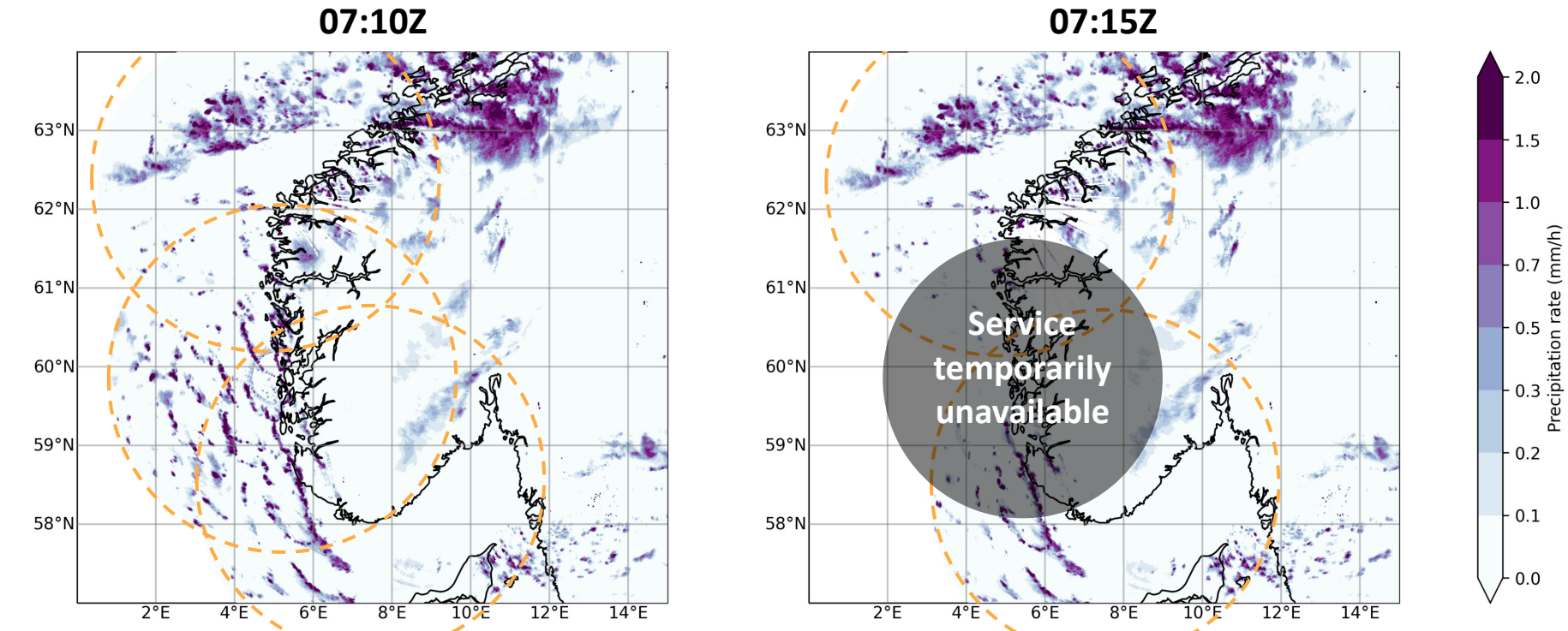
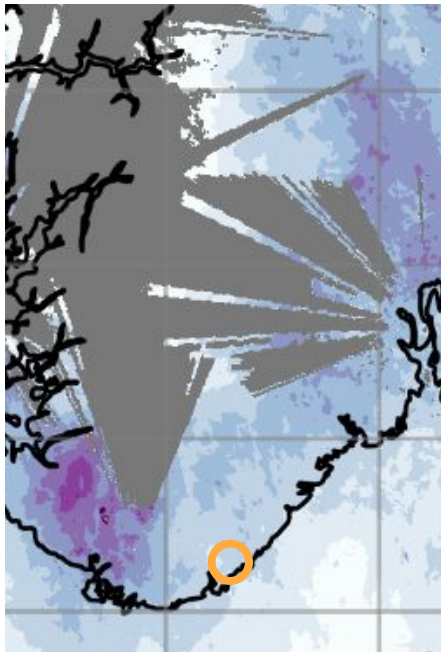


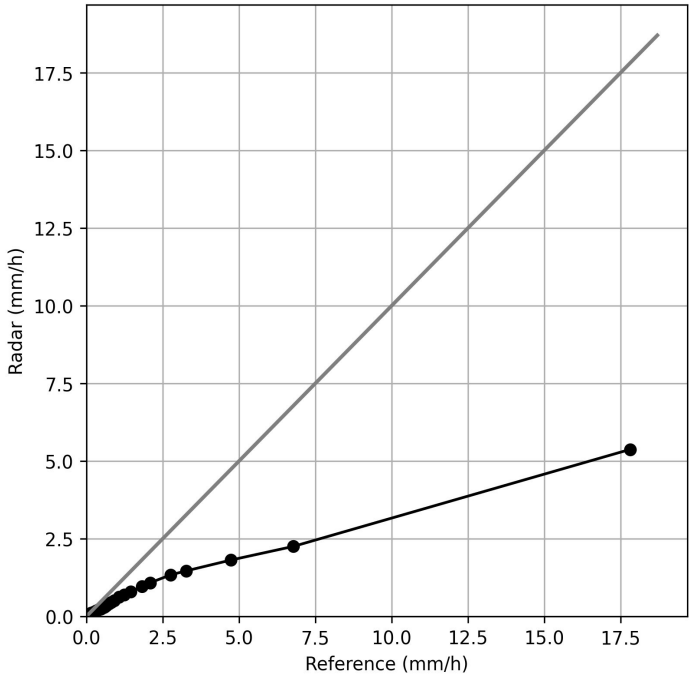
Handling systematic errors in radar

Adjustment of systematic errors using climatology from NWP.
Spatially varying quantile map.

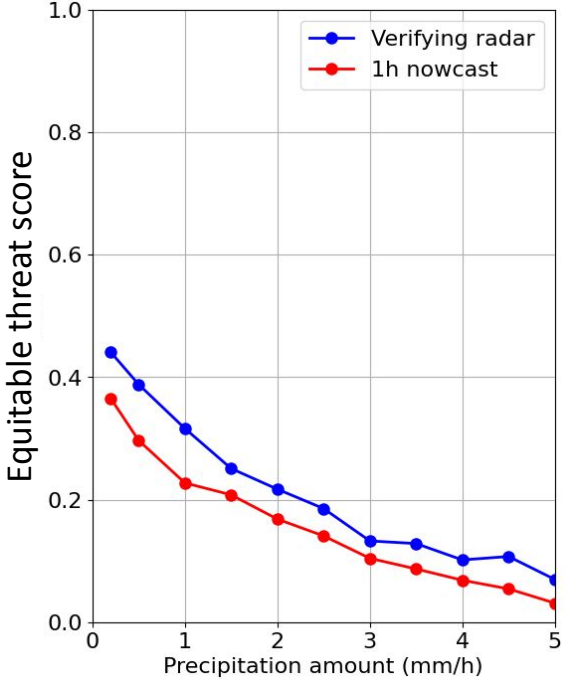
Example point



Historical quantile map at point



Verification for Norway



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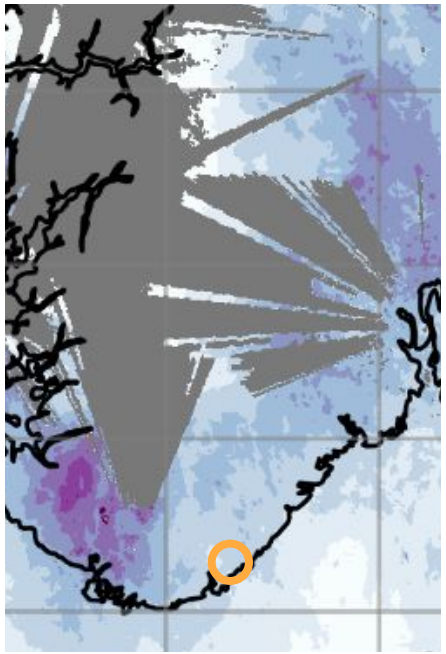

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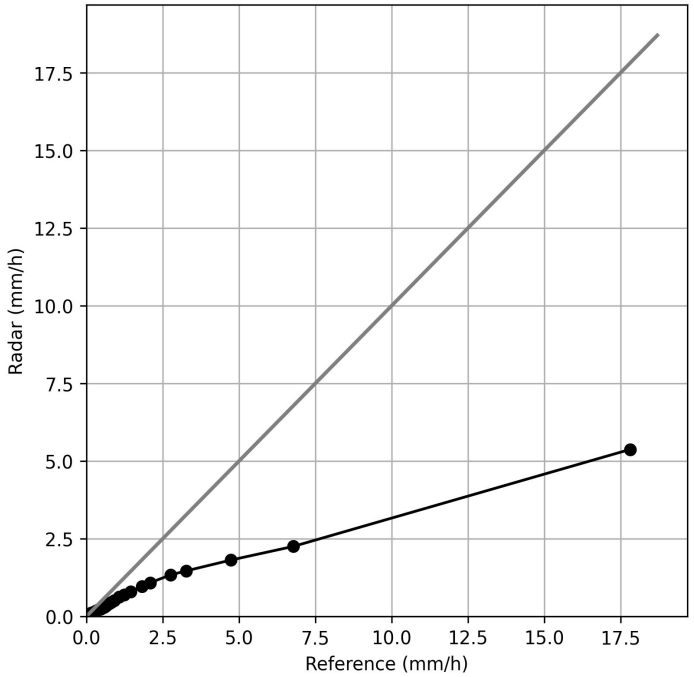

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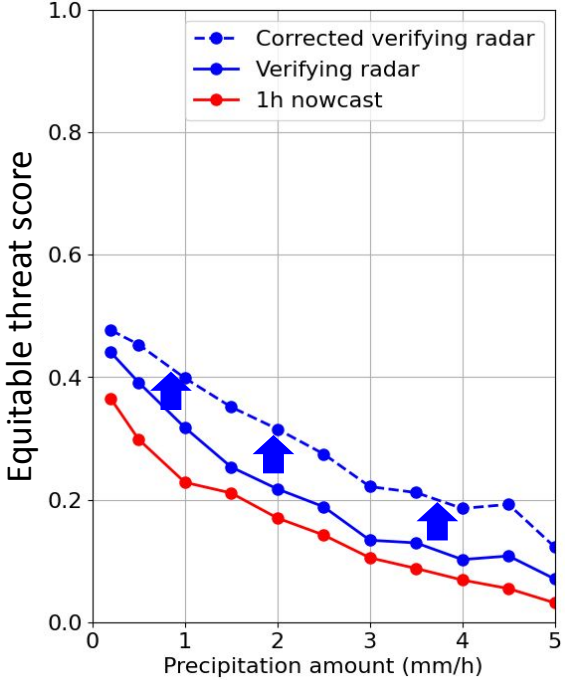

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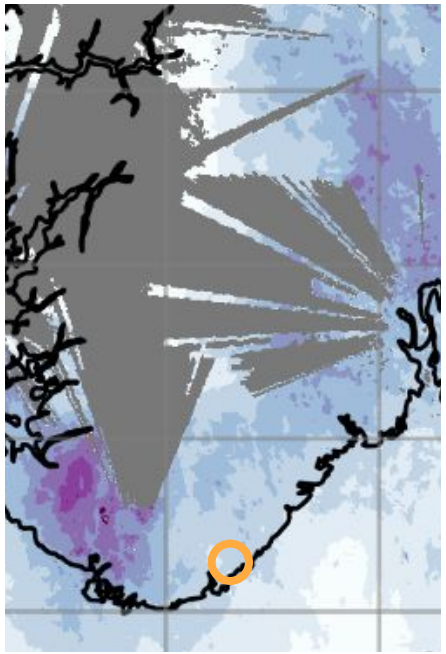

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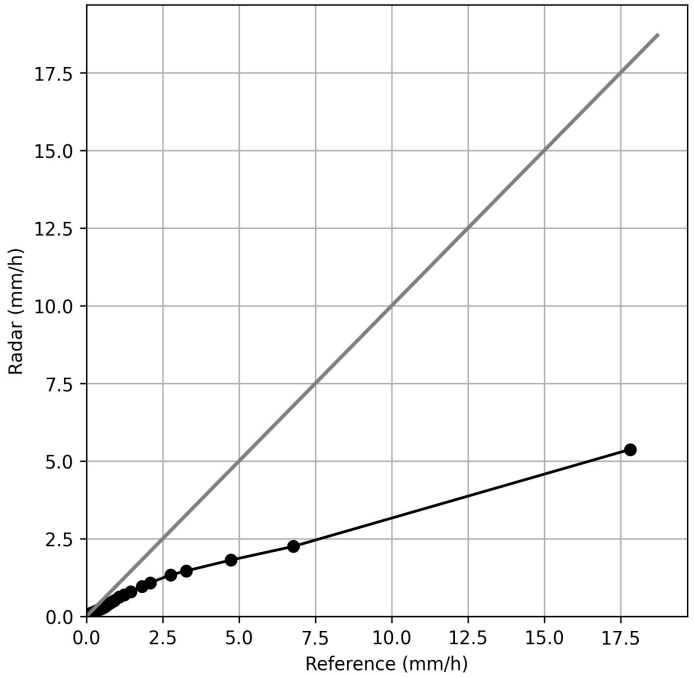

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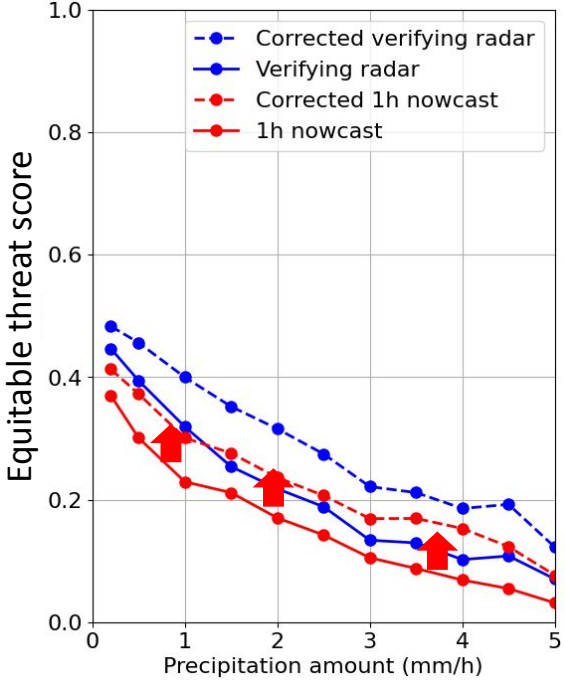
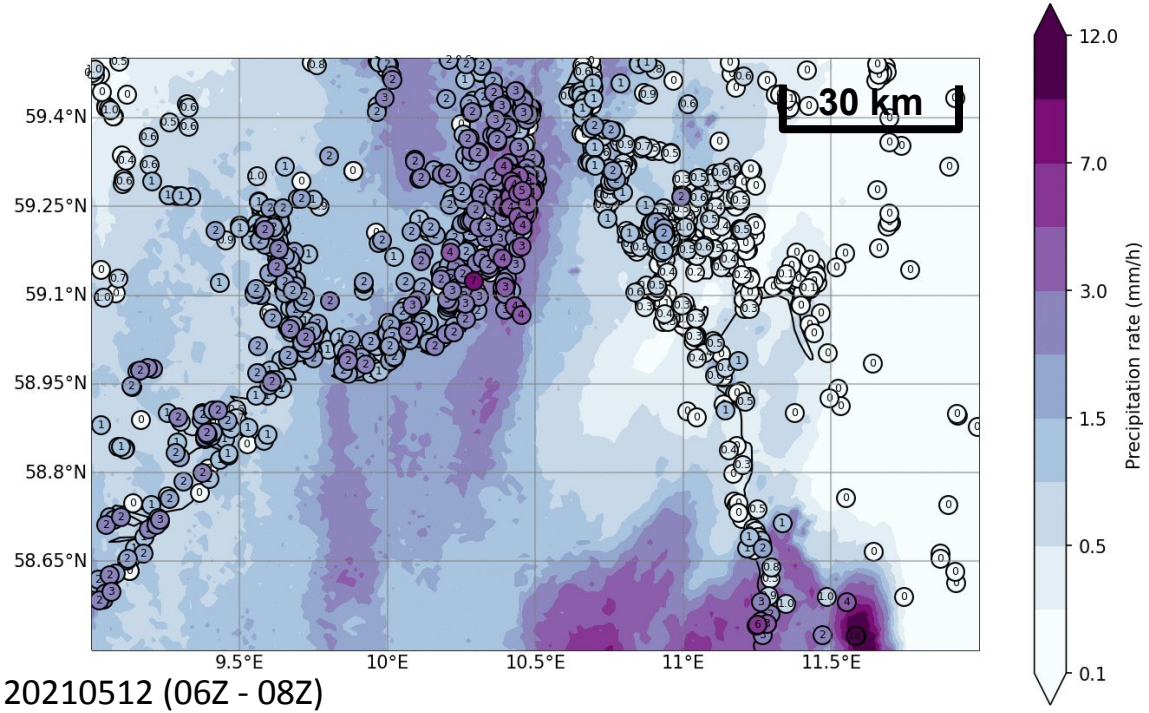


Real-time adjustment of radar

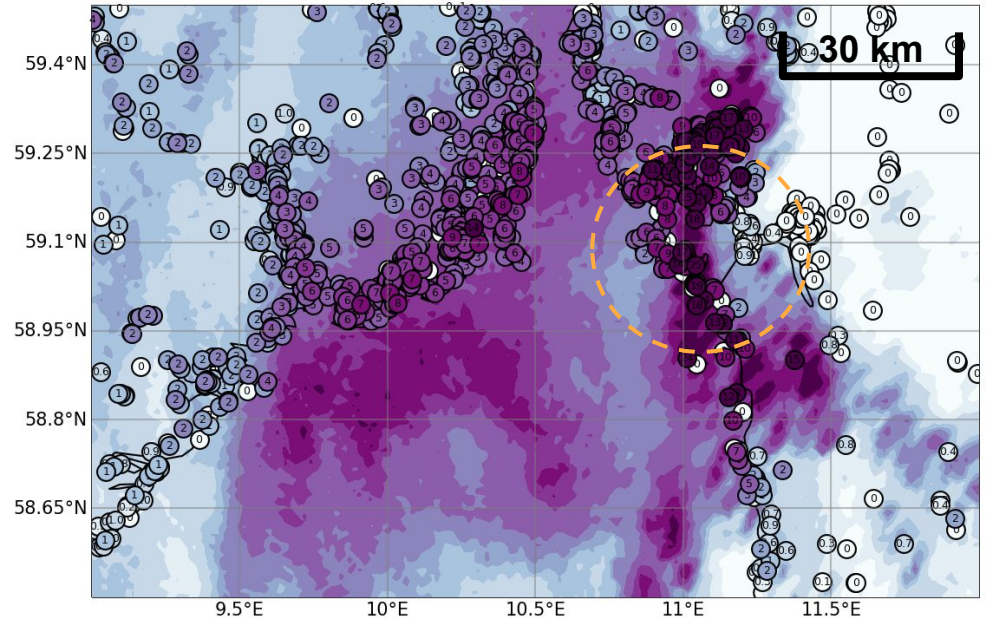
Here is a precipitation event as seen by radar and Netatmo citizen weather stations



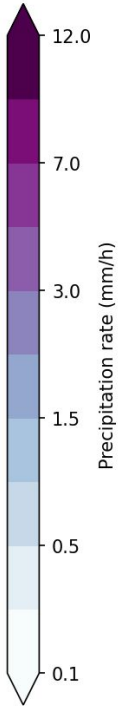
20210512 (06Z - 08Z)

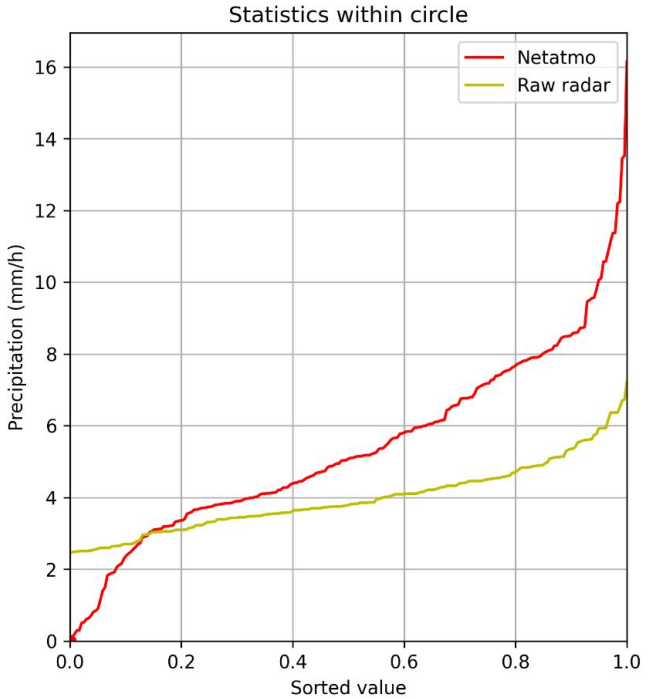
Real-time adjustment of radar

Local comparison of radar and Netatmo



20210512 (06:40Z)





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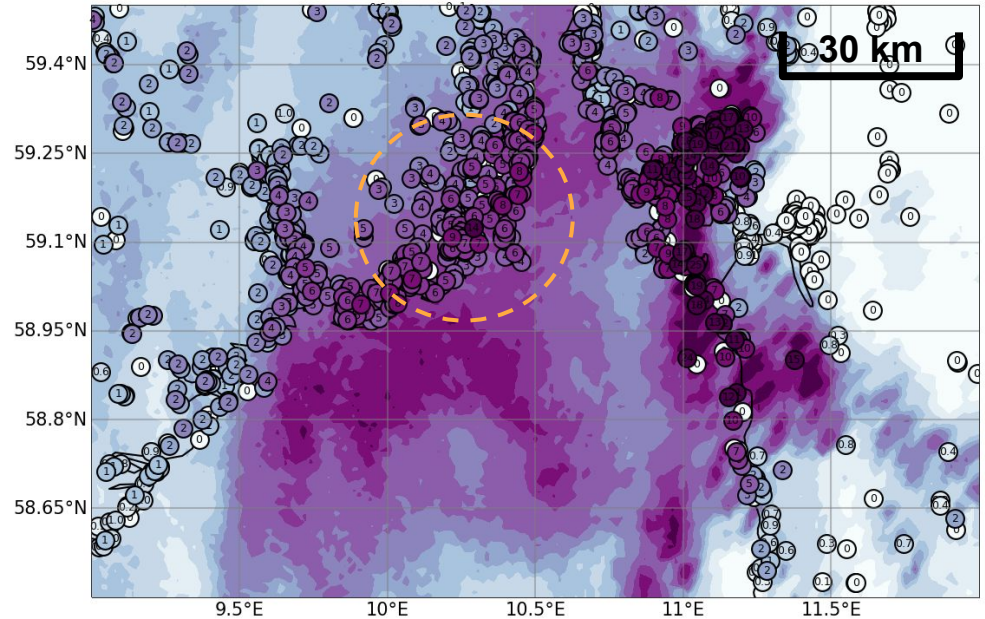
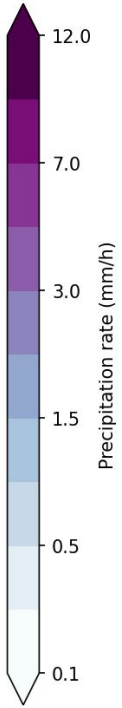
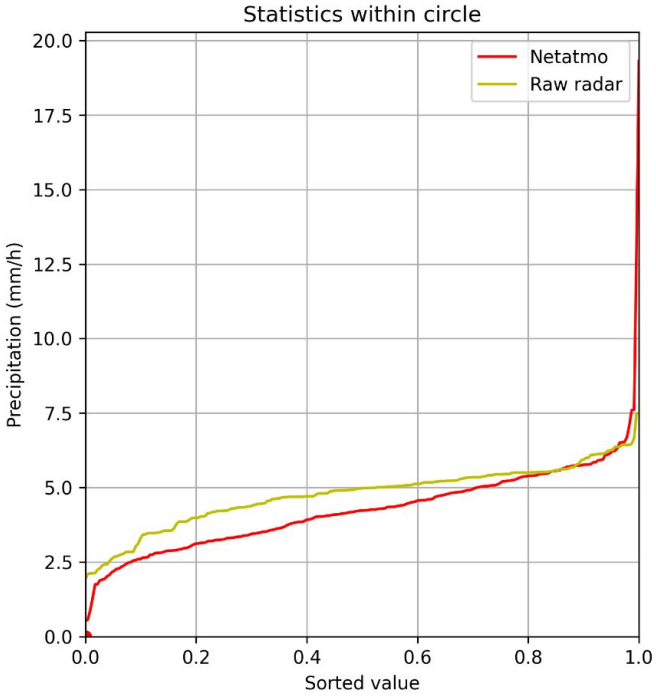


20210512 (06:40Z)

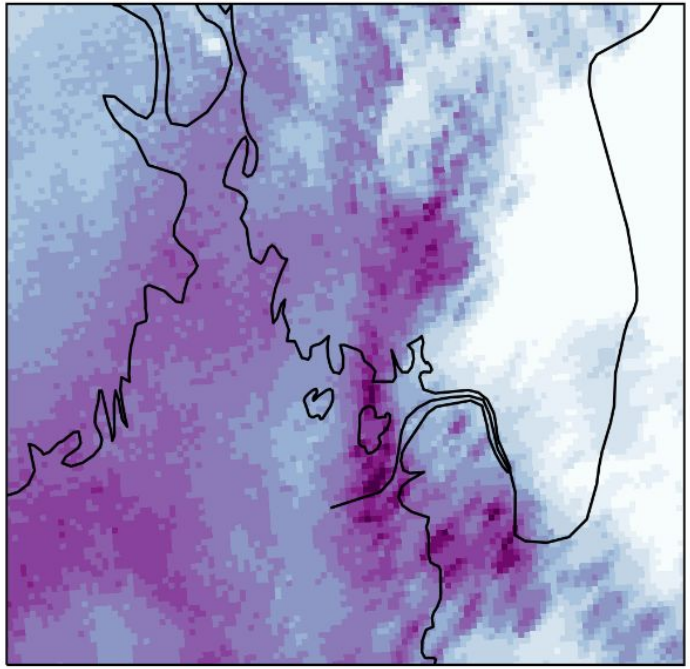




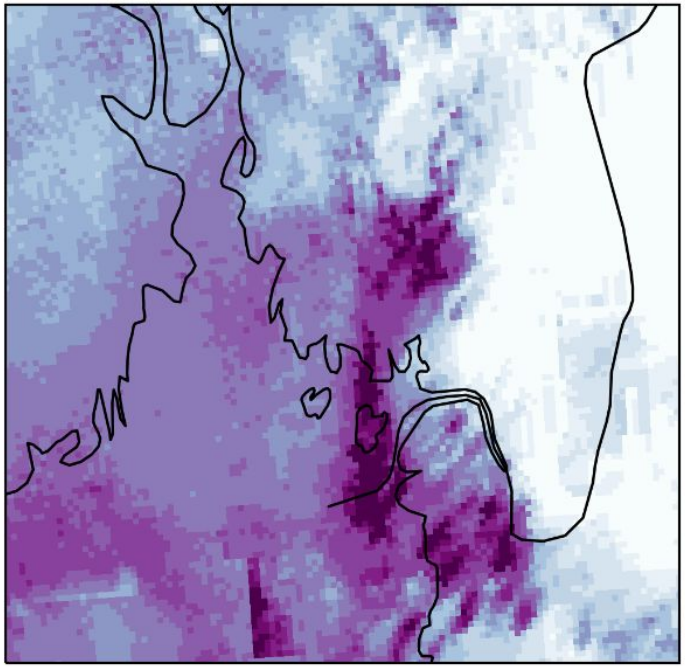
Real-time adjustment of radar

Example of corrected radar field

Raw radar



Netatmo corrected



Strategies for improving nowcasting product

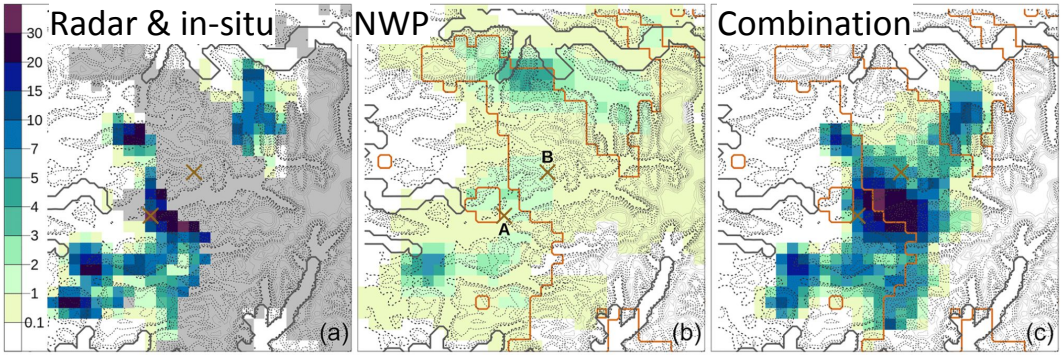
1) Predictors
2) Targets
3) ML-models
4) Working with users

- Complement radar measurements with other data sources, such as NWP model output
- NWP models cannot accurately place cells in real-time, but contain indirect information on cell lifetimes and capacity
- NWP ensemble systems provide information on uncertainty
- 1.5 PB of high resolution NWP data on disk at MET Norway

Strategies for improving nowcasting product

1) Predictors
2) Targets
3) ML-models
4) Working with users

- Training directly using radar as the target field will give limited improvements in Norway
- Need high resolution gridded analyses based on radar, NWP, and in-situ observations



Lussana et al, 2021: Ensemble-based statistical interpolation with Gaussian anamorphosis for the spatial analysis of precipitation, Nonlin. Processes Geophys.

Strategies for improving nowcasting product

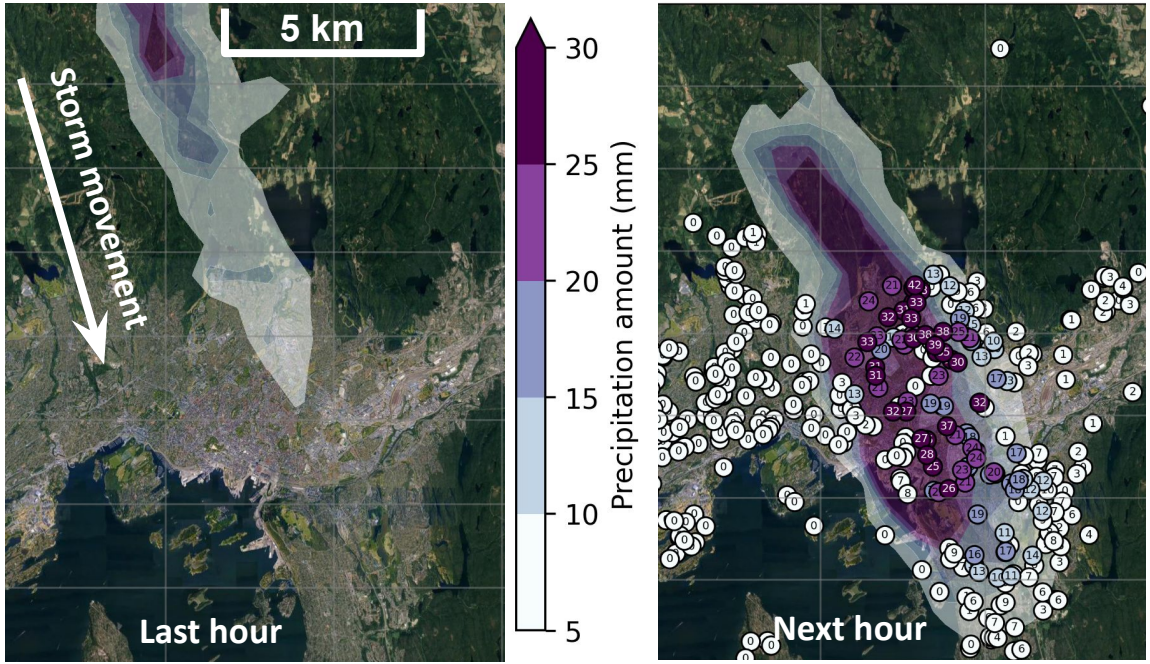
1) Predictors
2) Targets
3) ML-models
4) Working with users

- Grid-to-grid methods
- Anticipating rather than detecting
- Need to take into account non-homogenous radar coverage

Strategies for improving nowcasting product

1) Predictors
2) Targets
3) ML-models
4) Working with users

- How do users make decisions? What are suitable loss functions?
- What are acceptable false alarm rates for push notification?
- What information can we provide in this extreme situation?



Norway grants

Unitatea Executivă pentru Finanțarea Învățământului Superior, a Cercetării, Dezvoltării și Inovării

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The end!