



UNIVERSITY
OF COLOGNE



STUDYING CLOUDS WITH SEMI-OPERATIONAL ICON-LEM (600M) SIMULATIONS AT NY-ÅLESUND

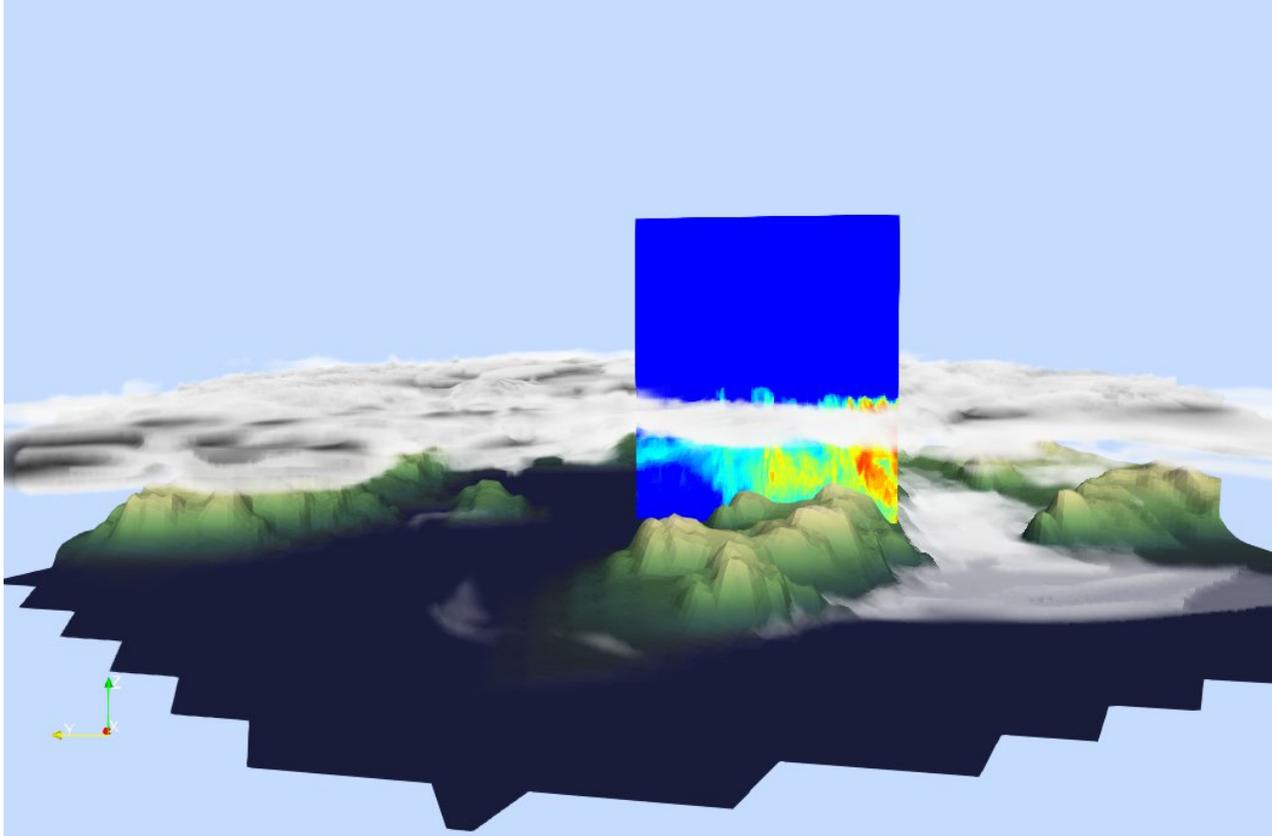
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Situation

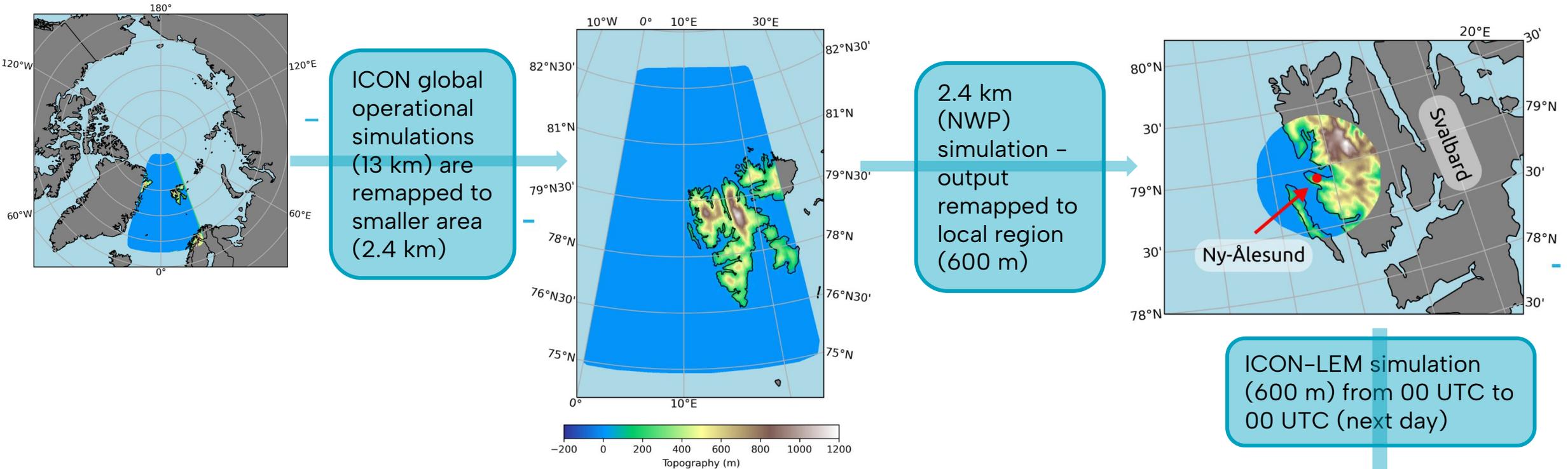


- Ny-Ålesund is very challenging for simulations
- The detailed observations are a great opportunity for model evaluation and improvements
- How are clouds (esp. Arctic mixed-phase) captured by our simulations?
- Important to approach observed scales (time and space)!

Motivation

- How are clouds captured in our simulations?
- **Hectometer simulations** allow to turn off some parameterizations and are approaching observed scales in time (seconds) and space and to resolve the **complex surface situation**
- Create a **longterm statistical** dataset of hectometer simulations at Ny-Ålesund (running since fall 2020)
- Focus output on vertical column close to Ny-Ålesund for statistical assessment – comparison to ground-based observations and day-to-day comparison
- Include topography and lateral boundary conditions
- Possibility to rerun and increase output
- Resolution (edge length) ~600 m, Domain size ~100 km, 150 vertical level, always from 0 UTC to 0 UTC

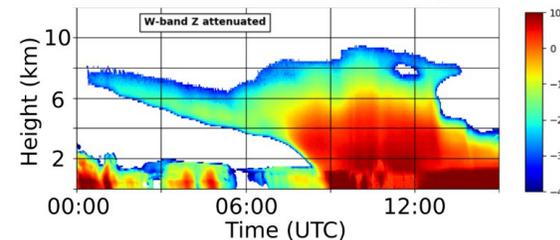
Model framework – setup



ICON-LEM simulation (600 m) from 00 UTC to 00 UTC (next day)

Further processing (e.g. instrument simulator) of output possible

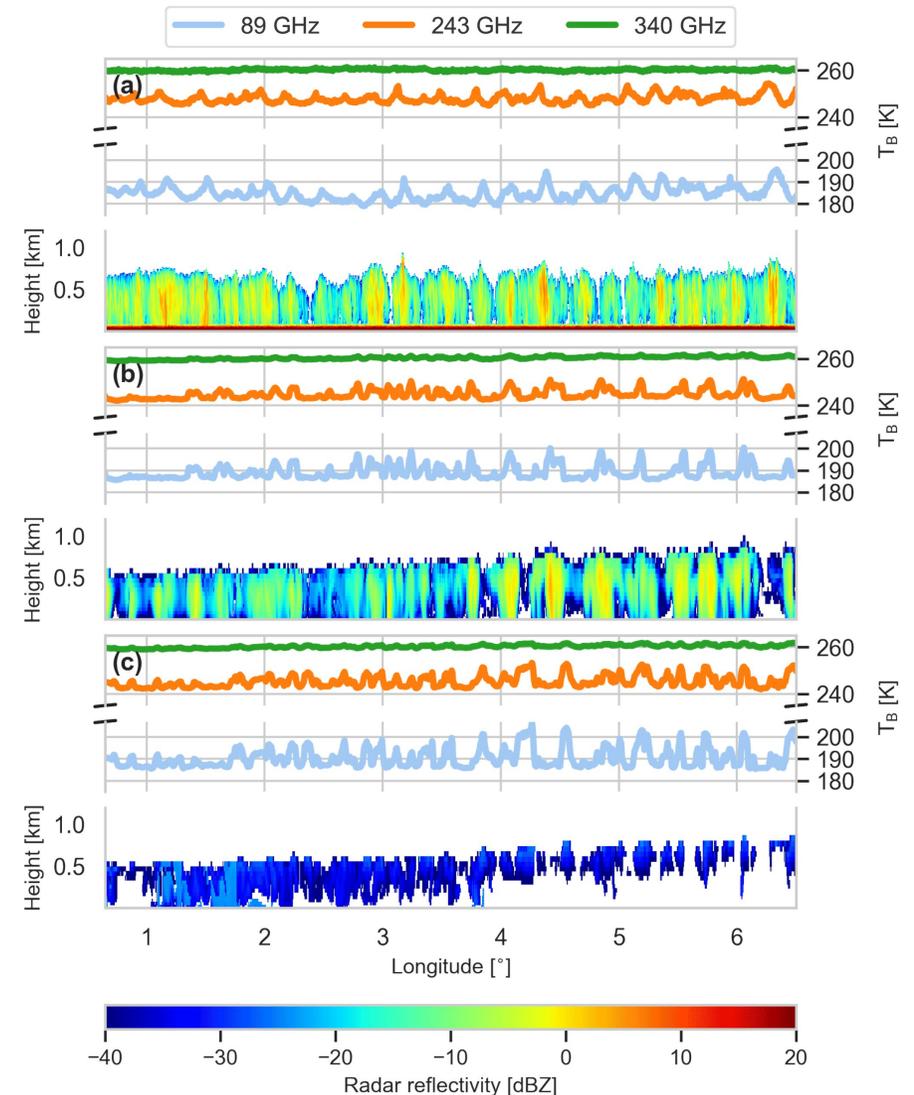
Forward simulated radar reflectivity example



Modified from: Kiszler, Theresa (2024). Improving our understanding of cloud phase-partitioning using long-term cloud-resolving simulations of Svalbard. PhD thesis, Universität zu Köln

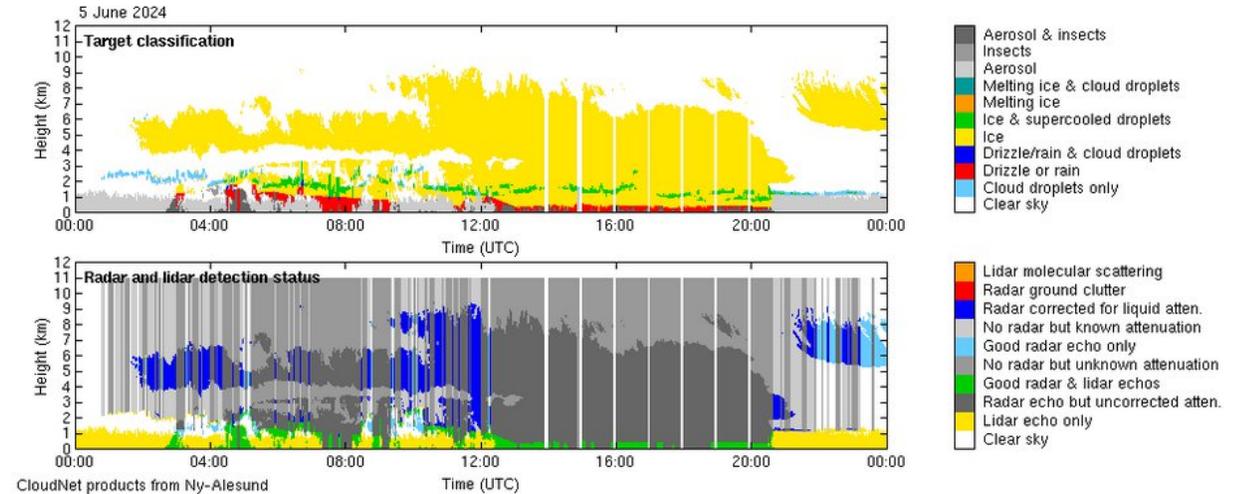
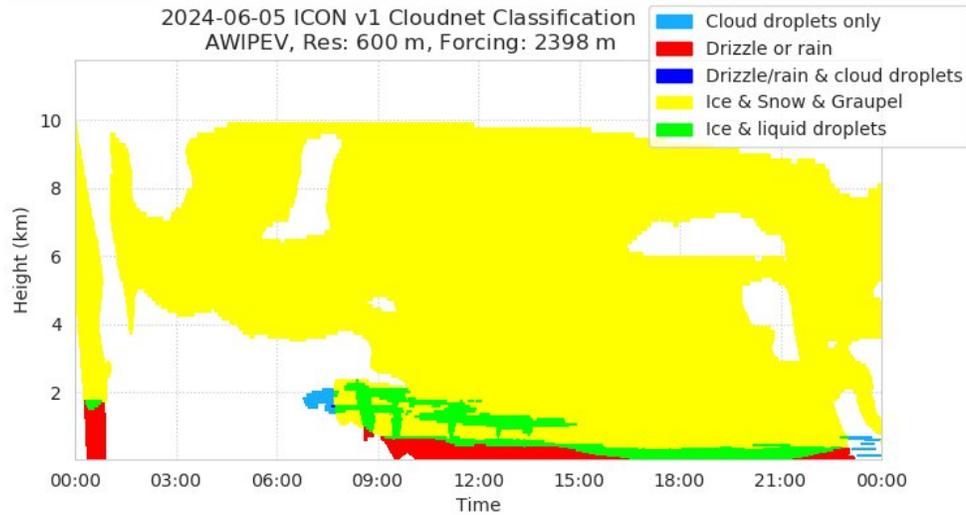
Instrument simulator

- The model provides parameter like temperature, pressure, wind, hydrometeors (mass mixing ratio...)
- For clouds, we often observe quantities like brightness temperature or radar reflectivity
 - We need a transfer between simulated and observed quantities
 - One example: Passive and Active Microwave radiative TRAnsfer tool for simulating radiometer and radar measurements (PAMTRA)



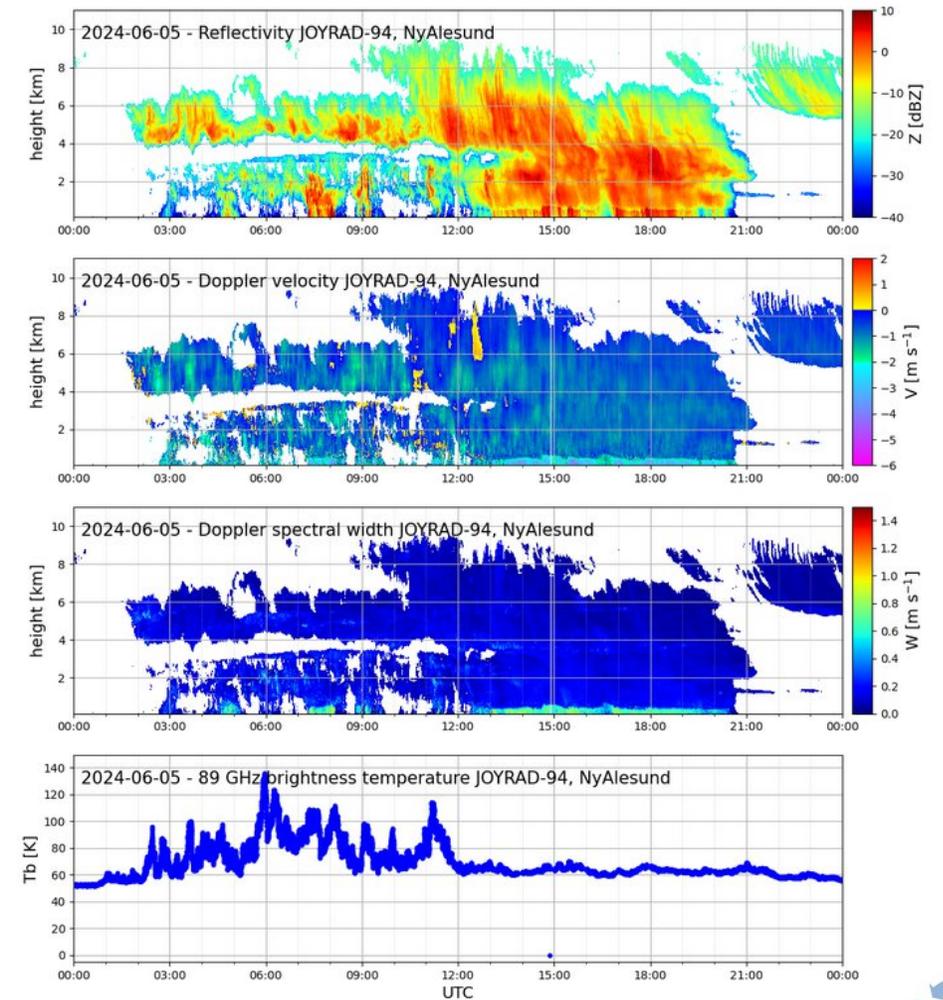
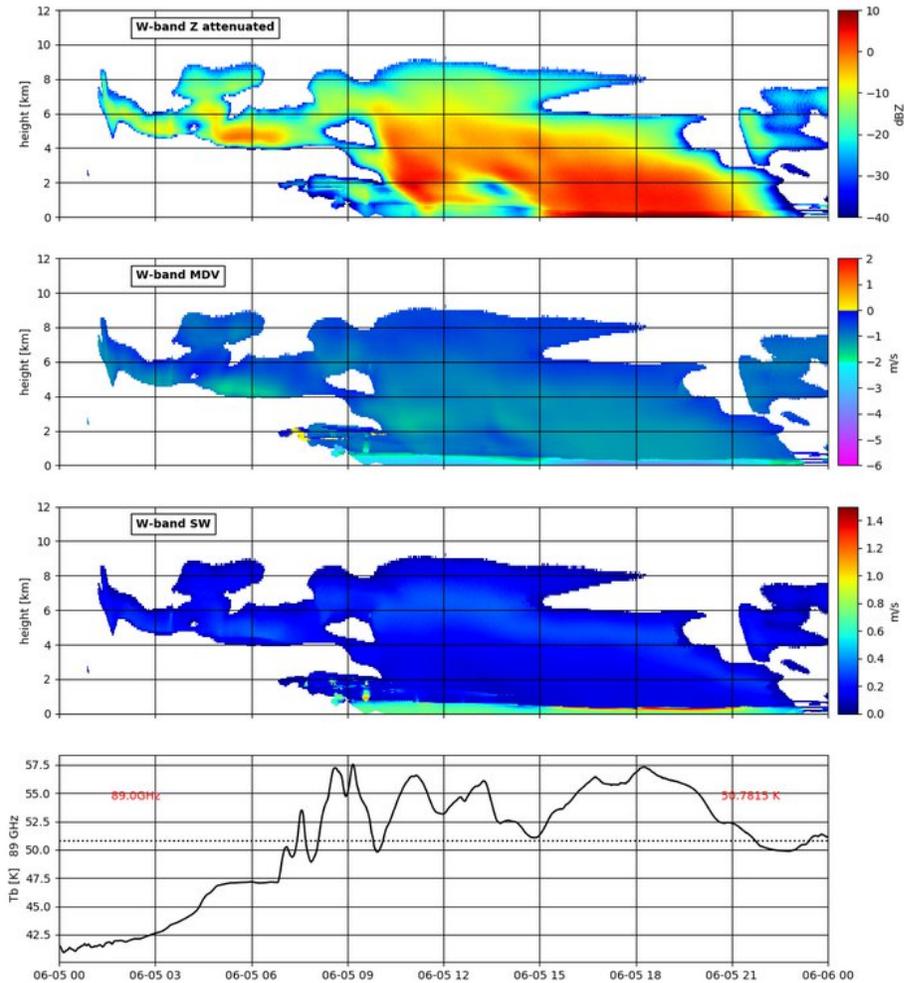
Mech, M., et al: PAMTRA 1.0: the Passive and Active Microwave radiative TRAnsfer tool for simulating radiometer and radar measurements of the cloudy atmosphere, GMD, 2020
<https://doi.org/10.5194/gmd-13-4229-2020>

Example – Quicklookbrowser 5.6.2024 – Classification

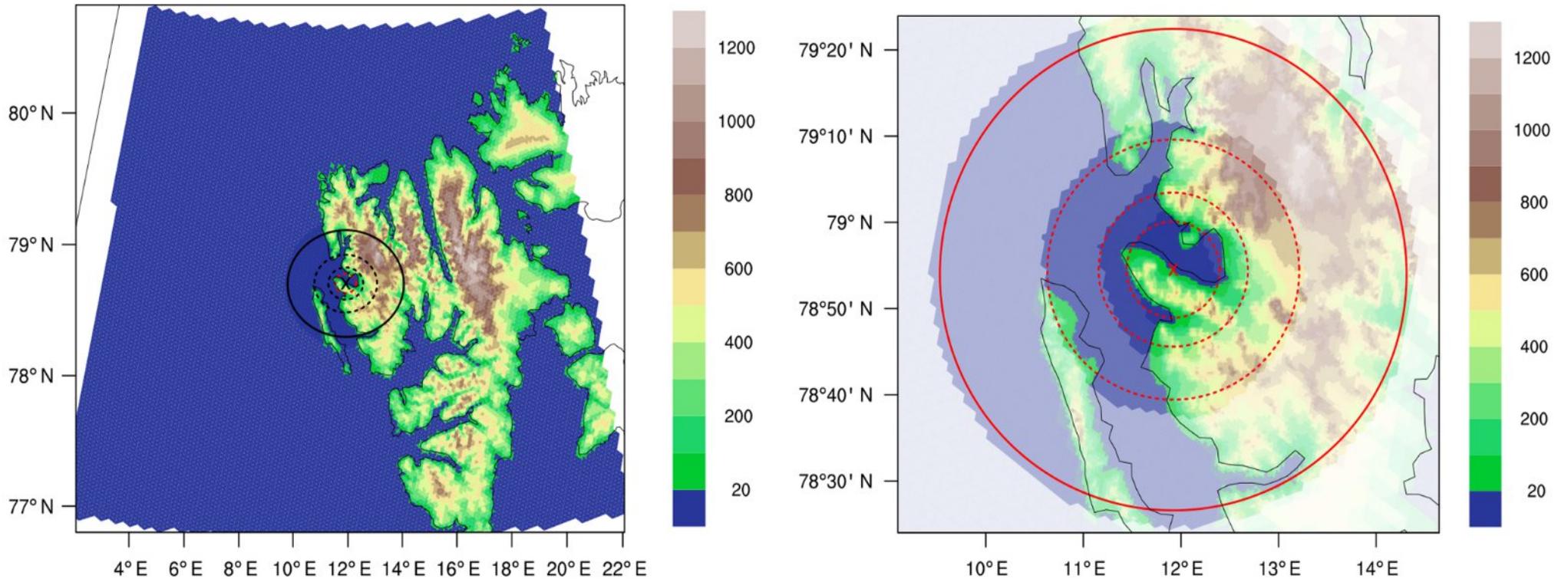


[Link Quicklookbrowser](#)

Example – Quicklookbrowser 5.6.2024 – Radar

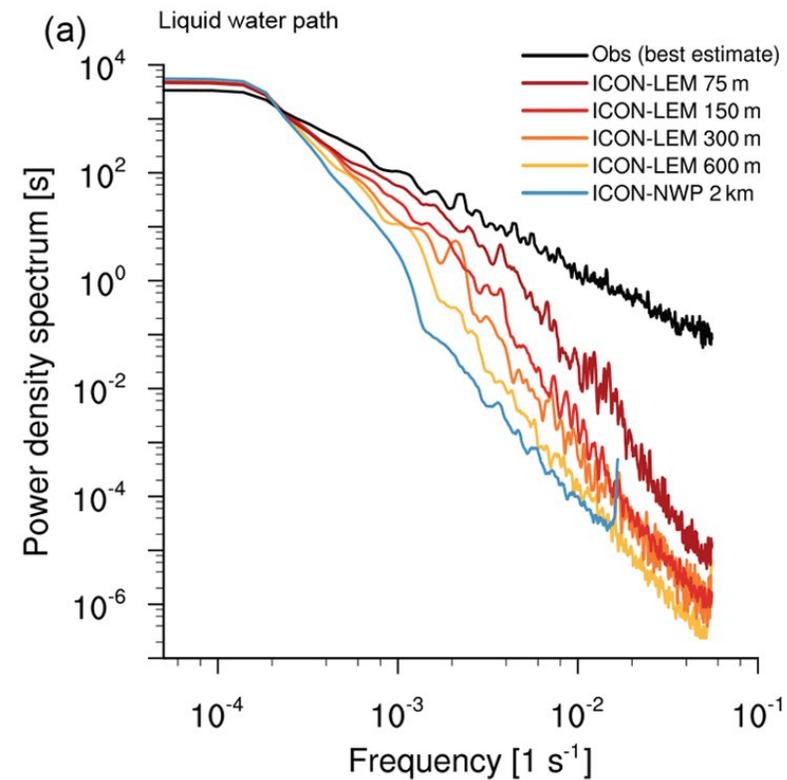
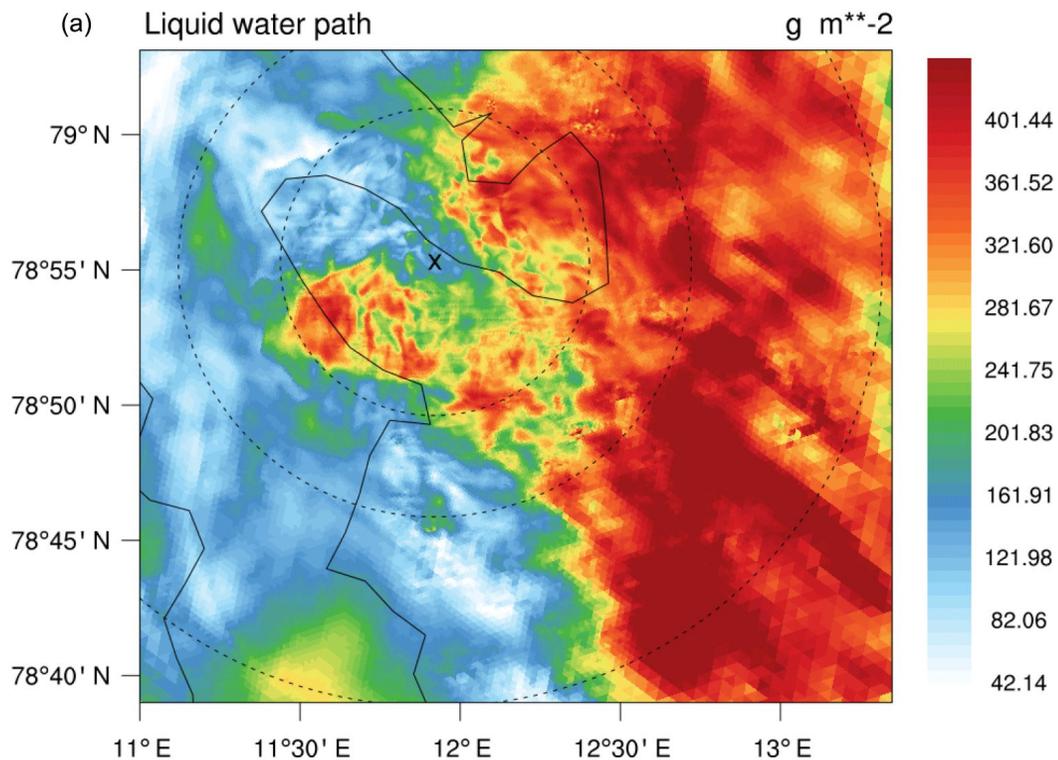


Approaching observed scales

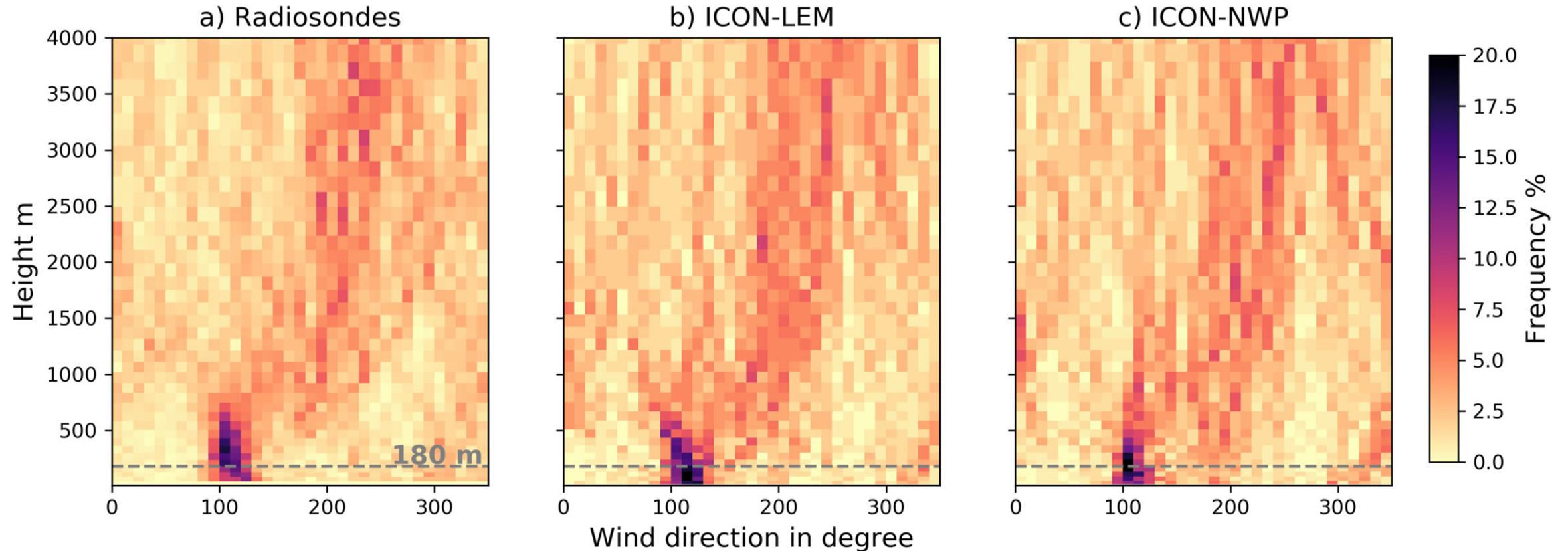


Schemann, V. and Ebell, K.: Simulation of mixed-phase clouds with the ICON large-eddy model in the complex Arctic environment around Ny-Ålesund, ACP, 2020, <https://doi.org/10.5194/acp-20-475-2020>

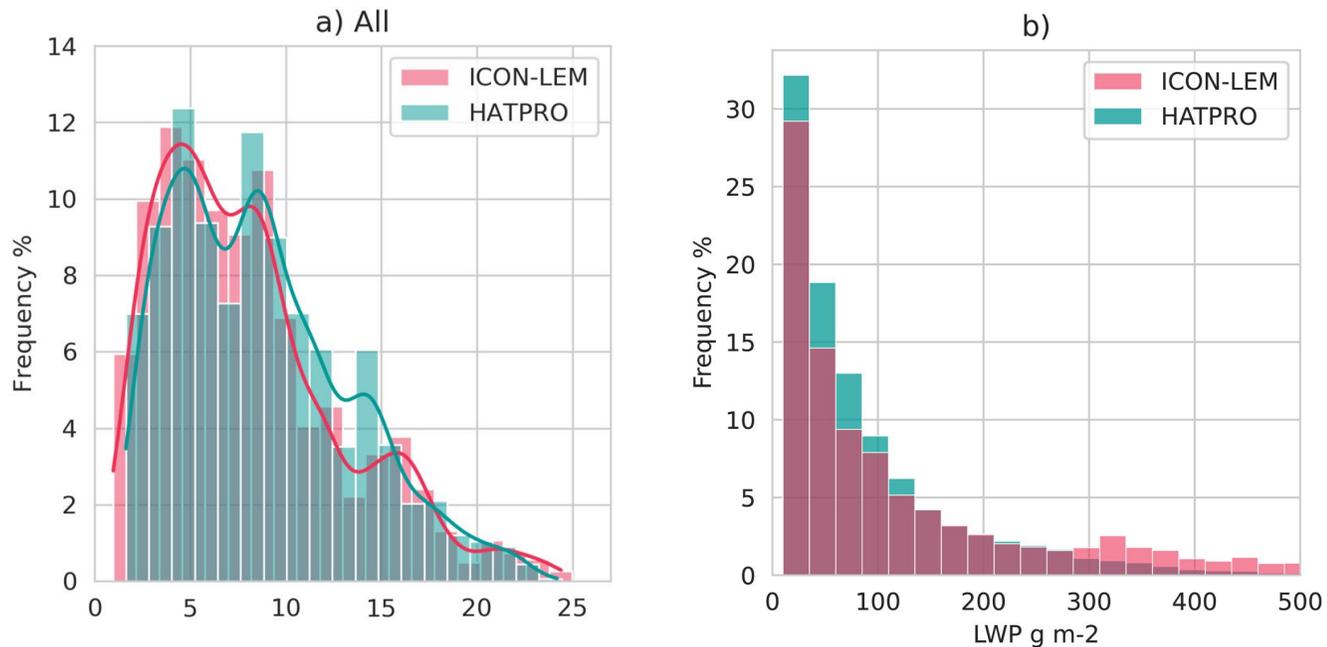
Scales in simulation and observation



Thermodynamics – e.g. Wind pattern



Evaluating clouds and phase partitioning



	Clear	Cloudy	LWP > 5
Obs %	27	73	70
ICON-LEM %	23	77	34

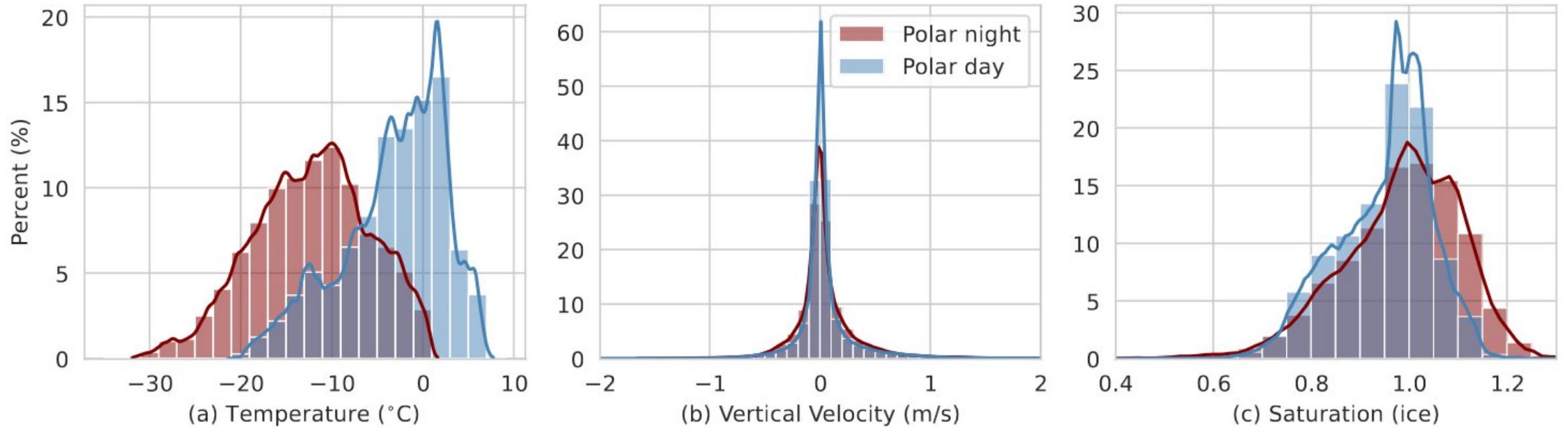
Distribution of clear and cloudy fits well, but not enough liquid containing clouds – investigate further, by looking into specific processes.



Kiszler, T., Ori, D., and Schemann, V.: Microphysical processes involving the vapour phase dominate in simulated low-level Arctic clouds, EGU sphere [preprint], <https://doi.org/10.5194/egusphere-2023-2986>, 2023.

Integrated water vapor and liquid water path fits quite well, but slight underestimation of small values and over estimation of large values in the model

Consistent and statistical dataset



Kizler, T., Ori, D., and Schemann, V.: Microphysical processes involving the vapour phase dominate in simulated low-level Arctic clouds, *EGUsphere* [preprint], <https://doi.org/10.5194/egusphere-2023-2986>, 2023.

Summary

- Simulating not only clouds, but the atmospheric state
- **Consistent dataset** – many variables available in 9s output for the column
- Potential to produce more 2D or 3D output
- **Growing dataset** – simulations since fall 2020, but growing every day
- Simulations since fall 2020 (change in ccn/in activation inbetween, change to new model version soonish)
- **Happy** about collaborations, comparison, interest in the simulations

