



UNIVERSITY
OF COLOGNE

CHASING AIRMASS TRANSFORMATIONS DURING HALO-(AC)³ WITH REMOTE SENSING AND ICON SIMULATIONS

Vera Schemann, Davide Ori, Susanne Crewell, Mario Mech, Tracy Kiszler, James Panton, José Vicencio Veloso, Erdem Aydin, Jan-Philipp Kraayvanger, ...



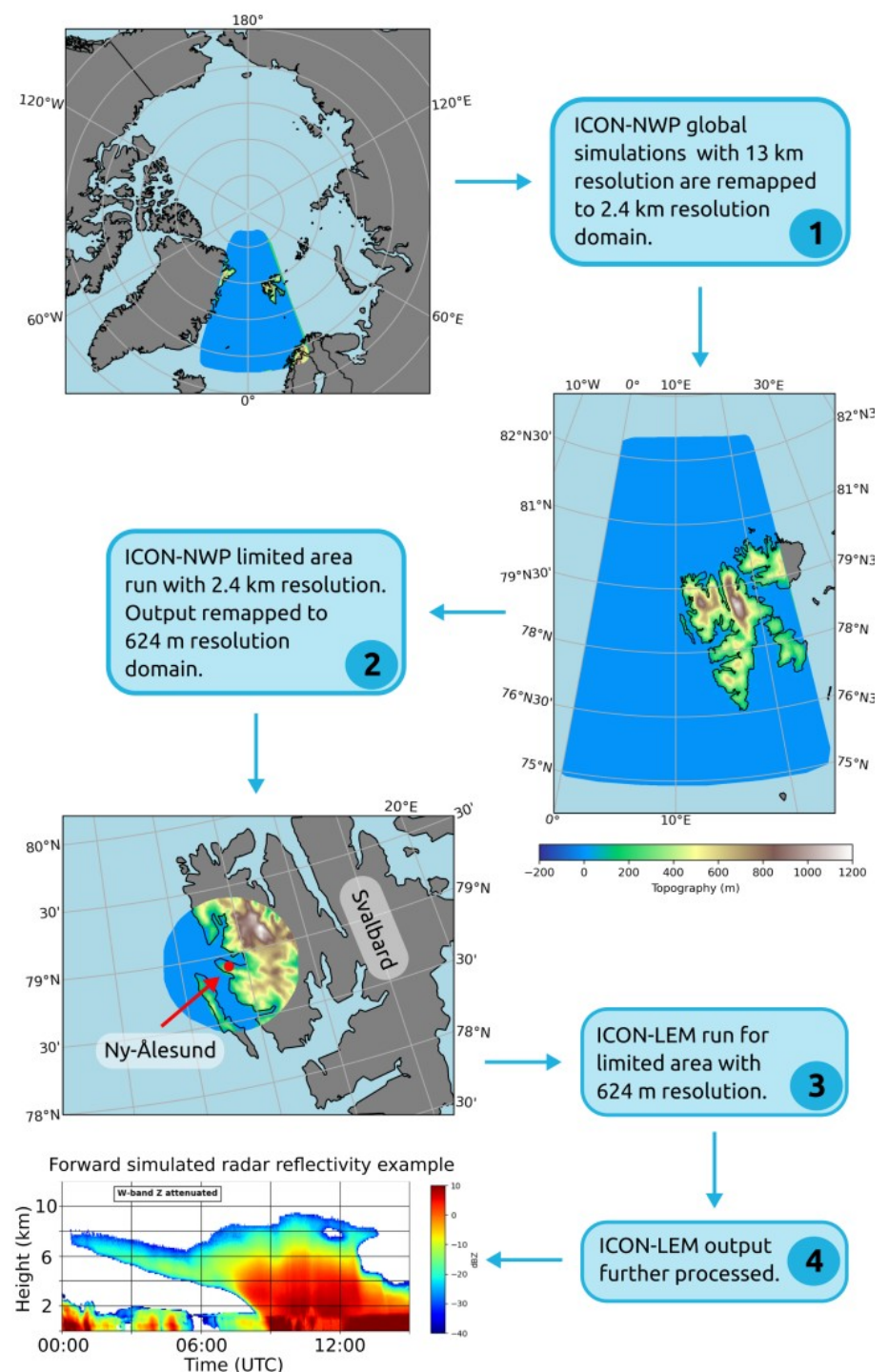
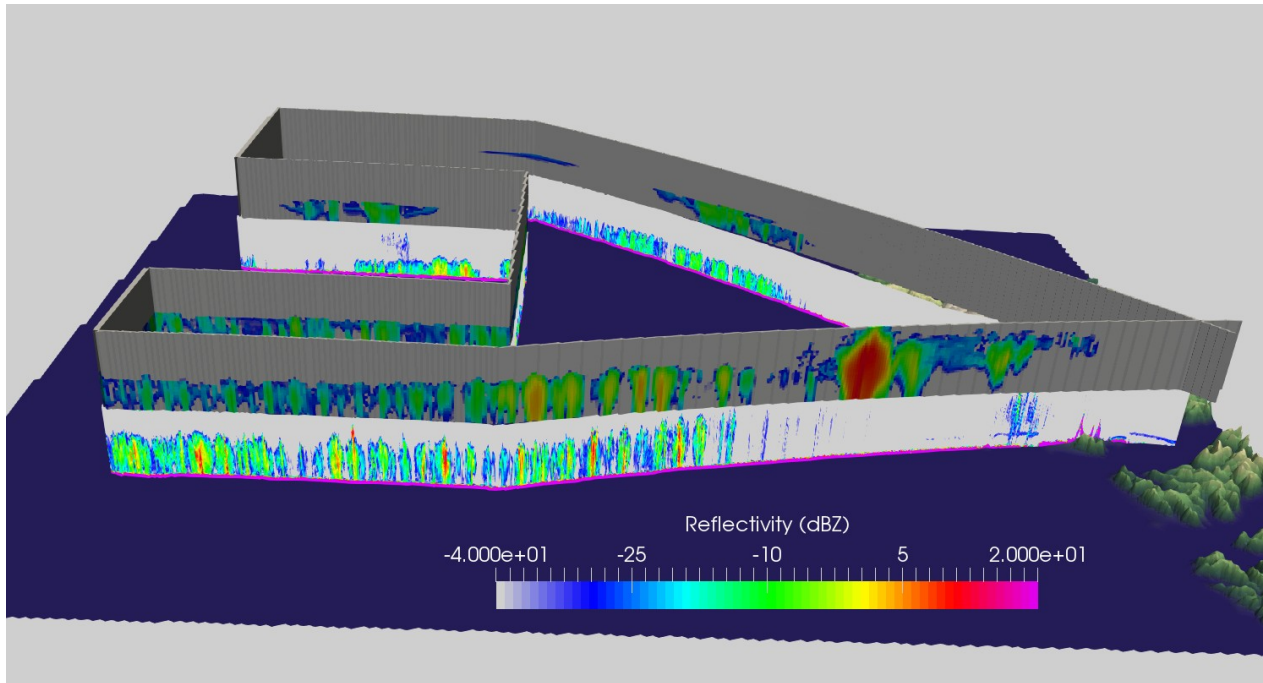
02.06.2026

More about potential...less about needs

- Comparing simulations and observations of mixed-phase clouds (e.g. CAOs) along flight track – evolving methods
- Basic comparison across campaigns – e.g. representation of temperature, stability, ... how good are our boundary conditions?
- Where is the liquid going (or why not coming)? And do we have too much or not enough?

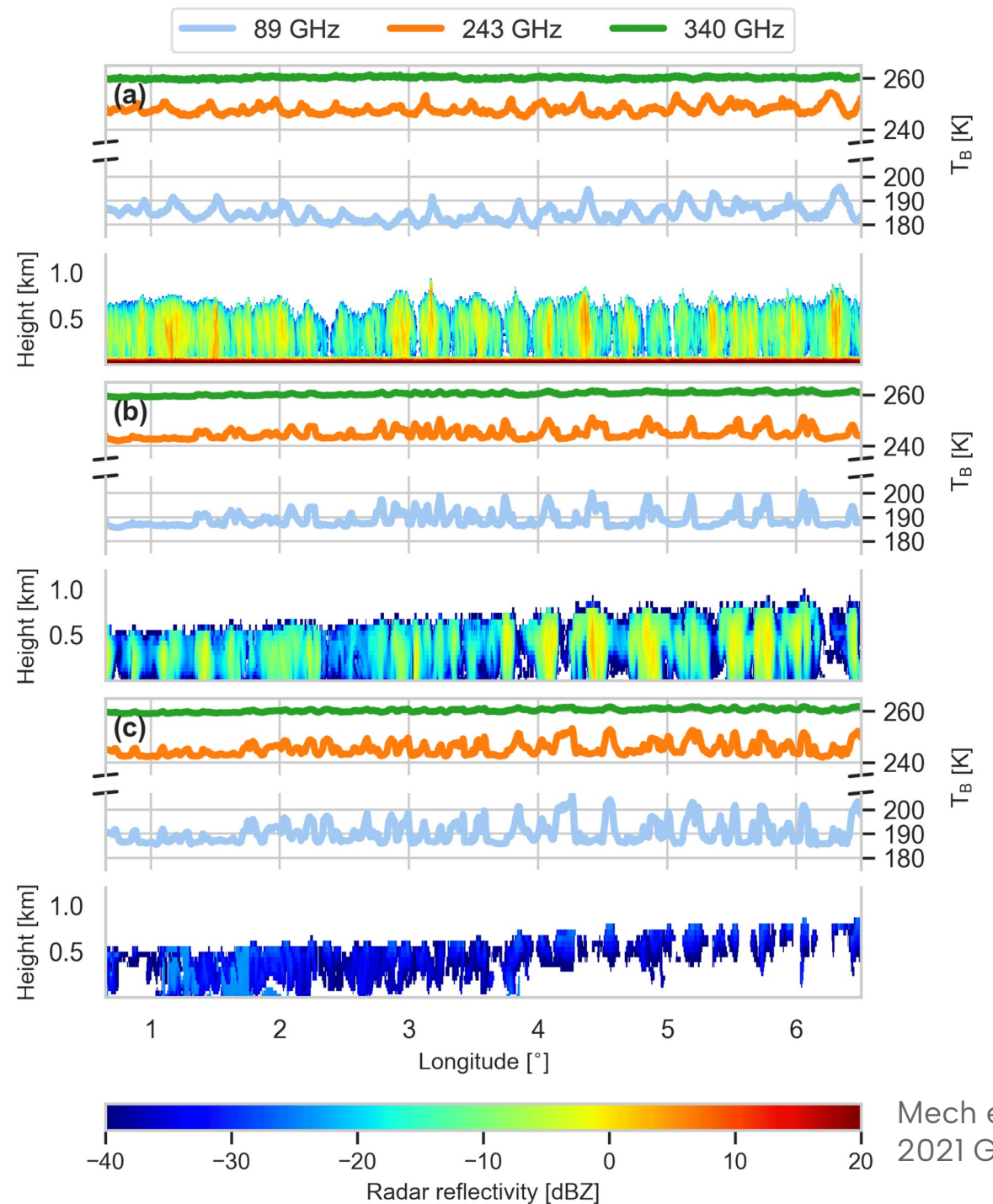
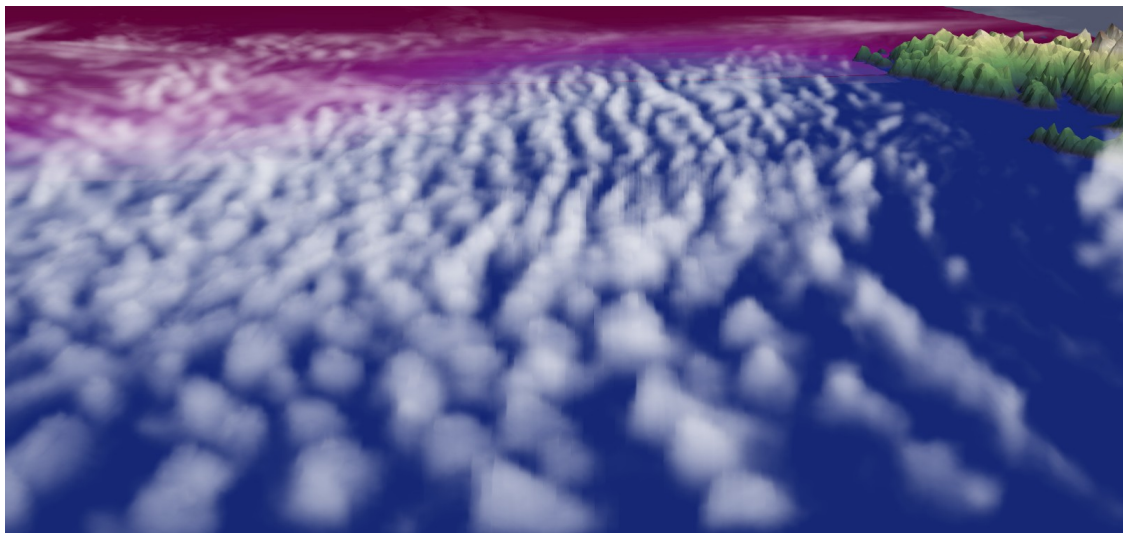
Workflow

- Forcing operational global ICON (13 km)
- 2km in limited area (potentially also 600m)
- So far: flighttrack cut out in post processing
- New: online / in-situ output / simulator
- PAMTRA instrument simulator to get observable quantities (e.g. radar reflectivity)

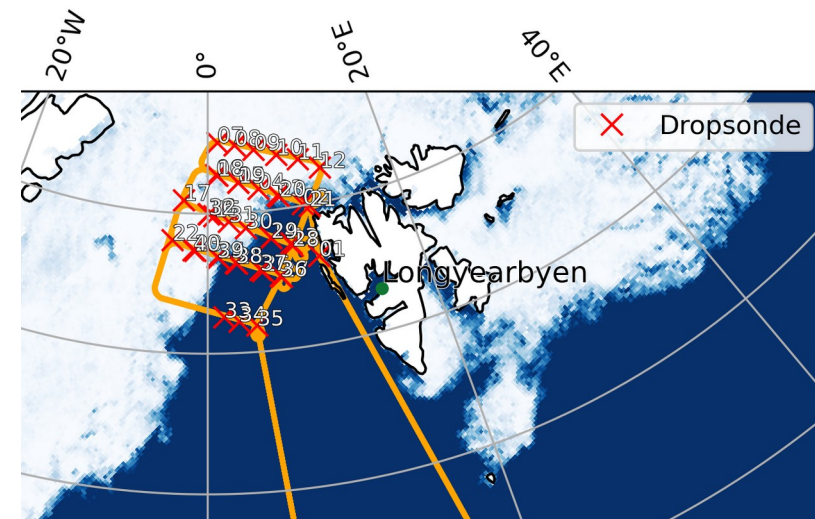
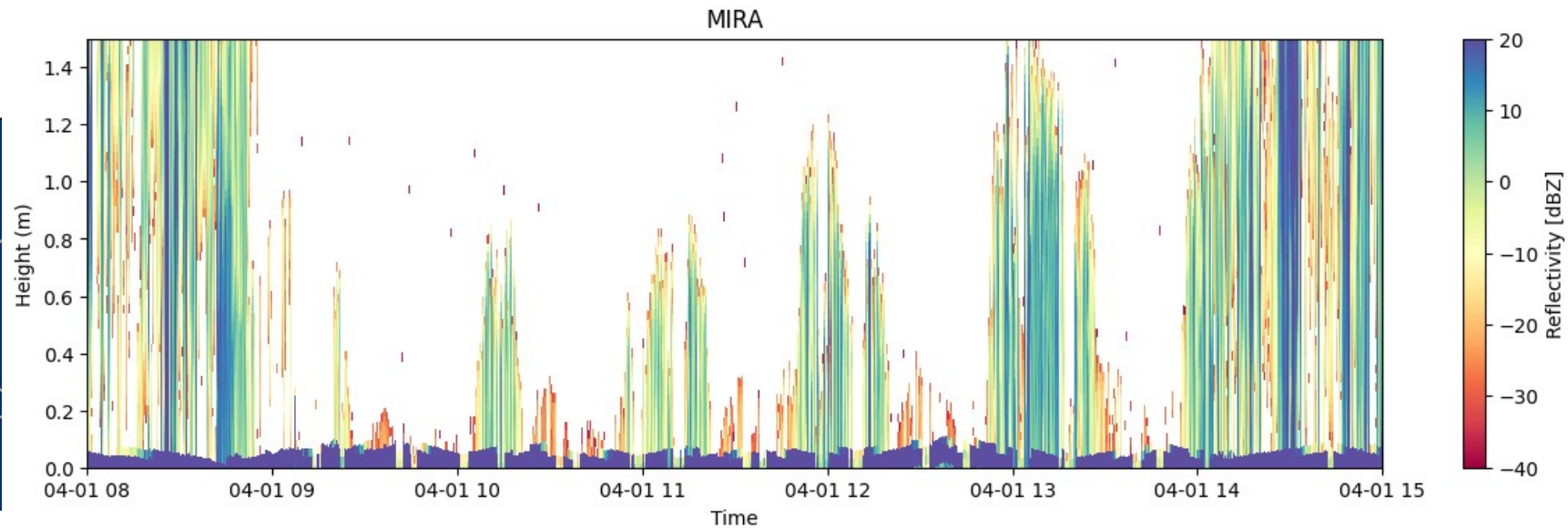
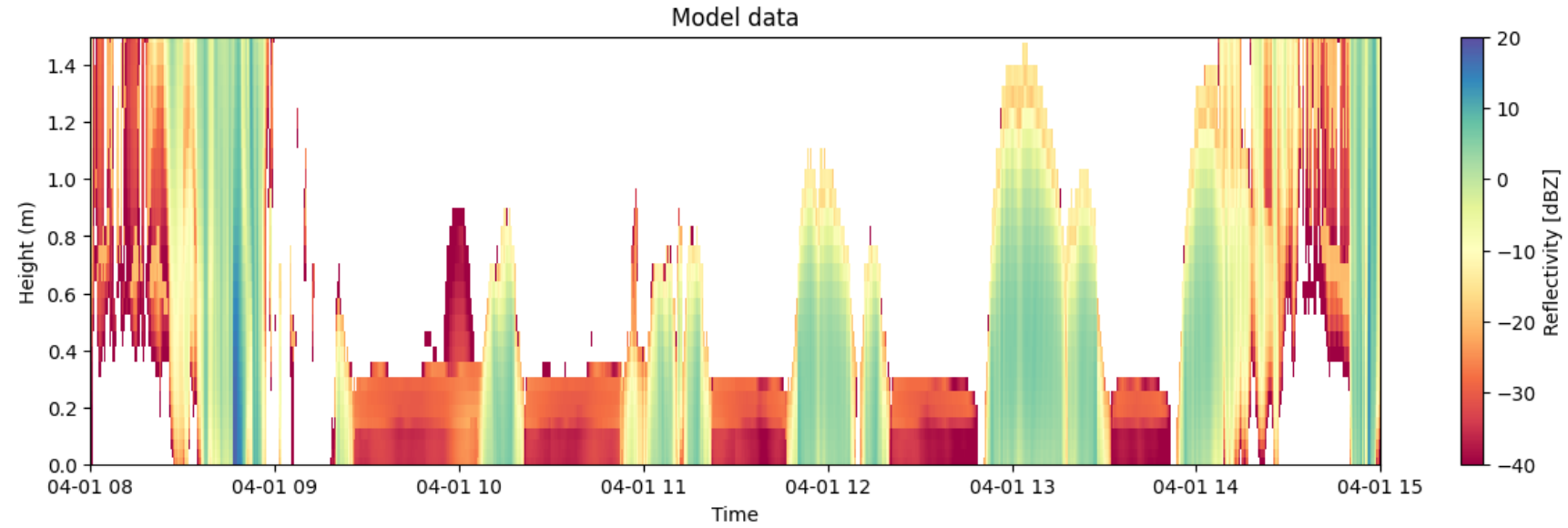


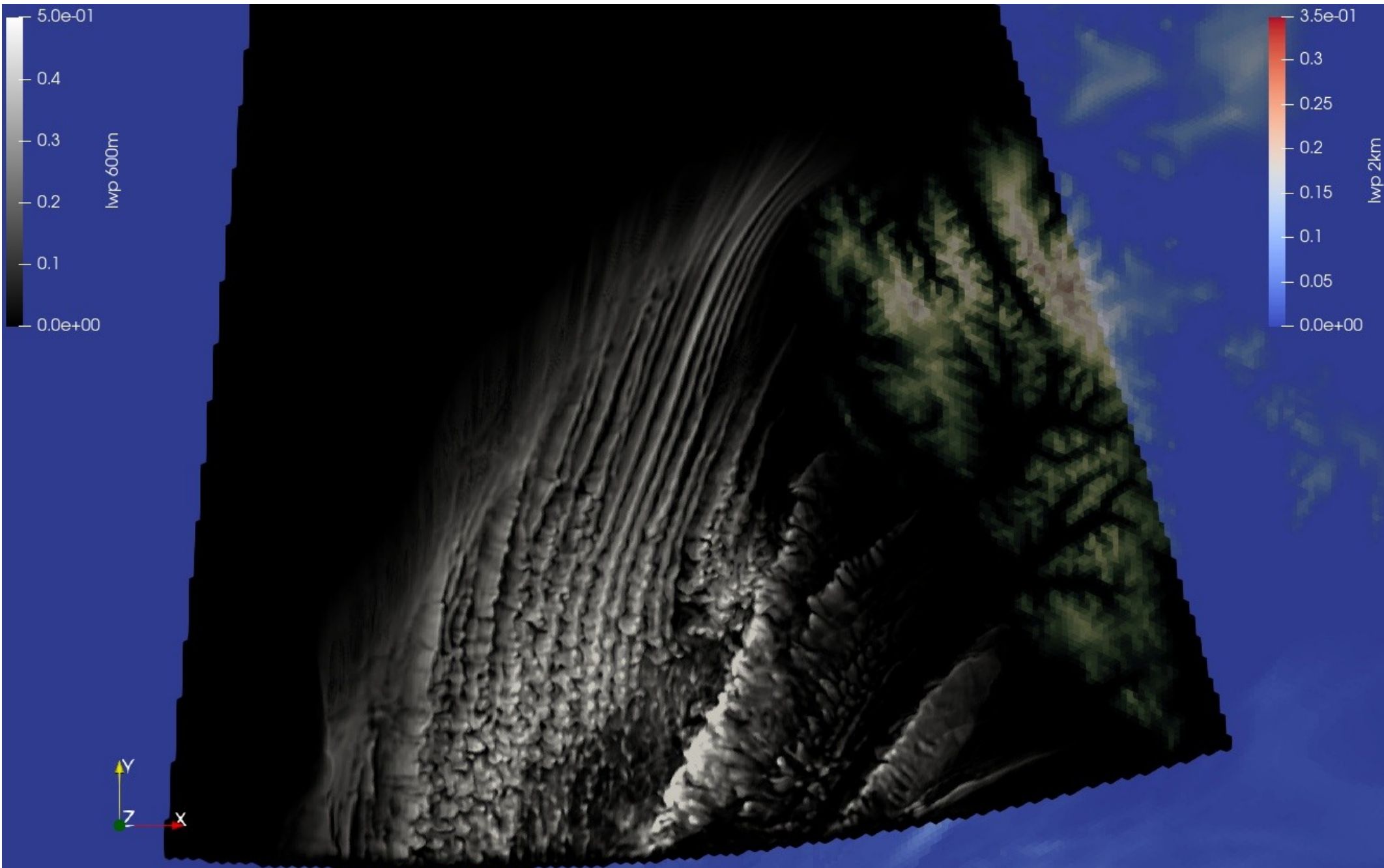
First try back in 2017...

- Possible to simulate cloud streets with 600m resolution – out of the box
- Boundary layer too deep and surface to warm (over sea-ice)
- Mainly liquid clouds (missing e.g. snow and ice)
- Improvement after adjusting boundary layer and changing CCN activation
- But what can we learn from one crosssection?

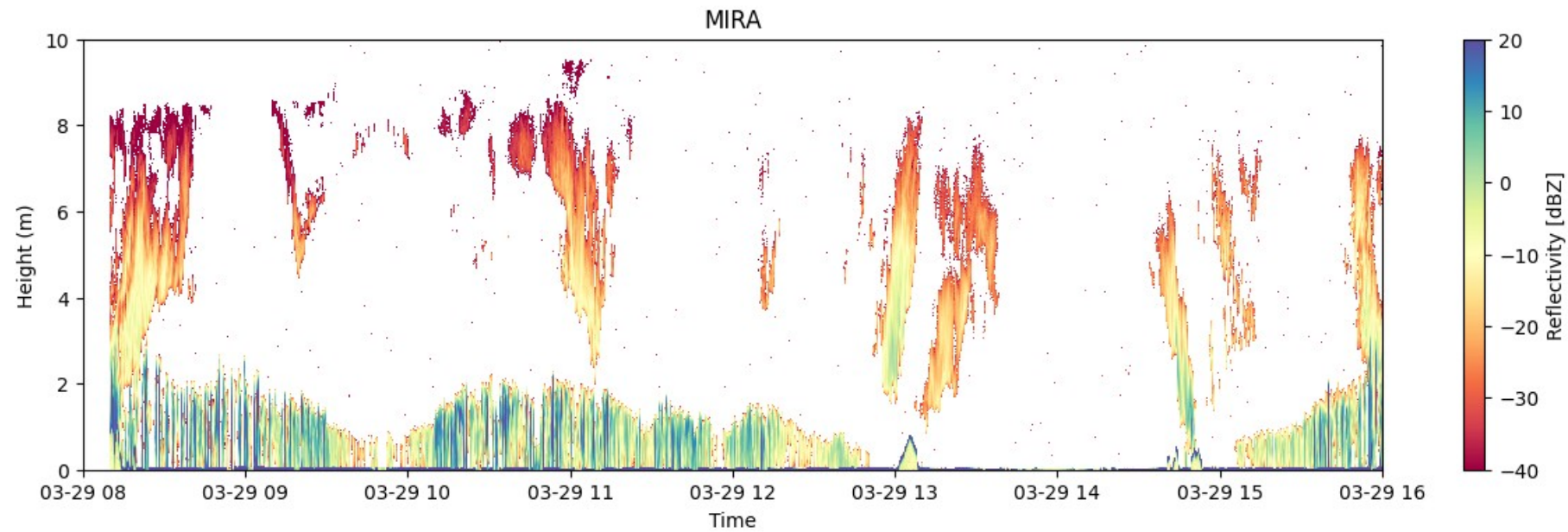
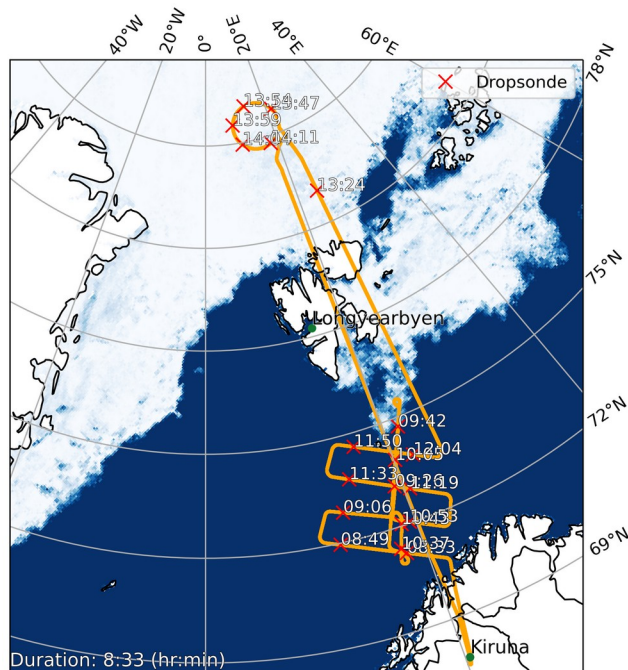
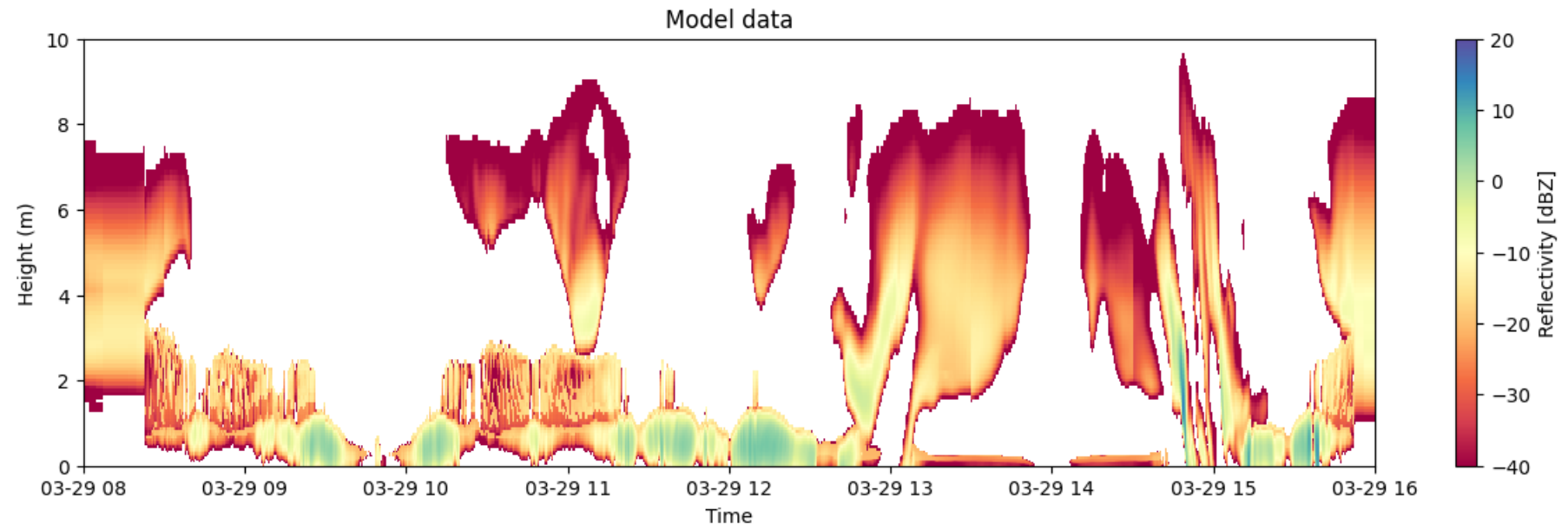


CAO case in Halo-AC3 1.4.

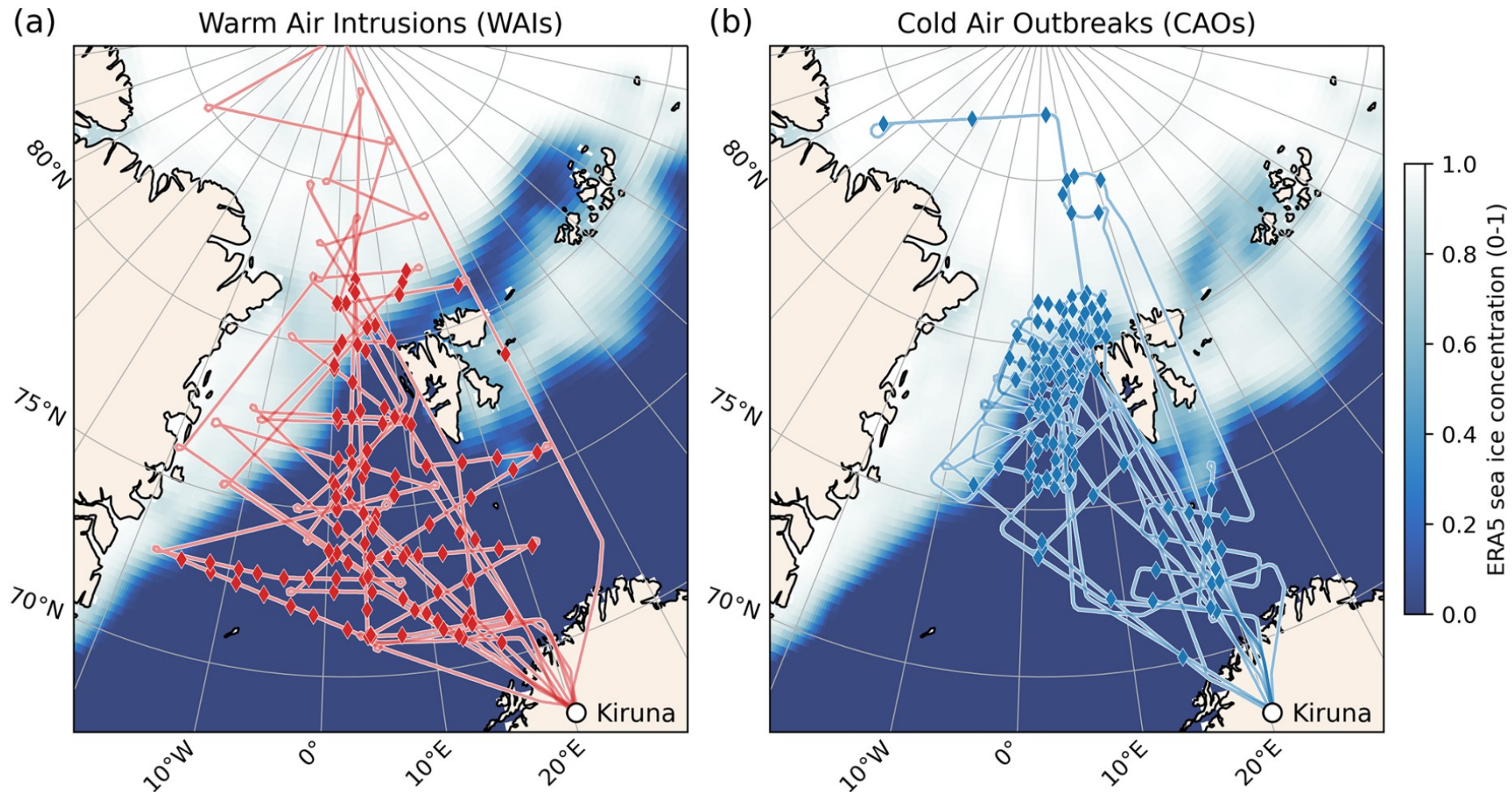




Joined case 29.3.

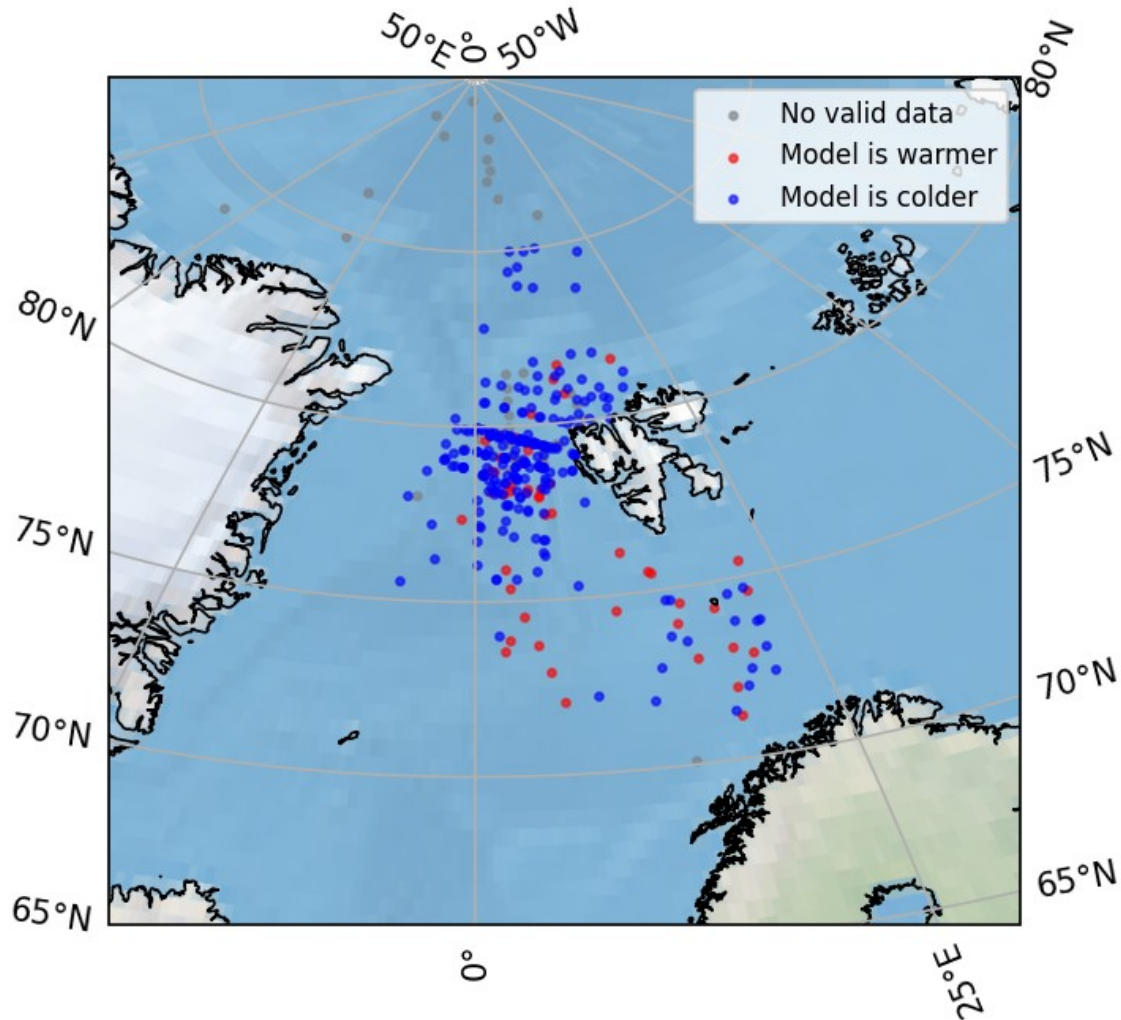


Statistical analysis for HALO-(AC)³ - surface conditions

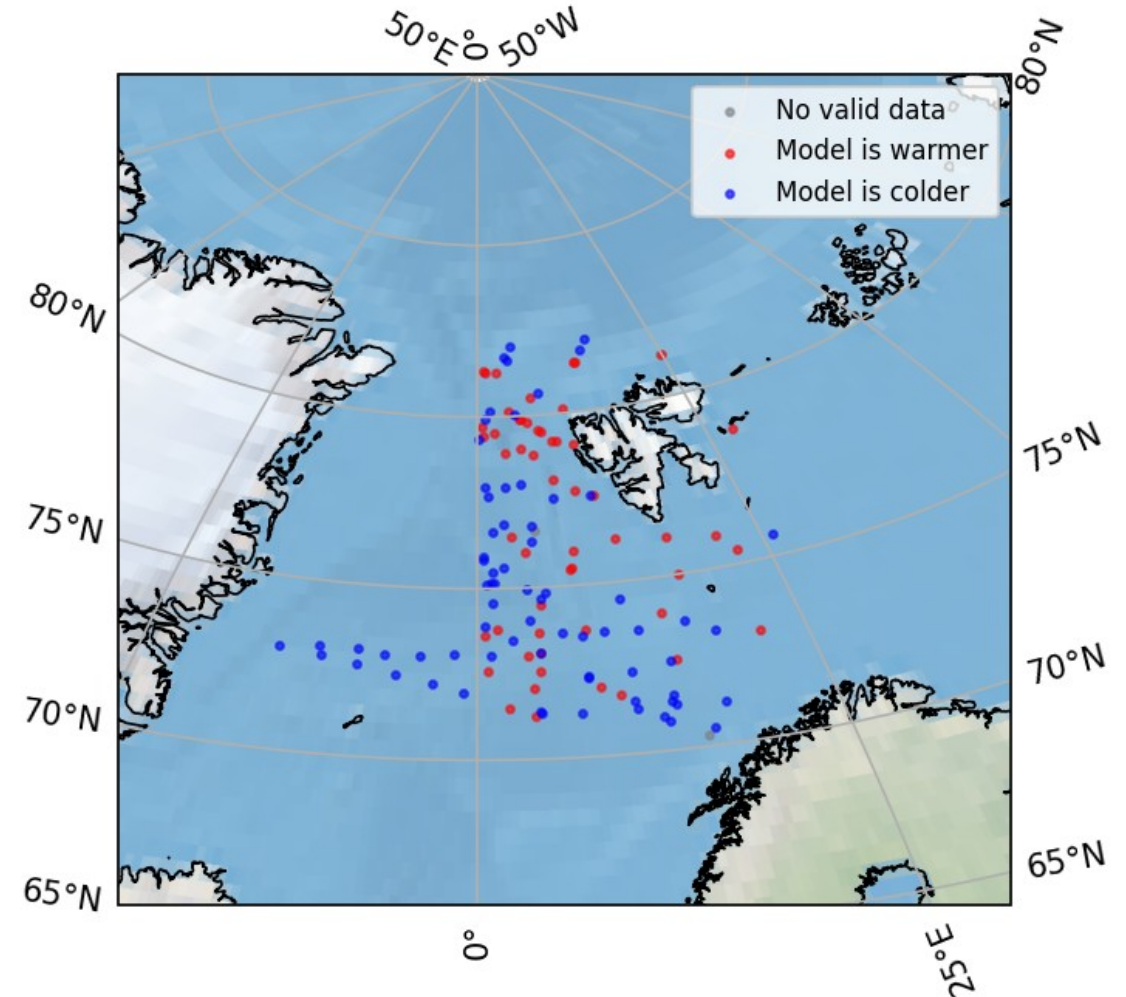


Do we see a significant signal? Too warm? Too cold?

During cold period (marine cold air outbreak)

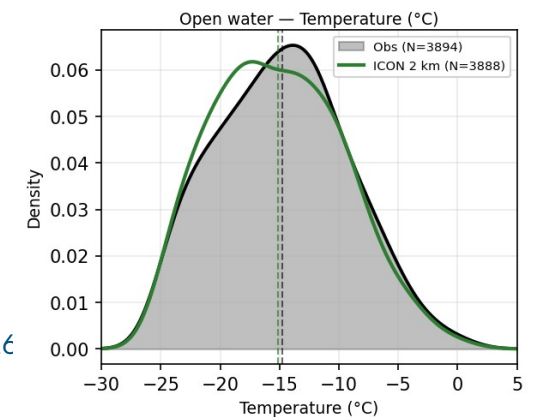
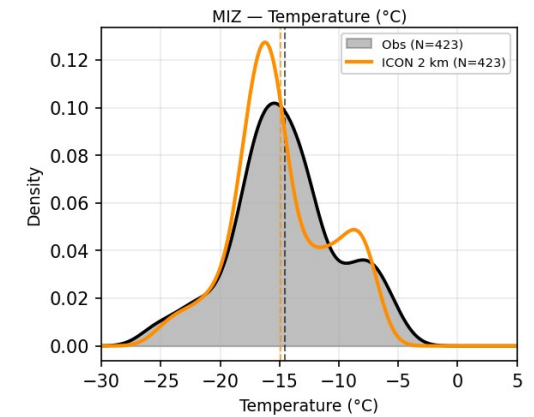
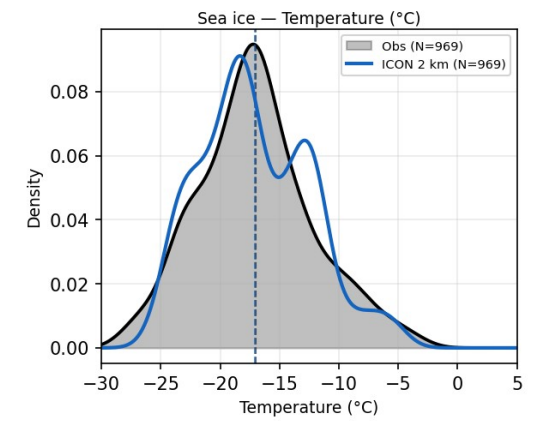
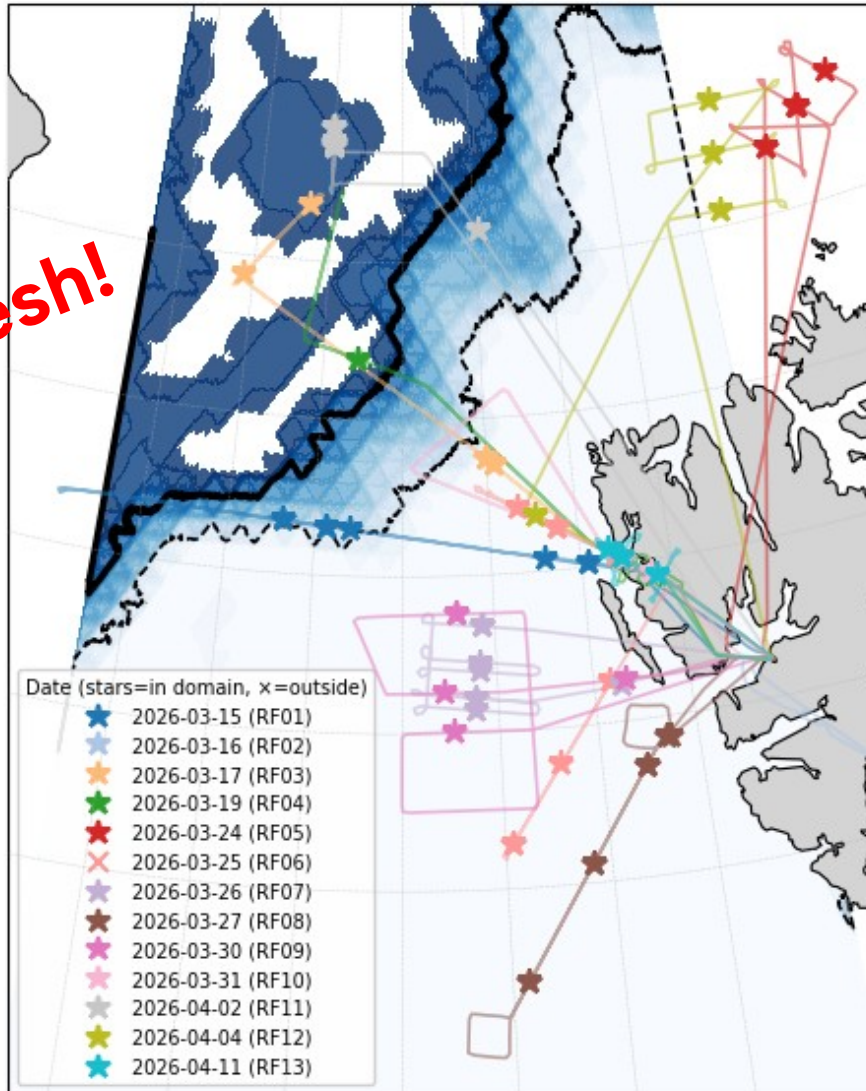


During the warm period (warm air intrusion)



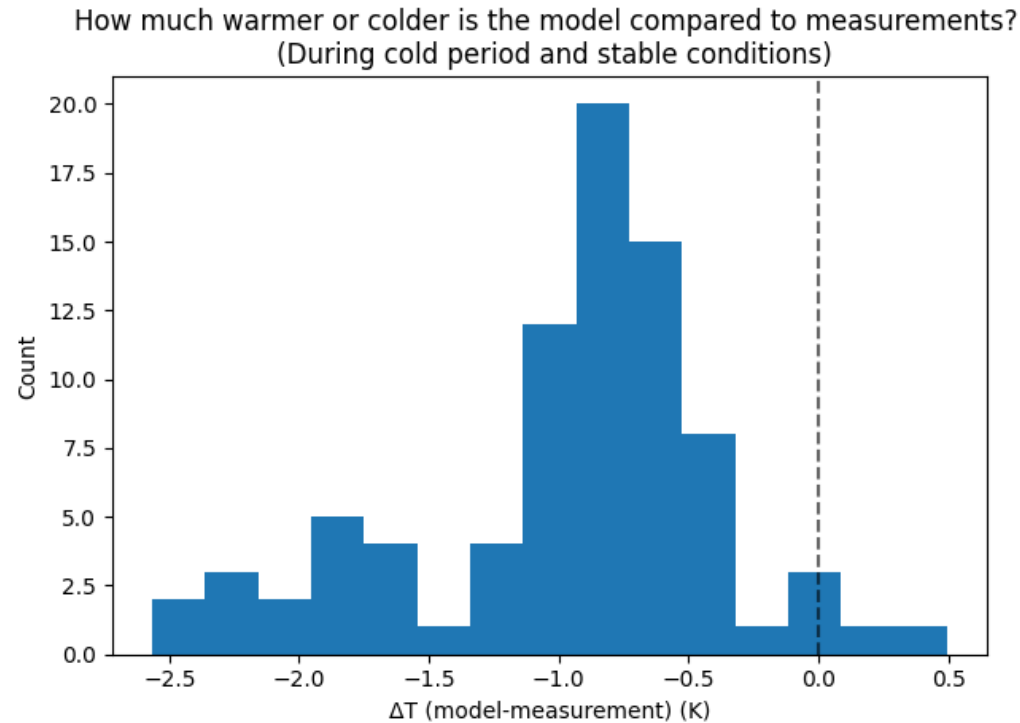
COMPEX campaign – March/April 2026

Really fresh!



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Sorting for different environments – stable vs unstable



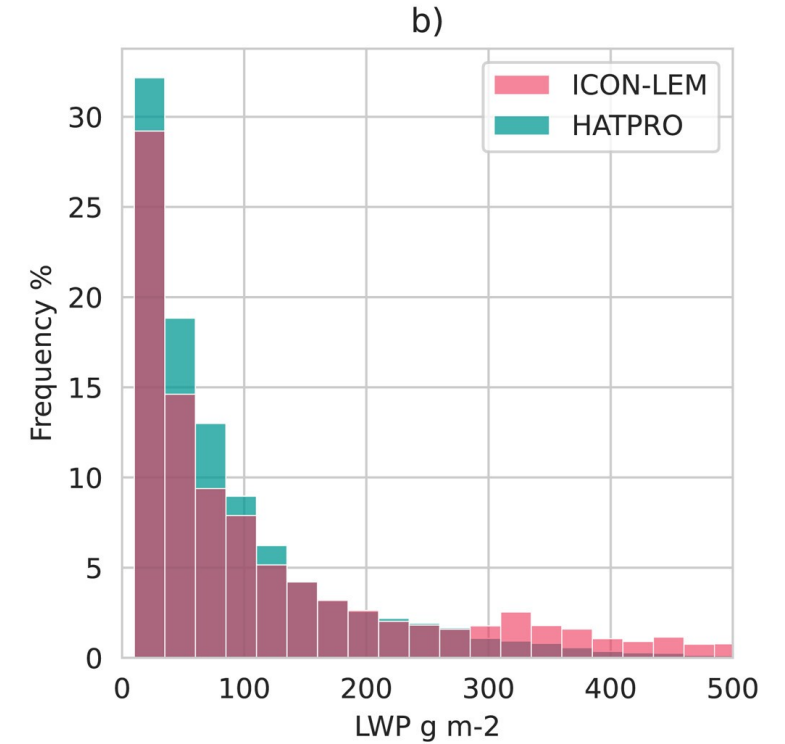
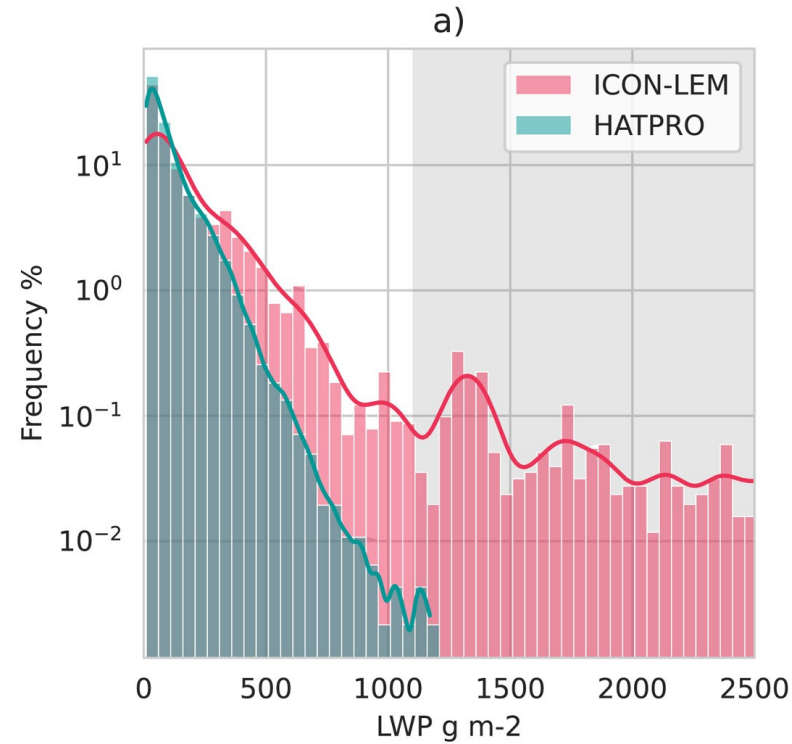
It seems we have a consistent “model is slightly too cold” signal.

Planned: General assessment across different campaigns – change in conditions? Or model quality?

Question: Are there similar studies for other models?

The issue with the liquid...

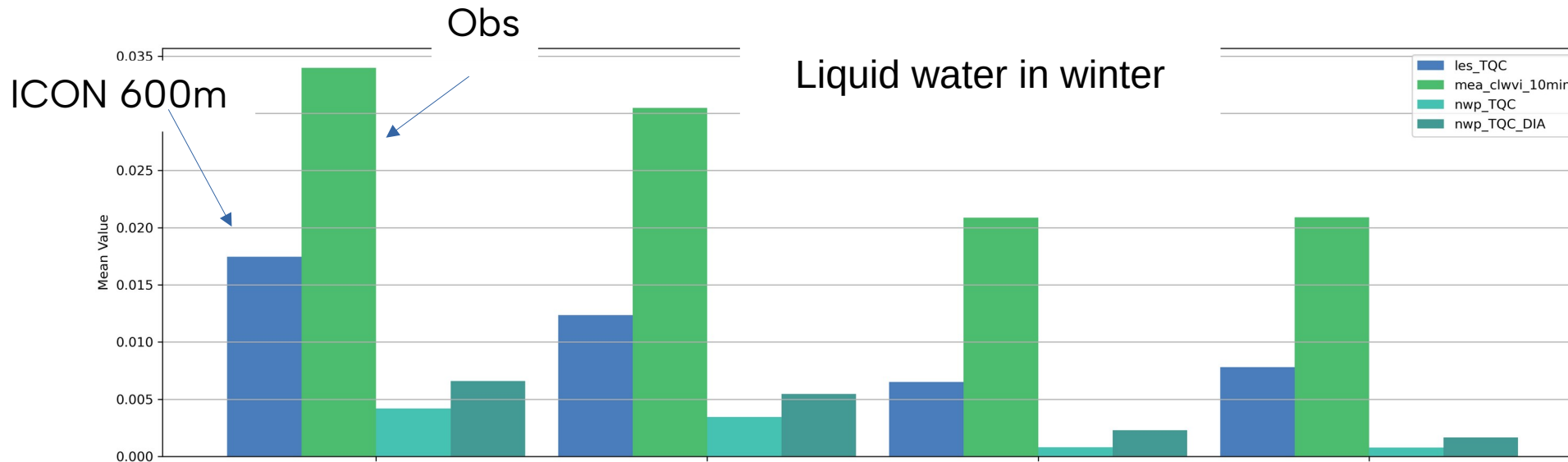
Analysis at Ny-Ålesund, shown period: August – December 2020



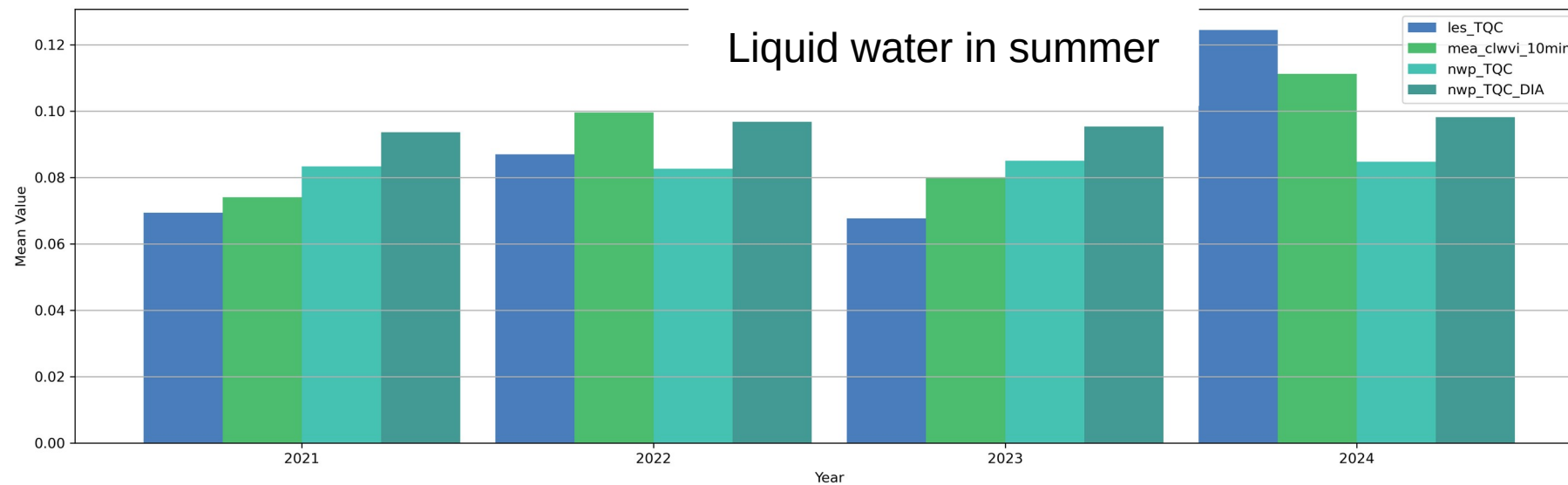
			Clouds with LWP		
	Clear	Cloudy	LWP > 5	LWP > 10	LWP > 20
Obs %	27	73	70	63	53
ICON %	23	77	34	31	26

- General good cloud representation
- But missing liquid
- And if liquid, then too much...

Looking at longterm statistics (2021 - 2024)



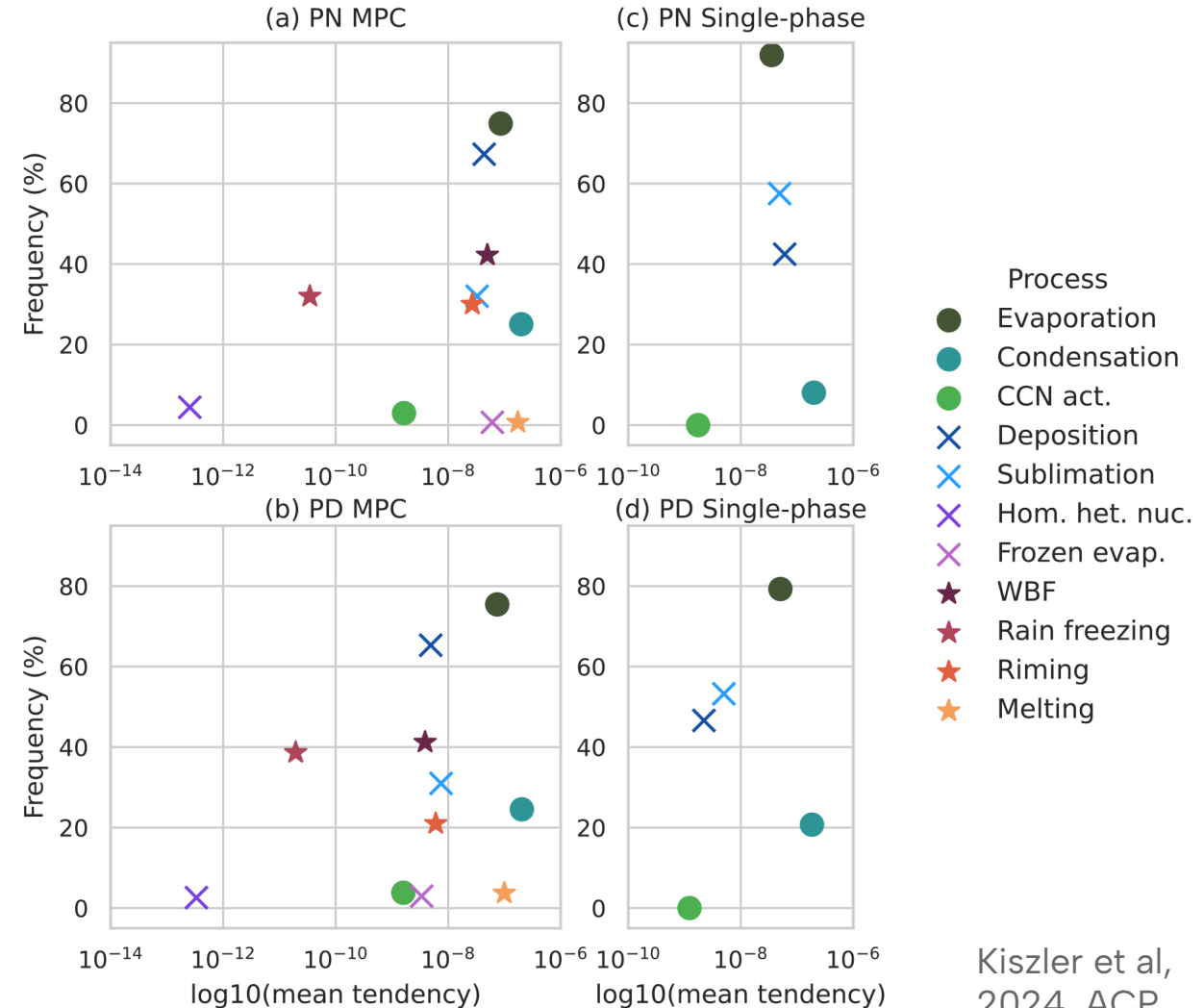
Liquid water is clearly underestimated in winter – in all configurations.



Work by Jan-Philipp Kraayvanger

Investigating microphysical processes in the simulation

Possibility to 'rerun' microphysics on model output to investigate the importance of different microphysical processes.



Some takeaways

- Planning together and thinking about processes – not only in different methods
- Ideas on flight tracks based on model evaluation
- Statistics – within flights and across campaigns. Single cases can be so different.
- New possibility to write output along flight tracks during model simulation (and/or use instrument simulator directly) – approximating observed timescales
- Possibility to re-run (process) microphysical process rates