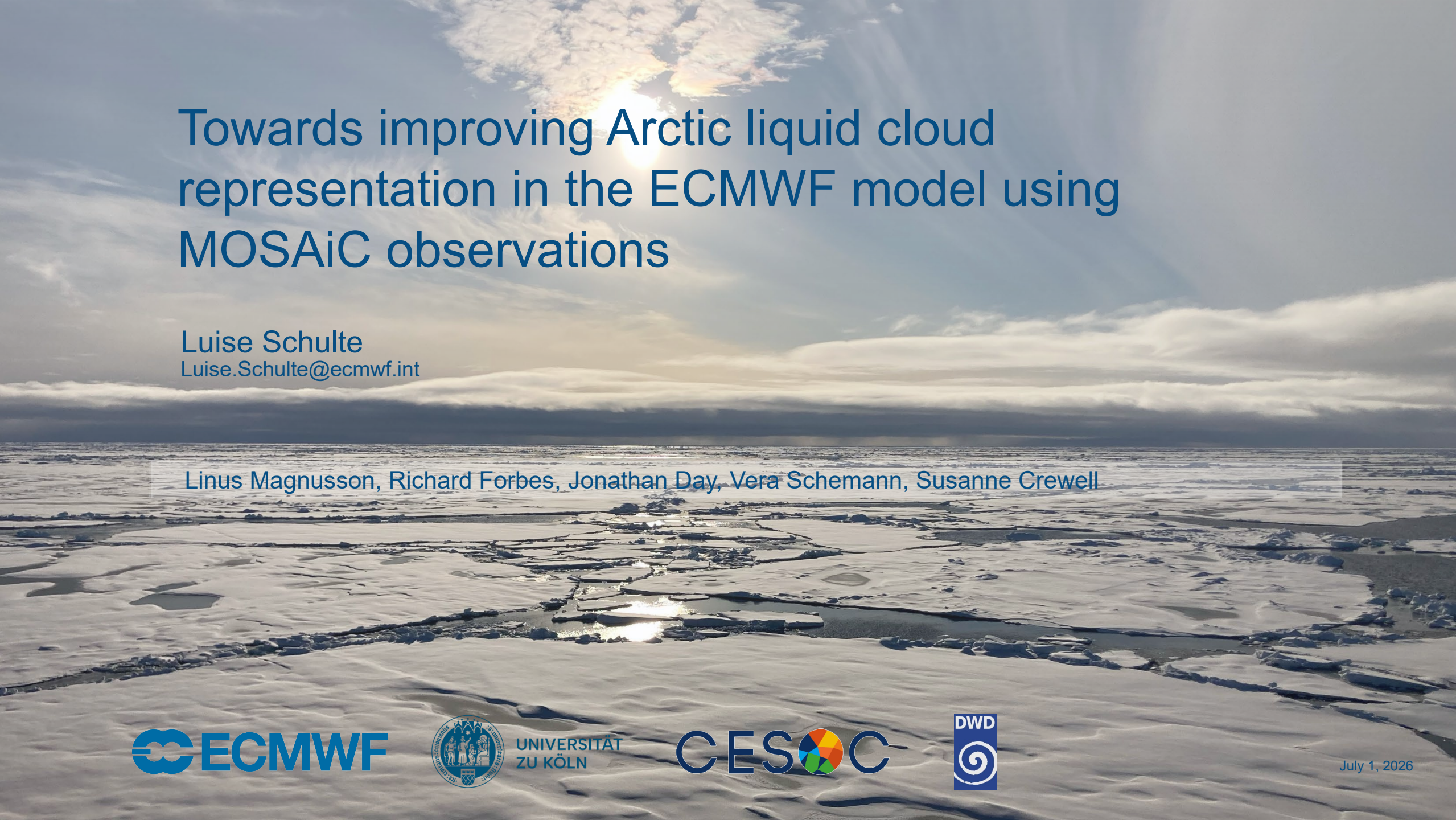

Towards improving Arctic liquid cloud representation in the ECMWF model using MOSAiC observations

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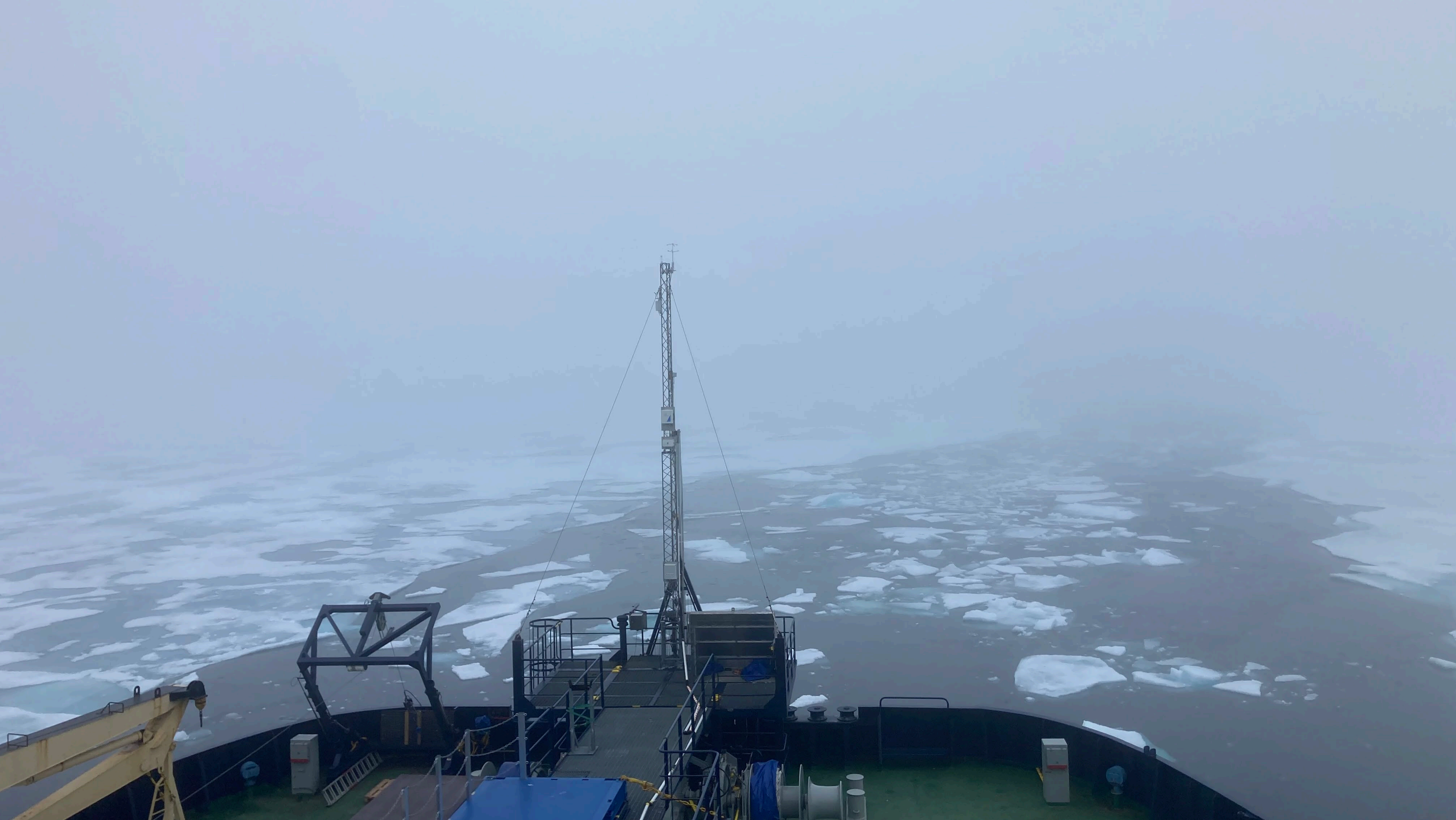
July 1, 2026



Why do we care about predicting Arctic clouds?

Fog

Low visibility Icing

Cloud phase Cloud lifetime

Surface energy budget

Precipitation

Snow on sea ice Surface albedo

How do we measure clouds?

PCAPS
POLAR COUPLED ANALYSIS AND PREDICTION FOR SERVICES

Radiosondes (00, 06, 12, 18 UTC)

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How do we measure clouds?

Remote sensing: Doppler cloud radar, ceilometer and microwave radiometer

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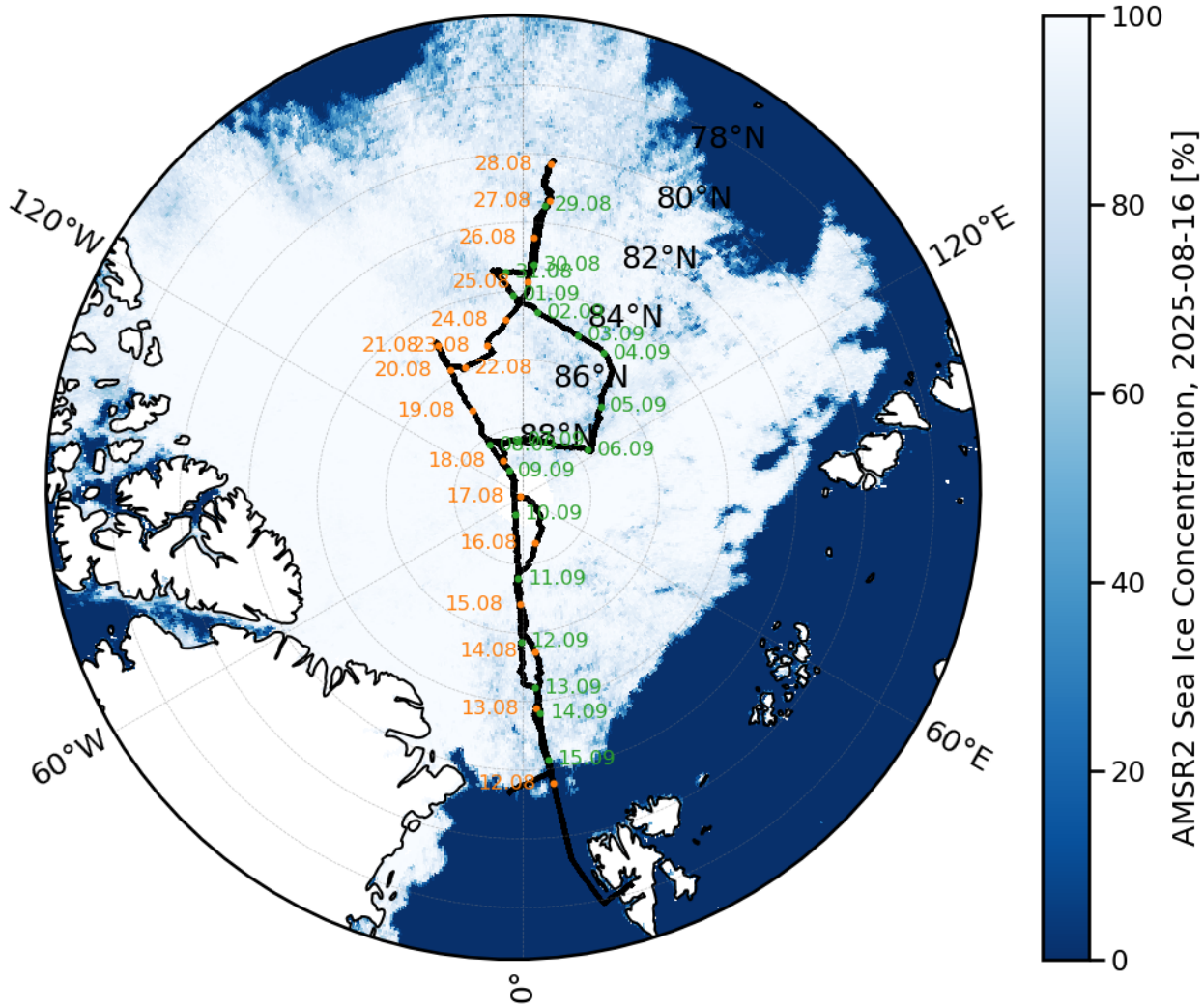
Canada-Sweden Arctic Ocean 2025 (AO2025)



Bolin Centre Database

https://bolin.su.se/data

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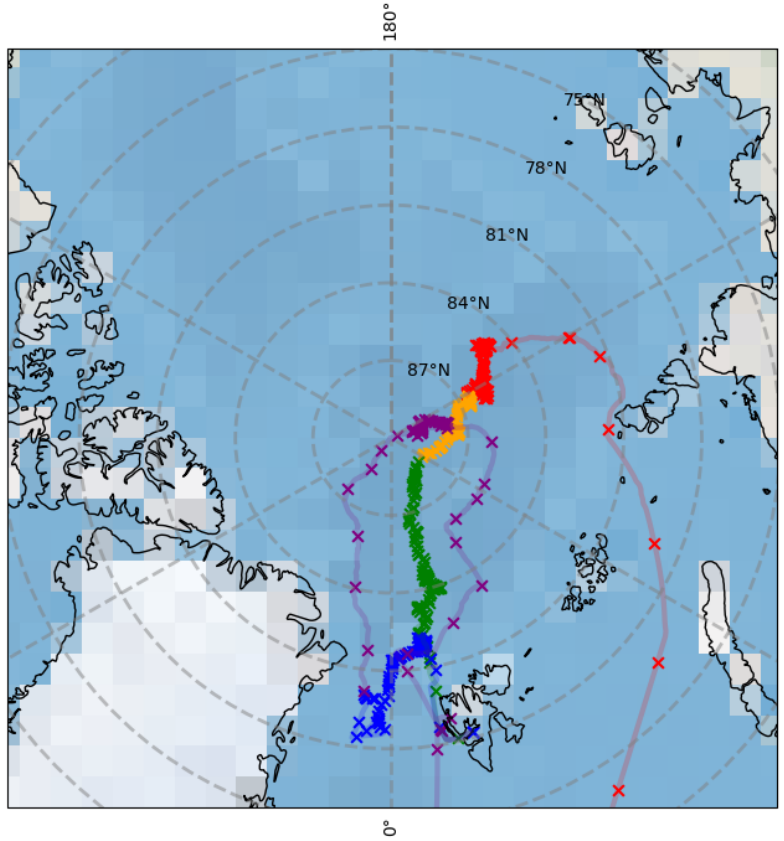
MOSAiC expedition – One year in the ice



Track of icebreaker *Polarstern*
(September 2019 – October 2020)

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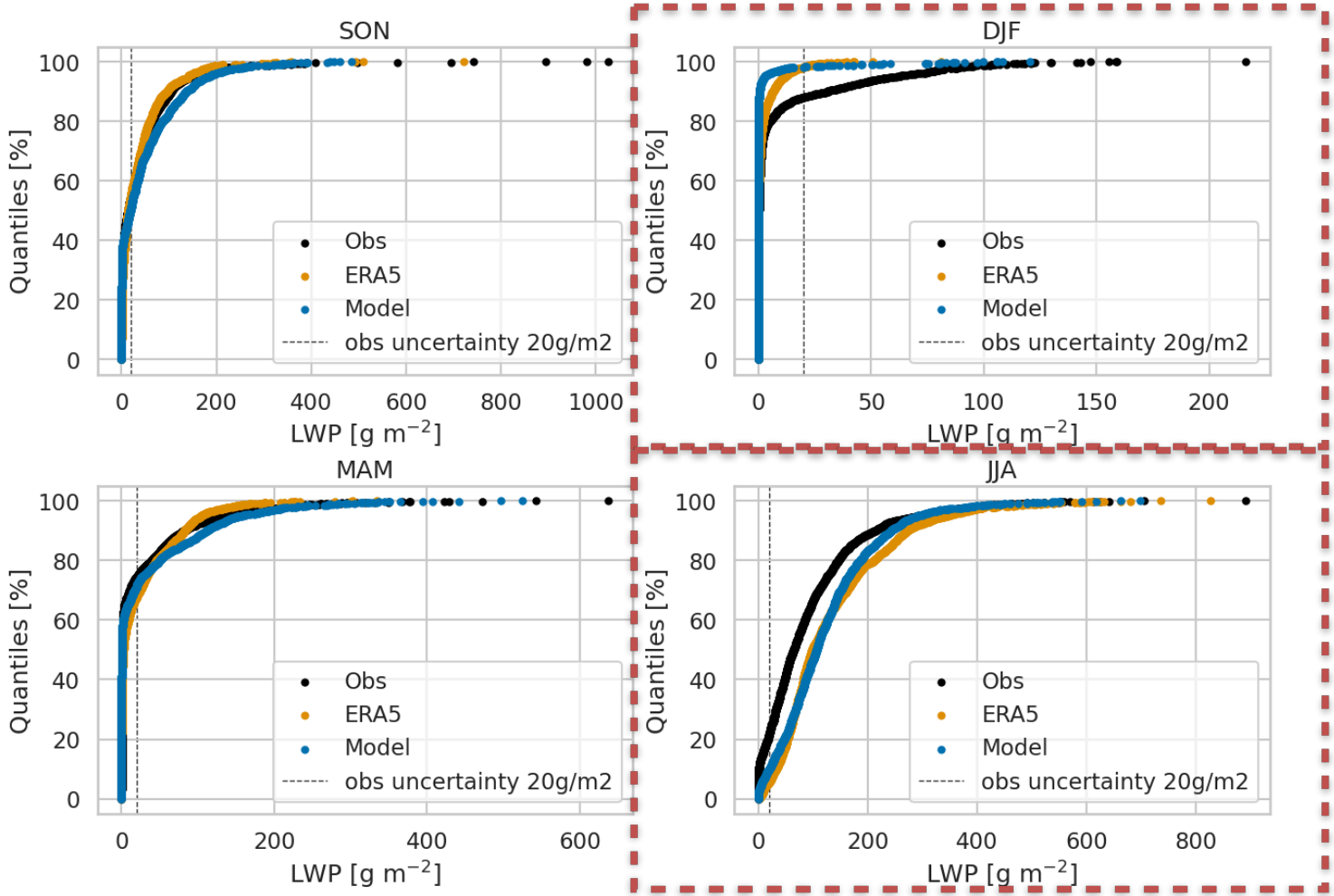
How much liquid water is in the clouds in each season?



Schulte et al. (2026), QJRMS

- **Underestimation** of liquid cloud water in **winter** (DJF)
- **Overestimation** of liquid cloud water in **summer** (JJA)

Obs: MOSAiC data, microwave radiometer (Walbröl et al. 2022)
Model: IFS forecast, version 48R1, lead time 24h to 48h, nearest grid point

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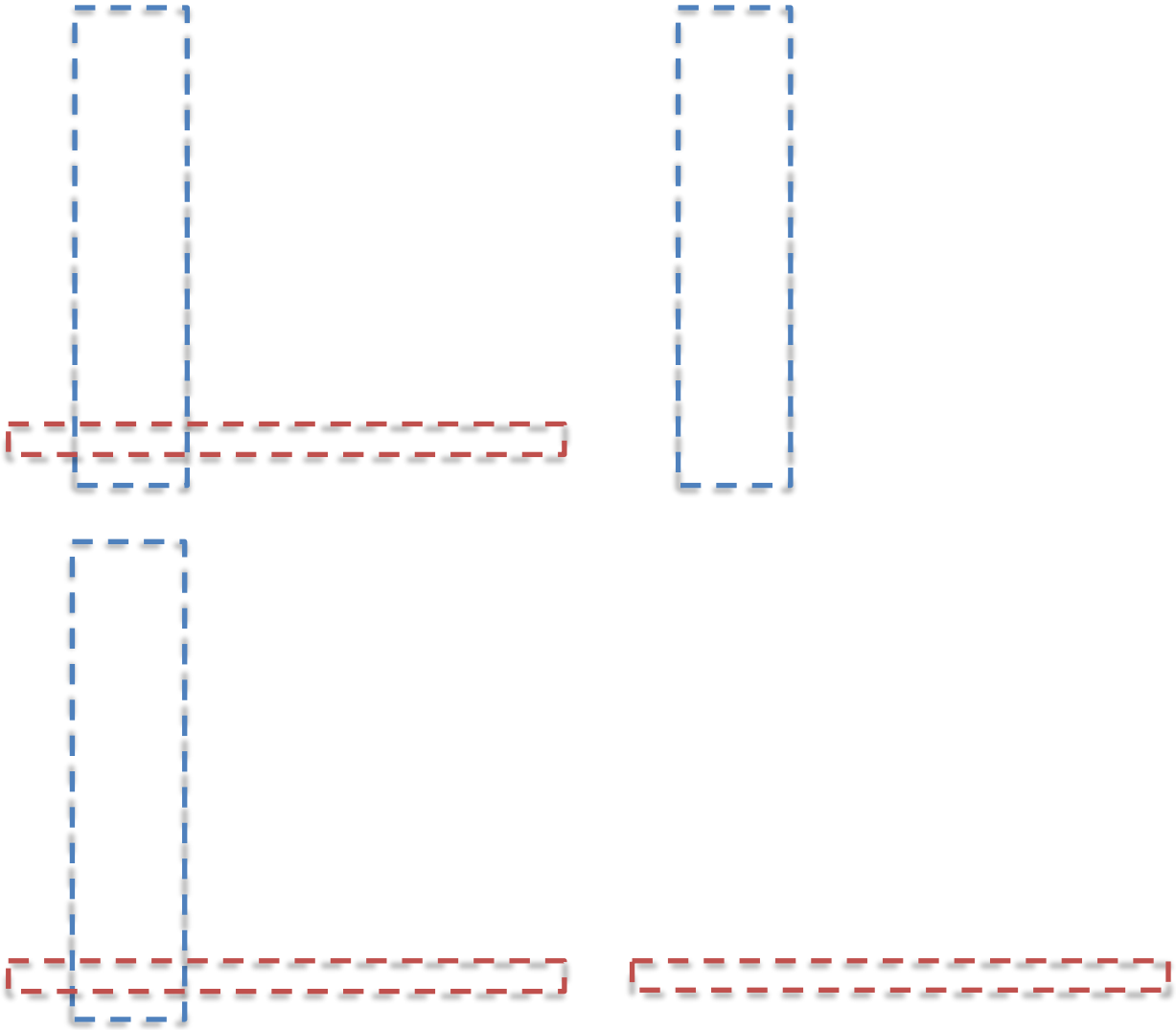
Which properties do the liquid-containing cloud layers have?



- **Underestimation** of liquid cloud water in **cold temperatures (<-20°C)**
- **Overestimation** of liquid cloud water **at low levels (<200 m)**

Obs: MOSAiC data, microwave radiometer, ceilometer, interpolated radiosonde
Model: IFS forecast, version 48R1, lead time 24h to 48h, nearest grid point

Schulte et al. (2026), QJRMS

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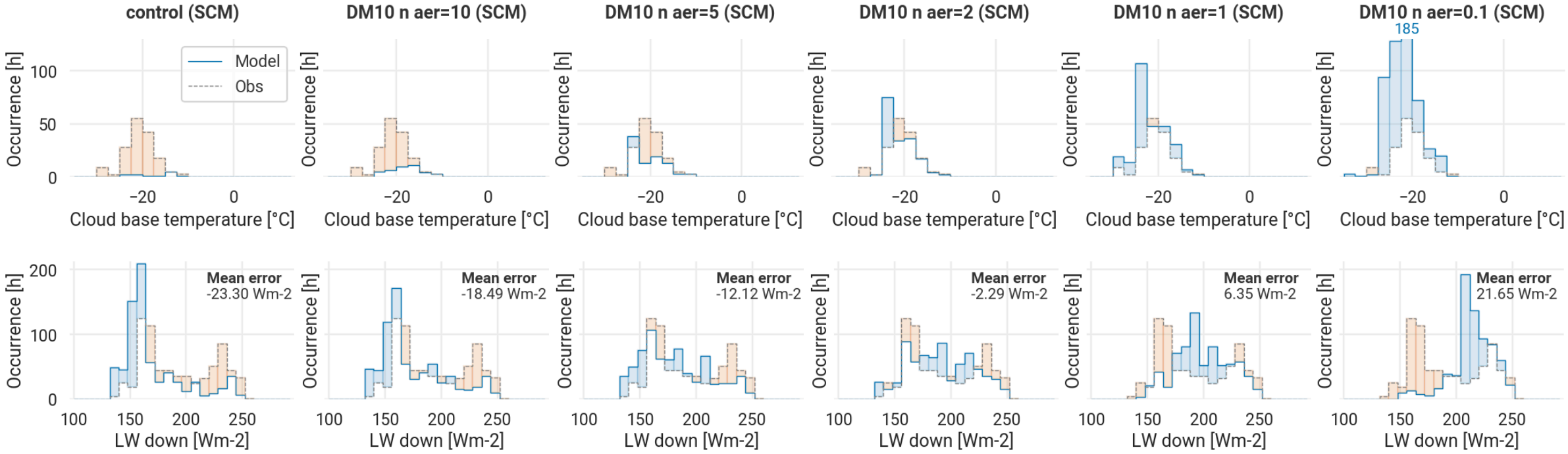
Sensitivity to ice growth rate in December (Single Column Model)

Reduce ice growth rate



- Increase the occurrence of liquid-containing clouds by reducing the ice growth rate.
- Improve mean surface radiation

Schulte et al. (2026), QJRMS

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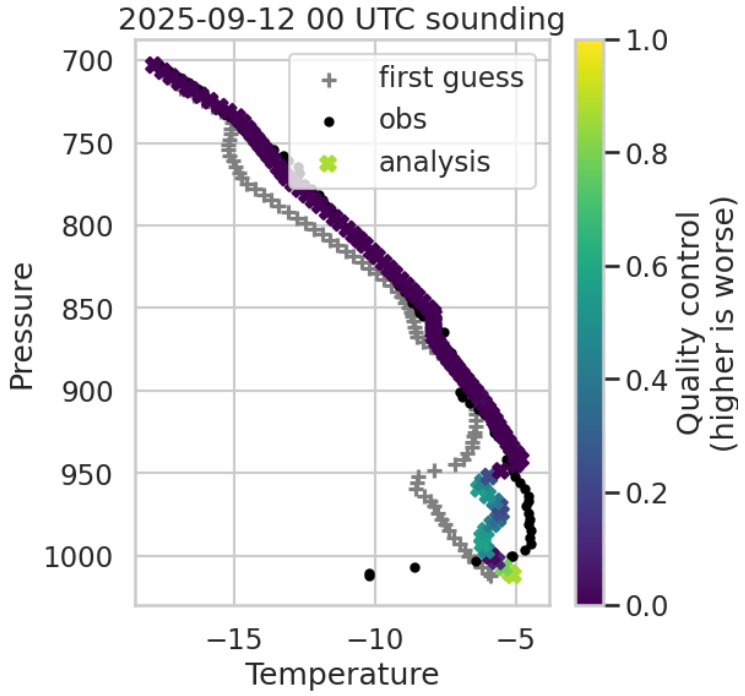
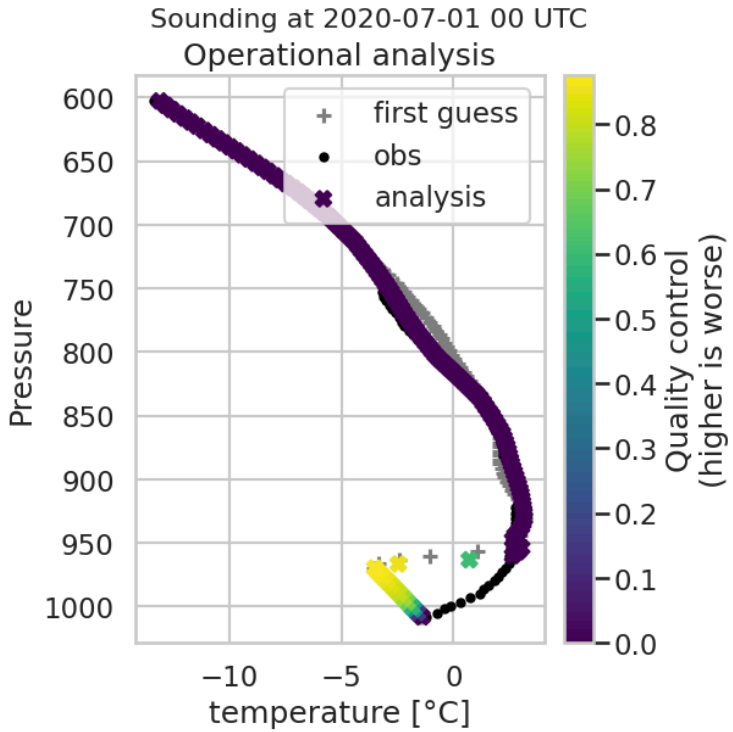
Why too frequent low clouds?

Initial profile already off





Obs: AO2025 & MOSAiC radiosonde
Model: IFS LWDA

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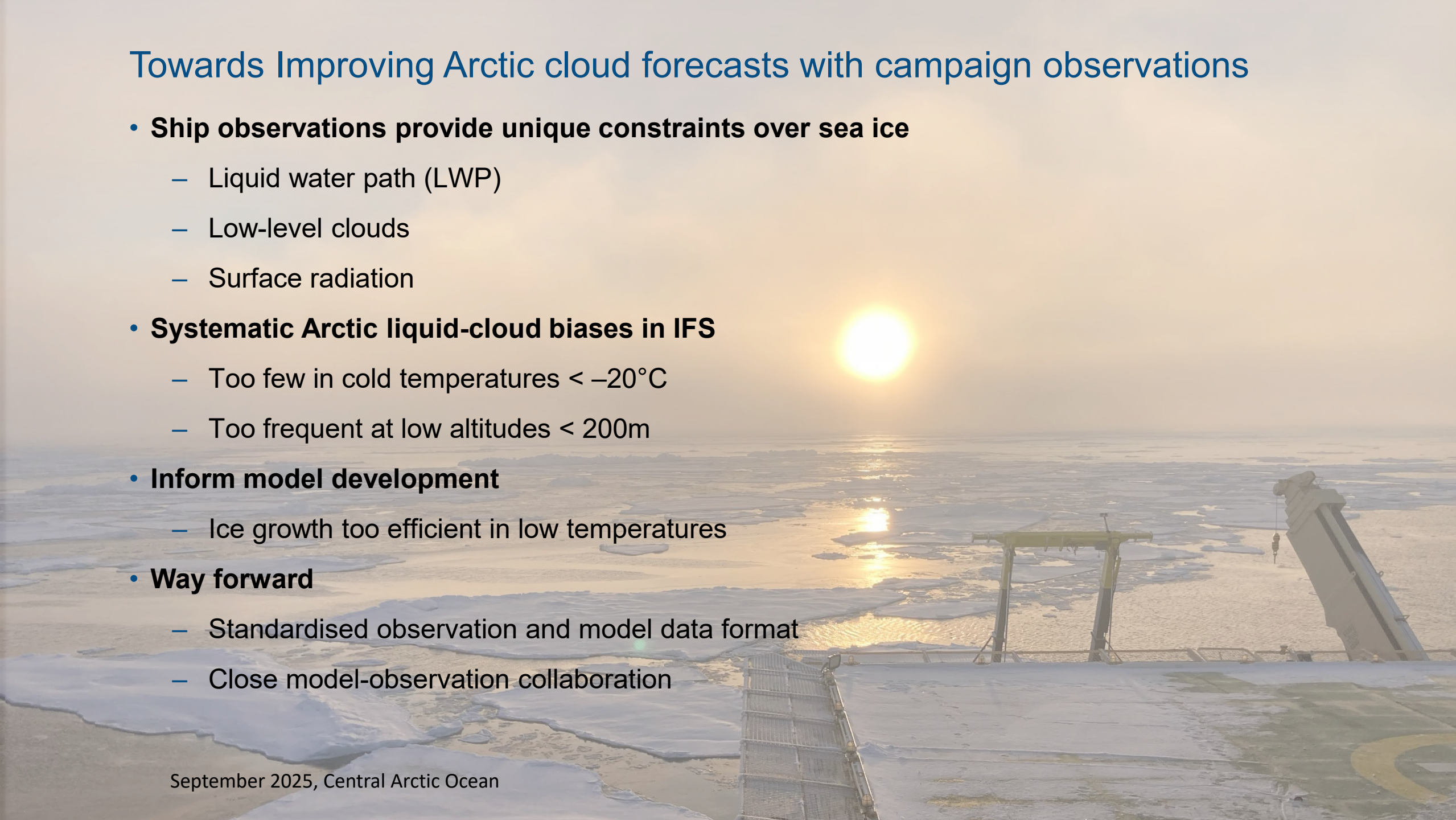
Towards Improving Arctic cloud forecasts with campaign observations

- **Ship observations provide unique constraints over sea ice**
  - Liquid water path (LWP)
  - Low-level clouds
  - Surface radiation
- **Systematic Arctic liquid-cloud biases in IFS**
  - Too few in cold temperatures < –20°C
  - Too frequent at low altitudes < 200m
- **Inform model development**
  - Ice growth too efficient in low temperatures
- **Way forward**
  - Standardised observation and model data format
  - Close model-observation collaboration



September 2025, Central Arctic Ocean