Project: **1137**

Project title: **Radiative Effects of Mixed-Phase Clouds Over the Oceans**

Principal investigator: **Anna Possner**

Report period: **2021-11-01 to 2022-10-31**

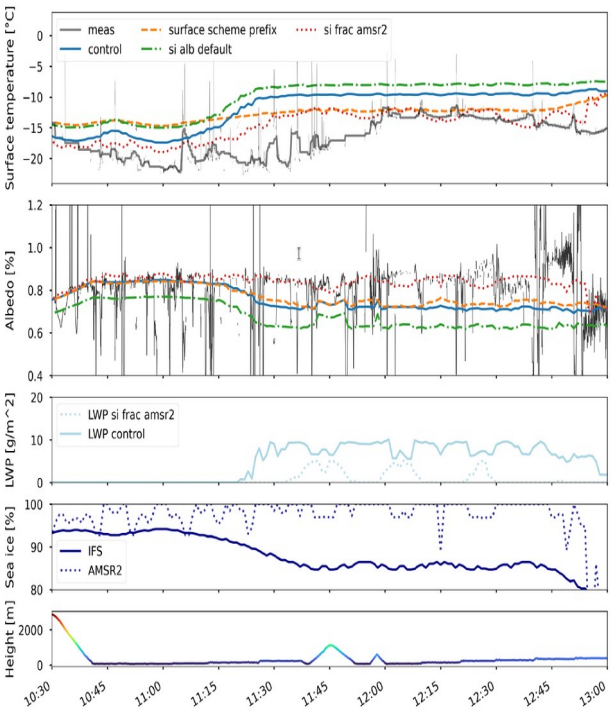
Resource Utilisation

Resources requested Levante	22
Resources consumed Levante	6
Resources expired Levante	11
Resources allocated Mistral	98
Resources consumed Mistral	46
Resources expired Mistral	3

Table 1: Overview of resources during the 01.01.2020 – 30.06.2020 reporting period. All entries are given in kNode hours [kNh].

During the transition time between Mistral and Levante, the computational budget on Mistral was extended in addition to the granted resources on Levante. During the first two quarters nearly all Mistral resources were used and most Levante resources expired. By the end of July 2022 the group shifted all simulations and analyses to the Levante cluster. After than merely 1kNh remained unused during the allocation period.

The resources were used for major internal revisions and bug fixes of ongoing projects improving the representation of Arctic and Southern Ocean mixed-phase clouds. Furthermore, this included the completion of two Master theses.

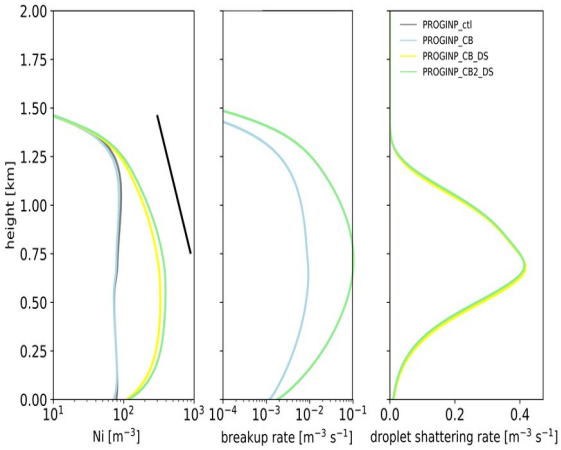


Case study of cloud radiative effects and model physics along a mesoscale cloud edge over the Arctic sea ice in km-scale simulations.

Fixing biases in sfc. sea ice scheme (XX pers. com.) and removing biases in input data were primary cause for simulated surface radiative biases during A-Flux flights. Remaining bias is due to too early onset of cloud, while the cloud edge is crossed at a later time during the observations.

Too little ice is observed and simulated cloud with representative ice crystal number concentration is unable to maintain itself and glaciates.

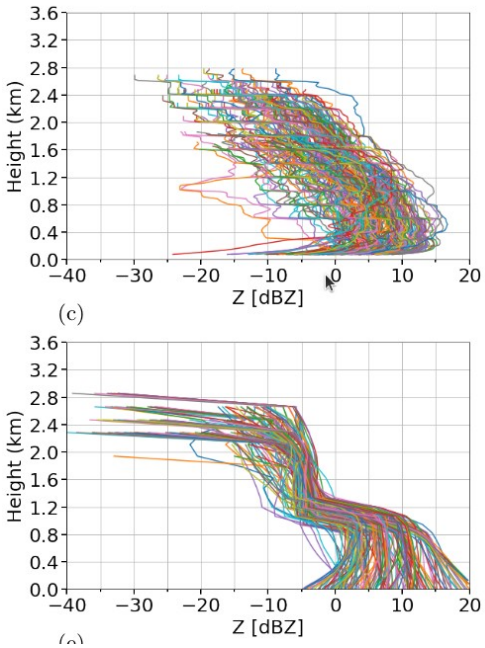
Figure: Time series of observed and simulated quantities for different sensitivity runs. AMSR sea ice fraction was used in „si amsr“ experiments.



Bug fixes, implementation of droplet shattering as an additional SIP mechanism and final production run for M-PACE study were completed. Final analysis is to be completed before publication submission .

Results show that at cloud-top temperatures of -17degC collisional breakup is inefficient and droplet shattering provides largest contributor to simulated ice crystal number concentration. Furthermore, we find the simulation results to be statistically invariant when schemes of different complexity in ice crystal nucleation are used.

Figure: simulated Ice crystal number concentrations and secondary ice production (SIP) rates for M-PACE runs.



Analyses of cloud phase and precipitation structures measured and simulated during two days of shallow cumuli/open-cell stratocumuli sampled during the Southern Ocean CAPRICORN campaign were continued. Further development, simulations with high-frequency (minute interval) output, and analyses were required to complete the internal review process of the author team. These analyses include vertical profile distributions of reflectivity demonstrating that cummulative frequency diagram (CFAD) results can be linked to vertical evolution of precipitation throughout the cloud.

The paper is now ready for submission until the end of the year.

Figure: Radar reflectivity (dBZ) fall streaks along ship track for a) observations and b) model simulations. Step function in ICON forward modelled PAMTRA results is likely caused by the absence of partial melting representation.

Publications in review:

Villanueva, D. et al. [incl. A. Possner]: „Glaciogenic seeding could help recover sea ice“, ERL in review.

Publications in prep:

Possner et al. “Resolution Dependence of Southern Ocean Mixed-Phase Clouds in ICON“ [encouraged JGR resubmission once satellite simulator is coupled]

Possner et al. „Interplay between Primary and Secondary Ice Formation in Arctic Mixed-Phase Clouds in the ICON model during M-PACE“

Ramadoss et al.: „An evaluation of kilometer-scale ICON simulations of mixed-phase stratocumulus over the Southern Ocean during CAPRICORN

Completed Master theses:

K. Pfannkuch (Master): „Simulating Ice-Phase Processes in Arctic Mixed-Phase Clouds during M-PACE with ICON“

L. Schultes (Master): „Modelling Case Study of Cloud Edge Effects of Arctic Mixed-Phase Clouds“

Expected Resource Utilisation remaining quarter (01.10. - 31.12.2022):

We expect a full resource utilisation during the remaining two quarters of this allocation. This will include testing of our setups on the new Levante computing system.