Project: **1137**

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

Principal investigator: **Anna Possner**

Report period: **2020-11-01 to 2021-08-31**

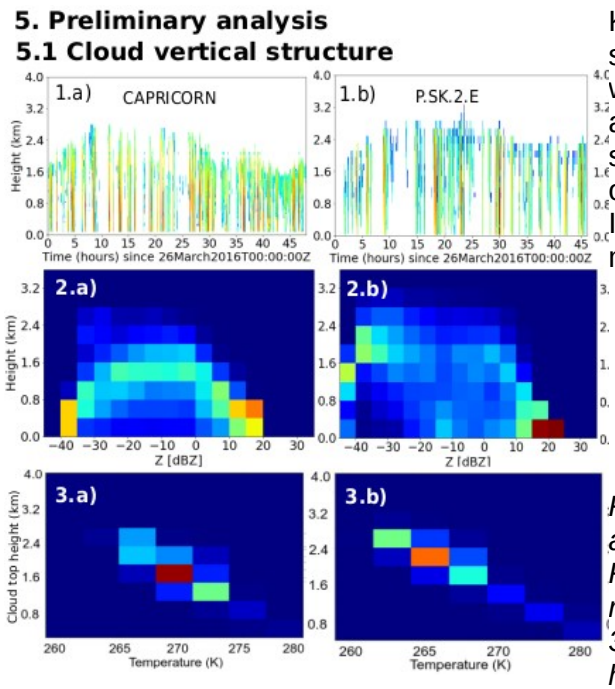
Resource Utilisation first two quarters (01.01. - 30.06.2021):

For the entire allocation period of 2021 a total resource budget of 98 kNh was granted, which corresponds to a resource allocation of 49 kNh during the first two quarters of this reporting period. 82% of these resources were used as planned. An overview of the requested and consumed resources for this reporting period is given in Table. 1.

Resources requested:	49
Resources consumed:	40
Resources expired	9

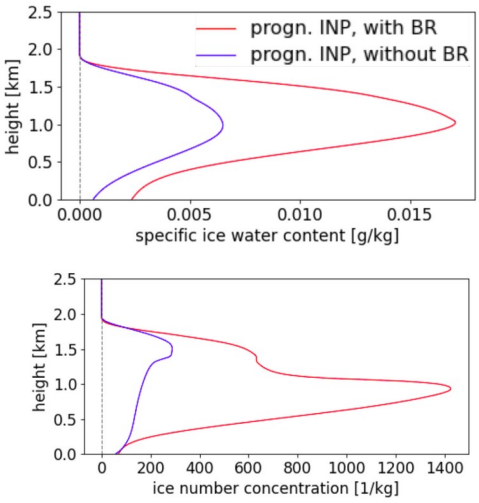
Table 1: Overview of resources during the 01.01.2020 – 30.06.2020 reporting period. All entries are given in kNode hours [kNh].

The resources of this project were used to evaluate and improve the representation of mixed-phase boundary layer clouds within the ICON model. To this end different numerical experiments were conducted in the Arctic for the M-PACE field campaign and the Southern Ocean during the "*Clouds, Aerosols, Precipitation, Radiation, and Atmospheric Composition over the Southern Ocean" (*CAPRICORN) field campaign.



Kilomenter-scale simulations during CAPRICORN showed that the intermittency of precipitation was well captured by the simulation, but precipitation amount itself was overestimated. Furthermore, suspended mid-sized precipitating hydrometeors observed during CAPRICORN are missing in the ICON simulations beformed with the two-moment microphysics scheme.

Figure: 1.a) to 1.b) represents reflectivity (dBZ) along the ship track. 2.a) to 2.b) Contour Frequency by Altitude Diagram (CFAD) of radar reflectivity normalized across the columns. 3.a) to 3.b) The frequency of occurrence of cloud top height on temperature and altitude bins.



Cloud resolving simulations for M-PACE with respect to collisional breakup of ice crystals showed that ice crystal number concentrations are enhanced considerably by this process assuming a sufficiently high rimed fraction of primary crystals.

Figure: 2-moment ICON simulations with and without collisional breakup during M-PACE.

Analyses of the DYAMOND dataset in combination with additional simulations showed that the occurrence of mixed-phase clouds increases at coarser resolutions in ICON-DWD simulations. Additional experiments showed that this is predominantly related to the degradation in spatial as opposed to temporal resolution of the simulations.

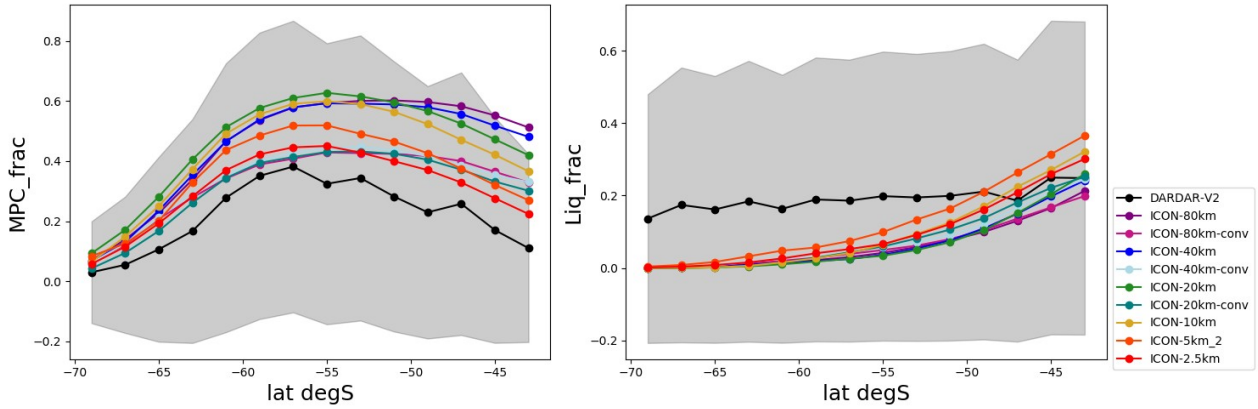


Figure 3: LHS: occurrence of mixed-phase clouds in different resolution ICON experiments of the DYAMOND dataset against the observed occurrence with DARDAR-V2. RHS: Same for liquid-phase cloud occurrence.

All three projects were presented at international conferences and are expected to be published. The following two publications are in prep with a planned submission until the end of this allocation period:

Ramadoss et al. (in prep): „An evaluation of kilometre scale ICON simulations of mixed-phase stratocumulus over the Southern Ocean during CAPRICORN“.

Possner et al. (in prep): „Resolution Dependence of Southern Ocean Mixed-Phase Cloud Fraction in ICON“.

<u>Expected Resource Utilisation remaining quarters (01.07. - 31.12.2021):</u>

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.