Project: **1036**
Project title: **ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes, and Feedback Mechanisms, (AC)³ – University of Leipzig contribution**
Principal investigator: **Johannes Quaas**
Report period: **2020-01-01 to 2020-12-31**

The work by the University of Leipzig in (AC)³ in the reporting period built on the previous work on the lapse-rate feedback (Block et al., 2020; Lauer et al., 2020), and on the assessment of aerosol-cloud interactions.
In this regard, in particular the kilometre-resolution simulations led to new scientific insights published by Kretzschmar et al. (2020). The model domain and location of the measurements is depicted in Fig. 1. A key target was the role of clouds and surface albedo for the atmospheric energy budget. This is shown in Fig. 2 in which the structure of four clusters is visible that show the high and low surface albedo states (over ocean and sea ice, respectively) as well as the low and high fluxes in the terrestrial spectrum (cloudy and clear atmosphere, respectively). The study investigated shortcomings and options for improvement in the ICON-NWP model. A key result was the requirement to account for turbulent updraughts in the cloud droplet activation, and a revision of the prescribed cloud condensation nuclei profiles, i.e. the importance of the cloud microstructure for well simulation the energy budgets.

It is important to note that the simulations for the MOSAIC campaign and the co-incident aircraft has not been conducted as of today, but is planned to be performed this year still. The aircraft campaign took place in September 2020 and the simulations are in preparation, based on the extensive experience described above.

References

Block, K., F. A. Schneider, J. Mülmenstädt, M. Salzmann, and **J. Quaas**, Climate models disagree on the sign of total radiative feedback in the Arctic, Tellus A, 72, 1-14, doi:10.1080/16000870.2019.1696139, 2020.

Kretzschmar, J., J. Stapf, D. Klocke, M. Wendisch, and **J. Quaas**, Employing airborne radiation and cloud microphysics observations to improve cloud representation in ICON at kilometer-scale resolution in the Arctic, Atmos. Chem. Phys., in press, doi:10.5194/acp-2020-641, 2020.

Lauer, M., K. Block, M. Salzmann, and **J. Quaas**, CO2-forced changes of Arctic temperature lapse-rates in CMIP5 models, Met. Z., 29, 79-93, doi:10.1127/metz/2020/0975, 2020.

Figures

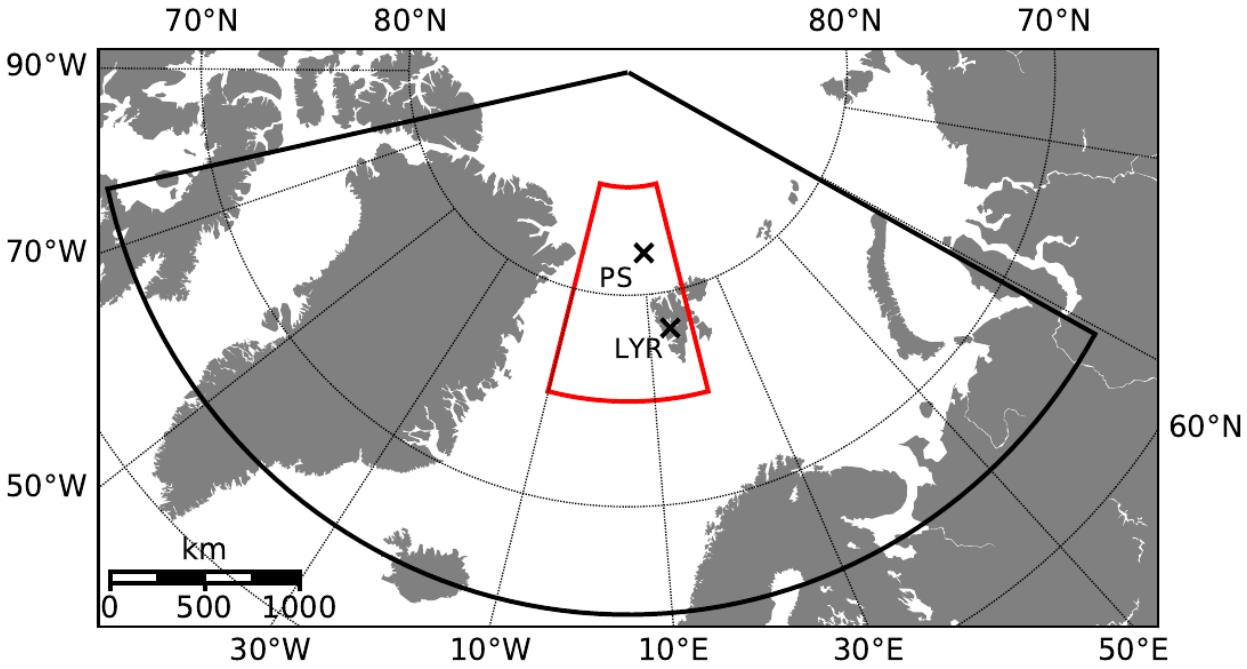

Fig. 1. Domain of the simulatoins, with outer nest (2.4 km resolution) in black, and the inner one (1.2 km) in red. Additionally marked is Longyearbyen/Norway (LYR) where Polar 5 and Polar 6 were stationed during ACLOUD, as well as the postion of the R/V Polarstern (PS) during the ice floe camp (From Kretzschmar et al., 2020).

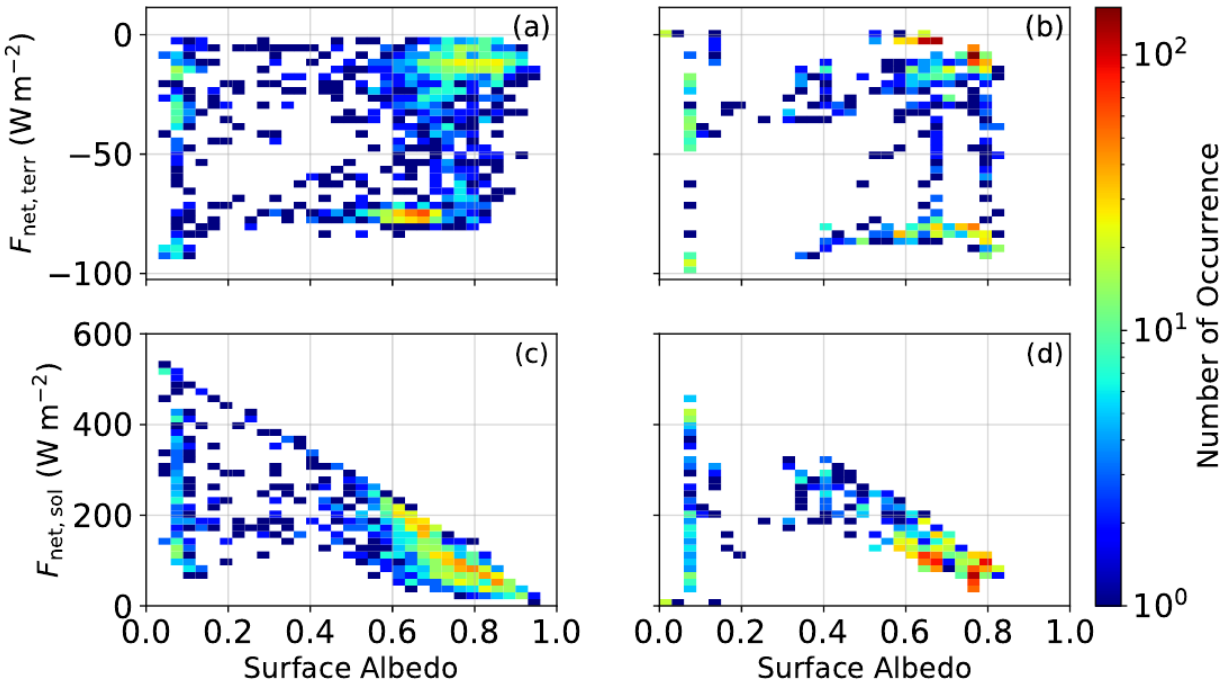

Fig. 2. Two dimensional histograms of surface albedo and (top row; a, b) net terrestrial-/ (bottom row; c, d) net solar irradiance at the surface (W m^{-2}) for (left column; a, c) observations form the ACLOUD aircraft campaing and (right column; b, d) ICON simulations. From Kretzschmar et al. (2020)