Supplemental Material

Analysis of an Arctic cold air outbreak during autumn and related air mass transformations forced by surface changes and advection in higher altitudes

Benjamin Kirbus[1, *], Jan Chylik[2], André Ehrlich[1], Sebastian Becker[1],

Michael Schäfer[1], Roel Neggers[2], and Manfred Wendisch

[1] Leipzig University, Leipzig Institute for Meteorology, Leipzig, Germany

[2] University of Cologne, Institute for Geophysics and Meteorology, Cologne, Germany

*Corresponding author: benjamin.kirbus@uni-leipzig.de

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Cited literature:

Egerer, U, Gottschalk, M, Siebert, H, Ehrlich, A, Wendisch, M. 2019. A new setup for combined turbulence and radiation measurements using a tethered balloon in the cloudy Arctic. Atmos Meas Tech 12(7): 4019–4038. doi:10.5194/amt-12-4019-2019.

Lonardi, M, Pilz, C, Akansu, EF, Dahlke, S, Egerer, U, Ehrlich, A, Griesche, H, Heymsfield, AJ, Kirbus, B, Schmitt, CG, Shupe, MD, Siebert, H, Wehner, B, Wendisch, M. 2022. Tethered balloon-borne profile measurements of atmospheric properties in the cloudy atmospheric boundary layer over the Arctic sea ice during MOSAiC: Overview and first results. Elementa: Science of the Anthropocene 10(1). ISSN 2325-1026. doi:10.1525/elementa.2021.000120.

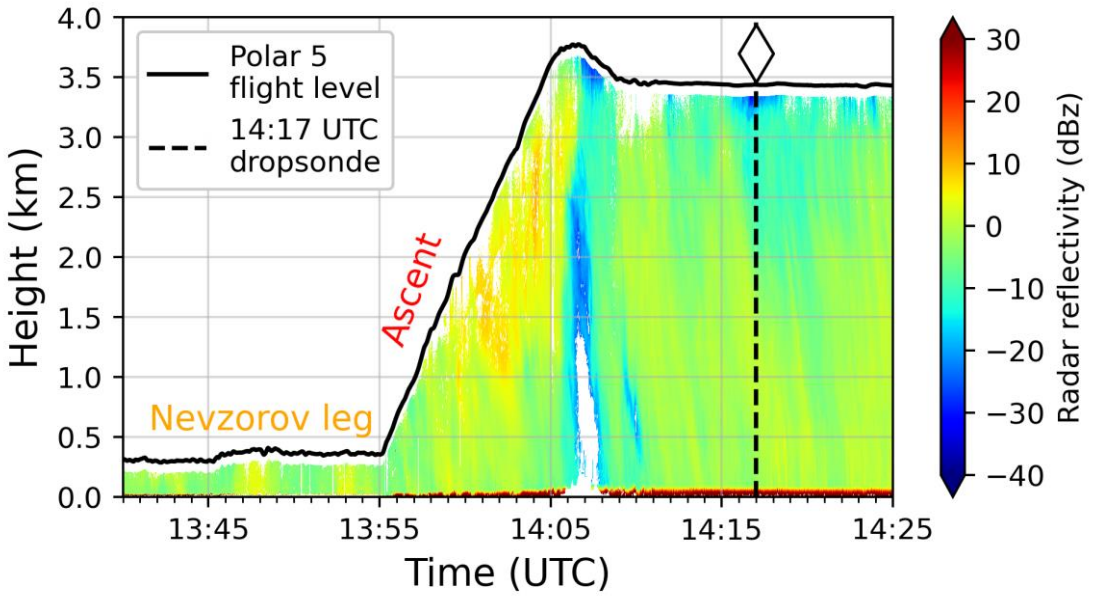

Figure S1. MIRAC radar reflectivities recorded aboard Polar 5 around the time of the dropsonde release on 13 September at 14:17 UTC. A low-level Nevzorov leg was followed by a rapid ascent to the final altitude of around 3.4 km.

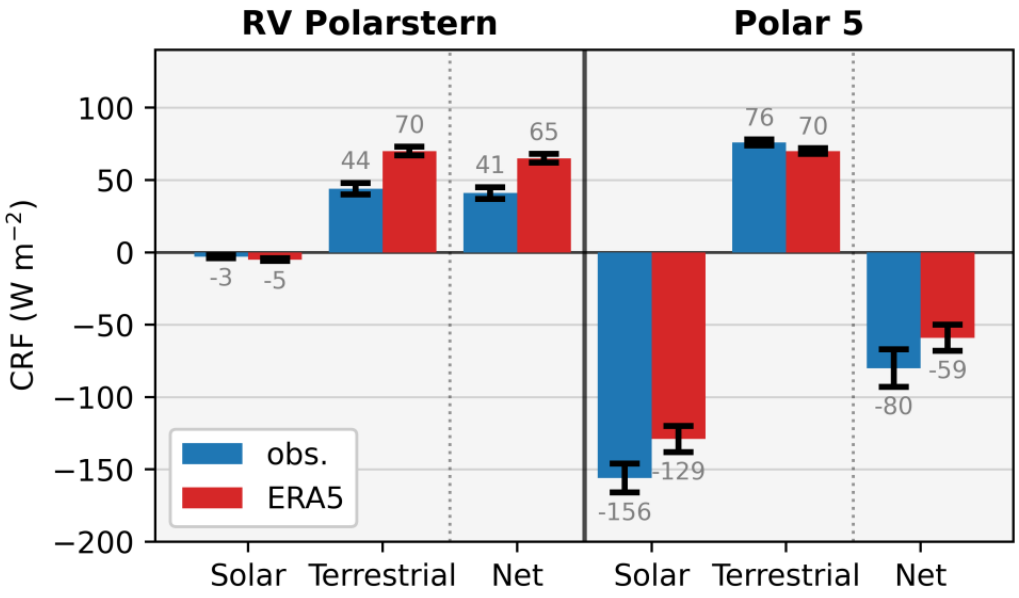

Figure S2. Graphical overview of cloud radiative forcing (CRF) near RV Polarstern in the central Arctic and as observed by Polar 5 in Fram Strait. Depicted are the solar and terrestrial CRF components, as well as the sum of both resulting in the net CRF. For ERA5, mean and standard deviation were extracted from the 28x28 km^2 box; Observations were sampled so that equal distances were covered.

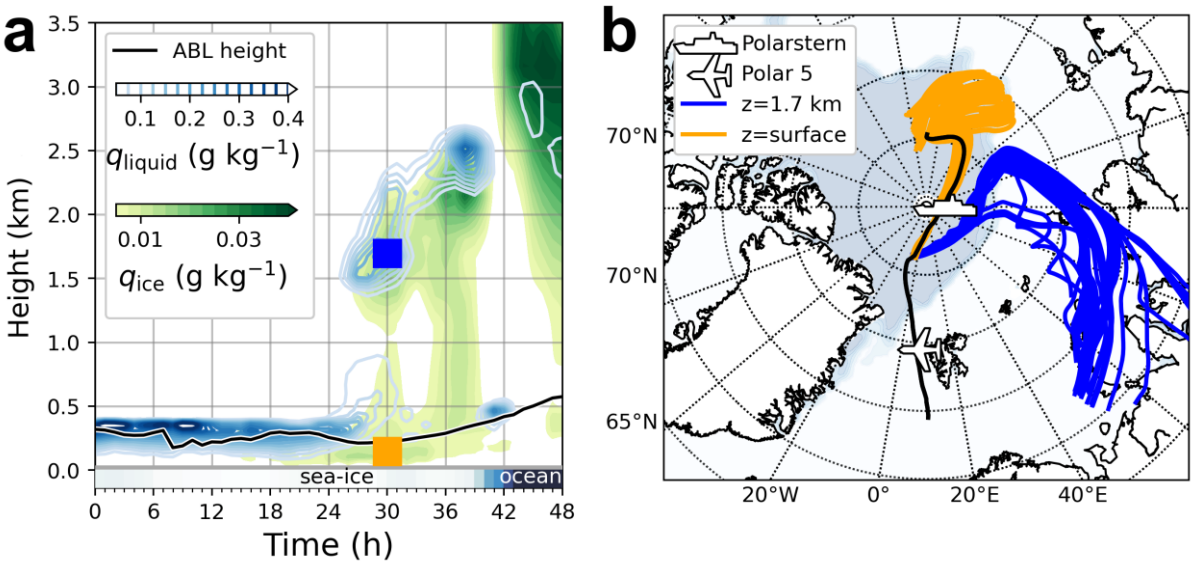

Figure S3. Origin of the advected mid-level clouds. a) Time and altitudes chosen to initiate 5-day backward trajectories. This was performed for surface air masses (orange box) and some of the mid-level cloud air masses (blue box). b) Top view of the calculated 5-day backward trajectories. The near-surface air masses were of Arctic origin, the mid-level cloud air masses had originated at the Siberian coastline.

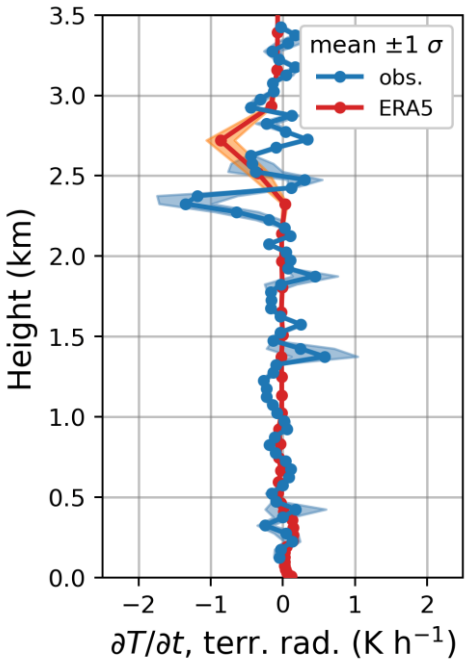

Figure S4. Vertical profile of heating rates due to terrestrial radiation. Mean values and standard deviations derived from the broadband radiometers aboard Polar 5 compared to ERA5 reanalysis. The vertical profile of heating rates was calculated by analyzing the vertical divergence of broadband terrestrial radiation recorded aboard Polar 5 during ascent. This method has previously been applied in the Arctic to atmospheric vertical profiles obtained using tethered balloons (Egerer et al., 2019; Lonardi et al., 2022).