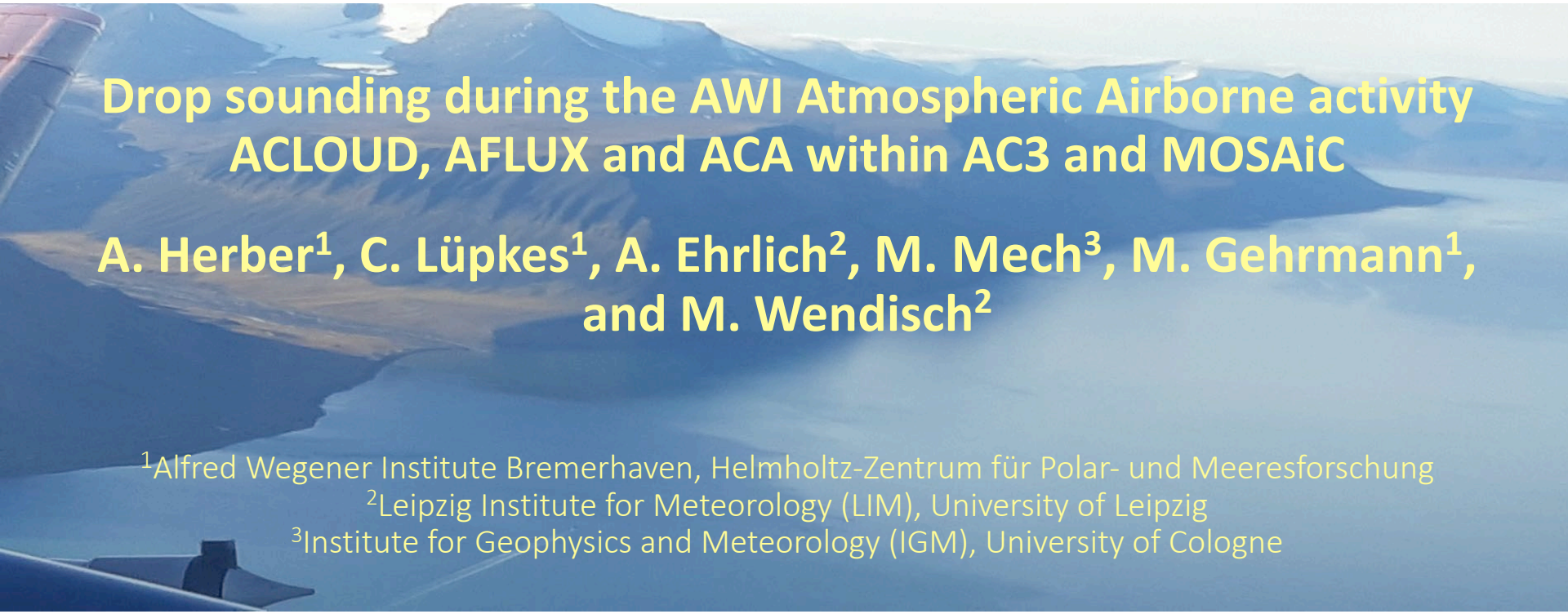
ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes, and Feedback Mechanisms (AC)³



Drop sounding during the AWI Atmospheric Airborne activity ACLOUD, AFLUX and ACA within AC3 and MOSAiC

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AVAP User Group Meeting – 14 April 2021

TRANSREGIO TR 172 | LEIPZIG | BREMEN | KÖLN
http://ac3-tr.de/ sponsored by DFG

AWI Research Aircraft POLAR 5 / POLAR 6

Basler BT-67	**modified DC-3**
Major Research Field	Atmospheric and Geophysics studies
Endurance	Up to 2,300 km
Length and Height	20.66 m / 5.20 m
Wingspan & Cabin Width/Height	29.00 m & 2.34 m / 2.00 m
Highest /Lowest Flight Altitude	**7,600 m / 61 m**
Cruise Speed	100 – 130 knots
Take-off Weight	**14.039 kg (6 – 7 flight hours)**

Drop sounding system AVAPS II on board of POLAR 5

- **AVAPS II**
  - **Airborne Atmospheric Vertical Profiling System**
  - **Actual used dropsonde: RD 41**
  - **Altitude for drop sounding: 10.000 feet**

Martin Gehrmann, AWI

Stephan Schön, SZ

Stephan Schön, SZ

Mario Mech, IGM

Airborne missions within ArctiC Amplification $(AC)^3$

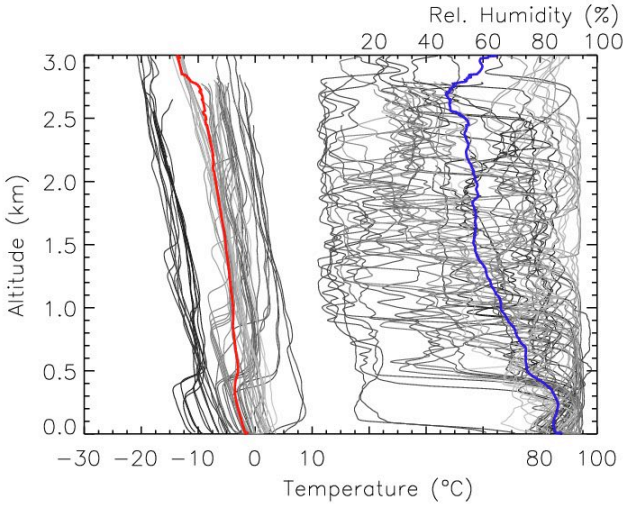
- **ACLOUD**
  - **A**rctic **C**loud **O**bservations **U**sing airborne measurements during polar **D**ay
  - **Time:** 22 May – 28 June 2017
  - **Aim:** Study and quantification of specific physical processes in, above, and below Arctic clouds.

- **AFLUX**
  - **A**irborne measurements of radiative and turbulent **FLUX**es of energy and momentum in the Arctic boundary layer
  - **Time:** 15 March – 15 April 2019
  - **Aim:** Study of the impact of clouds on the Arctic amplification.

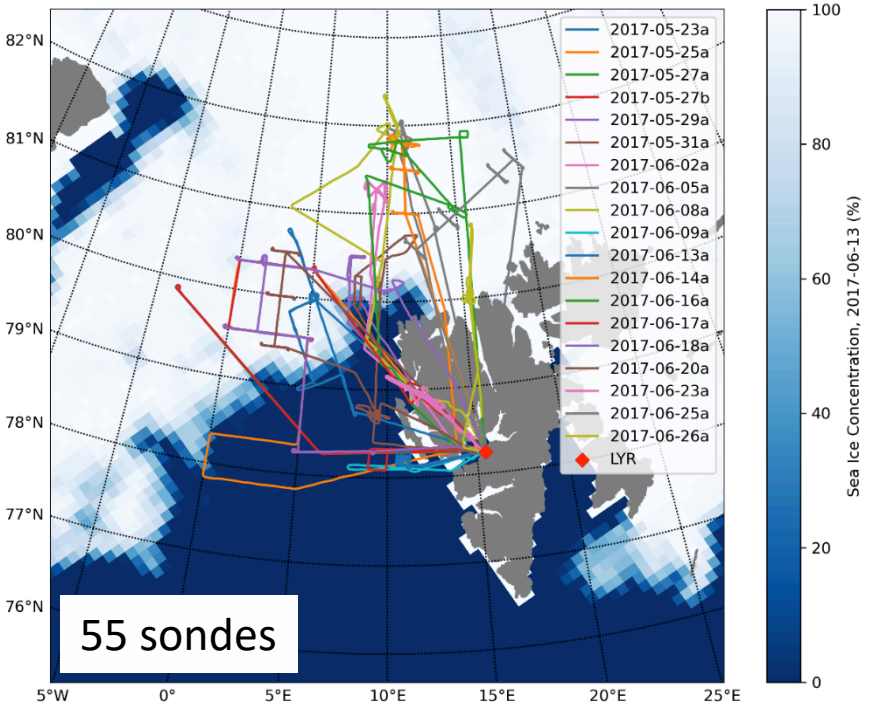
- **ACA**
  - **A**tmospheric Airborne observations in the **C**entral **A**rctic
  - **Time:** 17 August – 17 September 2020
  - **Aim:** Study of Arctic boundary layer processes, like ocean-atmosphere interaction, clouds, radiation, and aerosols.

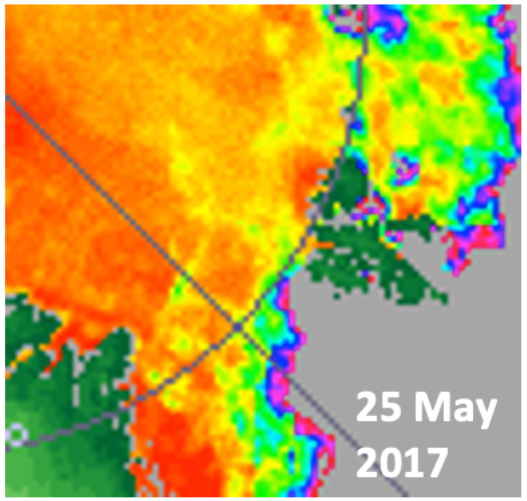
Flight pattern & number of drop sounding during ACLOUD

* warm + cold air, always low clouds



ACLOUD 2017 (May - June)





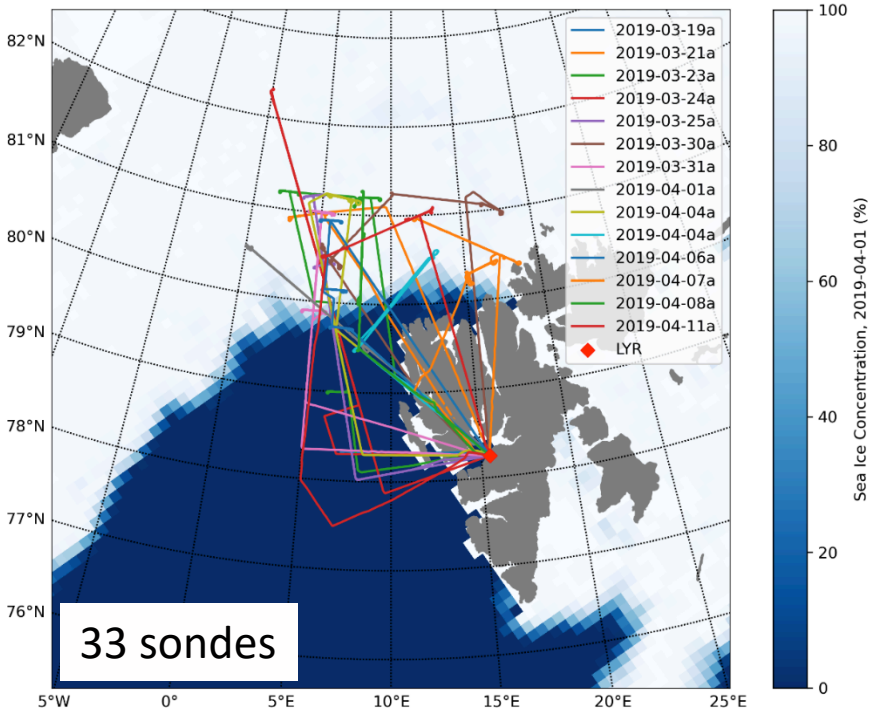
https://doi.org/10.1594/PANGAEA.900204

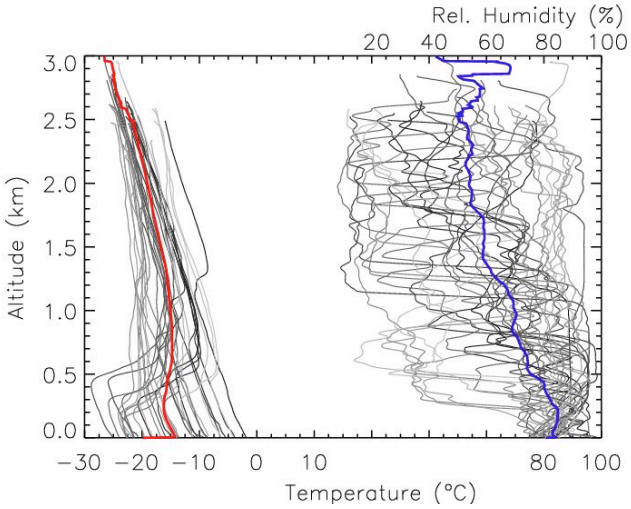
Sea ice concentration
(http://Cersat.ifremer.fr)

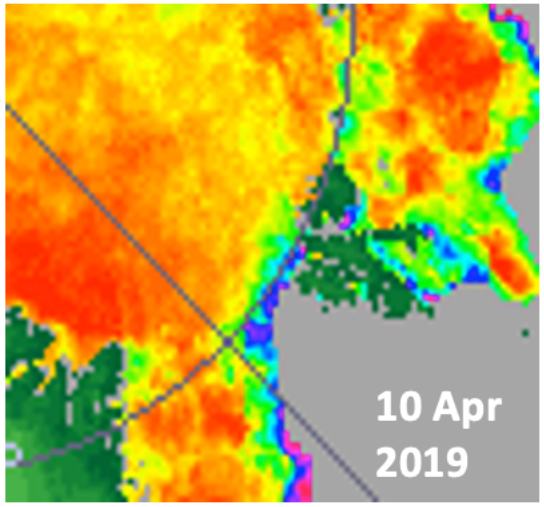
Flight pattern & number of drop sounding during AFLUX

* „warm” + cold air, always low clouds

AFLUX 2018 (March - April)







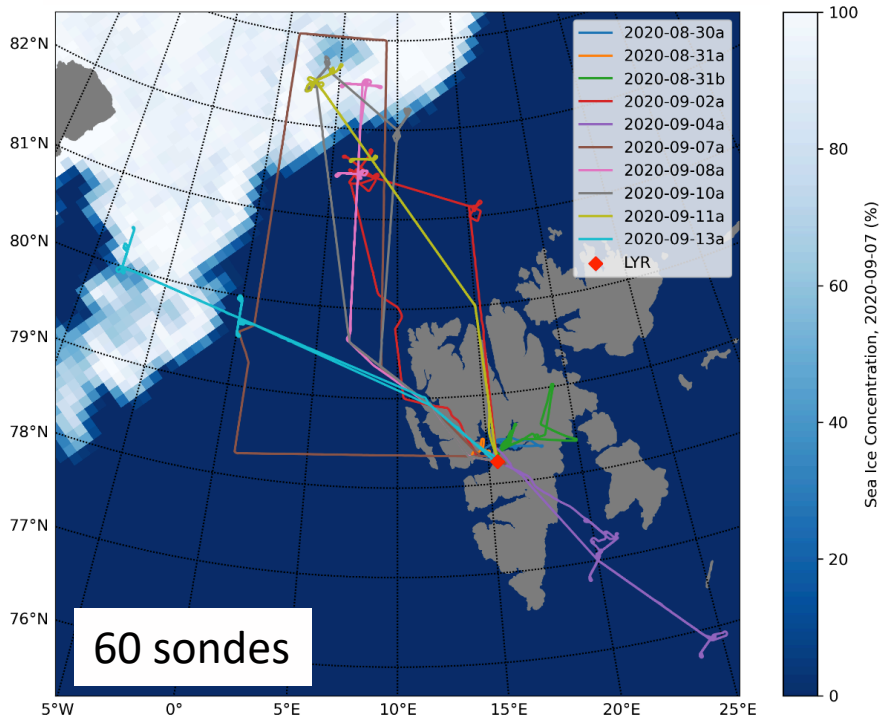
Sea ice concentration
(http://Cersat.ifremer.fr)

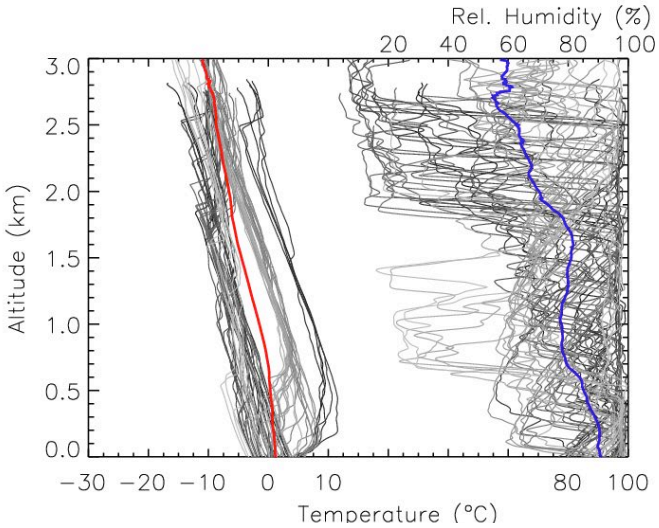
https://doi.org/10.1594/PANGAEA.921996

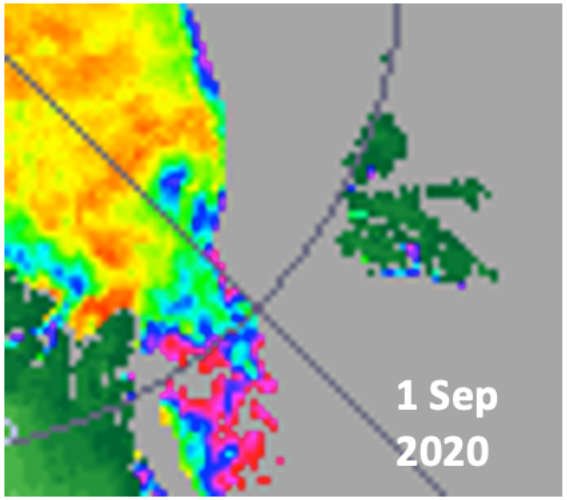
Flight pattern & number of drop sounding during MOSAIC ACA

* warm + „cold“ air always clouds up to 2km

MOSAiC-ACA (August -September)



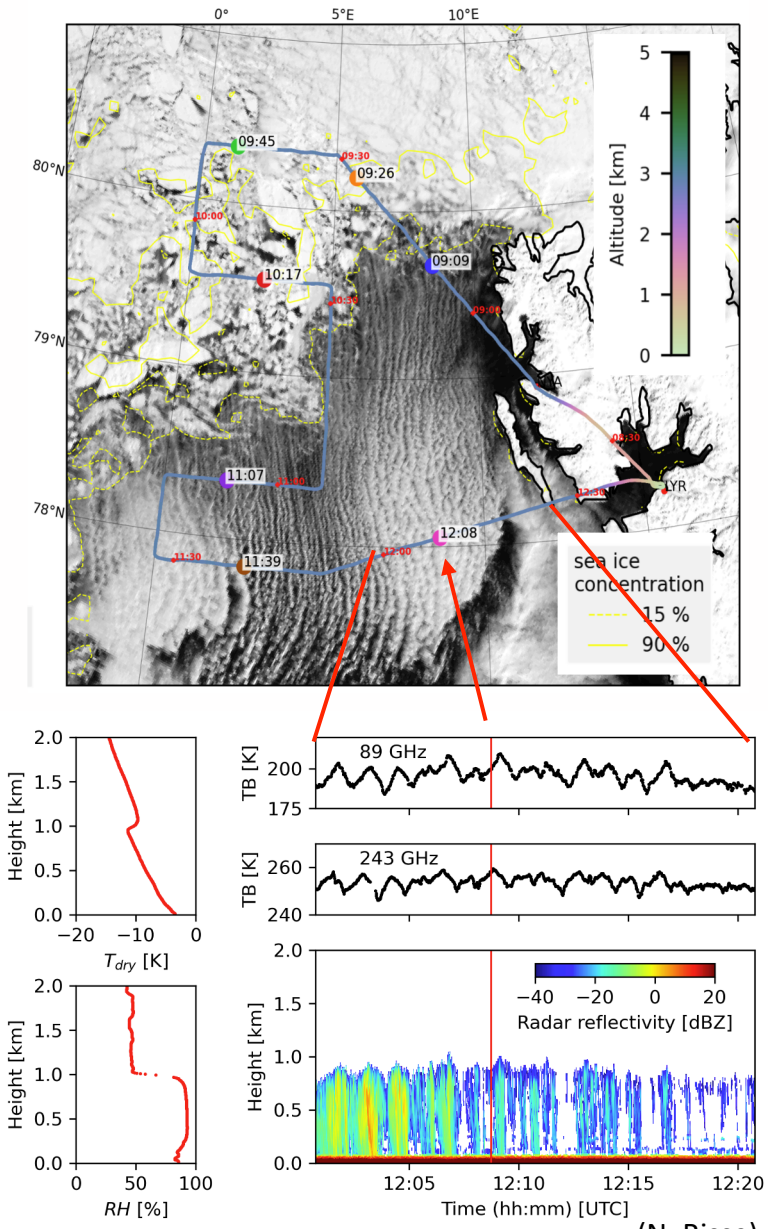




Sea ice concentration
(http://Cersat.ifremer.fr)

"Originally, two airborne campaigns were planned during MOSAiC. One in spring with flights to Polarstern and landings on the central Arctic sea ice, and another one in summer. Due to the Corona Pandemic the airborne campaign in spring had to be cancelled a few days before its start !"

Liquid Water Path from passive microwave measurements, based on drop sounding profile from 25 May 2017



(N. Risse)

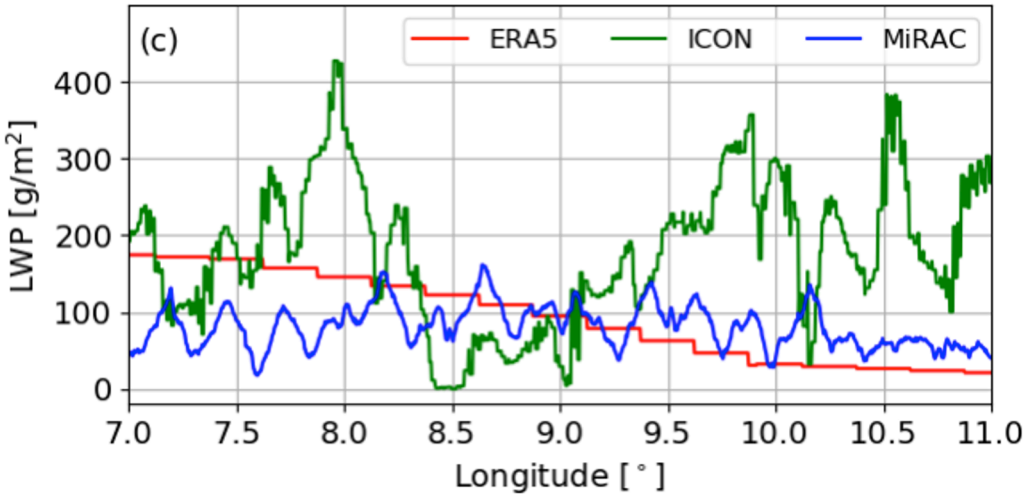
Liquid Water Path (LWP)

- Important quantity of Arctic mixed-phase clouds
- Can be derived from T_B measurements on Polar 5

*Retrieval based on **dropsonde profiles** that serve together with artificial liquid clouds as input to a radiative transfer model (PAMTRA; Mech et al. 2020, GMD)*

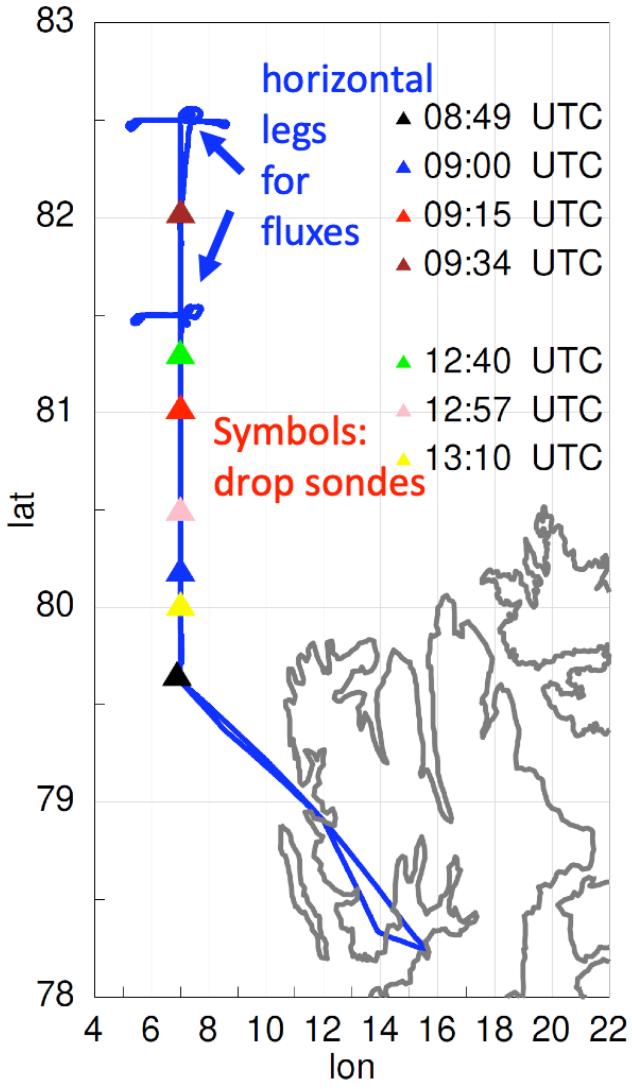
*T_B measurements at 89 and 243 GHz corrected by simulations with clear sky **dropsondes** are used together with the developed coefficient to derive LWP*

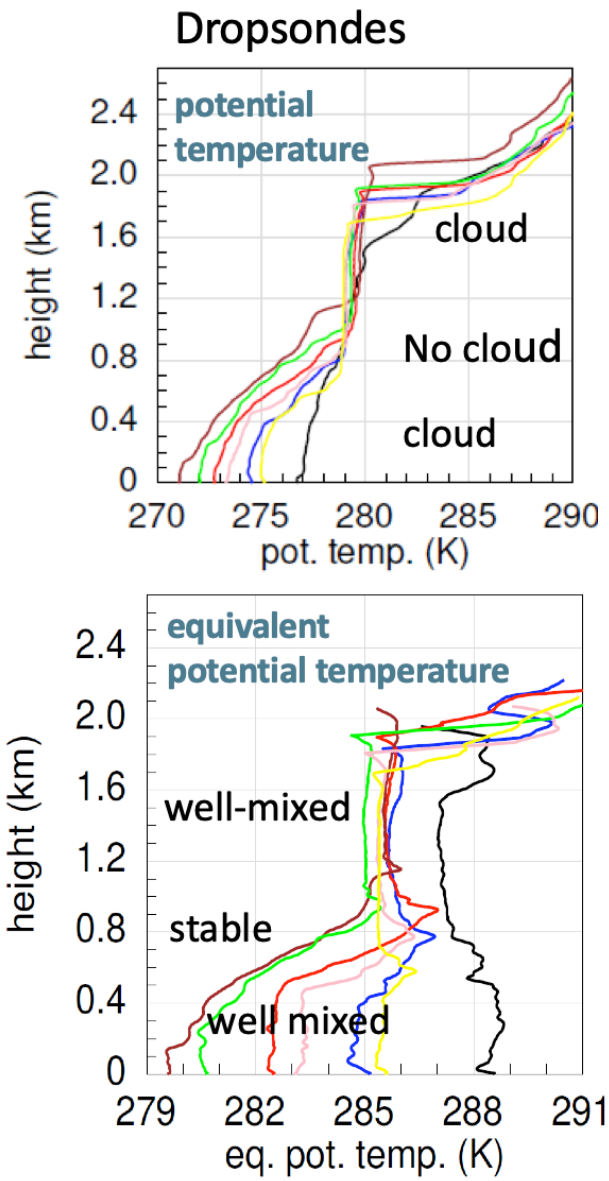
➡ Difference between measured and modelled LWP



(Kliesch et al., 2021)

MOSAiC ACA - case study of 8 September 2020





- *Drop sondes allow efficient ABL probing with less fuel than aircraft in situ measurements based on saw teeth patterns.*
- *After release of drop sondes, results allow subsequent planning of altitudes and positions for turbulence measurements.*
- *Equivalent potential temperature gives first Impression of stability conditions in cloudy air. Structures of profiles hint to layers with strong mixing.*


Thank you for your attention
Gerit Biernbaum, AWI