



# HALO - (AC)<sup>3</sup>

## Arctic Air Mass Transformations During Warm Air Intrusions and Marine Cold Air Outbreaks

### Measurement campaign

The HALO-(AC)<sup>3</sup> measurement campaign aims to investigate the processes causing the drastic climate changes in the Arctic. The Arctic temperature increase, with over 3°C in the last 50 years, is much more pronounced than the changes in other regions of the Earth and impacts the regional climate system, e.g., sea ice loss. This phenomenon is called „Arctic Amplification.“ The focus of the campaign is to study warm air intrusions into the central Arctic as well as cold air outbreaks from the Arctic. These events may not only amplify Arctic warming via feedback effects (positive feedback), but also influence our mid-latitude weather through meridional heat and moisture transports.

### Why?

The exchange of Arctic air masses with mid-latitudes is driven by synoptic scale dynamic weather events which develop over several hours and days. These warm air intrusions and cold air outbreaks cannot be characterized by local ground-based measurements. Therefore, HALO-(AC)<sup>3</sup> aims to make use of the long endurance of aircraft and characterize the air masses transformations by quasi-Lagrangian observations. In this type of measurement, the air-mass is followed by aircraft and changes of clouds, humidity and temperature can be observed directly. The observations by HALO-(AC)<sup>3</sup> will test whether numerical atmospheric models are able to reproduce measurements that can help to investigate the influence of Arctic Amplification on mid-latitude weather.

### How?

Three research aircraft will be used for the HALO-(AC)<sup>3</sup> measurements. HALO, Germany's most powerful research aircraft, will operate from Kiruna, Sweden. The Polar 5 & Polar 6 polar aircraft which have provided valuable measurements in the Arctic for more than 10 years, will measure in the vicinity of Longyearbyen, Svalbard. The aircraft are equipped with state of the art instrumentation, which are able to characterize the entire atmospheric column, in particular cloud properties, temperature and humidity profiles, energy fluxes and aerosol particle and trace gas properties. The aircraft measurements will be supplemented by tethered balloon observations in Ny-Ålesund, Svalbard. Measurements from advanced ground-based remote sensing instruments in Ny-Ålesund as well as the latest satellite remote sensing methods and state-of-the-art numerical climate modeling will complete the extensive data set of the HALO-(AC)<sup>3</sup> campaign.



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### When and Where?

The field campaign will take place from March 11 to April 15, 2022, spread over 3 sites. The HALO research aircraft will be based in Kiruna, Sweden for the full period. Polar aircraft Polar 5 & Polar 6 will operate from Longyearbyen, Svalbard, during the period March 18 to April 13, 2022, and balloon measurements will take place in Ny-Ålesund, Svalbard, covering about 8 weeks in March extended to May 2022. The measurements will focus on an area in the Northern Arctic Ocean and Fram Strait and around Svalbard (78°N, 16°E).

### Who?

HALO-(AC)<sup>3</sup> is a research campaign jointly performed by the University of Leipzig, the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, the German Aerospace Center, the Leibniz Institute for Tropospheric Research, the Max Planck Institutes for Meteorology and Chemistry, as well as the Universities of Bremen, Cologne, Hamburg, Mainz and the Ludwig Maximilian University of Munich and international partners. More than 100 researchers from 12 countries will participate in the research project. The campaign name HALO-(AC)<sup>3</sup> embraces the lead research projects HALO-SPP (High Altitude and Long Range Research Aircraft - Priority Program) and the Collaborative Research Center/Transregio Arctic Amplification (AC)<sup>3</sup> (Arctic Amplification: Climate Relevant Atmospheric and Surface Processes, and Feedback Mechanisms).