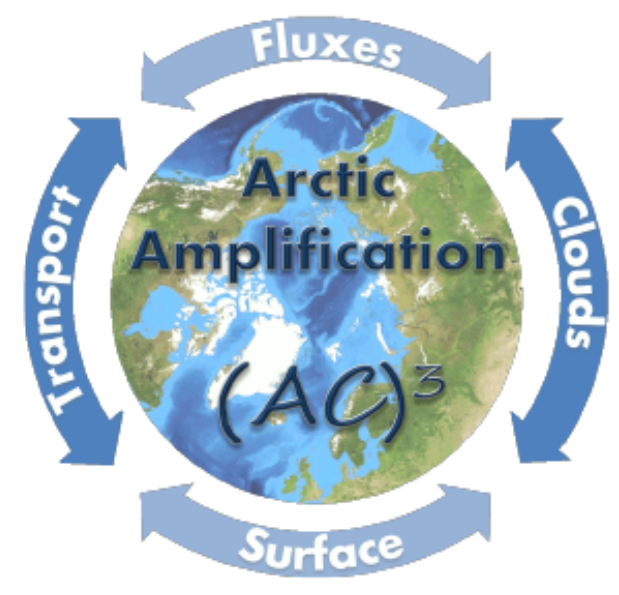


Properties and sources of Arctic ice nucleating particles and cloud condensation nuclei

B04

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TROPOS
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1 Summary

- Comprehensive physical and chemical characterization of the Arctic aerosol during a RV Polarstern cruise (PASCAL)
- Special focus on ice nucleating particles and cloud condensation nuclei
- Laboratory studies of sea-surface microlayer material as a potentially important local marine source of ice nucleating particles

Hypothesis

Local oceanic sources influence the populations of Arctic ice nucleating particles and cloud condensation nuclei.

2 Research rationale

Current state of understanding

- Number and chemical composition of Ice Nucleating Particles (INP) and Cloud Condensation Nuclei (CCN), may significantly influence the properties of Arctic clouds.
- Possible sources for Arctic INP and CCN are long-range transport and local sources (e.g., primary marine organic matter from the sea surface microlayer, SML, anthropogenic and “natural” combustion emissions).
- In a changing Arctic climate both, particle sources and particle properties are changing.

➔ **Strong need for investigating the physical and chemical properties of Arctic aerosol particles, their possible sources, and effects as INP and CCN**

Preliminary work

- TROPOS has a long history in carrying out worldwide land- and ship-borne field studies characterizing aerosol physical properties.
- TROPOS is one of the world-wide leading institutions in the field of heterogeneous ice nucleation.
- TROPOS is highly experienced in the chemical characterization and source apportionment of aerosol particles.

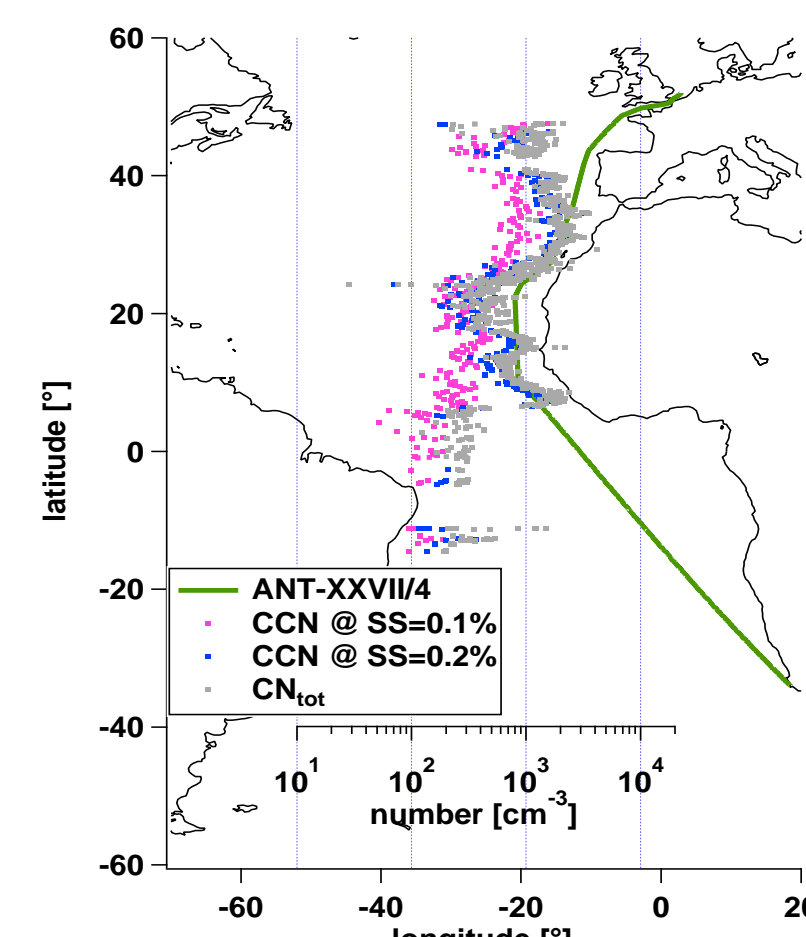


Fig. 1: CN and CCN number concentrations during the ANT XXVII/4 Polarstern cruise

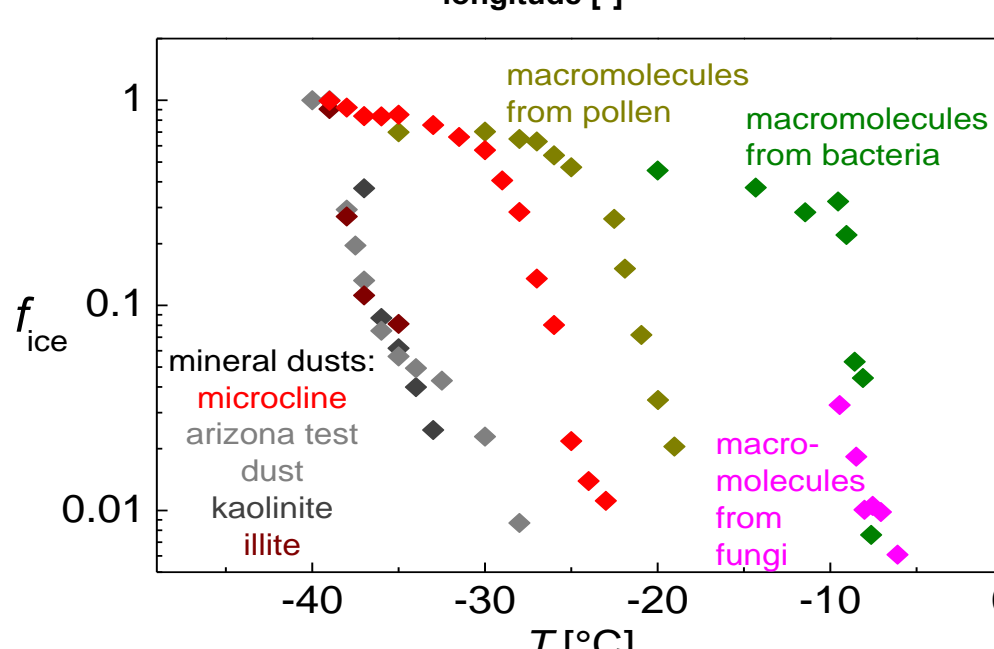


Fig. 2: Ice fractions as function of temperature for various dusts and biological materials

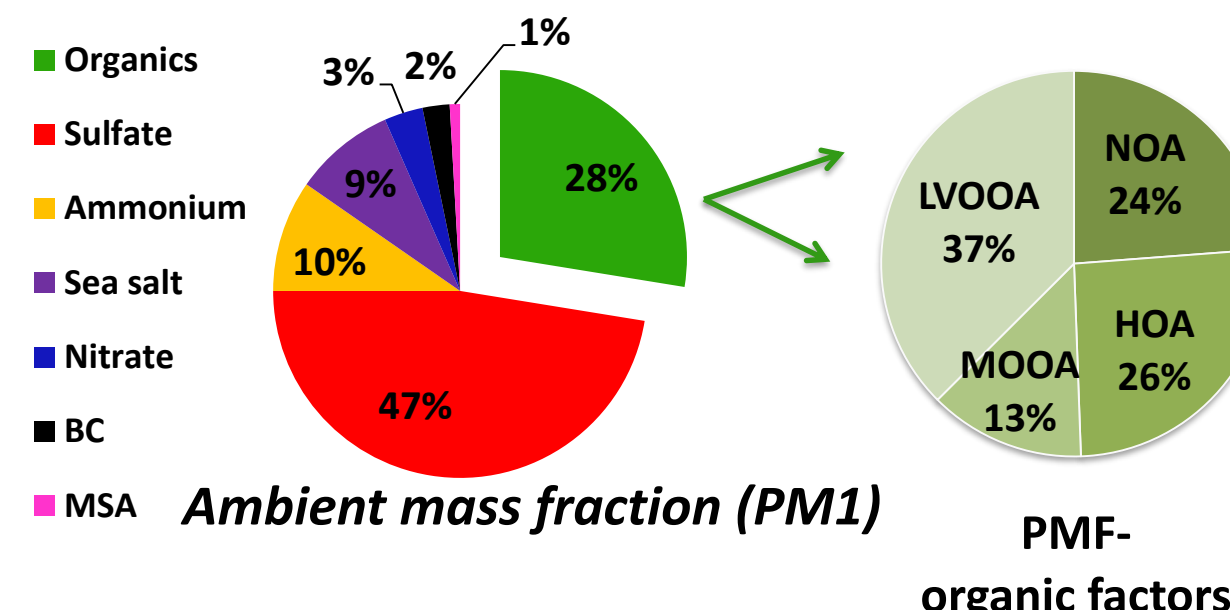


Fig. 3: Source apportionment based on PMF-AMS method for the ANT XXVII/4 Polarstern cruise

3 Research plan

Scientific Questions

- What are the INP and CCN number concentrations in the Central Arctic Atmospheric Boundary Layer (ABL), can we draw conclusions concerning the Arctic INP's and CCN's nature (mineral, organic), and are there INP in the sea surface micro layer and/or the bulk seawater, which could possibly contribute to the arctic INP population? (WP1)
- What is the chemical composition of Arctic aerosol particles, the Arctic sea surface micro layer, and the bulk seawater, and are there relationships with observed CCN and INP? (WP2)

Methods

Ship-based comprehensive physical and chemical characterization of the Arctic aerosol, the sea-surface micro-layer, and the bulk seawater

WP1: Physical Aerosol Properties:

- INP/CCN concentrations
- Number size distribution
- Volatility
- Hygroscopicity
- Mixing state
- Scattering and absorption coefficients



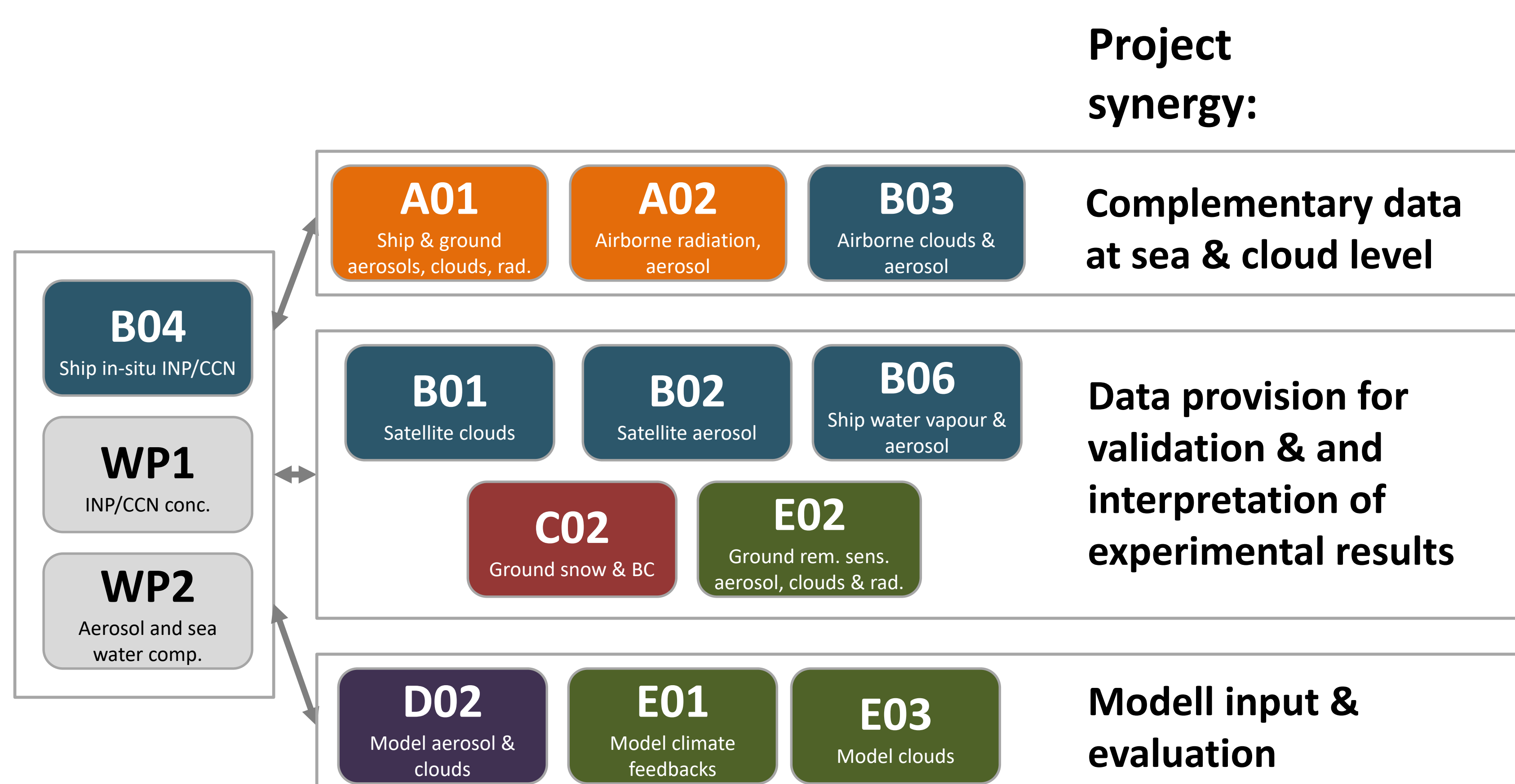
WP2: Chemical Aerosol, SML and Bulk Sea-Water-Properties:

- Offline and online aerosol measurements (filter+AMS)
- Source apportionment: mineral and organic constituents
- SML as INP/CCN source

Expected Results:

- INP's and CCN's abundance and properties (e.g., freezing onsets, hygroscopicity)
- Clear indications concerning the existence and the chemical nature of INP in the SML and/or the bulk seawater
- Chemical nature of the INP in the ABL and their source(s)

4 Role within (AC)³ & perspectives



Project synergy:

Perspectives

- Measurements on longer time and larger spatial scales (e.g., MOSAiC)



www.mosaicobservatory.org

- Determine aerosol effects on clouds (extend ground-based measurements into the vertical: balloon, HALO, UAV)
- Quantitative insights into the chemical nature of Arctic INPs
- Measurements of INP fluxes (if concentrations permit)