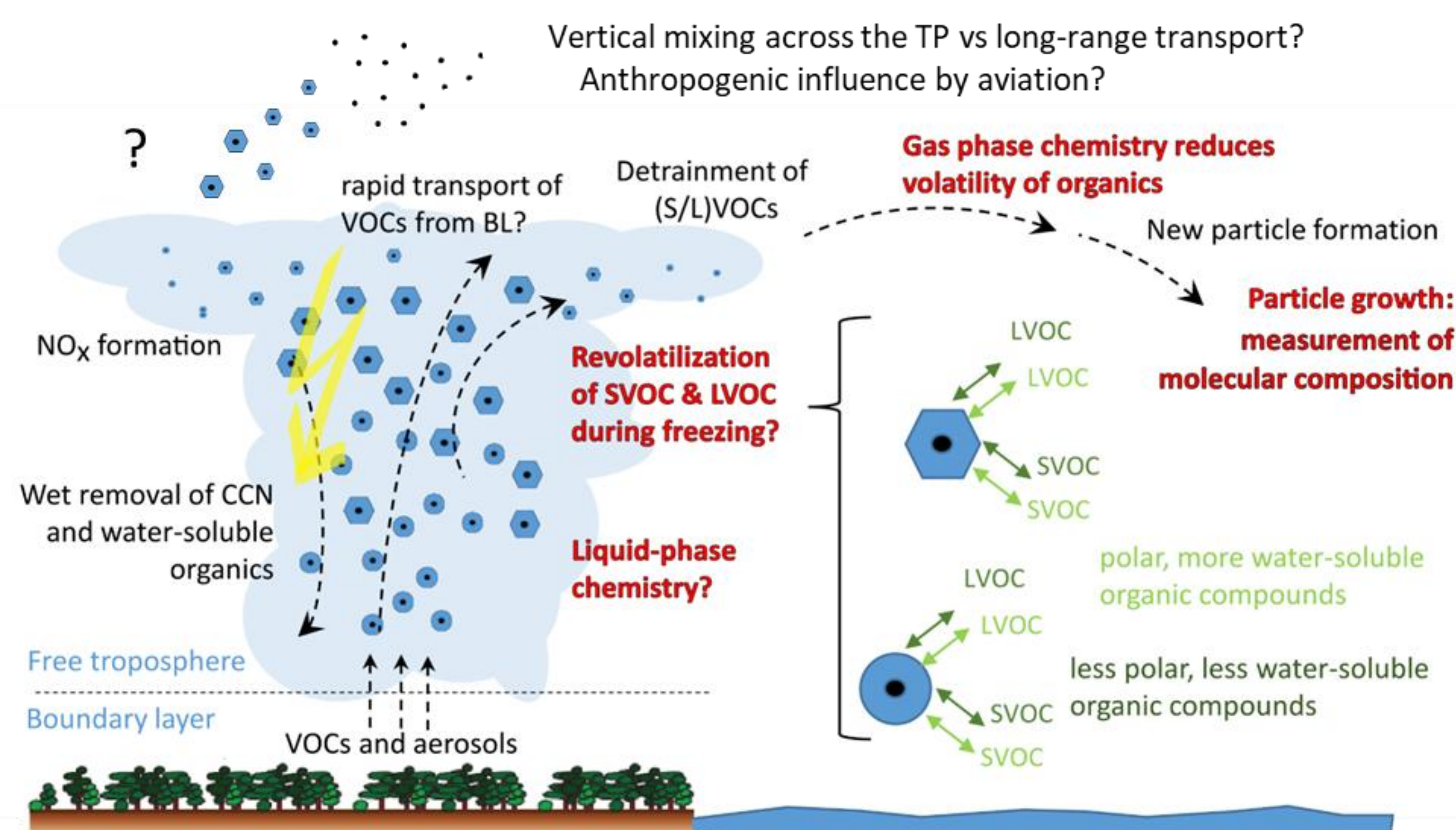


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Motivation

- Organic aerosols (OA) originate from diverse anthropogenic and biogenic sources, follow multiple formation pathways, and exhibit variable atmospheric lifetimes.
- OA is a major contributor to UTLS aerosol mass, however, their molecular composition, spatial and temporal variability, and transport is poorly understood.
- Limited understanding of OA sources and processes in the UTLS hampers accurate climate modelling.

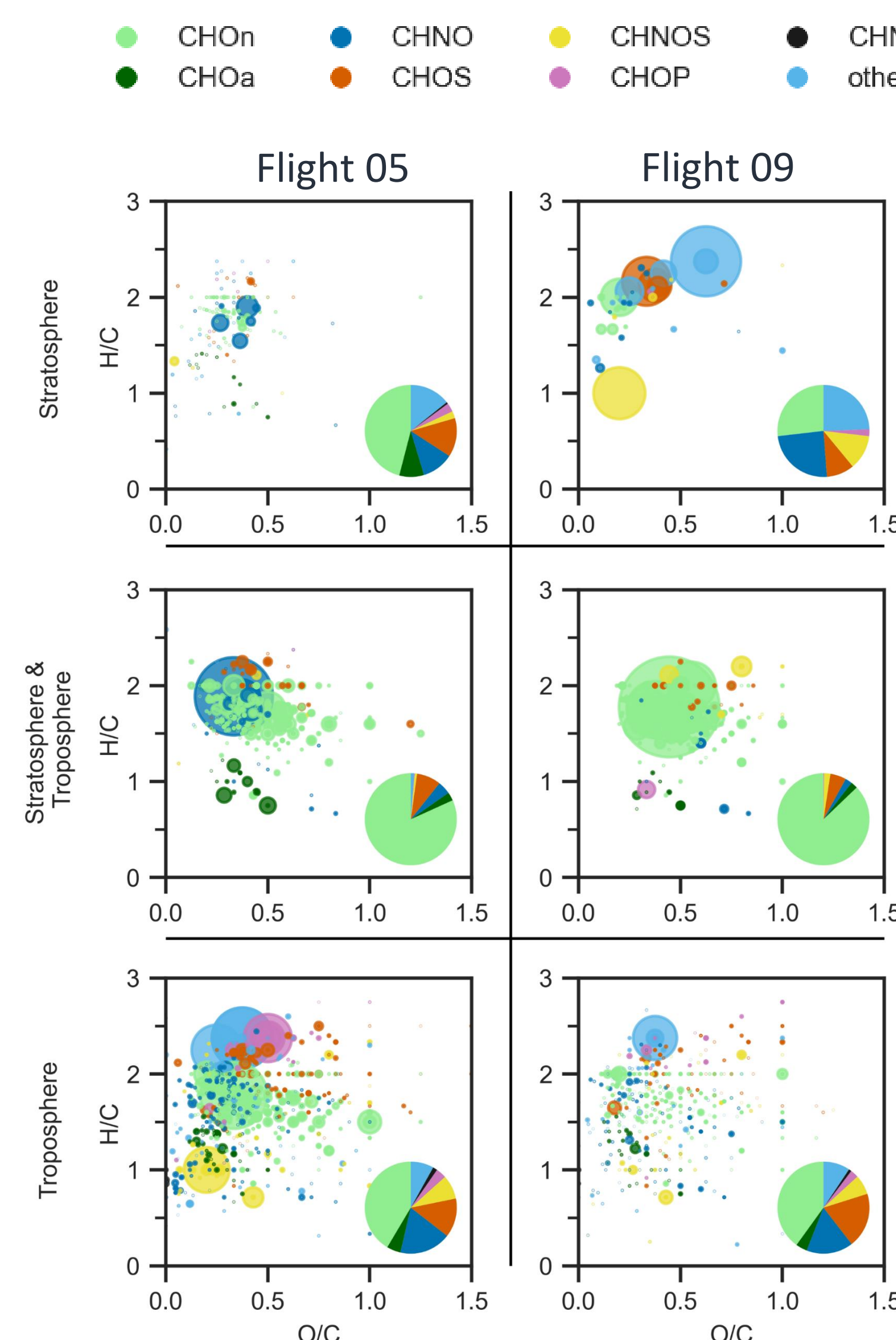
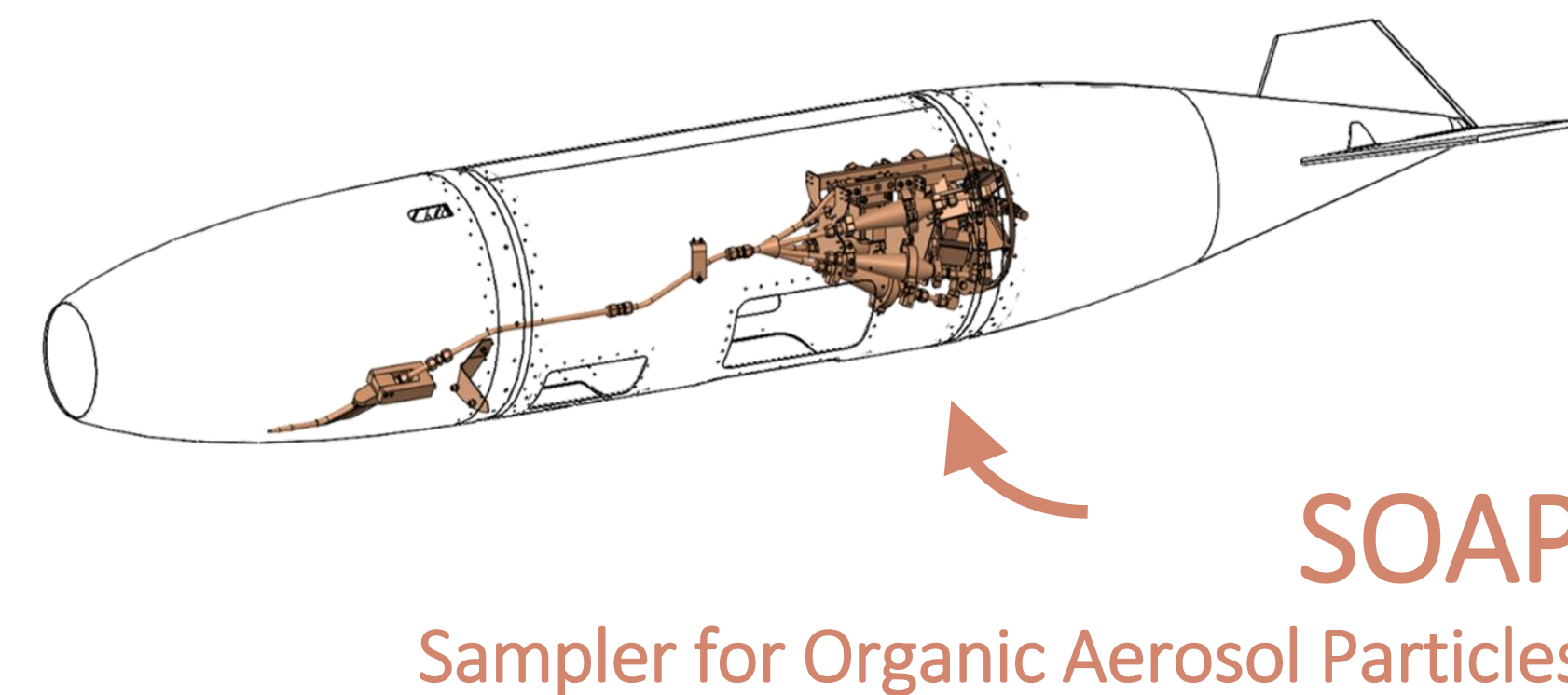


Collaborations within TPChange

- A01** Measure lubrication oil in contrails during AEROCLOUD.
- A03** Investigation of vertical redistribution of organic compounds in convective systems during CONTANGO-FIRE.
- A04** Contribution to laboratory experiments at KIT investigating the role of aviation emissions, their aging and ice formation.
- B01** Joint aircraft field campaign (TPEX II).
- B02** & **C02** Organic aerosol sampling on balloon platforms.
- B08** Backward trajectory modelling for TPEX II and implementation of the organic retention in convective cells into a box model.
- Z01** Analyse retention of organic compounds and provide data from the aircraft campaigns.

Results from phase I

- Development and successful application of a lightweight sampling system for height-selective drone-based measurements of organic aerosol particles. [Borchers et al., EGU sphere, 2025](#)



- Successful sampling and analysis of filter samples from the TPEX campaign in 06/2024.
- Molecular-resolved comparison of tropospheric and stratospheric OA via HPLC-HRMS measurement and subsequent target and non-target analysis.
- Indication for anthropogenic pollutants (PFAS, flame retardants, lubrication oil from aviation) present in the upper troposphere.
- Stratospheric OA contains unique (likely anthropogenic) organic compounds that were not detected in the UT. [Breuninger et al., EGU sphere, 2025](#)
- Laboratory experiments on the retention of α -pinene oxidation products and nitro-aromatic compounds during riming. [Borchers et al., ACP, 2024](#)
- Retention of organic compounds from complex ambient filter extracts indicate less revolatilization during freezing in an acoustic levitator setup. Seymore et al., ACP, 2024 (collab with A07)

Research plan phase II

Main goal: Achieve molecular-level insight on the anthropogenic footprint in UTLS organic aerosol, contributing to the understanding of vertical mixing across the tropopause and of the occurrence of lubrication oil from aviation.

Hypotheses

- The anthropogenic contribution to the organic aerosol composition in the UTLS is larger than previously thought and differs in the NH compared to the SH.
- Vertical transport via convection, warm conveyor belts and pyroconvective clouds are important transport processes that affect organic aerosol composition in the UTLS.
- Organic compounds such as engine lubrication oils are emitted from aviation during cruise, are present over continental Europe and the North-Atlantic flight corridor at detectable levels, and are key compounds in contrail formation in the low-soot regime.

Scientific approach

- Extend the applicability of offline sampling technique toward intermediate- and semi-volatile organic compounds on adsorption cartridges in addition to the successful filter sampling strategy of phase I.
- Deploy SOAP and HERA4HALO for organic aerosol sampling during the **TPEX II** campaign in spring 2027 (Germany), **AEROCLOUD** in summer/autumn 2027 (Canada, North Atlantic, Germany) and **CONTANGO-FIRE** in early 2028 (Argentina).
- Perform comprehensive molecularly-resolved chemical analysis of organic compounds, with a specific focus on anthropogenic pollutants, comparing samples from the UT against the LS, and from the NH against SH.
- Run target analysis of jet engine lubrication oil to quantify the concentration in contrails and aviation-induced cirrus.