Carbon balance field campaign in free troposphere with intermittent planetary boundary layer influence

When: August to September 2022

Where: Jungfraujoch high altitude research station, Switzerland

Application deadline: TNA call open until 15 November 2021

Motivation and Aim

Aerosol and trace gas observations at the high-altitude research station Jungfraujoch in the Swiss Alps are continuously performed by the Paul Scherrer Institute and by Empa as part of the Global Atmosphere Watch program of the World Meteorological Organization as well as the Aerosol, Clouds and Trace Gas Research Infrastructure (ACTRIS). These are complemented with intense field campaigns, addressing specific research questions on a regular basis.[1]

Particulate and gaseous organic carbon species are key players in chemical processes in the atmosphere and thereby affect climate, ecosystem and human health. While they often enter the atmosphere as volatile gases, subsequent cascades of oxidation reactions generate a plethora of chemical species in the gas phase as well as in the particle phase. The resulting oxidized species are either deposited or fully oxidized to CO or CO_2.[2] Even though a complete characterization of this dynamic chemical mixture is needed to better understand its fate and consequences, it remains poorly understood due to its high complexity in terms of composition and processes. Chamber experiments have recently achieved carbon closure under controlled conditions.[3,4] Atmospheric studies with the same aim are scarce[5], and demonstrate the need to quantify semi-volatile and intermediate volatility species, providing closure on OH reactivity and secondary organic aerosol formation. Therefore, we invite researches with experimental expertise in quantification and speciation of gaseous and particle bound organic carbon to join a campaign at the Jungfraujoch site with the aim to achieve a complete carbon balance in the atmosphere in conditions in both the free troposphere along with influences of the planetary boundary layer.

Experimental Outline

During late summer, air masses at Jungfraujoch arise from the lower free troposphere with intermittent planetary boundary layer influence. In addition, aged biomass burning plumes from North America and the Iberian Peninsula are often observed to reach the observatory during this time. We therefore consider mid-August to late September as the most interesting season to study the atmospheric carbon balance.

We envision to have a suite of on-line mass spectrometry measurements for gaseous (from volatile organic compounds to semi-volatile) and aerosol components in parallel with total carbon measurements. In addition, we propose offline filter and cartridge sampling.

ACTRIS trans national access (TNA)

Financial support can be made available through the ACTRIS TNA scheme supported by the ACTRIS-IMP project (www.actris.eu). Formal application for TNA support is handled through the central access management (https://www.actris.eu/access-services). Potential applicants are asked to get in contact with the local contact persons.

Local contact persons to this TNA activity

Primary contact: Nora Nowak (nora.nowak@psi.ch) and Dave Bell (david.bell@psi.ch)

Secondary contact: Martin Gysel-Beer (martin.gysel@psi.ch)

References

1. Bukowiecki, N. *et al.* A review of more than 20 years of aerosol observation at the high altitude research station Jungfraujoch, Switzerland (3580 m asl). *Aerosol Air Qual. Res.*, **16**, 764–788 (2016), doi:10.4209/aaqr.2015.05.0305.

2. Goldstein, A. H. & Galbally, I. E. Known and Unexplored Organic Constituents in the Earth's Atmosphere. *Environ. Sci. Technol.* **41**, 1514–1521 (2007).

3. Isaacman-VanWertz, G. *et al.* Chemical evolution of atmospheric organic carbon over multiple generations of oxidation. *Nature Chem.* (2018) doi:10.1038/s41557-018-0002-2.

4. Isaacman-VanWertz, G. *et al.* Using advanced mass spectrometry techniques to fully characterize atmospheric organic carbon: current capabilities and remaining gaps. *Faraday Discuss.* **200**, 579–598 (2017).

5. Hunter, J. F. *et al.* Comprehensive characterization of atmospheric organic carbon at a forested site. *Nat. Geosci. 2017 1010* **10**, 748–753 (2017).