

Airborne measurements of reactive organic trace gases in the atmosphere – with a focus on PTR-MS measurements onboard NASA’s flying laboratories

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Reactive organic gases (ROGs) play an important role in atmospheric chemistry as they affect the rates of ozone production, particle formation and growth, and oxidant consumption. Measurements of ROGs are analytically challenging because of their large variety and low concentrations in the Earth’s atmosphere, and because they are easily affected by measurement artefacts. On aircraft, ROGs are typically measured by canister sampling followed by off-line analysis in the laboratory, fast online gas chromatography or online chemical ionization mass spectrometry. In this work, we will briefly sum up the state-of-the-art in this field before focusing on proton-transfer-reaction mass spectrometry (PTR-MS) and its deployment onboard NASA’s airborne science laboratories. We will show how airborne PTR-MS was successfully used in NASA missions for characterizing emissions of ROGs from point sources, for following the photochemical evolution of ROGs in a biomass burning plume, for determining biosphere-atmosphere fluxes of selected ROGs and for validating satellite data. We will also present the airborne PTR-MS instrument in its most recent evolution which includes a radiofrequency ion funnel and ion guide combined with a compact time-of-flight mass spectrometer and discuss its superior performance characteristics.

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