

Research Highlight

'Characterization of a high detection-sensitivity atmospheric pressure interface time-of-flight mass spectrometer'

Summary

In this work, we have shown that the detection sensitivity (or limit of detection) of a new Atmospheric Pressure-interface Time-of-Flight Mass Spectrometer (API-TOF-MS) is in the parts per quintillion (i.e., 10^{-3} parts per quadrillion, ppq; which is ~ 30 ions cm^{-3}) range with temporal resolutions of 1 s. When increasing the temporal resolution up to 1 min, the detection sensitivity could be reduced to the 10 parts per sextillion (i.e., 10^{-5} ppq; which is ~ 0.3 ions cm^{-3}) range, enabling the system to measure gaseous ions of extremely low concentrations. We also show that the mass spectrometer has a transmission of up to 1 %, and a mass resolution of 23,000 for ionic masses of ca. 600 Da, while it can be used in ways to induce collision dissociation of the sampled ions by tuning the operating conditions of the Atmospheric-Pressure-interface stage.

Impact

This work shows that equipping an API-TOF-MS with an octapole ion trap for accumulating the sampled ions before orthogonally accelerating them into the mass analyser can result in remarkably high detection sensitivities.

In contrast to other mass spectrometers that employ spectra accumulation to improve the detection sensitivity for atmospheric observations, ion accumulation amplifies the signal without increasing the noise level; something that among others is highly important for probing short-lived ionic clusters during new particle formation events in the atmospheric environment.

Authors' bios



Fabian Schmidt-Ott is a PhD researcher at the Climate and Atmosphere Research Centre (CARE-C) of The Cyprus Institute and the Institute for Atmospheric and Earth System Research (INAR) at the University of Helsinki, Finland.

His research focuses on the development and application of advanced instrumentation for atmospheric measurements of aerosol particles and trace gases, with particular emphasis on mass spectrometry and the advancement of electrical mobility-based aerosol measurement techniques.

Reference

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