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Measuring the temporal evolution of aerosol composition in a remote marine environment influenced by Saharan dust outflow using a new single particle mass spectrometer.

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Refractory material constitutes a significant fraction of the atmospheric aerosol burden and has a strong influence on climate through the direct radiative effect and aerosol-cloud interactions, particularly in cold and mixed phase clouds. Composition of refractory aerosols is traditionally measured using off-line analytical techniques such as filter analyses. However, when using off-line techniques the temporal evolution of the data set is lost, meaning the measurements are difficult to relate to atmospheric processes. Recently, single particle mass spectrometry (SPMS) has proven a useful tool for the on-line study of refractory aerosols with the ability to probe size resolved chemical composition with high temporal resolution on a particle by particle basis.

A new Laser Ablation Aerosol Time-of-Flight (LAAP-TOF) SPMS instrument with a modified optical detection system was deployed for ground based measurements at Praia, Cape Verde during the Ice in Cloud – Dust (ICE-D) multi-platform campaign in August 2015. A primary aim of the project was to evaluate the impact of Saharan dust on ice nucleation in mixed phase clouds. The instrument was operated over a 16 day period in which several hundred thousand single particle mass spectra were obtained from air masses with back trajectories traversing the Mid-Atlantic, Sahara Desert and West Africa.

The data presented indicate external mixtures of sea salt and silicate mineral dust internally mixed with secondary species that are consistent with long range transport to a remote marine environment. The composition and size distributions measured with the LAAP-TOF are compared with measurements from an aerodynamic particle sizer (APS), Single Particle Soot Photometer (SP2), and data from SEM-EDX analysis of filter samples. The particle number fraction identified as silicate mineral from the mass spectra correlates with a fraction of the incandescent particles measured with the SP2. We discuss the suitability of the modified LAAP-TOF instrument design for the on-line study of mineral dust and sea salt aerosol and highlight the benefits of this system when deployed in tandem with other aerosol measurement techniques.