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Evidence for a High Proportion of Atmospheric Organic Aerosol from Isoprene

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The tropics emit a huge amount of volatile organic compounds (VOCs) into the Earth's atmosphere. The processes by which these gases are oxidised to form secondary organic aerosol (SOA) are currently not well understood or quantified. Intensive field measurements were carried out as part of the Oxidant and Particle Photochemical Processes (OP3) and the Aerosol Coupling in the Earth System (ACES) projects around pristine rainforest in Malaysian Borneo. This is the first campaign of its type in a South East Asian rainforest.

We present detailed organic aerosol composition measurements made using an Aerodyne High Resolution Time of Flight Aerosol Mass Spectrometer (HR-ToF-AMS) at Bukit Atur, a Global Atmosphere Watch site located in the Danum Valley Conservation Area. This is a state-of-the-art field deployable instrument that can provide real time composition, mass loading and aerodynamic particle sizing information. In addition, the mass spectral resolution is sufficient to perform an analysis of the elemental composition of the organic species present. Off line analysis of filter samples was performed using comprehensive two-dimensional gas chromatography coupled to time of flight mass spectrometry (GCxGC/ToFMS). This technique provides a more detailed chemical characterisation of the SOA, allowing direct links back to gas phase precursors.

The ground site data are compared with Aerodyne Compact Time of Flight Aerosol Mass Spectrometer (C-ToF-AMS) measurements made on the UK Facility for Airborne Atmospheric Measurements (FAAM) BAe-146 research aircraft. Airborne measurements were made above pristine rainforest surrounding the Danum Valley site, as well as nearby oil palm agricultural sites and palm oil rendering plants. Proton Transfer Reaction Mass Spectrometry (PTRMS) measurements of VOCs were made at the ground site and from the FAAM aircraft.

Novel organic aerosol was measured by both AMSs, and identified as being isoprenoid in origin by GCxGC/ToFMS analysis and by comparison of aerosol to gas phase precursor measurements. Isoprene SOA is estimated to compose as much as 12% of the total organic aerosol loading with a median proportion of 7%, during the OP3 campaign. This is the first atmospheric measurement of SOA from isoprene and the proposed source is currently not included in atmospheric aerosol models.