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Aerosol fluxes and dynamics within and above a tropical rainforest in South-East Asia

James Whitehead (1), Martin Gallagher (1), Niall Robinson (1), Andrew Gabey (1), James Dorsey (1), Hugh Coe (1), Gordon McFiggans (1), James Ryder (2), Eiko Nemitz (2), and Fay Davies (3)

(1) University of Manchester, Centre for Atmospheric Science, SEAES, Manchester, United Kingdom (james.whitehead@manchester.ac.uk), (2) Centre for Ecology and Hydrology, Edinburgh Research Station, Bush Estate, Penicuik, Midlothian, EH26 0QB, UK., (3) School of Environment and Life Sciences, Peel Building, University of Salford, Salford M5 4WT, UK.

Atmospheric aerosol measurements over tropical rainforests are important in order to understand their sources and sinks, and hence the rainforests' influence on local and regional climate. To date, there have been no published studies in South-East Asia, which, compared to the African and South American continents, represents a unique mixture of tropical seas and islands. Aerosol measurements were conducted near Danum Valley, in the Malaysian state of Sabah, North-east Borneo, as part of the OP3 and ACES projects, in April and June/July 2008.

Ultrafine particle fluxes were calculated by eddy covariance from measurements above the rainforest canopy on the Global Atmosphere Watch (GAW) tower. Upward fluxes were seen on most mornings between 09:00 and 11:00 local time and this could be attributed to entrainment of particles into the growing mixed layer. In-canopy measurements were conducted at a nearby site. Profiles in aerosol number concentrations were investigated using GRIMM Optical Particle Counters (OPCs) at various levels within the rainforest canopy as well as a single OPC on a vertically moving platform. These showed an overnight increase in larger particles (1 – 20 μm) at all levels, but much more prominently near the top of the canopy, which could be attributed to fog formation. Number concentrations in this size range in the canopy understory correlated with enhancements in biological aerosol concentrations, measured using a Wide Issue Bioaerosol Spectrometer (WIBS) located near the forest floor, suggesting that coarse particle number concentrations were dominated by biological aerosols.

A comparison of particle number concentrations (in the size range 0.5 – 1.0 μm) between above and below canopy showed correlations, despite turbulence data suggesting persistent decoupling between the two measurement sites. These correlations often relied on a shift of the particle time-series against each other, implying a time delay in observations between the sites, which varied according to time of day. This lag time was shortest during the middle of the day by a significant margin. This was not observed for coarse mode (> 1.0 μm) aerosols. Further evidence of daytime coupling between above and below canopy in terms of aerosol measurements is implied by comparison of measurements from an Aerosol Mass Spectrometer (AMS) at the GAW tower and simultaneous bag sampling at the in-canopy site, subsequently analysed with the AMS.

The transport of particles through the canopy, and fluxes above canopy, will be discussed in terms of mechanisms and diurnal variation, and the results of this study will be examined in order to build up a picture of the dynamics of aerosols above and within the rainforest canopy.