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Organic chemical components of fog water and aerosol particles in a subtropical forest in Taiwan

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This study was conducted at Xitou, a forest site in central Taiwan, in order to investigate the composition of organic chemical components in fog water and aerosol particles. Different types of air samplers were used, including an active fog collector, Mini-Vol-, Met One Speciation Air Sampling System SuperSASS- and ChemComb Cartridge Model 3500 -aerosol-samplers, and impingers to collect fog water and air samples within and above the canopy on different media, such as fog water, Quartz, Teflon and Nylon filters. Samples were analyzed by various techniques, such as high-performance anion exchange chromatography (HPAEC).

Particulate matter (PM) concentrations within and above the canopy were similar, while higher during day time.

Ammonium, nitrate and sulfate were the major species in samples in both, fog water and aerosol samples, derived from compounds emitted from regional agriculture, industry and traffic.

Total organic carbon (TOC) and carbonaceous species (organic and elemental carbon) were measured, showing that on average more than 80% of organic carbon in fog water was water-soluble and the concentration of organic carbon in aerosol particles was rather high. Low-molecular-weight organic acids (LMWOA), including acetic, formic and oxalic acids, gave information about the emission type, and accounted for the great majority of identified organic species. Acetate (A) to formate (F) ratios well above unity indicate the contribution of anthropogenic emissions from biomass burning and automobile exhaust at the site.

Selected carbohydrate species, including arabitol, mannitol and 2-methyl-tetrols, were quantified and used as molecular source tracers for bioaerosol (fungal spores) and secondary organic aerosols (SOA). The total amount of fungal spores was estimated by the molecular tracer method. Ambient concentrations of the fungi and SOA tracers in the subtropical forest were high, with average concentrations of 73.4 ± 34.5 ng m^{-3} (SD) for 2-methyltetrols, indicating important influence of microbial activities and secondary aerosol formation on the activity of cloud condensation nuclei (CCN) and resulting fog water chemistry. Furthermore, the biomass burning tracers levoglucosan and mannosan were detected.

As few studies have investigated the role which organic compounds play in cloud-aerosol interactions, especially in form of ambient measurements, and specifically in subtropical forests in East and Southeast Asia, the results from this study reveal new insights into the composition and sources of aerosol particles and fog/cloud water in mountain forest environments.