

Chemical composition of bulk and size-resolved cloud water during the HCCT-2010 cloud experiment

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Clouds represent important media for chemical reactions in the atmosphere. Uptake of gases and dissolution of cloud condensation nuclei (CCN) constituents lead to a complex composition of their aqueous phase. A multitude of possible reactions can take place and modify the chemical composition and thus ultimately the physical properties of aerosol particles after cloud dissipation.

To improve our understanding of aerosol cloud interactions and cloud chemistry, the 'Hill Cap Cloud Thuringia 2010' (HCCT-2010) field campaign was performed at Mt. Schmucke in the Thuringian forest of Germany in September/October 2010. The campaign setup consisted of an upwind, an in-cloud, and a downwind site.

A large pool of instrumentation was installed at all three sites to physically and chemically characterize incoming air masses, the different cloud phases, and the residual aerosol after cloud passage. At the in-cloud site, four Caltech Active Strand Cloud Water Collectors (CASCC2, (Demoz et al., 1996) were operated with a 50% droplet size cut (D50) of 3.5 μm and a one hour time resolution. Additionally, two multistage versions of the CASCC were used. A 3-stage collector (Raja et al., 2008) with D50 of 22, 16, and 4 μm diameter, and a 5 stage collector (Moore et al., 2002) with D50 of 30, 25, 15, 10, and 4 μm with a 2-hourly and 4-hourly time resolution, respectively. To complement the liquid cloud water samples, droplet residuals and interstitial particles were sampled downstream of a counterflow virtual impactor (CVI) and an interstitial inlet (INT) using filters and two aerosol mass spectrometers (AMS). Many different organic and inorganic compounds were analyzed from the cloud water samples and their bulk aqueous phase concentrations are summarized in Figure 2.

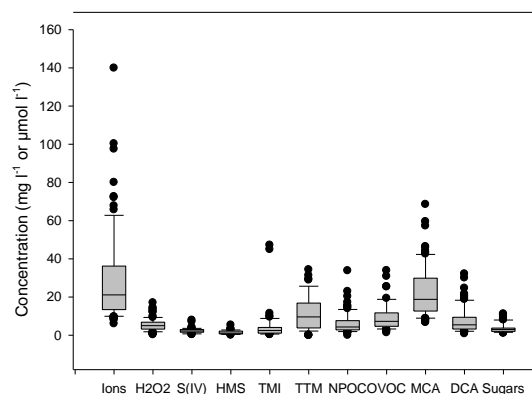


Figure 2: Bulk cloud water concentration ranges of the sum of inorganic ions (mg l^{-1}), hydrogen peroxide ($\mu\text{mol l}^{-1}$), sulfur(IV) ($\mu\text{mol l}^{-1}$), hydroxymethanesulfonic acid ($\mu\text{mol l}^{-1}$), sum of transition metal ions ($\mu\text{mol l}^{-1}$), sum of total transition metals ($\mu\text{mol l}^{-1}$), non-purgable organic carbon (mg l^{-1}), sum of oxygenated volatile organic compounds ($\mu\text{mol l}^{-1}$), sum of monocarboxylic acids ($\mu\text{mol l}^{-1}$), sum of dicarboxylic acids ($\mu\text{mol l}^{-1}$), and sum of monosaccharides ($\mu\text{mol l}^{-1}$).

In this contribution, concentration trends of bulk cloud water constituents in relation to cloud conditions, air mass origins, and upwind CCN concentrations, as well as their distribution between different droplet size classes will be presented. A focus will be laid on the organic fraction.

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