Cloud chemistry and aerosol processing during the HCCT-2010 hill cap cloud experiment

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Clouds represent an important medium 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 reactions can take place and modify the chemical composition and thus ultimately the physical properties of aerosol particles after cloud dissipation.

To study physical and chemical interactions of aerosol and clouds, the Lagrange-type cloud experiment "Hill Cap Cloud Thuringia 2010" (HCCT-2010) was performed in 2010 at Mt. Schmücke, Germany, where a hill cap cloud served as a natural flow-through reactor. The campaign setup consisted of an upwind, an in-cloud, and a downwind site, where a pool of various offline- and online-instruments was installed. This included e.g. several bulk and size-resolved cloud water collectors at the in-cloud site, four aerosol mass spectrometers (AMS) at both the valley and the in-cloud sites, a fluorescence assay by gas expansion (FAGE) instrument for HO_x measurements in-cloud, as well as other instrumentation for physical and chemical aerosol and cloud characterization.

A comprehensive analysis of meteorological parameters and inert tracers allowed for the identification of several cloud events where the air flow along the measurement sites was fully connected and representative air masses were sampled before, during, and after their passage through the hill-cap cloud (full cloud events, FCEs).

In this presentation a general overview over the campaign will be given and some of the main results will be presented. These include, among others, indications of aerosol processing by chemical in-cloud mass production - mainly of sulfate and organics - during some FCEs, an increased hygroscopicity of aerosol particles after cloud passage, time-resolved bulk as well as size-resolved cloud chemical compositions, a direct observation of HO_2 depletion in cloud through heterogeneous loss to cloud droplets, as well as an unexpectedly high importance of transition metal ion catalysed oxidation of SO_2 during some events.