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Cloud Chemistry with High Temporal Resolution

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Context/Purpose. The scope of this project is to develop the understanding of the temporal dynamics of cloud chemistry in various cloud types at a subtropical mountain site. Up to now, cloud water samples were collected with an active collector and with sample integration times of 30 minutes or more. We now improved the temporal resolution of the cloud water sampling intervals by reducing the minimum required water volume and by using an autosampler. The minimum sampling period is significantly reduced, in some cases as low as 15 seconds. The central research question of this investigation is to study the variability of cloud chemistry on short time scales during the wet season. How fast are pH and electric conductivity (EC) changing? How is the temporal variability of ion concentrations and of ion loads? What are the main drivers for heterogeneity of cloud chemistry?

Method. We employed an active fog collector (modified Caltech design) at the Lulin Atmospheric Background Station (LABS, 2862 m asl) in mountainous southern-central Taiwan. The measuring period was in August and September 2018. Fog water samples were collected automatically whenever sample volumes of 10 ml were reached. EC and pH were measured immediately after the collection. Aliquots of the samples were kept deep-frozen until chemical analysis with anion and cation chromatography. A total of 623 samples was collected, of which 189 were fully analyzed for their anions' and cations' concentrations.

Results and Interpretation. The median sampling time for one sample was about 3 minutes and depended on the liquid water content. All water samples show low EC and low ion concentrations. Some events exhibit a high variability of EC and ion concentrations on a short time scale. The fog water was rather acidic (pH's as low as 3.8) for most samples, although high pH's (up to over 5.5) also occurred. Further analysis of the composition of the fog will be conducted together with an analysis of air mass back trajectories. Data analysis is underway.

Conclusion. This is one of the first applications of active fog collectors with a high temporal sample frequency. It is suggested that a perennial fog collection project should be initiated that covers all seasons and includes systematic rain collection for chemical analysis as well. The role of in-cloud turbulence as a driver for heterogeneity of chemical conditions should be studied in more detail.