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Fog Chemistry at the subtropical cloud forest of Xitou in Central Taiwan

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Fog water was collected at the subtropical mountain site of Xitou in the center of Taiwan. Investigations took place in different years, covering all four seasons, with the aim to identify and compare the chemical composition of fog water at the site. Fog was sampled with identical active fog collectors (modified Caltech design) using the same sampling strategies. The fog collector was triggered with a Vaisala Present Weather Detector PWD11/12 and automatically started sampling whenever the visibility was below 1000 m. Samples were removed manually as soon as there was sufficient collected fog water for chemical analysis by ion chromatography (approx. 50 ml).

In total, 237 fog samples were taken, 69 samples during autumn 2013, 106 samples during spring 2017, and 62 samples during winter 2017. While no fog water could be collected during summer, the amounts of fog water collected during spring, autumn and winter varied largely in terms of liquid water content (LWC), ion concentrations and potential sources of constituents in fog water.

The chemical composition of fog water was in all cases clearly dominated by H^+, NH_4^+, NO_3^- and SO_4^{2-}, making up more than 84 % of the total ion concentrations. The median pH ranged from 4.10 in autumn to 5.62 in winter, median total ion concentration (TIC) ranged from 275 μeq L^{-1} in winter to 3210 μeq L^{-1} in autumn. Ion concentrations in autumn were up to ten times higher than in winter. Different chemical composition of fog samples during the seasons were caused by the different origin of the air masses and different meteorological conditions. A relatively high median pH was caused by acid neutralization through ammonium, which originated from local NH3 emissions from agriculture and other sources such as vehicular traffic.

Median NO_3^-/nss-SO_4^{2-} ratios during all seasons were larger than unity, indicating a particularly large influence of NO_x emissions from local road traffic and nearby urbanized central-west Taiwan. Nitrogen oxides emissions as well as sulfur dioxide emissions from coal combustion in Taiwan and long range transport from mainland China were the main precursors of fog acidity.

As no fog water could be sampled during south-westerly monsoon season during summer, further research is advisable to fully cover the two main monsoon seasons and also investigate changes in LWC due to regional effects of global climate change.