

## Reactive nitrogen fluxes and gas-aerosol interactions above a semi-natural forest in the Po Valley, Italy

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The Po Valley, Italy, is known to be a nitrogen hotspot through the co-emissions of nitrogen oxides ( $\text{NO}_x$ ) and ammonia ( $\text{NH}_3$ ) due to intensive agriculture and industry within the region. Due to the regions poor air quality there have been a number of studies to understand the atmospheric composition and the tropospheric chemistry. Studies on the deposition of reactive N to the local ecosystems are however limited due to the complexities of measuring species such as  $\text{NH}_3$ . The following study presented took place above an oak-hornbeam forest “Bosco Fontana” near Mantova, situated in the Po Valley, Italy with the aim to determine the importance of individual N species to the dry deposition budget and understand the impact of the chemical interactions and changes in the gas-aerosol partitioning.

Water soluble gases ( $\text{NH}_3$ , HONO and  $\text{HNO}_3$ ) and their counter-part aerosol species ( $\text{NH}_4^+$  and  $\text{NO}_3^-$ ) were measured using an online wet chemistry instrument called the GRAdient of Aerosols and Gases Online Registration (GRAEGOR, ECN, NL). The fluxes were calculated using a modified gradient method, with concentration measurements at 2 heights. In addition,  $\text{NH}_4^+$  and  $\text{NO}_3^-$  species were also measured by eddy covariance using an aerosol mass spectrometer (AMS, Aerodyne Inc.). Eddy Covariance was also used to measure NO fluxes.

Nitric acid ( $\text{HNO}_3$ ) as expected had the fastest deposition rate ( $V_d$ ) of  $18.80 \text{ mm s}^{-1}$  of all the N species measured. The study however did demonstrate that the deposition of  $\text{NH}_4^+$  and  $\text{NO}_3^-$  was greatly enhanced during the day due to the evaporation during deposition close to the surface of the canopy, which resulted in the  $V_d$  of  $\text{HNO}_3$  to be reduced.

Overall, the largest deposition flux over the forest was from  $\text{NH}_3$ , with an average of  $-253.42 \text{ ng m}^{-2} \text{ s}^{-1}$ , which accounted for 75% of the total N deposition budget during the period presented. The aerosols ( $\text{NH}_4^+$  and  $\text{NO}_3^-$ ) combined accounted for 19% and  $\text{HNO}_3$  contributed just 5% to the total N deposition budget. Taking this budget, measured over 2 weeks, an inferred annual budget of  $75 \text{ Kg N ha}^{-1} \text{ yr}^{-1}$ , which is greater than previously measured at the same site using a throughfall method for N deposition.