

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 (NO_x) and ammonia (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 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 (NH_3 , HONO and HNO_3) and their counter-part aerosol species (NH_4^+ and 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, NH_4^+ and 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 (HNO_3) as expected had the fastest deposition rate (V_d) of 18.80 mm s^{-1} of all the N species measured. The study however did demonstrate that the deposition of NH_4^+ and 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 HNO_3 to be reduced.

Overall, the largest deposition flux over the forest was from 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 (NH_4^+ and NO_3^-) combined accounted for 19% and 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.