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The influence of ammonia deposition on nitrogen oxide emissions from soil

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Intensive livestock farms emit large concentrations of NH_3, most of which is re- deposited very close to the source. The presence of trees enhances the re-deposition and N deposition rates to down wind forests can exceed 40 kg N ha^{-1}. The steep gradient of large NH_3 deposition rates at the edge of a downwind forest to background concentrations within a few hundred meters provides are ideal site to study in vivo the effect of different rates of N deposition on biological and chemical processes under same climatic conditions. We have investigated the effect of different rates of NH_3 deposition (62,45,28 and 1.5 kg NH_3-N $h^{-1}y^{-1}$) on the flux of NO and N_2O from soil in mixed woodland downwind of a large poultry farm (160,000 birds) in Scotland, which has been operating for about 40 years. Measurement were carried out for a 9 month period, with hourly NO flux measurements, daily N_2O fluxes close to the farm and monthly at all sites and monthly cumulative wet and dry N deposition rates. The increased N deposition rate to the woodland increased emissions of NO and N_2O and soil available NH_4^+ and NO_3^- concentrations. NO emissions followed a diurnal pattern with maximum emissions around 3 hours in the afternoon. The oscillation frequency was much larger for the chambers with large NO emissions, close to the farm than smaller ones. For N_2O no consistent diurnal pattern was observed. On average the NO emissions expressed as a fraction of the elevated N deposited were 7.1% (at 15 m), 6% (at 25 m) and 2.3% (at 45 m) downwind of the farm, whereas for N_2O the emissions were only 2.8% (at 15 m), 3% (at 25 m) and 3% (at 45 m) downwind. These emission fractions greatly exceed the emission factor advised by the IPCC for N2O emissions resulting from atmospheric N deposition.