NO_2 and O_3 deposition to intensively managed grassland - Findings, characterization and parameterization from a multi-year dynamic chamber study

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Motivation

Though nitrogen dioxide (NO_2) is an important player in the deposition of reactive nitrogen, only few flux measurements are reported in literature and deposition pathways are poorly understood, especially on the ecosystem level. Accordingly, inferential models only comprise very simple deposition schemes for NO_2, usually linking its deposition to stomatal uptake (Flechard et al., 2011).

Using dynamic chamber measurements (Pape et al. 2009) of the NO-NO_2-O_3 triad at an intensively managed grassland site (Oensingen in the Swiss central plateau, 7°44'E, 47°17'N, 450 m a.s.l.), we aim at (a) an integrative interpretation of the chamber fluxes in respect to ambient exchange processes, accounting for chemical interactions within the NO-NO_2-O_3 triad, (b) the investigation of NO_2 and O_3 deposition pathways, e.g. stomatal vs. non-stomatal uptake, and (c) formulating an empirical parameterization for NO_2 deposition based on the in-situ flux measurements.

Preliminary results and outlook

While O_3 deposition shows consistent deposition patterns with regular diurnal cycles and R_c values between around 100 sm^{-1} during daytime and above 600 sm^{-1} during night, the proximity to the highway and consequent instationarity of NO_2 concentration lead to a highly noisy chamber flux signal for NO_2. Daytime stomatal resistance was estimated from eddy covariance H_2O fluxes and adjusted for the reduced molecular diffusivities of O_3 and NO_2. Both O_3 and NO_2 deposition processes cannot be explained by the stomatal resistance alone. In periods without the influence of fertilization, NO_2 was found to be the dominant reactive nitrogen compound at the site. In such conditions the NO_2 deposition derived from chamber flux measurements compare well to total reactive nitrogen exchange fluxes (Ammann et al., 2012). The residual non-stomatal resistances are related to meteorological parameters with the aim of a suitable parameterization of $R_c(O_3)$ and $R_c(NO_2)$ for our site.

References

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