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# Atmospheric deposition of nitrogen over Czech forests: refinement of estimation of dry deposition for unmeasured nitrogen species

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The accurate quantification of atmospheric deposition is very important for assessment of ambient air pollution impacts on ecosystems. Our contribution presents an advanced approach to improved quantification of atmospheric deposition of nitrogen over Czech forests, merging available measured data and model results.
The ambient air quality monitoring in the Czech Republic is paid an appreciable attention (Hůnová, 2001) due to the fact, that in the recent past its territory belonged to the most polluted parts of Europe (Moldan and Schnoor, 1992). The time trends and spatial patterns of atmospheric deposition were published (Hůnová et al. 2004, Hůnová et al. 2014). Nevertheless, it appears that the atmospheric deposition of nitrogen, particularly the dry deposition, is likely to be underestimated due to unavailability of data of certain nitrogen species as $HNO_3$(g) and NH3. It is known that $HNO_3$(g) may contribute significantly to the dry deposition of nitrogen even in regions with relatively low concentrations (Flechard et al., 2011).
We attempted to substitute unmeasured nitrogen species using an Eulerian photochemical dispersion model CAMx, the Comprehensive Air Quality Model with extensions (ESSS, 2011), coupled with a high resolution regional numeric weather prediction model Aladin (Vlček, Corbet, 2011). Preliminary results for 2008 indicate that dry deposition of nitrogen, so far based on detailed monitoring of ambient $NO_x$ levels, is underestimated substantially. The dry deposition of N/$NO_x$ in 2008 reported by Ostatnická (2009) was about 0.5 g.m-2.year-1 over 99.5 % of the nation-wide area, while the contribution of unmeasured nitrogen species estimated by CAMx model were much higher. To be specific, the dry deposition of N/$HNO_3$(g) accounted for 1.0 g.m-2.year-1, and N/NH3 for 1.6 g.m-2.year-1. In contrast, the deposition of N/HONO (g) with 0.001 g.m-2.year-1, N/PAN with 0.007 g.m-2.year-1, particulate N/$NO_3$- with 0.002 g.m-2.year-1, and particulate N/NH4+ with 0.003 g.m-2.year-1, were negligible. If we summarized all nitrogen species considered, the dry deposition over most part of the CR was as high as 3.1 g.m-2.year-1, indicating six-fold higher deposition as compared to the value reported by Ostatnická (2009).
Preliminary verification comparing measured and modeled wet deposition (particularly N/$NO_3$- and N/NH4+) indicated that modeled values were two times lower for N/$NO_3$-, and three times lower for N/NH4+ as compared to measured values.
Substitution of unmeasured nitrogen species by modeled values seems to be a plausible way for approximation of total nitrogen deposition, and getting more realistic spatial pattern for further studies of likely nitrogen impacts on ecosystems.

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