Utilizing the nitrogen isotopic composition of ammonia to investigate regional transport of ammonia emissions: δ^{15}N-NH_3 values at AMoN sites

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Ammonia (NH_3) emissions are largely unregulated in the U.S. although wet and dry atmospheric deposition of NH_3 and ammonium (NH_4^+) can be a substantial source of nitrogen pollution to sensitive terrestrial, aquatic, and marine ecosystems. Despite the adverse effects of excess NH_3 and NH_4^+ deposition (e.g. eutrophication of surface waters, decreased biodiversity, and increased soil acidity), until recently, gaseous NH_3 concentrations were not routinely measured as part of the suite of NADP networks. The Ammonia Monitoring Network (AMoN), established in 2007, has rapidly grown to 55 sites. Here, to supplement studies that trace NH_3 across local landscapes (e.g. conventionally managed cornfields, confined animal feeding operations, dairy operations), we deployed NH_3 passive samplers at 9 AMoN sites to assess the isotopic composition of NH_3 (δ^{15}N-NH_3) as a regional tracer of NH_3 emission sources. Monthly NH_3 samples from 9 sites were analyzed for nitrogen isotopic composition over a period of a year (7/09 to 6/10). Our results suggest that isotopic compositions of NH_3 at individual AMoN sites generally corresponds with primary regional NH_3 sources. To further explore these spatial patterns, we couple an inventory of the δ^{15}N-NH_3 values of NH_3 sources with county-level NH_3 emission inventory (Davidson et al. 2002) to model the average monthly δ^{15}N-NH_3 values occurring in U.S. counties. These modeled isotopic compositions are then compared to observed δ^{15}N-NH_3 values occurring at individual AMoN sites. This comparison provided insight into possible inaccuracies in the NH_3 inventory and the lack of the modeled isotopic compositions to account for transport of NH_3 sources. These results demonstrate how the nitrogen isotopic composition of NH_3 can be utilized to investigate the source, transport, and fate of NH_3 emissions across varying spatial scales.

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