2.016 The role of dew as a nighttime reservoir and morning source for atmospheric ammonia.

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Abstract:

Several field studies have proposed that the volatilization of NH_3 from evaporating dew is responsible for an early morning pulse of ammonia frequently observed in the atmospheric boundary layer. Laboratory studies conducted on synthetic dew showed that the fraction of ammonium (NH_4^+) released as gas-phase ammonia (NH_3) during evaporation is dependent on the relative abundances of anions and cations in the dew. Hence, the fraction of NH_3 released during dew evaporation (Frac(NH_3)) can be predicted given dew composition and pH. Twelve separate ambient dew samples were collected at a remote high elevation grassland site in Colorado from 28 May to 11 August, 2015. Average [NH_4^+] and pH were 26 µM and 5.2, respectively, and were on the lower end of dew [NH_4^+] and pH observations reported in the literature. Ambient dew mass (in g m^{-2}) was monitored with a dewmeter, which continuously measured the mass of a tray containing artificial turf to track the accumulation and evaporation of dew. Simultaneous measurements of ambient NH_3 indicated that a morning increase in NH_3 was coincident in time with dew evaporation, and that either a plateau or decrease in NH_3 occurred once the dew had completely evaporated. Dew composition was used to determine an average Frac(NH_3) of 0.94, suggesting that nearly all NH_4^+ is released back to the boundary layer as NH_3 during evaporation at this site. An average NH_3 emission of 6.2 ng m^{-2} s^{-1} during dew evaporation was calculated using total dew volume and evaporation time, and represents a significant morning flux in a non-fertilized grassland. The observed loss of NH_3 during nights with dew is approximately equal to the observed amount of NH_4^+ sequestered in dew at the onset of evaporation. Hence, there is strong evidence that dew is both a significant night-time reservoir and strong morning source of NH_3.