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Spatial variability of ammonium deposition across the Greenland ice sheet and implications for past forest fire reconstructions

Content

Ammonium (NH₄) has been used as a proxy for fire activity in ice core reconstructions as biomass burning in boreal forests emits large quantities of gases and aerosols— including NH₄—to the atmosphere. While background ammonium deposition across the Greenland ice sheet can also originate from soil emissions, such contributions are relatively minor and have low temporal variability, thus past research has linked large spikes in ammonium concentration in summer ice layers to forest fire events. The large-scale coherence of NH₄ deposition across the Greenland ice sheet, however, has not been evaluated to determine the repeatability and spatial representativeness of single ice core records. Here, we present an array of high resolution, independently-dated NH₄ records developed using continuous flow analysis (CFA) in an array of Greenland ice cores. We use these records to assess NH₄ as a proxy for regional biomass burning in high latitude boreal forests in North America and Eurasia during the last ~1000 years. The frequency, magnitude, and timing of these biomass burning-derived spikes is compared across the broad array to determine the spatial extent of ammonium deposition resulting from burning events. These analyses will be coupled with atmospheric modeling to determine possible mechanisms of transport as well as potential forest fire source location in North America or Eurasia.

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