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Interactions of anthropogenic and natural atmospheric sources and global N cycle: Past and Future changes

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Nitrogen is important nutrient that controls the productivity of terrestrial and marine ecosystems. Emissions of reactive nitrogen into the atmosphere are increasing due to human activities, affecting also nitrogen deposition to the surface. Although emission controls are applied for nitrogen oxide emissions, those of ammonia are expected to further increase. There is also growing evidence that a significant fraction of nitrogen deposition occurs in the form of organic nitrogen, partially resulting from interactions between anthropogenic and natural gases, although the chemical characterization of this organic fraction remains a challenge. Furthermore interactions between natural aerosols and anthropogenic nitrogen are affecting the forms and amounts of nitrogen present on aerosols and subsequently atmospheric deposition of nitrogen.

The present study uses a global chemistry transport model (TM4-ECPL) and historical and projected emissions scenarios to calculate the changes in the global distribution of nitrogen atmospheric deposition since pre-industrial period as well as expected future changes. It considers both inorganic and organic nitrogen in gaseous and particulate phases. The model accounts for all major aerosol components, for oxidants and volatile organic chemistry and for secondary organic aerosol formation as well as for reactions of nitrogen and sulfur compounds on dust aerosols. The global distributions of organic and inorganic fractions of nitrogen deposition are computed and evaluated against recent observations. Sensitivity simulations are performed to evaluate the importance of anthropogenic emissions and of the interactions of natural and anthropogenic atmospheric constituents for N atmospheric deposition.