The global Nitrogen cycle, an update on the major fluxes, human influence and effects

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Abstract

The cycling of reactive nitrogen (Nr) through the atmosphere, and marine and terrestrial ecosystems is central to the functioning of life on Earth and prior to the industrial revolution, the global cycle was sustained by the natural processes of biological nitrogen fixation and denitrification by microbial activity. Combustion, of fossil fuels and biomass and industrial fixation of nitrogen by the Haber-Bosch process has changed the global nitrogen cycle with half of all annual nitrogen fixation resulting from human activity.

Climate change interacts with the global nitrogen cycle through modifying emissions, atmospheric chemistry, transport and deposition processes. Overall, the impacts of a warmer climate have the greatest effects on emission processes and partitioning between gas and solid phase, resulting in positive feedback between current warming trends and emissions of reactive nitrogen to the atmosphere.

The additional anthropogenic Nr cycling through the atmosphere has contributed to large increases in tropospheric ozone, acid rain, particulate matter. The consequences of these regional scale pollutants increases premature human mortality, biodiversity declines and crop loss and imposes a large financial burden on society. These costs are substantially greater than the control measures which could reduce emissions to the atmosphere and have been tested at country scales. Control measures on emissions of oxidised nitrogen, mainly though regulating vehicle emissions and industrial combustion have substantially improved air quality over North America, Europe and increasingly East Asia. Similar control measures to reduce emissions of ammonia have the potential to further improve air quality and reduce effects on ecosystems and human health.

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[3] **A chronology of global air quality**
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