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Aerosol, cloud and biosphere interactions (Arne Richter Award for Outstanding Young Scientists Lecture)

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The response of cloud characteristics and precipitation processes to increasing anthropogenic aerosol concentrations is one of the largest uncertainties in the current understanding of climate change. We have investigated the formation of cloud droplets using models with detailed spectral microphysics. Depending on the ratio between updraft velocity and particle number concentration, we found distinctly regimes of CCN activation, cloud, rain and snow formation, which implies strongly dynamic dependence for the aerosol impact. In a further study, we also found that the cloud droplet formation is more sensitive to the aerosol number concentration and its size than to its chemical composition.

Nitrous acid (HONO), as an important precursor of OH radical, is a key species in atmospheric photochemistry. Field observations suggest a large missing source of HONO. We show that biogenic nitrite in soil can release HONO and explain the reported strength and diurnal variation of the missing source. On the other hand, HONO emission provides another pathway for the emission of reactive nitrogen from soil, which is currently missing in the nitrogen cycle. Fertilized soils appear to be particularly strong sources of HONO and OH. Thus, agricultural activities and land-use changes may strongly influence the oxidizing capacity of the atmosphere. Because of the widespread occurrence of nitrite-producing microbes, the release of HONO from soil may also be important in natural environments, including forests, boreal and polar regions.

The above stories summarize most of my previous studies, but are a snapshot of Aerosol, cloud and biosphere interactions.