2.076 Modulation of nitrogen deposition by natural and anthropogenic land surface heterogeneities.

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Abstract:

Anthropogenic activities have increased N deposition to terrestrial ecosystems by more than threefold relative to preindustrial levels. Such increase has been associated with a wide array of ecosystem responses ranging from increased productivity to eutrophication, soil acidification, and loss of biodiversity. However, significant challenges remain in quantifying the impacts of N deposition on ecosystems in part due to uncertainties in the surface removal of nitrogen, estimates of which are largely based on coarse-resolution (~100km) models. Here, we use the GFDL land-model (LM3) coupled to the GFDL atmospheric chemical model (AM3) to characterize the impact of physical, hydrological, and ecological properties of the land surface on the removal of trace gases and aerosols. In particular, we focus on the sensitivity of reactive nitrogen dry deposition to both natural (e.g., species type, wetness) and man-made (e.g., deforestation, cropping) heterogeneities in the surface properties. We show that land use associated with agriculture increases nitrogen deposition to natural ecosystems both near source regions and in downwind receptor regions. In particular, model estimates of nitrogen deposition to forested ecosystems (in particular coniferous forests) need to be revised upward in regions with significant land-use change. We also show that the response of N deposition to projected changes in nitrogen emissions can vary considerably by land type. In particular, we find that N deposition to North American forests will decline thanks to lower oxidized nitrogen emissions, while N deposition to water bodies will increase in response to higher ammonia emissions. The implications of the heterogeneity in the surface removal of reactive nitrogen for particulate nitrate will also be discussed.