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Impact of agricultural practices on soil nitrogen oxide emissions simulated with a global dynamic vegetation model

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Nitrogen oxides (NOx) are key compounds for tropospheric chemistry and have a crucial role in the ozone formation. NOx emissions from soils, which are now generally recognized to contribute significantly to global source, are not only influenced by environmental parameters such as soil temperature and moisture or vegetation type, but are also strongly affected by human activities, for instance biomass burning or fertilizer application. Moreover, since the preindustrial era, vegetation distribution and agricultural practices underwent major changes, and could be significantly modified in the future, in response to the increasing food demand of growing population.

The objective of our study is to analyze the impact of land-use changes and fertilizer application on soil NOx emissions, over a period ranging from the preindustrial era to 2050. Based on the interactive global biogenic emission and dynamic vegetation model ORCHIDEE, we completed several simulations for the years 1850, 2000 and 2050, taking into account the vegetation distribution change related to crop expansion, as well as the fertilizer application increase. Furthermore, we considered four cases of fertilizer evolution in the future, based on the IPCC-SRES scenarios A1, A2, B1 and B2. We estimate that between preindustrial and present-day, net NOx emissions from soils to the atmosphere increase from 4.9 TgN/yr to 8.1 TgN/yr, with highest increase in northern mid-latitude regions of America and Europe, as well as in Indonesia and China. In the future, net NOx emissions from soils could reach 9.9 to 11.1 TgN/yr,

depending on the scenario considered.