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Nitrate aerosols today and in 2030: a global simulation including aerosols and tropospheric ozone

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Abstract. Nitrate aerosols are expected to become more important in the future atmosphere due to the expected increase in nitrate precursor emissions and the decline of ammonium-sulphate aerosols in wide regions of this planet. The GISS climate model is used in this study, including atmospheric gas- and aerosol phase chemistry to investigate current and future (2030, following the SRES A1B emission scenario) atmospheric compositions. A set of sensitivity experiments was carried out to quantify the individual impact of emission- and physical climate change on nitrate aerosol formation. We found that future nitrate aerosol loads depend most strongly on changes that may occur in the ammonia sources. Furthermore, microphysical processes that lead to aerosol mixing play a very important role in sulphate and nitrate aerosol formation. The role of nitrate aerosols as climate change driver is analyzed and set in perspective to other aerosol and ozone forcings under pre-industrial, present day and future conditions. In the near future, year 2030, ammonium nitrate radiative forcing is about -0.14 W/m^2 and contributes roughly 10% of the net aerosol and ozone forcing. The present day nitrate and pre-industrial nitrate forcings are -0.11 and -0.05 W/m^2, respectively. The steady increase of nitrate aerosols since industrialization increases its role as a non greenhouse gas forcing agent. However, this impact is still small compared to greenhouse gas forcings, therefore the main role nitrate will play in the future atmosphere is as an air pollutant, with annual mean near surface air concentrations, in the fine particle mode, rising above 3 μg/m^3 in China and therefore reaching pollution levels, like sulphate aerosols.

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