Geophysical Research Abstracts
Vol. 15, EGU2013-4618, 2013
EGU General Assembly 2013

Global model simulations of the impact of the transport sectors on atmospheric aerosol and climate

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The transport sector, including land transport, shipping and aviation, is one of the major sources of tropospheric aerosol. Land transport, in particular, is a relevant source of pollution in highly populated areas (e.g. megacities), with significant impacts on climate and health. Transport emissions are expected to grow in the near future, especially in the developing countries. In this work we use the EMAC-MADE global aerosol model to quantify the impact of transport emissions on global aerosol, for both present-day (2000) and future (2030) scenarios. Number emissions are also included in the model and derived from mass emissions under different assumptions on the size distribution of particles emitted by the three transport modes. Additional sensitivity experiments are performed to quantify the effects of the uncertainties behind such assumptions. The model simulations reveal that land transport is the most important source of black carbon pollution in the densely populated regions of Eastern U.S. and Europe. High particle concentrations are simulated for Southeast Asian areas, although pollution in this region is mostly due to non-transport sources. Shipping strongly contributes to aerosol sulphate concentrations along the most-traveled routes of the Northern Atlantic and Northern Pacific oceans, with significant impact along the coastlines and nearby major harbors and with large effects on cloud properties. The impacts on particle number concentrations are very sensitive to the assumptions on size distribution of emitted particles, with the largest uncertainties simulated for the land transport sector. The model results further reveal significant climate impacts of transport-induced particles.