Geophysical Research Abstracts
Vol. 13, EGU2011-7610, 2011
EGU General Assembly 2011
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Global Radiative Forcing from Megacities - Results From MEGAPOLI

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Air pollutants from megacities (NO_x, VOC, particulate matter) have the potential to impact the climate. NO_x and VOC contribute to tropospheric ozone formation and affect the lifetime of long-lived greenhouse gases such as methane. The sign of the impact is determined by the NO_x/VOC ratio and is highly localised and variable. Anthropogenic aerosols comprise sulphate, black carbon (BC) and particulate organic matter (POM). Aerosols impact climate directly by either absorbing (BC) or backscattering (sulphate, POM) radiation but also have indirect (cloud) effects.

The climate impact of megacity pollutants is assessed with the Met Office Hadley Centre Earth System Model HadGEM2 and the MATCH-MPIC chemistry-transport model operated by the Max Plank Institute for Chemistry in Mainz. We compare a control and an "annihilation" scenario in which anthropogenic emissions of short-lived species (excluding methane) from megacities were removed.

Generally, the contribution of megacities to global pollutant emissions is on the order of 2% to 5% of the total global annual anthropogenic emission flux. The impact of megacity pollutants is assessed via a direct radiative forcing from ozone, methane and aerosols. Megacity pollutants are found to contribute a radiative forcing of +6.3$\pm$0.4 mW/m^2 from an increase in the ozone burden and the change in the CH_4 abundance contributes a forcing of -1.0$\pm$0.5mW/m^2. The aerosol forcing from megacity pollutants amounts to -15.3$\pm$0.6mW/m^2 in the short-wave spectrum and +2.0$\pm$0.1 mW/m^2 in the long-wave spectrum. The combined effect of all of these individual terms is a slightly negative forcing, that is a cooling, of -8.0$\pm$1.6 mW/m^2 of the climate at presentday (2005) conditions.