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Atmospheric Absorption by Regional Black Carbon Emissions

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In the recent years there has been an increased attention in the aerosol research community about the potential of black carbon (BC) for global warming. Black carbon is mostly emitted from anthropogenic sources and exerts a positive forcing as opposed to sulphate and organic matter. The major sources of BC are from fossil fuel and biomass burning. Recent regional aerosol characterization studies over the Indian Ocean and the Mediterranean Sea demonstrated that the atmospheric absorption by BC has potential impacts on the hydrological cycle at regional to global scale. To understand the contribution of BC emissions from different geographical regions to global radiative forcing, we have simulated the BC transport in the *Laboratoire de Météorologie Dynamique - General Circulation Model (LMDZ-GCM)* using tagged emissions from different geographical regions–South America (SAM), North America (NAM), Africa (AFR), Europe (EUR), South and West Asia (SWA), East Asia (EAS), Australia and Pacific Islands (AUP), and Oceanic Regions (OCE). The BC emissions considered in the simulation are only energy related from fossil fuels and biofuels [*Bond et al.*, 2004]. Such a study is required for evaluating mitigation options tailored to regional development. The atmospheric residence time of BC from different regions varies from 4.2 to 7.2 days. The emissions from ships over the ocean (relatively wet region) have the shortest lifetime and emissions from Africa (relatively dry region) have longest lifetime. Asia accounts for more than 50% of global emission and burden. The estimated global annual mean atmospheric absorption is +0.48 Wm^{-2} with largest contribution from East Asia (36%) followed by South and West Asia (21%), Africa (14%), Europe (11%), North America (10%),

and South America (7%). Emissions from Australia and ships account for about 1% of the global mean atmospheric absorption. There are significant differences in absorption efficiencies, defined as atmospheric absorption (Wm^{-2}) per unit mass BC loading (gBC m^{-2}), among different regions. The differences in regional BC burdens and radiative forcing will be discussed. Intercontinental transport of BC, and potential impacts on the regional to global hydrological cycle will be addressed in the paper.

References

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