



Simulation of black carbon aerosol distribution over India: A sensitivity study to different convective schemes

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Black carbon (BC) aerosols absorb solar radiation, thereby causing a warming at the top-of-the-atmosphere (TOA) in contrast to most of the other aerosol species that scatter radiation causing a cooling at TOA. BC is considered to be an important contributor of global warming, second only to CO₂ with a net radiative forcing of 1.1 w/m². They have important regional climate effects, because of their spatially non-uniform heating and cooling. So it is very important to understand the spatio-temporal distribution of BC over India. In this study, we have used a regional climate model RegCM4.5 to simulate BC distribution over India with a focus on the BC estimation. The importance of incorporation of regional emission inventory has been shown and the sensitivity of BC distribution to various convective schemes in the model has been explored. The model output has been validated with in-situ observations. It is quite evident that regional inventory is capturing larger columnar burden of BC and OC than the global inventory. The difference in BC burden is clear at many places with the largest difference (in the order from 2×10^{-11} kg m⁻² sec⁻¹ in global inventory to 4×10^{-11} kg m⁻² sec⁻¹ in regional inventory) being observed over the Indo-Gangetic Basin. This difference is mainly attributed to the local sources like kerosene lamp burning, residential cooking on solid biomass fuel and agricultural residue burning etc., that are not considered in the global inventory. The difference is also noticeable for OC. Thus BC burden has increased with incorporation of regional emission inventory in the model, suggesting the importance of regional inventory in improved simulation and estimation of aerosols in this region. BC distribution is also sensitive to choice of scheme with Emanuel scheme capturing a comparatively smaller BC burden during the monsoon than Tiedtke scheme. Further long-term simulation with customized model is required to examine impact of BC.

Keywords: Black carbon, RegCM4, regional emission inventory, convective schemes.