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Evaluation of black carbon estimations in global aerosol models

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Abstract. We evaluate black carbon (BC) model predictions from the AeroCom model intercomparison project by considering the diversity among

year 2000 model simulations and comparing model predictions with available measurements. These model-measurement intercomparisons include BC surface and aircraft concentrations, aerosol absorption optical depth (AAOD) retrievals from AERONET and Ozone Monitoring Instrument (OMI) and BC column estimations based on AERONET. In regions other than Asia, most models are biased high compared to surface concentration measurements. However compared with (column) AAOD or BC burden retreivals, the models are generally biased low. The average ratio of model to retrieved AAOD is less than 0.7 in South American and 0.6 in African biomass burning regions; both of these regions lack surface concentration measurements. In Asia the average model to observed ratio is 0.7 for AAOD and 0.5 for BC surface concentrations. Compared with aircraft measurements over the Americas at latitudes between 0 and 50N, the average model is a factor of 8 larger than observed, and most models exceed the measured BC standard deviation in the mid to upper troposphere. At higher latitudes the average model to aircraft BC ratio is 0.4 and models underestimate the observed BC loading in the lower and middle troposphere associated with springtime Arctic haze. Low model bias for AAOD but overestimation of surface and upper atmospheric BC concentrations at lower latitudes suggests that most models are underestimating BC absorption and should improve estimates for refractive index, particle size, and optical effects of BC coating. Retrieval uncertainties and/or differences with model diagnostic treatment may also contribute to the model-measurement disparity. Largest AeroCom model diversity occurred in northern Eurasia and the remote Arctic, regions influenced by anthropogenic sources. Changing emissions, aging, removal, or optical properties within a single model generated a smaller change in model predictions than the range represented by the full set of AeroCom models. Upper tropospheric concentrations of BC mass from the aircraft measurements are suggested to provide a unique new benchmark to test scavenging and vertical dispersion of BC in global models.

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