

Anonymous review of “Constraining Black Carbon Aerosol over Asia using OMI Aerosol Absorption Optical Depth and the Adjoint of GEOS-Chem” by Zhang et al.

In this paper, the authors attempt to improve the simulation of black carbon aerosol over India, China, and Southeast Asia in GEOS-Chem using its adjoint and a data assimilation technique. They have chosen to assimilate OMI AAOD, which they use as a proxy for BC by scaling the observed AAOD by their model-predicted BC aerosol. This is problematic on multiple fronts. First, OMI measures AAOD in the UV, where it has been shown by numerous studies that organics absorb strongly in the UV, as does dust. In scaling the OMI AAOD by your model BC, and attributing that fraction of observed AAOD to BC, you assume that your model OC/BC/Dust ratios are correct. This is highly unlikely given past studies from this model. Next, you have a strange matter of combining model-predicted aerosol vertical distributions with the OMI AAOD retrieval that neither makes sense nor seems appropriate. Finally, in this exercise any error in BC in the model is attributed to lack or excess mass, rather than perhaps to insufficient assumptions for optical properties. Therefore, any improvements to the emissions you make will only be useful in your model given your exact assumptions for going from mass to AAOD.

This paper needs to be revised substantially to better explain the rationale for combining the model and observations in the manner described. Justification must be made for why this is a useful exercise for the community in general, as opposed to just a way to improve emissions for use in this model alone.