Tropospheric aerosol optical thickness from the GOCART model and comparisons with satellite and sunphotometer measurements

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Abstract

The Georgia Tech/Goddard Global Ozone Chemistry Aerosol Radiation and Transport (GOCART) model is used to simulate the aerosol optical thickness, t, for major types of tropospheric aerosols including sulfate, dust, organic carbon (OC), black carbon (BC), and sea salt. The GOCART model uses a dust emission algorithm that quantifies the dust source as a function of the degree of topographic depression, and a biomass burning emission source that includes seasonal and interannual variability based on satellite observations. Our results have shown that on global average, dust aerosol has the highest at 500 nm (0.057), followed by sulfate (0.037), sea-salt (0.027), OC (0.017), and BC (0.007). There are large geographical and seasonal variations of t, controlled mainly by emission, transport, and hygroscopic properties of aerosols. The model calculated total t's at 500 nm have been compared with the satellite retrieval products from the Total Ozone Mapping Spectrometer (TOMS) over both land and ocean and from the Advanced Very High Resolution Radiometer (AVHRR) over the ocean. The model reproduces most of the prominent features in the satellite data, with an overall agreement within a factor of 2 over the aerosol source areas and outflow regions. While there are clear differences among the satellite products, a major discrepancy between the model and the satellite data is that the model shows a stronger variation of from source to remote regions. Quantitative comparison of model and satellite data is still difficult, due to the large uncertainties involved in deriving the values by both the model and satellite retrieval, and by the inconsistency in physical and optical parameters used between the model and the satellite retrieval. The comparison of monthly averaged model results with the sunphotometer network (AERONET) measurements shows that the model reproduces the seasonal variations at most of the sites, especially the places where biomass burning or dust aerosol dominates.