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VERIFICATION OF MODEL-DERIVED AEROSOL TYPES AND TYPE SPECIFIC SINGLE SCATTERING ALBEDO AND ASYMMETRY PARAMETERS ACROSS NORTH AMERICA

Abstract

In situ measurements, remote sensing, and models have been widely used to characterize the radiative effects of aerosols, yet the direct radiative effect (DRE) of aerosols remains one of the leading contributors to climate prediction uncertainty. We propose a methodology for using High Spectral Resolution Lidar (HSRL)-derived aerosol types to quantify the direct radiative effect of aerosols. HSRL aerosol types are derived using aerosol intensive properties and therefore expected to best represent the aerosol microphysics that influences the DRE calculations. Currently, the global data for HSRL aerosol types do not exist, making it impossible to develop and validate an algorithm that will use HSRL derived aerosol types for DRE calculations. So we use CATCH (Creating Aerosol Types from Chemistry)-derived HSRL-like aerosol types for algorithm development. The CATCH algorithm, developed by our research group, is using the GEOS-Chem model output to generate aerosol types. GEOS-Chem is run with 47 vertical levels and a nested grid with a resolution of 0.25 0.3125 (latitude longitude) for the North American region. Aerosol properties and radiative fluxes are outputted hourly. The model predicted variables used for aerosol classification are based on aerosol extensive (i.e., the mass ratio of total carbonaceous aerosol to total carbonaceous aerosol and sulfate, the mass ratio of organic carbon to black carbon) and intensive properties (i.e., the effective lidar ratio, the effective real index of refraction, and the effective single-scattering albedo). The purpose of this work is twofold. Firstly, to compare the accuracy of the model predicted types with HSRL in-situ data from a variety of field campaigns across North America where there is a wealth of HSRL data. This is the first time CATCH-derived aerosol types will be systematically compared with HSRL data for a range of locations, times, and aerosol regimes. Secondly, to compare aerosol type-specific values of single scattering albedos and asymmetry parameters with ones derived through in situ measurement campaigns. The aerosol type-based algorithms will likely lead to improved usage of the future space-based sensors needed for narrowing the uncertainty in aerosol DRE. Such algorithms also make a step towards differentiating between the natural and anthropogenic aerosol radiative effects.