The Basis and Development of the CMIP6 Stratospheric Aerosol Record

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Stratospheric aerosols are important climate forcers as they scatter a part of the incoming solar radiation back to space, thus cooling the earth surface and troposphere, and absorb a part of the upwelling terrestrial radiation, thus heating the stratosphere. In addition, they are important players in stratospheric ozone chemistry, by hosting heterogeneous reactions. Volcanic eruptions can modulate both radiative and chemical effects of stratospheric aerosol by more than an order of magnitude. Here we present a data record of size distributions and the radiative properties of stratospheric aerosols from 1850 to 2014. Backbone of the dataset is GloSSAC (Thomason et al., 2018), the Global Space-based Stratospheric Aerosol Climatology, a continuous 35-year record of stratospheric aerosol extinction coefficients (1979-2014), tackling the issue of data gap filling. GloSSAC is based on the SAM/SAGE series of instruments through mid-2005 and on the OSIRIS and CALIPSO data thereafter. In the pre-satellite era, we use pyrheliometer data providing aerosol optical depth at 550 nm between 1883-1979, complemented by microphysical modeling, and before 1883 observations of moon eclipses and modeling. The resulting data set is termed "SAGE-3λ record", because its backbone is the use of three SAGE II wavelengths. For the SAGE II time period, this allows to fit a lognormal size distribution to the extinction data, with mode radius r_m and width σ. From the size distribution, the radiative properties required to force climate models (extinction coefficient, single scattering albedo, asymmetry factor) were calculated using the Mie theory for each wavelength band of each model. For other times, we apply correlations obtained from the SAGE II period of r_m and of σ to reduce the number of unknowns. SAGE-3λ compares well with other data not used in the record, making it ideal for use in global climate modeling such as CMIP6.

Key words: Stratosphere, Aerosol, SAGE, CMIP6

References

Thomason, L.W., and Coauthors, 2018: *Earth Sys. Sci. Data*, **10**, 469-492.