The Tables of Aerosol Optics (TAO)

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There is a need to quickly convert aerosol microphysical properties into optical properties for global modeling, data assimilation, and remote sensing applications. This is generally accomplished through look-up tables (LUTs) of aerosol mass extinction coefficients (MEC), mass absorption coefficients (MAC), asymmetry parameters, normalized phase functions, etc. Unfortunately, many scientists are using outdated LUTs that are based upon measurements and computational techniques first published by Shettle and Fenn (1979) and later updated by Hess et al. (1998). Thus, the computations in common use are still largely based upon Mie theory and *in situ* information that has not been updated during this century.

The Table of Aerosol Optics (TAO) is an open relational database (under construction) that expands upon existing LUTs by including recent measurements and new computational techniques for non-spherical particles (https://science.larc.nasa.gov/mira-wg/topics/tao/). The 'open' aspect of TAO is important, since the measurements and techniques of today will undoubtedly yield to different values in the future. This open architecture allows specialists to add new tables and gain exposure for their work and benefits modelers and remote sensing scientists by giving them easy access to computations that utilize the latest techniques. Quality is controlled by requiring methods to be peer-reviewed in the scientific literature.

We have computed optical properties (including phase matrices) for 22 size distributions of bare aggregated BC using the Multi-Sphere T-Matrix (MSTM) code (https://github.com/dmckwski/MSTM) at several remote sensing wavelengths. Our MSTM computations use aggregates of 20-nm spherules with particle-cluster growth. We obtained mass absorption coefficients (MACs) of 7.2-7.5 m^2g^{-1} at a mid-visible wavelength (532 nm) when the BC fractal dimension was fixed at $D_f = 1.8$ (i.e., fresh BC), consistent with values commonly recommended in literature reviews.

We have also computed optical properties throughout the 0.25-40 µm spectral range for black carbon (BC) internally-mixed with brown carbon (BrC) for 37 relative humidities ranging from 0-99%. Additionally, we use hexahedra shapes and mineral mixtures of montmorillonite, illite, hematite, and goethite to compute the optical properties of dust.

We will present the TAO vision and example results for several aerosol types. TAO is part of the Models, In situ, and Remote sensing of Aerosols (MIRA) working group. MIRA seeks to build collaboration, consistency, and openness amongst the aerosol disciplines. We seek community feedback from aerosol scientists regarding the construction and content of TAO, especially in this early phase. Check out the MIRA webpage at https://science.larc.nasa.gov/mira-wg/ and subscribe to our mailing list at https://espo.nasa.gov/lists/listinfo/mira.

Hess et al. (1998): Optical properties of aerosols and clouds: The software package OPAC, BAMS, 79, 831–844.

Shettle and Fenn (1979): Tech. Rep. AFGL-TR-790214, Air Force Geophysics Laboratory, 1979.