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Title: **Global Aerosol: Identifying, Classifying, and Mapping - based in NASA's AERONET data**

Abstract:

Development of a robust bulk columnar aerosol (BCA) typology for use in global aerosol studies, is an ongoing pursuit by researchers across differing scientific agencies. Using NASA's global sunphotometer network (AERONET) is compelling for its geographic expanse, and the tractability of analyzing its historic data archive. We pursue a goal of reducing uncertainty in modeled aerosol radiative forcing, by making direct use of retrieved intrinsic aerosol optical properties. The result is a database linking a specific set of aerosol optical properties, aerosol typology (i.e. labeled sub-type of aerosol observed), and geo-located coordinates. We implement an aerosol typology based in AERONET inversion products from 1993-2018. We identified 5 globally ubiquitous BCA types: dust, biomass burning, maritime, urban/industrial and mixed. The model returns values of specific optical properties at specific geolocations. Aerosol classifications obtained by this strategy are useful in calibration/validation studies of satellite aerosol retrievals. By averaging individual AERONET retrievals by classified aerosol type, and determining the most frequent classified aerosol type at each AERONET site for each historic month, we determine the *Historic Monthly Dominant Aerosol Type* (HMDAT). Applying the results of our global seasonal aerosol typology onto the global AERONET grid, results in maps of *historic seasonal aerosol climatologies* by historic month. The database of HMDAT is reposited in an open archive. Database users can link AERONET associated locations, and the optical property values associated with the reported HMDAT - without AOD-based inferences on extensive aerosol properties. We aim to understand the relationship between ground-based BCA, and satellite-retrieved layered aerosol data products; explore the comparability of optical property derived aerosol typologies based in passive-received ground data, to those of satellite aerosol classification algorithms; and provide a tool for integration to NASA PACE data products. This work aims a ground-based *Global Seasonal Aerosol Climatology* toward a spatio-temporally, typologically-resolved *3-D global seasonal aerosol climatology*. HmDAT database values are to be used as input to forward scattering radiative transfer models to calculate surface and atmospheric radiative forcing in W/m^2.