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Systematic aerosol characterization by combining UV Aerosol Indices with trace gas concentrations

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Measurements of aerosol optical thickness (AOT) from ground-based, airborne, and satellite-borne instruments show us that aerosols are ubiquitous and highly variable throughout the globe. But for the calculation of aerosol radiative effects, for the development and monitoring of mitigation strategies, and for the construction of climatologies of aerosol optical properties (needed for, e.g., AOT retrievals) knowledge of aerosol type (and/or source) is also of importance.

Detecting the optical properties of aerosols from passive satellite-borne measurements alone is a difficult task due to the rather smooth effect that aerosols have on measured spectra and the influences of surface and cloud reflection. We therefore chose another approach to determine aerosol type: by studying the relationship of AOT with trace gas abundance, aerosol absorption, and mean aerosol size. Our Global Aerosol Classification Algorithm, GACA, examines monthly mean maps of aerosol properties (MODIS AOT and extinction Angstrom exponent, GOME-2 UV Aerosol Indices) and trace gas column densities (NO_2, HCHO, SO_2 from GOME-2, and CO from MOPITT) for temporal correlations. First, aerosol types are assigned based on size (Angstrom exponent) and absorption (UV Aerosol Indices), then the main sources are inferred by performing threshold tests (for mean trace gas columns) and correlation tests (between AOT and trace gas columns) on the data set.

We present global aerosol climatologies of aerosol type (ranging from small, non-absorbing to large, absorbing aerosols) for different seasons, as well as maps of aerosol sources (e.g., biomass burning, urban, or biogenic). The results from GACA are compared to aerosol types modeled using MACC-II.