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Relating changing aerosols to changing clouds: two decades of Terra and Aqua observations

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The global aerosol system of today is not the same as it was two decades ago when Terra and Aqua were launched. As a result of a changing climate (natural and anthropogenic) convolved with changes in human activity (deliberate and accidental), some regions have experienced significant changes to their total aerosol burden (increases or decreases of total loading) or their aerosol composition (as defined by relative size or source type). Other regions have had less or no significant changes. At the same time, changes in aerosol amount and composition affect clouds through direct and indirect microphysical and radiative processes. We can theoretically predict what might happen to clouds when you add aerosol to an otherwise pristine environment. Conversely, there is the situation of removing aerosol from a polluted environment.

Over the past two decades, sensors on both Earth Observing Satellites (Terra and Aqua) have observed the radiative signatures of aerosols and clouds, as well as their trends. Via massive efforts by their respective characterization teams, the resulting data records appear to have a minimum of artificial drifts. Therefore, we are trying to assess, region by region, our 20-year records of aerosols and clouds, along with meteorological variables. Where have been the most significant changes of aerosols and/or clouds? Where do the changes in clouds conform with expectations based on changes of aerosols and meteorology and where do they not? In addition to separate 'aerosol' and 'cloud' retrievals from the Moderate Resolution Imaging Spectrometer (MODIS), there is a 'twilight zone' that is not accounted for in either product. What are these regions, and have they changed over the past two decades? We will present our early efforts at characterizing the MODIS view of aerosol and cloud changes, while also relating to changes in radiative fluxes at the top-of-atmosphere (TOA) from corresponding observations by the Clouds and the Earth's Radiant Energy System (CERES).