Multi-angle polarimetry: the once and future king of aerosol remote sensing

Although aerosols (and their interactions with clouds) are widely known to be one of the most uncertain components of the climate, they remain largely unconstrained in climate simulations. This is because global observations of all the parameters relevant to such simulations - quantity, size, shape, optical properties and chemical composition - are very difficult to simultaneously retrieve from existing remote sensing instruments. The problem can be addressed by maximizing the scene information gathered by a remote sensing instrument, by the use of (passive) multi-spectral, multi-angle and polarimetrically sensitive sensors. These observations, coupled with a radiative transfer model, can be inverted to solve for aerosol parameters. However, the choices to be made when designing an such an observing system and retrieval algorithm are complex, and a variety of approaches have been undertaken by the scientific community.

I will review the various multi-spectral, multi-angle, polarimetric observation systems employed for aerosol remote sensing and their corresponding retrieval algorithms. This includes the French Polarization and Directionality of Earth Reflectance (POLDER) instrument, which has been the only such instrument successfully deployed in orbit thus far (most recently from 2004-2013), the NASA Aerosol Polarimetry Sensor (APS) on the ill-fated NASA Glory Mission (launch failure in 2011), potential or planned polarimeters on the NASA Aerosol-Cloud-Ecosystem (ACE) and Pre-Aerosol, Clouds and ocean Ecosystems (PACE) missions, and airborne prototypes from around the world.

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