Modulation of Albedo and Solar Absorption by Aerosols and Clouds: First Observations with a New Observing System of Stacked Multiple UAVs and Ground Based Observatory.

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We report here first time demonstration with three autonomously flying Unmanned Aerial Vehicles (UAVs) of cloudy sky albedo, transmission atmospheric solar absorption, aerosol and cloud droplet concentrations and number densities. The observing system consisted of 3 light weight UAVs, instrumented with miniaturized instruments (Roberts et al, 2006; Ramana et al, 2006; Corrigan, 2006) for measuring aerosol concentrations and size distribution, cloud microphysical properties, black carbon concentration and broad band and narrow band solar fluxes. The airborne measurements were validated and augmented by the Atmospheric Brown Clouds Maldives Climate Observatory (ABC_MCO) in the island of Hanimaadhoo in the N. Indian Ocean (Corrigan et al, 2006; Ramana and Ramanathan 2006). The campaign was conducted during March and early April of 2006 when this region is subject to long range transport of pollution from S. Asia. In the stacked 3_UAV configuration, one flew in the boundary layer below clouds to characterize the aerosols feeding the clouds and the transmission of solar radiation by the absorbing aerosol layer and clouds above; the second inside the trade cumulus clouds to directly observe the fully nucleated cloud drop size and concentrations and total liquid water content; and the third above the cloud to determine the incoming solar and the reflected solar radiation. The 3-UAVs were programmed to sample the same region(or clouds) within seconds of each other, thus providing unique insights into how aerosols and boundary layer dynamics modulate the cloud microphysics and thus the albedo and solar absorption of cloudy skies in the planet. The array of instruments including Lidar, CCN spectrometers, aerosol chemical and microphysical sampling in the ABC_MCO completed the observing system, providing a near complete suite of instruments. We will present results from this campaign on how 3-dimensional clouds with absorbing aerosols modulate atmospheric solar absorption, cloud microphysical properties, cloudy sky albedos and surface solar radiation.