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New Observational and Modeling Approaches for Understanding Radiative Effects in Polluted Boundary Layer Clouds

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Ubiquitous broken boundary layer clouds that are are embedded in absorbing aerosol layers remain a primary challenge for passive imagers that are currently in space, most importantly because three-dimensional (3D) radiative cloud effects lead to spectrally-dependent perturbations in the 'clear-sky' regions that are comparable in magnitude to the aerosol radiative effects. We apply recently developed parameterizations of net horizontal photon transport in broken cloud fields to this problem and show how they can help to retrieve aerosol radiative properties in presence of inhomogeneous cloud fields. We then use data from the recent NASA SEAC^{4}RS (Studies of Emissions, Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys) field campaign (Houston, Texas, August/September 2013) to examine the combined radiative effects of aerosols and clouds from the vantage point of airborne and satellite observations, and reconcile our new remote sensing approach, which is largely based on idealized clouds, three-dimensional radiative transfer calculations, and parameterizations, with real-world clouds. We will then discuss how much detail is required to derive the radiative effects such as forcing of cloud-aerosol fields with future airborne and spaceborne spectral imagers.