Geophysical Research Abstracts
Vol. 21, EGU2019-12873, 2019
EGU General Assembly 2019
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Remote Sensing Study of the Interactions Between Biomass Burning Aerosols and Marine Stratocumulus during ORACLES Campaign

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Aerosol-cloud interactions in the South-East (SE) Atlantic Ocean were studied using data collected from the ORACLES campaign (ObseRvations of Aerosols above CLouds and their intEractionS) in August/September of 2016, August 2017 and October 2018. This region is of particular interest due to its semi-permanent stratocumulus (Sc) cloud decks that are an important component in the climate system, and the periodic biomass burning smoke plumes that are transported over extensive Sc cloud decks. Before mixing with the cloud layer, the elevated smoke plumes are often separated by smoke-free gaps for a certain period of time. The smoke aloft can influence the underneath cloud properties through changing radiation fluxes and local instability, known as the semi-direct effect. The smoke entrained into the cloud layer can modify cloud microphysical properties by serving as cloud condensation nuclei, known as the indirect effect. These effects may cause either positive or negative cloud radiative forcing depending on cloud type, smoke layer position, smoke optical properties, meteorological conditions, etc. However, the governing physical processes of these interactions and their representations in current climate models remain largely uncertain. The ORACLES campaign provides great opportunity to study these interactions with comprehensive in-situ and remotely-sensed airborne measurements, such as aerosol optical depth (AOD), cloud liquid water path (LWP), particle number concentration, and thermodynamic profiles. In this study, we focus on remote sensing measurements from High Spectral Resolution Lidar 2 (HSRL-2), Research Scanning Polarimeter (RSP) and Enhanced MODIS Airborne Simulator (eMAS). Preliminary results show contrast responses of cloud LWP to AOD between smoke and cloud layers contact and separate cases, indicating microphysical and radiative responses to the presence of absorbing aerosols.