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Airborne Observations Above Cloud Aerosol Optical Depth in the Southeast Atlantic during biomass burning season over 3 years

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Aerosol overlying marine stratocumulus clouds is a persistent feature in the southeast Atlantic during the biomass burning season, July through November. We sampled aerosol above cloud from an airborne research platform, the NASA P3, during the deployments of ObseRvations of Aerosols above CLouds and their intEractionS (ORACLES) encompassing the peak biomass burning season, August, September, and October in 2016, 2017, and 2018. We used the Spectrometer for Sky-Scanning, Sun-Tracking Atmospheric Research (4STAR) to quantify the aerosol's optical properties, notably the aerosol optical depth (AOD) by directly measuring the amount of light attenuation. We present an overview of AOD measurements from October 2018 and contrast those to previous deployments. We observed an average AOD at 500 nm of 0.32, 0.37, and 0.27 in September 2016, August 2017, and October 2018 respectively. The spatial dependence of the above cloud AOD was similarly observed by the MODIS instrument on board the TERRA and AQUA satellites. We also observed the largest Angstrom Exponent (which is inversely proportional to aerosol size) in September 2016, and the lowest in October 2018. We also show full spectral vertical dependence of AOD from flight profiles, which compares favorably to the integrated aerosol extinction profile obtained by the active remote sensing High Spectral Resolution Lidar-2 (HSRL-2). We also present a quantification of the gap extent separating cloud top and aerosol layer bottom.