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# Subseasonal Variability of Biomass Burning Aerosol Radiative Properties Retrieved by 4STAR during the ORACLES 2016-2018 Campaigns and Comparison with In-Situ Observations and the AERONET Extended Record

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The interactions of Biomass Burning (BB) aerosols with the semi-permanent subtropical stratocumulus cloud deck over the Southeast Atlantic Ocean are not yet well represented by models [1]. Nearly three decades (1995-2021) of AERONET (AErosol RObotic NETwork) sun photometer measurements [2] have documented intense BB aerosol emissions over Southern Africa from August to October and subsequent transport to the Southeast Atlantic via the Southern African easterly jet [3]. During 2016-2018, NASA conducted the ORACLES (ObseRvations of Aerosols above CLouds and their intEractionS) airborne field campaign to study BB aerosol-cloud-radiation interactions above, within, and below the stratocumulus cloud deck over the Southeast Atlantic [4]. ORACLES employed a 4STAR (Spectrometer for Sky-Scanning, Sun-Tracking Atmospheric Research) spectrophotometer to measure direct beam sun irradiances and diffuse sky radiances [5, 6].

Aerosol radiative properties, including Single Scattering Albedo (SSA), Aerosol Optical Depth (AOD), Aerosol Absorption Optical Depth (AAOD), and Absorption Ångström Exponent (AAE) are retrieved via AERONET-adapted aerosol inversion code [7]. All three ORACLES campaigns are examined, so that the subseasonal variability of these radiative properties can be assessed. Additionally, SSA and AOD are compared against the AERONET extended record to evaluate aerosol evolution during Southern African easterly jet transport. Finally, the latitudinal impact on SSA is investigated for both 4STAR retrievals and in situ scattering and absorption to further isolate the subseasonal variability.

Changes in SSA indicate increased scattering (relative to total extinction) as the season progresses, with a concurrent decrease in AAOD and aerosol absorption. The median AAE values (nominally 1) and small subseasonal variations indicate that Black Carbon (BC) is the dominant aerosol type throughout the period. The latitudinal dependence of SSA from 4STAR and in situ measurements adequately accounts for differences in SSA between the ORACLES 2016 campaign and AERONET. The agreement between ORACLES over the Southeast Atlantic and AERONET over mainland Southern Africa suggests that aerosol radiative properties are not notably impacted by aerosol evolution during Southern African easterly jet transport. This reinforces the ability of 4STAR, coupled with an AERONET-like inversion code, to retrieve airborne aerosol properties over otherwise inaccessible regions.

**Keywords**: aerosols, biomass burning, black carbon, radiation, inversion algorithms, field campaigns, in situ observations, measurement synergy

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