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On the seasonal cycle of dominant aerosol-cloud-radiation interactions over the southeast Atlantic

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Seasonal biomass burning (BB) in southern Africa during the austral spring produces BB aerosol particles that are transported westward over the southeast Atlantic (SEA), where the aerosol interact microphysically and radiatively with a large semi-permanent subtropical stratocumulus cloud deck. The representation of these interactions in climate models remains highly uncertain, in part because of the scarcity of observational constraints. However, with the data gathering phase of several major field campaigns (ORACLES, LASIC, CLARIFY) now completed, new if preliminary insights into the southeast Atlantic cloud-aerosol system are developing. A strong seasonal cycle in the dominant aerosol-cloud interactions is apparent. Smoke is transported westward at lower altitudes in July and August, over warmer waters with deeper boundary layers that more easily entrain the smoke, with an easterly momentum flux sustaining the distribution of smoke in the boundary layer. The maximum BB aerosol loading in the remote SEA boundary layer occurs in August, coinciding with a minimum in the smoke's single-scattering-albedo and with lower cloud covers. In August, shortwave absorption in the boundary layer by the highly radiatively-absorptive BBA reduces the cloud fraction further. This is responsible for an overall climate warming, despite a cooling from the direct aerosol radiative effect. The smoke particles are easily activated into cloud condensation nuclei, and precipitation is less frequent, though how that feedbacks to the cloudy boundary layer is not yet clear. In September, the smoke is initially transported at higher altitudes, with recirculation increasing the likelihood that the aged BBA comes into contact with the low cloud deck. The ability of BB aerosols to absorb sunlight increases as the aerosols age while they subside. Microphysical interactions are more common than previously thought for September, and preferentially remove the larger smoke particles. Overall, boundary layer aerosol loadings are significantly reduced in September compared to August. We will conclude with an outlook for the integrative work we envision for addressing the overarching science questions regarding aerosol-radiation-climate interactions in the SE Atlantic. This presentation represents the work of the entire ORACLES and LASIC science teams, although the views are slanted by those of the first author.