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On Further Defining the Low Cloud Response over the Southeast Atlantic to its Large-Scale Environment

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The southeast Atlantic is home to one of the largest stratocumulus decks on the planet. It is also unique in that it is overlain by shortwave-absorbing aerosols during the months when the cloud deck is most pronounced. The dominant cloud-aerosol interaction has been held to be a strengthening of the cloud deck in response to the stabilization of the lower troposphere by the absorbing aerosols. In this presentation we better define the large-scale meteorology supporting this dominant aerosol-cloud interaction. From radiosondes from St. Helena Island (15S, 5W) combined with satellite datasets, we find that stratocumulus cloud tops are lower when biomass-burning aerosols are present overhead, supporting stronger coupling to the surface. The aerosol layers are also more moist, enriching the possible low cloud responses. Simultaneously, the large-scale vertical velocity is reduced. While this may reflect the influence of the shortwave-absorbing aerosols in part, ERA-Interim reanalysis also reveals vertical ascent associated with the free-tropospheric zonal winds at 10S that are instrumental for the offshore aerosol transport. HYSPLIT forward trajectories from MODIS-detected fire sources further confirm the importance of a narrow latitudinal range centered on 10S for the offshore transport. These free-tropospheric zonal winds occur at the northern edge of a land-based anticyclonic circulation, and a stronger anticyclone with stronger zonal winds at 10S encourages more recirculation of the biomass burning aerosol back to land, further helping to distribute the aerosol. The reanalysis also shows enhanced warm temperature advection off of the continent at 800 hPa strengthens the cloud-top inversion, more so when the land-based anticyclone is stronger. Thus, strong atmosphere-land coupling works in concert with the fire emissions to exert pronounced constraints on the response of the offshore stratocumulus deck.