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Modulation of Atlantic aerosols by the Madden-Julian Oscillation

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Our previous study found large intraseasonal variations in satellite-derived aerosol products over tropical Atlantic Ocean associated with the Madden-Julian Oscillation (MJO). This study aims to investigate the physical mechanism of these aerosol anomalies through analyzing aerosol optical thickness (AOT) from the MODIS instrument on Aqua satellite and low-level (averaged from 925 hPa to 700 hPa) horizontal winds from NCEP/NCAR reanalysis. We first show that the intraseasonal variance related to the MJO accounts for about 25% of the total variance of MODIS AOT over the tropical Atlantic. Thus, the intraseasonal variability is one of important forms of Atlantic aerosol variability. Second, we show that the AOT anomalies are negatively correlated with the low-level zonal wind anomalies over most parts of tropical Atlantic, especially over the equatorial Atlantic (60W-10W, 10S-15N), when the low-level zonal wind anomalies lead the AOT anomalies by about one MJO phase (6-10 days). When enhanced MJO convection is located over the equatorial Indian Ocean (western Pacific), persistent low-level westerly (easterly) anomalies over the equatorial Atlantic suppress (enhance) the background trade winds that cause the negative (positive) AOT anomalies over the Atlantic region. These results indicate that the AOT anomalies over the tropical Atlantic are produced by the low-level zonal wind anomalies there although the detailed mechanisms are still to be determined. This study implies that Atlantic aerosol concentration might have predictable components with lead times of 2-4 weeks given the predictability of the MJO and Atlantic trade winds. The relative contribution of dust and biomass burning smoke to the AOT anomalies will also be discussed.