Large Variability of Springtime African Dust in Recent Decades: A Consistent Characterization from Multiple Remote Sensing Observations

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Dust affects key components of the climate system, including energy, water, and carbon cycles. The emission and transport of dust is strongly modulated by surface and meteorological conditions. In this study, we acquire an observational understanding of the interannual variability of African dust over the last two decades by analysing remote sensing measurements from MODIS, CALIOP, MISR, IASI and AERONET. Dust is separated from non-dust aerosol using observed quantities for particle size and shape. These dust measurements show a consistent interannual variability of dust optical depth in North Africa and tropical North Atlantic Ocean, which is mainly driven by that in spring. A composite analysis between high-dust years and low-dust years shows that the springtime dust interannual variability in source regions is mainly controlled by surface wind variability, which is associated with the northward progression of West African Monsoon. Extended analysis of the dust-monsoon association with long-term dust records from AVHRR remote sensing and Barbados in-situ sampling suggests that the variability of West African Monsoon progression could explain 30-40% of dust variability over tropical North Atlantic Ocean. In NASA GEOS model, more than half of dust emission variability in spring are explained by the West African Monsoon variability.