

The role of African easterly wave on dust transport and the interaction between Saharan dust layer and Atlantic ITCZ during boreal summer

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In this paper, we investigate the relationships among Saharan dust outbreak and transport, African easterly waves (AEW), African easterly jet (AEJ) and associated convective activities of Atlantic Intertropical Convergence Zone (ITCZ) using Cloudsat-Calipso, MODIS and MERRA data. We find that a major Saharan dust outbreak is associated with the formation of a westward propagating strong cyclone around 15-25N over the western part northern Saharan. The strong cyclonic flow mobilizes and lifts the dust from the desert surface to a high elevation. As the cyclone propagate westward, it transports a thick elevated dust layer between 900 -500 hPa from the African continent to the eastern Atlantic. Cloudiness is reduced within the warm, dry dusty layer, but enhanced underneath it, possibly due to the presence of a shallow inversion layer over the marine boundary layer. The dust outbreak is linked to enhanced deep convection in the northern part of Atlantic ITCZ, abutting the southern flank of the dust layer, and a strengthening of the northward flank of the AEJ. As the dust layer spreads westward, it loses elevation and becomes increasing diffused as it reaches the central and western Atlantic.

Using band pass filtered EOF analysis of MERRA winds, we find that AEWs propagating westward along two principal tracks, centered at 15-25N and 5-10N respectively. The easterly waves in the northern track are highly correlated with major dust outbreak over North Africa and associated with slower moving systems, with a quasi-periodicity of 6-9 day. On the other hand, easterly waves along the southern track are faster, with quasi-periodicity of 3-5 days. These faster easterly waves are closely tied to rainfall/cloud variations along the Atlantic ITCZ. Dust transport along the southern track by the faster waves generally leads rainfall/cloud anomalies in the same region by one or two days, suggesting the southern tracks of dust outbreak are regions of strong interaction between Saharan dust layer and Atlantic ITCZ.