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Is Bodélé depression the dominant source of North African dust transported to the Americas?

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Dust from North Africa has been reported to affect the air quality over Caribbean Islands and southeastern United State, as well as supplying nutrients to fertilize the Amazon forest. However, the relative contribution from North Africa dust sources, namely the Bodélé depression and West African deserts, has been debated among different observational and modeling studies. In the current study, dust transport from the Bodélé depression and West African desert are investigated using an observationally constraint, advanced trajectory model that quantifies both dry and wet deposition along trajectory, based on observations of precipitation amount and cloud properties, and is initiated by stereo observations of dust plume height from the Multiangle Imaging SpectroRadiometer (MISR) instrument. Our advanced trajectory model provides an encouraging tool for investigating dust transport, given its capability at successful capturing the observed horizontal and vertical structures of dust transport across the Atlantic.

Based on the advanced trajectory modeling, we found the West African deserts contributes substantially more dust than the Bodélé depression to the trans-Atlantic transport in both boreal winter and summer. The relatively contribution from the two North African dust sources are mainly due to differentiated dust transport pathways. For dust particles emitted from both dust sources, wet deposition, primarily driven by substantial rainfall associated with Intertropical Convergence Zone over ocean and intertropical rainbelt over land, overwhelms dry deposition and largely reduces the amount of dust transport to south America in boreal winter and Central and North Americas in boreal summer. According to the precise observation of dust plume height and motion by MISR, substantial removal and suppression of dust plumes occur near the Bodélé depression, supporting the limited potential for long-range transport of dust from the Bodélé depression revealed by the current advanced trajectory modeling.