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Disproving the Bodélé Depression as the Primary Source of Dust Fertilizing the Amazon Rainforest

Research Letter

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Abstract

Motivated by the ongoing debates about the relative contribution of specific North African dust sources to the transatlantic dust transport to the Amazon Basin, the current study integrates a suite of satellite observations into a novel trajectory analysis framework to investigate dust transport from the leading two North African dust sources, namely, the Bodélé depression and El Djouf. In particular, this approach provides observation-constrained quantification of the dust's dry and wet deposition along its transport pathways and is validated against multiple satellite observations. The current large ensemble trajectory simulations identify favorable transport pathways from the El Djouf across the Atlantic Ocean with respect to seasonal rain belts. The limited potential for long-range transport of dust from the Bodélé depression is attributed to the currently identified extensive near-source dust removal primarily by dry and wet deposition during boreal winter and summer, respectively.

Plain Language Summary

North African deserts have been reported to export ~200 million tons of dust per year to the tropical Atlantic Ocean, degrading air quality over the Caribbean Islands in boreal summer and supplying nutrients to fertilize the Amazon Rainforest in boreal winter and spring through transatlantic dust transport. It has been assumed that the Bodélé depression is the main contributor to this transatlantic dust transport and Amazonian dust fertilization in boreal winter. However, these claims have not been supported by geochemical analysis. Here, we integrate a suite of satellite observations into a novel trajectory analysis framework to investigate dust transport from the leading two North African dust sources, namely, the Bodélé depression and El Djouf, and provide the first ever observation-constrained quantification of the dust's dry and wet deposition along its transport pathways. The approach yields the novel observational finding that the El Djouf is the preferred source of intercontinental transport across the Atlantic Ocean rather than the Bodélé depression, bridging the geochemical impact of North African minerals on the Amazon Basin to the specific dust origin.

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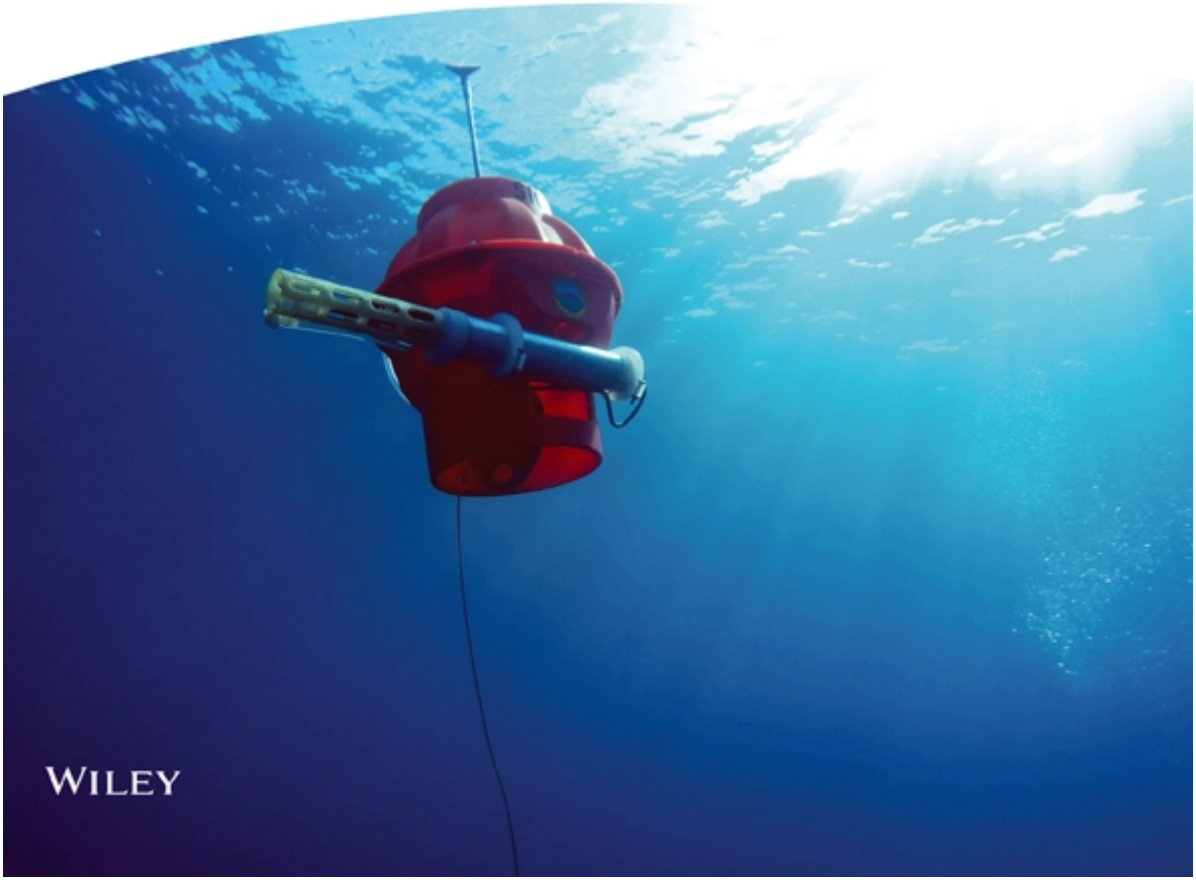

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- dust transport
- trajectory analysis
- MISR
- CALIOP
- AOD

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