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Current capabilities in desert dust observations and challenges ahead

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Mineral dust produced by wind erosion of arid and semi-arid surfaces is a major component of atmospheric aerosol that affects climate, weather, human health, ecosystems and socio-economic sectors, as transportation, solar energy and air quality. Understanding these effects and ultimately improving the resilience of affected countries requires a reliable, dense, and diverse set of observations along with the provision of skillful forecasts tailored to diverse groups of users. During the last decade, the dust observational capabilities have notably improved in terms of considered parameters, geographical coverage, and delivery times and development of tailored products of interest to both the scientific community and the various end users.
Here, we comprehensively review the dust available measurements including near surface ones and ground-based, airborne, and satellite remote sensing, along with their applicability in model data assimilation, model evaluation, and user-oriented applications. We also critically discuss currently unresolved questions and observational gaps, and we provide suggestions for overcoming the limits currently existing in dust observation and forecasting. This review is a milestone towards setting up a comprehensive mineral dust observational system with geographical coverage and availability of different parameters suitable to address the needs of users, from research communities to non-scientific stakeholders.

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