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Recent developments in dust electrification research

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Electrification of dust in the atmosphere is abundant, observed by helicopter blades glowing from corona discharge in dusty environments, and sparks from barbed wire fences during the US Dust Bowl. Electrification of particles in blowing sand, dust devils and dust storms can result from contact charging/triboelectrification during dust generation or through its atmospheric transport, causing particles to accumulate large amounts of charge on their surface. Strong electrostatic forces can affect the lofting of dust particles from the ground, as well as the transport of dust particles, however the details of such effects are still largely unexplored. The charging of dust particles, and separation of the charge by mechanical processes yields large electric fields (E-fields, up to tens of kV m^{-1}). Satellite remote sensing of dust is based on measurements of electromagnetic wave propagation, which can be attenuated by large electric fields, thereby the accuracy of dust measurements can be affected by electric fields arising from charge separation in dusty environments. Such E-fields are also expected to alter the orientation of dust particles, changing the effective optical depth of dust layers, existing calculations for which assume randomly oriented particles.

Although the existence of dust electrification has been known about for over a century, the details of the electrification mechanisms, and impact of dust electrification on particle behaviour are not yet fully understood. This is partly due to a lack of observations of coincident space charge, E-field and particle measurements in dusty regions, particularly at altitudes above the surface. This presentation will discuss recent research in understanding dust electrification processes, including surface observations of dust electrification in the United Arab Emirates (UAE), and measurements of charge in high altitude dust layers above the surface.