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Measuring the electrical and optical properties of fog using balloon borne instrumentation in the UAE

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Countries in arid and desert climates that have small amounts of rainfall each year use cloud seeding techniques to enhance the little rainfall that is present. Typically, this is achieved by seeding the cloud with hygroscopic nuclei to increase the rainfall. A possible alternative method is to inject the cloud with electric charge, which has been shown in models to alter the droplet size and distribution and influence rainfall properties.

Here, in-situ observations of the electrical and optical properties of clouds are described from a desert site. These are used to inform droplet growth models. For this, a yearlong campaign, during which 10 weather balloons carrying electric charge and optical sensors were launched through fog layers from Abu Dhabi airport, United Arab Emirates. Here we present 2 case studies. The first is a clear air ascent comparison between the desert site at Abu Dhabi and a temperate site in northern Finland. The second is a fog comparison between Abu Dhabi and a temperate site in the United Kingdom

The results show that the fogs in Abu Dhabi are highly charged with a charge density of 0.1-1 nC m⁻³ as opposed to the charge densities of fogs in Northern Hemisphere temperate regions which have a typical charge density of 10 pC m⁻³. The droplet concentration in the Abu Dhabi fog case study is significantly smaller, approximately 150 cm⁻³ as opposed to droplet concentrations of 300-400 cm⁻³ in fog over a temperate site.

The results suggest that dust contributes strongly to the atmospheric electrical conditions in the UAE region, due to charging of the dust tribo-electrically. This dust charge may also affect the droplet distribution within the fog. These new measurements of the vertical profile of charge through fog layers in desert climates will be used to improve understanding in droplet growth models.