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Rainfall in the desert: anatomy of rainfall events in the United Arab Emirates

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The occurrence and characteristics of rainfall events in arid and water scarce regions are of great interest to many, as it is vital to understand the efficient use of this finite resource, for example in terms of water management, agriculture, irrigation, and domestic food security. Fundamental to this is understanding the numerous environmental aspects that affect the generation and persistence of rain. These include the presence of cloud droplets, activation and growth processes, temperature and relative humidity of the within and below cloud regions, and the cloud base height. Not only must what causes rainfall to be initiated be understood, but also the conditions that allow that rain to reach the surface.

This work examines the conditions required for a successful rain event (i.e. one in which rainfall reaches the ground) to occur in the arid desert region of Al Ain, in the United Arab Emirates (UAE) (annual rainfall 76mm). The high surface temperatures and dry air mean that rain events at Al Ain commonly occur as virga, as the rain droplets cannot survive evaporation under the local atmospheric conditions. Here we examine individual rainfall events using backscatter data from a laser ceilometer, in conjunction with C-band radar data, to further understand the processes required for successful rain generation. During the 2 year period of study, there was a total of 57.5 hours of rain (rainfall 0.5% of the time), with a total of 105 rainfall events. Here we examine the effect on rainfall of (a) the initial size of the droplets falling from the cloud base, which must be large enough to survive the fall to the surface; and (b) the effect of the below cloud thermodynamic profile on the evaporation of the droplet (which also depends on the height of the cloud base). Preliminary conclusions find that smaller droplets, higher cloud bases, smaller cloud depths, and lower cloud base temperatures all favour the occurrence of a rain event terminating as virga before it reaches the surface. Understanding the details of why many potential rainfall events don't reach the surface can ultimately lead to the more efficient implementation of rainfall enhancing measures such as cloud seeding.