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Relationships between wind speed, humidity and precipitating shallow convection

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Precipitation from shallow cumulus is observed to be a frequent phenomenon over subtropical oceans, yet ignored in most theories that describe shallow cumulus convection and its bulk characteristics. It is questioned what factors control variability of precipitation in a typical undisturbed trade-wind regime and how precipitation relates to cloud behavior and mean boundary layer characteristics.

Two-months of observations suggest that even within such a meteorological regime subtle fluctuations in the strength of the easterlies and in subsidence play a major role in regulating boundary layer humidity, hence clouds and precipitation. In particular the covariability between wind speed, humidity and precipitation stands out, with interesting similarities to cases of precipitating deep convection. It is hypothesized that stronger winds, through enhanced surface evaporation and upward mixing of moisture, lead to more and on average deeper cumuli that rain more. Possible aerosol effects on large-scale precipitation occurrence, through an influence of wind speed on wave-breaking and sea-salt aerosol concentrations, likely play a minor role. Large-eddy simulation (LES) studies are used to explore the idea that the observed wind speed - precipitation relationship resides in a change in macroscopic cloud properties.