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Cloud field organisation in trade-wind cumulus: a consequence of precipitation efficiency

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The influence of aerosol on precipitation in shallow clouds is a topic of longstanding interest. We will address the case of aerosol effects on warm trade-wind cumulus and show that the cloud system develops spatial organization structures in such a way as to generate similar amounts of precipitation, regardless of the aerosol input.
In aerosol-poor conditions, precipitation formation is efficient, and the system generates widespread surface rain. As a result, divergent cold pools are small because they encounter adjacent divergent flows within a short distance.
With increasing aerosol there is a reduction in the efficiency by which precipitation is generated and the system has to generate large clusters of clouds in order to achieve a similar amount of surface rain. These large clusters are embedded in extensive, relatively cloud-free areas that are associated with divergent cold pools generated by the precipitating clusters themselves.
Finally we show that these response are not unique to aerosol perturbations; similar changes in organization result from meteorological controls such as wind shear. Thus, we view spatial organisation in trade-wind cumulus fields as a consequence of the efficiency by which rain is produced.

Author: FEINGOLD, Graham (NOAA ESRL Chemical Sciences Division)

Presenter: FEINGOLD, Graham (NOAA ESRL Chemical Sciences Division)

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