Geophysical Research Abstracts
Vol. 20, EGU2018-17249, 2018
EGU General Assembly 2018

Assessing the strength of self-aggregation feedbacks from in-situ data

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Recent idealized simulations of the tropical atmosphere have revealed the spectacular ability of deep clouds to spontaneously cluster in space, a phenomenon known as self-aggregation. It results in a tropical climate where intense deep convection is localized in space, and is surrounded by a very dry environment devoid of deep convection. Self-aggregation was first discovered in idealized cloud-resolving simulations. It has now been confirmed to occur in a hierarchy of models and in more realistic settings, but despite this, its relevance to the real world is still debated.

Here we investigate in observations the strength of the physical processes known to be key for self-aggregation in simulations. Of particular interest is the longwave radiative cooling from regions outside deep clouds. We use in-situ data from Nauru Island, motivated by the need to resolve the vertical structure of low-level humidity, which is difficult to accurately estimate from satellites. We then use a synergy of in-situ data and cloud-resolving simulations to assess whether the variability of low-level longwave cooling resulting from the observed variability of water vapor is sufficient to trigger self-aggregation.