National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

Entrainment Relationship of Convective Plumes

Hanii Takahashi

Land-ocean contrast in convective characteristic

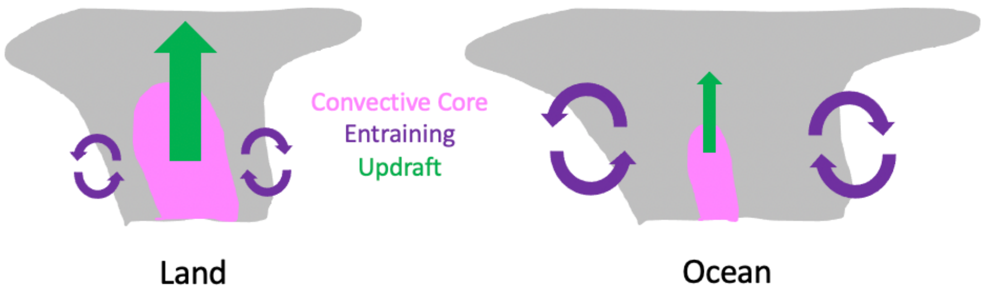

Figure 1: A schematic illustration describing the deep convection over land (left) and ocean (right).

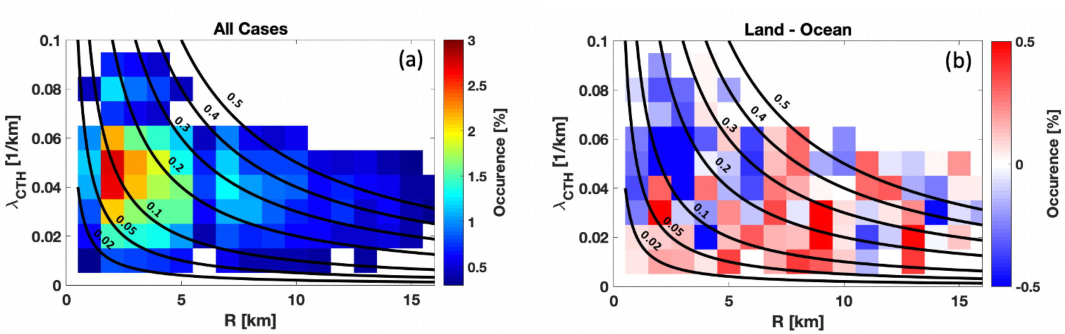

Figure 2: (a) Occurrence of cloud objects, and (b) the difference between convective cloud objects over land and ocean, as functions of λ and R .

Science Question: The narrower the convective updraft (R), the stronger the mixing of environmental air into clouds (entrainment, $\boldsymbol{\lambda}$)?

Data & Results: Analysis based on five years of CloudSat data over the tropics reveals that (1) larger convective cores are better protected from entrainment dilution, and (2) land has wider and less entrained updraft cores than ocean (Figure 1).

Significance: For over half a century, the inverse relationship between λ and R, has been a "*cornerstone of the dynamic modeling*" although it has never been tested with global cloud observations. **Our study adds observational evidence, for the first time, to the correlation between λ and the inverse of R (Figure 2a),** which emphasizes that land has wider and stronger updraft that can transport cloud material to higher levels more efficiently compare to ocean (Figure 2b). The satellite-based approach has a potential to be a new diagnostic metric to assess the representation of cloud and convection in weather and climate models.

Takahashi, H., Z. J. Luo, and G. L. Stephens, 2021: Revisiting the entrainment relationship of convective plumes: A perspective from global observations, Geophys. Res. Lett., doi: 10.1029/2020GL092349

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