Abstract

Ensemble of ten RCE simulations near the sharp transition zone between scattered and aggregated states are examined in SCALE-RM.

- Surprisingly, occurrence of self-aggregation (SA) is not deterministic near the marginal boundary: 6 aggregated & 4 scattered runs.
- Development of moisture contrast in boundary layer (BL) is the key indicator for SA. To reach aggregated state, a part of BL needs to be sufficiently dry and extensive to suppress convection triggered by cold pools.
- Marginal behavior of RCE near the transition boundary shows that convective organization, moisture aggregation, & large-scale overturning circulation each operate at different temporal and spatial scales.

Results

- Evolution to distinct RCE states
  PW at Day 100 (pink ctr: precipitation, 10 mm/d)
  [Image of RCE Regime Diagram]
  - Scattered regimes?
  - How strict is the boundary line between aggregated and scattered regimes?

- What controls the expansion of dry patch?
  [Image of Autocorrelation length of moisture: free troposphere (FT) vs. BL]
  - two competing mechanisms
    (+) drying by radiative subsidence
    (−) homogenization by cold pools
  - Aggregated: extensive dry FT & BL suppress convective triggering by cold pools. Dry patch grows through positive moisture-LW radiative feedback.
  - Scattered: BL doesn't dry & extensive enough to suppress convection triggered by cold pools. Convection develops in dry patch & destroys dry anomalies in FT.

- Autocorrelation length of moisture: free troposphere (FT) vs. BL
  [Image of Autocorrelation length of moisture: free troposphere (FT) vs. BL]
  - FT variation dominates spatial variance of column moisture, but the development of BL moisture contrast is the key for the transition from scattered to aggregated state.

- Discussion: comparison of SA indices
  [Image of Discussion: comparison of SA indices]

Conclusion

1. Deterministic of self-aggregation (SA)
   - Occurrence of SA is not deterministic near the sharp transition zone between aggregated & scattered states: 6 aggregated & 4 scattered runs

2. Key processes controlling SA
   - Downward extension of dry patches from FT to BL is the key determining whether the system will reach aggregated state: competition between evaporation-driven cold pools & radiative cooling

3. Multiscale structure of SA
   - Convective organization, moisture aggregation, & large-scale overturning circulation each operate at different time & spatial scales: complicated interactions between convection, moisture, radiation, & atmospheric circulation
   - Index based on 2-day-accumulated convective statistics is proposed to measure convective clustering in longer time scale.

Selected References


Animation for Simulation

[Video link: https://www.youtube.com/playlist?list=PL7wzeiGgqNumal-15z199J5hBSs4YhI2x]