Simulation of deep convection by use of an assumed PDF parameterization

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Why use a PDF parameterization to simulate deep convection?

A probability density function (PDF) parameterization predicts the subgrid distribution of moisture, heat content, velocity, and hydrometeors.

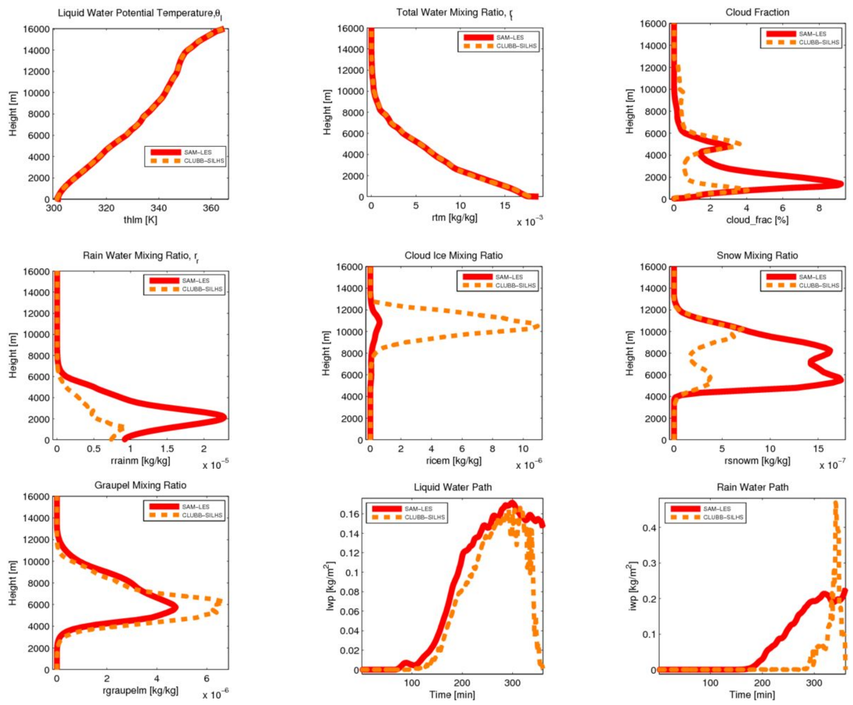
PDF parameterizations are well suited to simulating deep convection because they can drive microphysics using subgrid variability. To do so, we predict the subgrid PDF using CLUBB and draw subcolumns from that PDF using SILHS (Larson and Schanen 2013). The subcolumns are then fed into the microphysics.

Experiment design

We perform single-column simulations using CLUBB-SILHS of two tropical deep convective cases and compare them with cloud-resolving simulations (SAM-CRM). CLUBB-SILHS uses 16 subcolumns, 128 vertical grid levels, and a 1-min time step. CLUBB-SILHS and SAM-CRM use the same prognostic, double-moment microphysics scheme (Morrison et al. 2005).

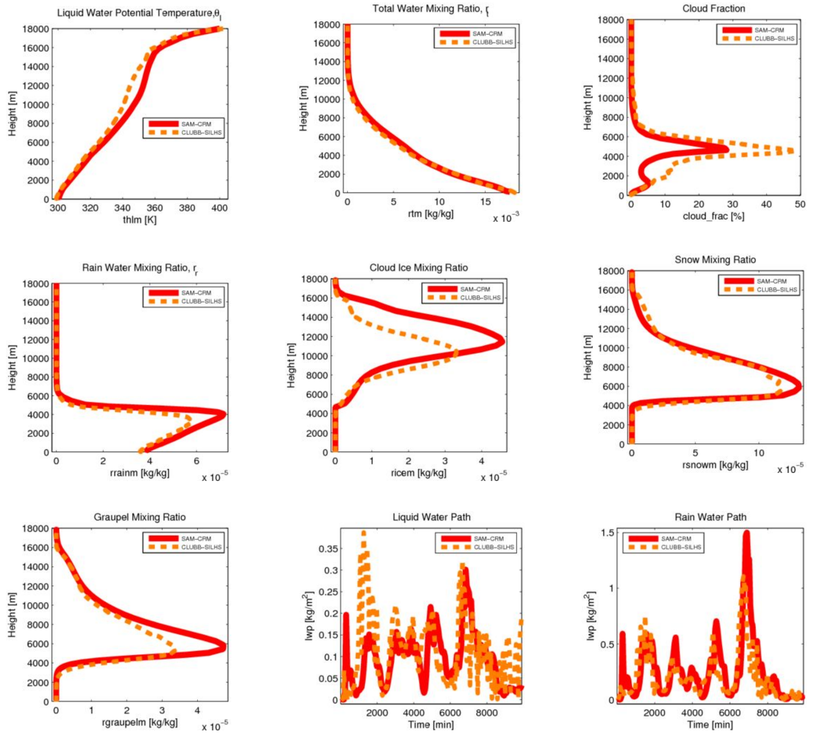
Simulations of shallow to deep transition (LBA)

The LBA case is a 6-hour simulation of the onset of deep convection over a tropical land mass (Amazon). Shown are SAM-CRM (red) and CLUBB-SILHS (orange dashed).



Simulations of coastal deep convection (TWP-ICE)

TWP-ICE is a near-coastal week-long tropical deep convective case that was observed near Darwin, Australia.



Summary

CLUBB-SILHS can successfully simulate a shallow-to-deep transitional case (LBA) and a coastal deep convective case (TWP-ICE). Although CLUBB-SILHS has some difficulty predicting the timing and magnitude of hydrometeors in LBA and underpredicts temperatures aloft in TWP-ICE, the overall accuracy is quite satisfactory. The simulations are successful largely because they use a sophisticated prognostic microphysics scheme (Morrison et al. 2005), and they drive this scheme with a detailed representation of subgrid variability.

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