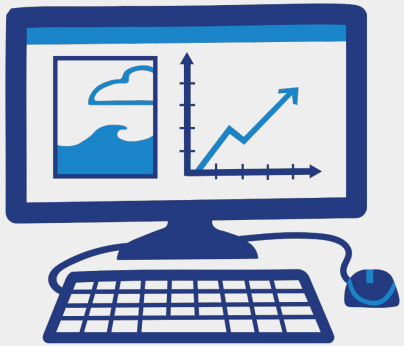
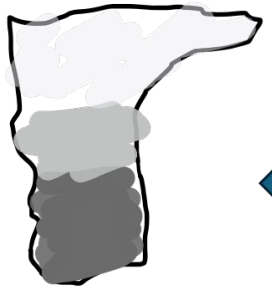


Non-Equilibrium Convection and Cold Pools

Climate Process Team (CPT) NCAR, JPL, NOAA
Bosong Zhang and Leo Donner (PI)

Q1: Concerning GFDL's core strength of building and improving models of the weather, oceans, and climate for societal benefits, how can GFDL leverage advances in science and computational capabilities to improve its key models? What are the strengths, gaps, and new frontiers?

Standard AM4 Convection

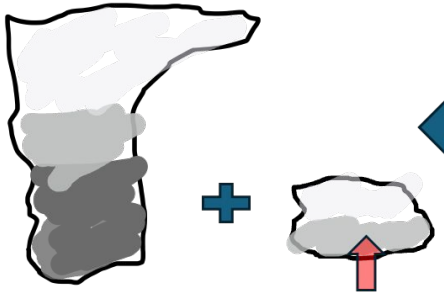


Deep plume

Relaxed Quasi-Equilibrium

- advection
- radiation
- PBL heating + moistening

Non-equilibrium Convection



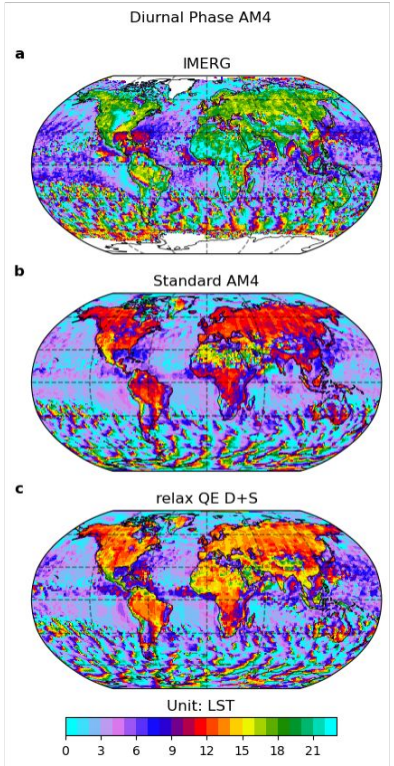
Deep plume Shallow plume

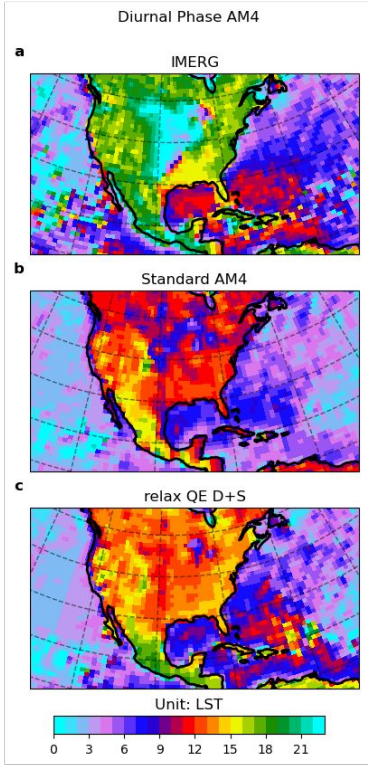
Relaxed Quasi-Equilibrium

- advection
- radiation
- PBL heating + moistening

Mass flux of the ***non-equilibrium*** shallow plume depends on PBL turbulent kinetic energy and convective inhibition

Improved precipitation diurnal cycle with Non-Equilibrium Convection (NEC) in AM4

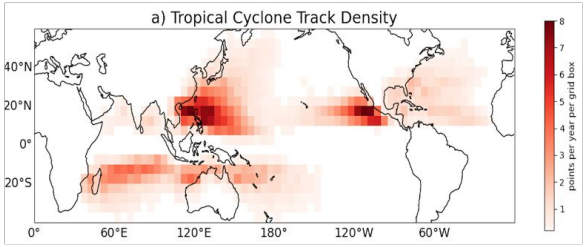




Diurnal phase (unit: LST hour) during boreal summer (June-August) for (a) IMERG, (b) Standard AM4, and (c) NEC.

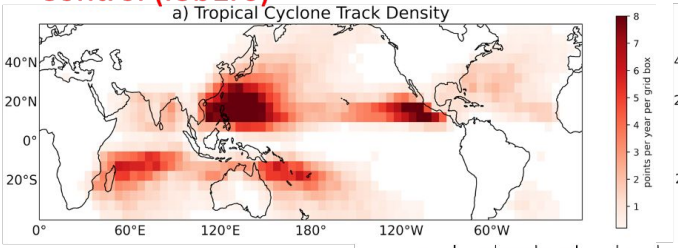
Improved tropical cyclone track density (AM5 development)

Obs

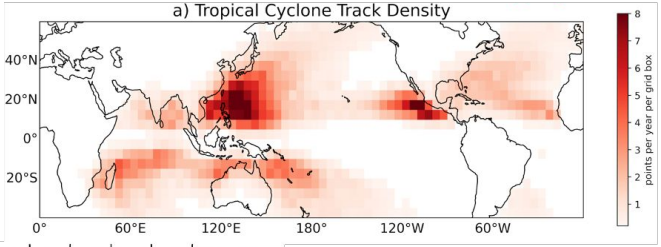


25-km AM5 experimental

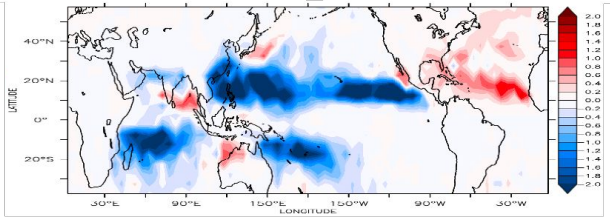
Control (f3b1r0)



NEC



NEC - Control



from Baoqiang Xiang, GFDL

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Effects of Cold Pools - Future Developments

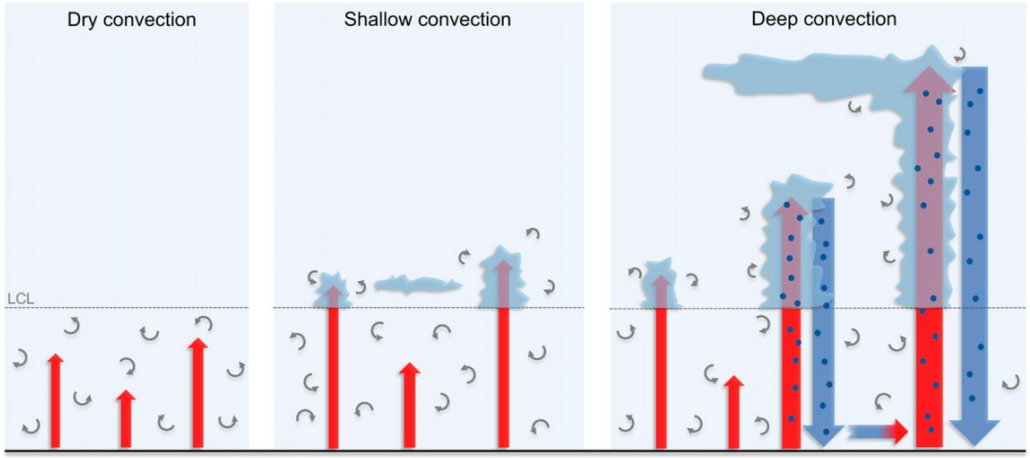
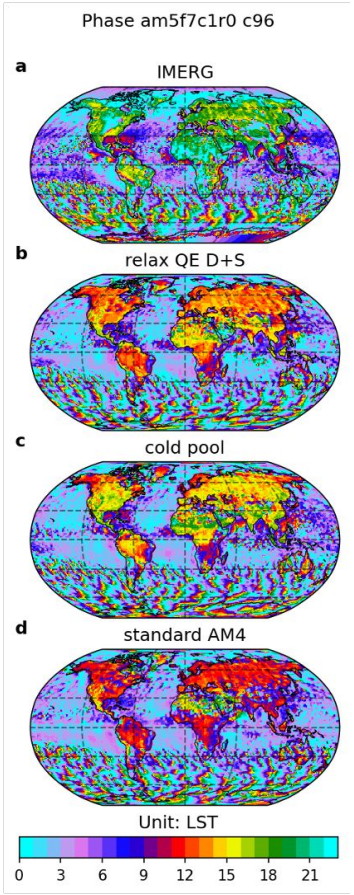
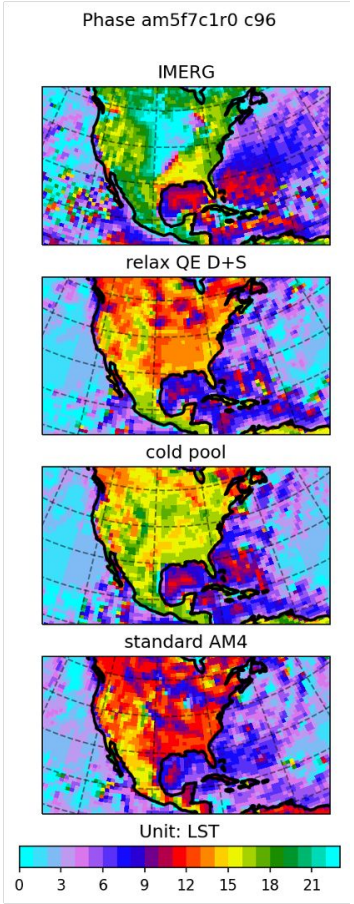


FIG. 1. Schematic of three archetypes of convection: (left) dry, (middle) shallow, and (right) deep convection. Vertical blue arrows denote downdrafts associated with the precipitating updrafts. The horizontal arrow in the right panel indicates cold pools that can affect the properties of newly formed updrafts.

Suselj, K., Kurowski, M. J., & Teixeira, J. (2019). A unified eddy-diffusivity/mass-flux approach for modeling atmospheric convection. *Journal of the Atmospheric Sciences*, *76*(8), 2505-2537.

AM5 Development





observation

Non-equilibrium Convection (NEC) only

Cold Pools + NEC

Control