Toward understanding a climate (time mean) signal in convective precipitation in CAM

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Our "UWens-org" CAM5 version

• Park-Bretherton plume convection only
  – ZM scheme is disabled

• A two-plume ensemble
  – 1\textsuperscript{st} plume is P-B standard "shallow convection"
  – 2\textsuperscript{nd} plume has a lower entrainment rate

• A new prognostic field: "organization" $\Omega$
  • governs 2\textsuperscript{nd} plume's entrainment (via org2rkm)
  • governs 2\textsuperscript{nd} plume's base mass flux (via org2cbmf2)
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• "organization" \( \Omega \) defined thusly:

\[
\frac{\partial \Omega}{\partial t} = - (V_{sfc} \cdot \nabla_h \Omega) - \frac{\Omega}{10 \text{ks}} + \sum_{\text{sources}} S_i
\]

1. Advected by low-level flow
2. Decays with timescale 10 ks \( \sim \) 3h
3. Has Sources:
   a) \( \text{evap2org} \) *(column_integrated_precip_evap) --- basic
   b) \( \text{coast2org} \) where \((0.1 < \text{landfrac} < 0.9)\) --- experiment
Conceptual guide to these experiments

- evaporation of rain
- subgrid geography and breezes
- stochastic component
- shear (rolls, deformation lines, etc.)
- updraft base warmer than grid mean
- wider plumes (entrain less)
- inhibition (base MF closure)
- more, deeper convection
- forced, decaying, \( \tau = 10 \text{ks} \)
- advected
- oceanography
- more likely
- preconditioned local environs
- plume overlap
- precipitation

Org(x,y,t)
org2rkm org2cbm org2cbm2 coast2org
A time-mean PRECC signal

• What is the impact of coast2org source?
• Expectation: coast2org $\rightarrow$ more $\Omega$ in coastal regions $\rightarrow$ more cloud base mass flux is sent up, into less-entraining 2nd plume $\rightarrow$ more PRECC
• But feedbacks can change that initial effect
  – positive (org $\rightarrow$ evap of precip $\rightarrow$ org)
  – or maybe negative (e.g. heating $\rightarrow$ dyn $\rightarrow$ drying)
  – or maybe eddy (via time correlations in disturbances)
  – few a priori constraints: why modeling is interesting!
Effect of coastal $\Omega$ source
(overlay of two 5-year means for sig.)
Counterintuitive sign is \textit{local} to MC
Effect of coastal $\Omega$ source only in MC:
Why *less* MC rain with coastal $\Omega$ source?

- yet with *more* deep mass flux in plume #2...
Explaining a time-mean surprise

• Some precip efficiency effect?
  – Saturated M in tropical qsat(T,p) profile produces a pretty constant condensation rate per unit mass flux.
  – So cond $\rightarrow$ PRECC must vary by many 10s of %
    • condensate $\rightarrow$ precip conversion?
    • re-evap of precip above surface?
Explaining a time-mean surprise

• Are time mean fields a sufficient basis for explanation, or must we consider temporal correlations of fluctuations (of M and RH for example)?

• And always, forever, we worry: ? bugs ?
Branch run strategy

- See how counterintuitive sign (opposite to immediate, local effect) emerges.

**Idea**: Explaining the turnaround in a case, and/or in the composite, plus showing that it is characteristic of a statistically meaningful number of branch cases, would constitute an explanation for the surprise/mystery sign.
Less than that, today

- IDV demo:
  - 20 fields in CAM5-UWens-org JJA weather
  - with x-sections and soundings