Linking MMF to garden-variety parameterizations

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"Why is this STC supporting work on traditional parameterizations?"

Because it's going to be challenging to understand what the MMF and
 what it produces (technology transfer)

Because we're likely to see new behavior in the MMF (relative to
 traditional parameterization)

- MMF as a source of new parameterization ideas
- What links are most important?

What does MMF provide to people working on heirloom parameterizations?

At the least, a unique, large, and valuable library of CRM simulations

- *deep*: long time-series
- *broad*: many large-scale states, cloud regimes
- Consistent with large-scale forcing
- With frequency weightings

Another context for CRM simulations

Explicit coupling between large and small scales

- Caveat: We still have to learn how to identify when this coupling is important

A library would be immediately useful

Groups working on (important) problems like

- PDF-based cloud schemes
- Stochastic schemes for various processes (esp. convection)
- Vertical structure

Example: stochastic convection

Convection schemes take (mean) thermodynamic profile,

produce (single, mean) profile of mass flux

In CRMs, the same mean thermodynamic profile may produce a

range of profiles of mass flux

Given a large set of varied CRM simulations, we can

test & tune parameterization mean response

estimate PDFs of response given large-scale state

(sample PDF instead of using mean in parameterization)

Might this enhance high-frequency variability?

Example: vertical structure

The representation of "clouds" has evolved over time

- from prescribed to diagnostic to prognostic

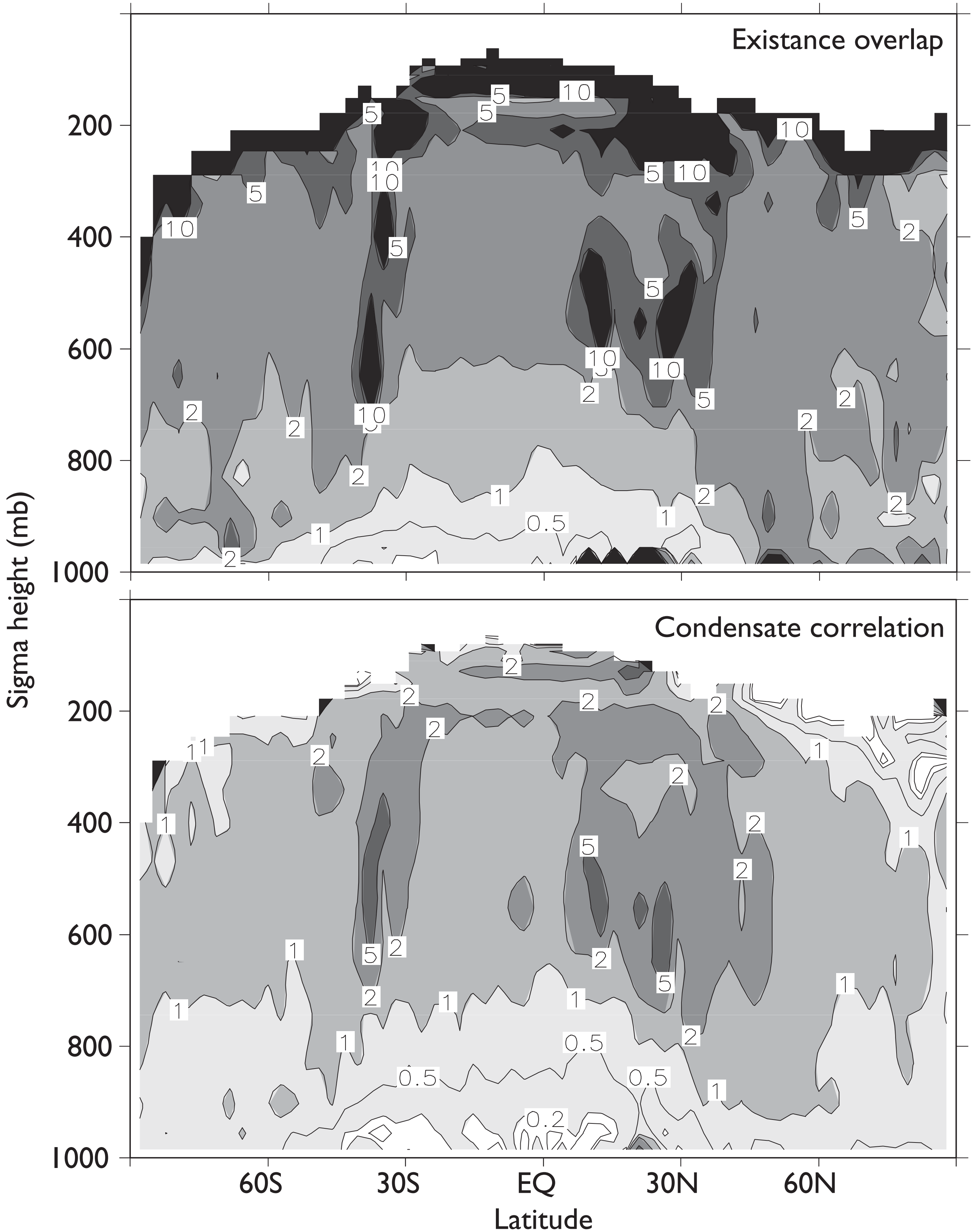
Vertical structure is prescribed

- Dirt simple: no geographical or temporal structure
- Known to affect mean climate through radiation, precipitation
- Lots of room for more complicated treatments

CRMs are an excellent source of structure

- Relatively easy to verify against observations
- Well sampled, complete
- Breadth and depth count for a lot here

Cloud structure varies a lot from place to place (correlation lengths after Räisänen et. al, 2004)



Storage strategies will influence how useful the library is

PNNL meeting: make several choices

- Hourly snapshots (PDFs, vertical structure)
- Five minute samples once a month (stochastic convection)
- Ten second snapshots of single CRM columns in a few places (comparison to point measurements)
- …

Looking at CRMs in a another context may help us isolate important processes

Jason Cole's result: gridcell-scale cloud properties are more sensitive
to the distribution of radiation at small scales than the grid scale

This has important implications for parameterization
Requires new *ideas* with no obvious path forward

Note bene: this might have been learned from off-line CRM runs

MMF provides quantitative measure of relative importance

Cold water: we learned this quasi-accidentally, and it was very
expensive - this isn't going to be common

- relative importance of:

  - getting domain-average radiative flux profiles correct

  - accounting for subgrid-scale cloud-radiation interactions

possible with a regular GCM

unlikely (impossible?) with a regular GCM

?

Unification, scaling, convergence

The small scale cloud-radiation interaction points to a place where
parameterizations need to *unified*.
MMF experiments may help us identify more places.

Insensitivity to resolution is an explicit goal for most developing
parameterizations
E.g. Avoid formulations in terms of model grid cells, layers

But: Parameterizations in big grid cells inherently statistical
Grid cells are large relative to individual clouds
Each cell contains an *ensemble* of stuff

Convergence needs a *lot* of thought

How can we identify important feedbacks between large and small scales?

We make two claims

- CRMs are more realistic than parameterizations on small scales
- That improving the small scale will improve the large scale
- (not exclusive to MMF)

How will we identify *feedbacks* between scales in the MMF that aren't represented in traditional parameterizations?

This would be MMF's unique contribution