Turbulence, Microphysics and Radiation: A Shallow Cloud Perspective

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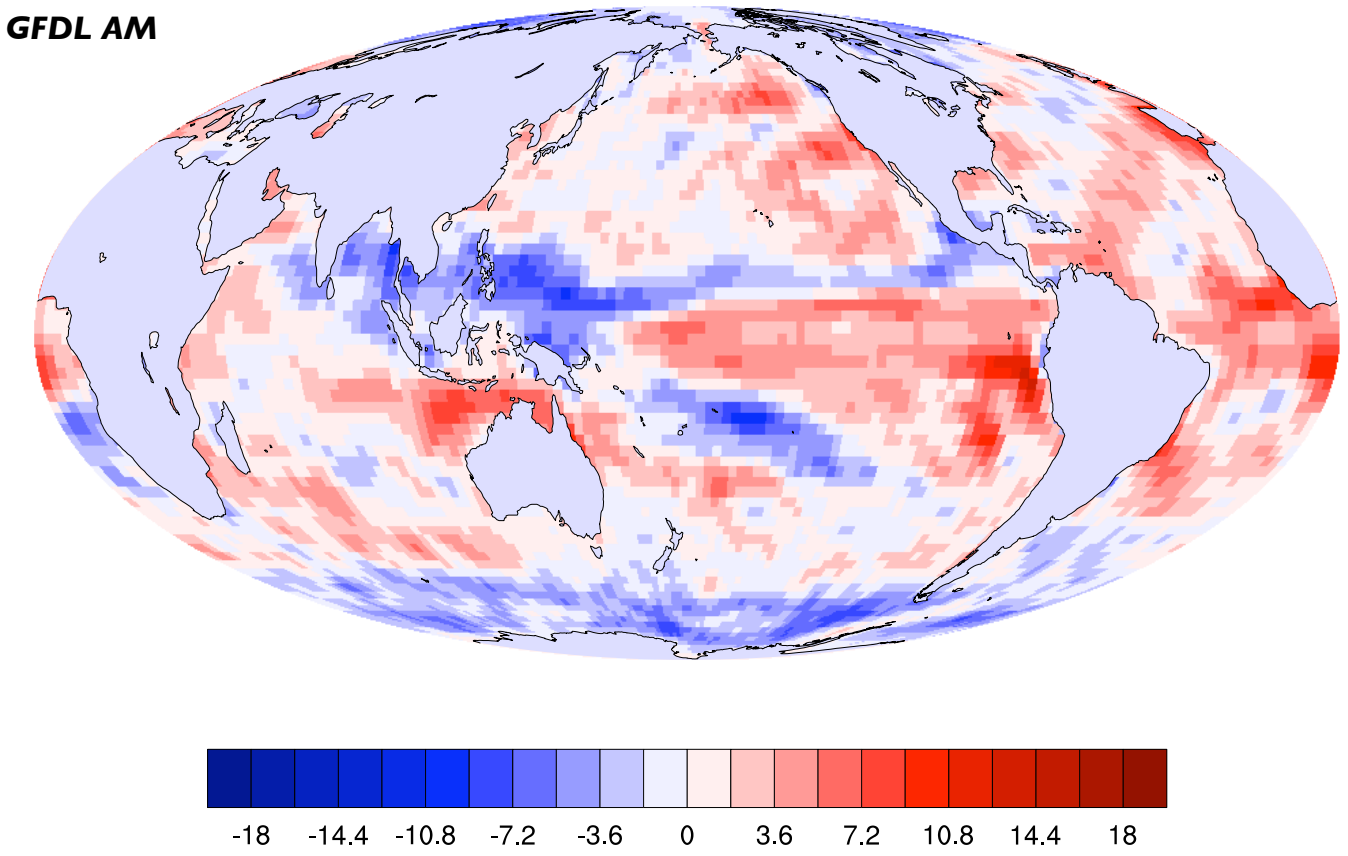
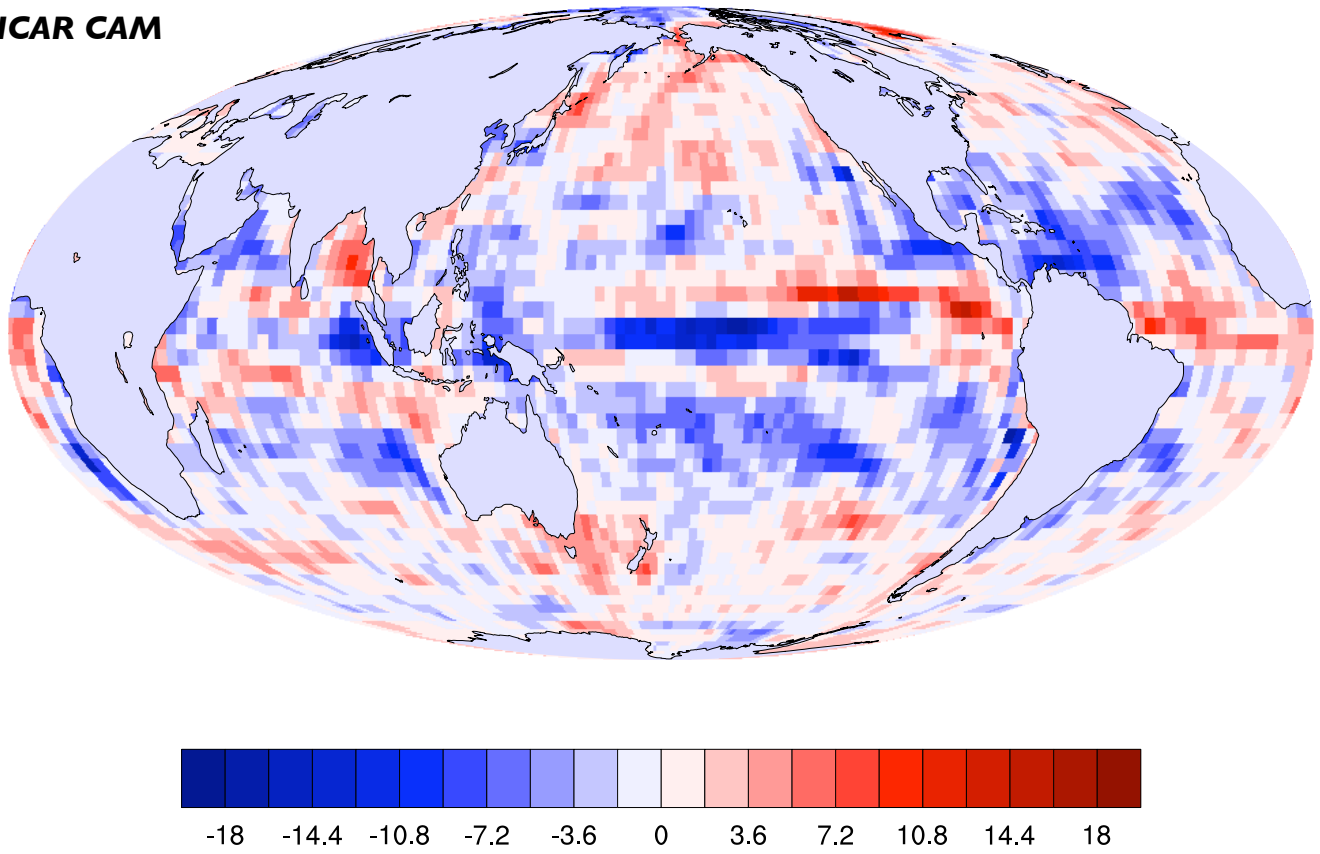
MMAP

- *shallow convection is not a strength of the MMF*
- *is it important?*



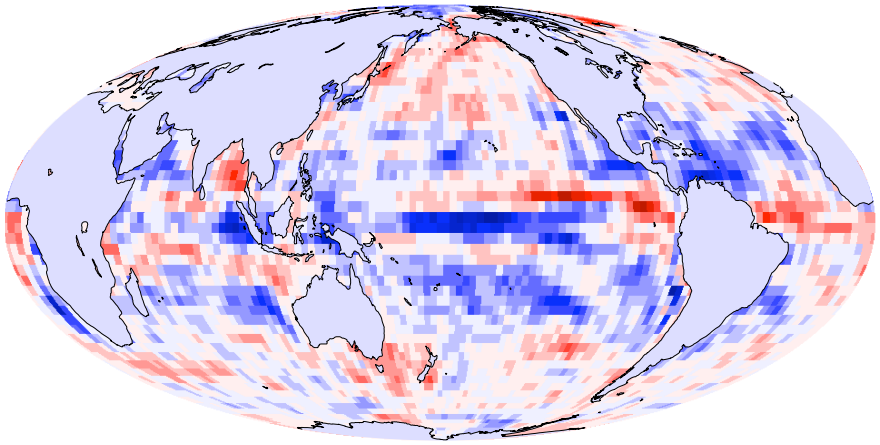
Medeiros, Stevens *et al.,* 2006

NCAR CAM

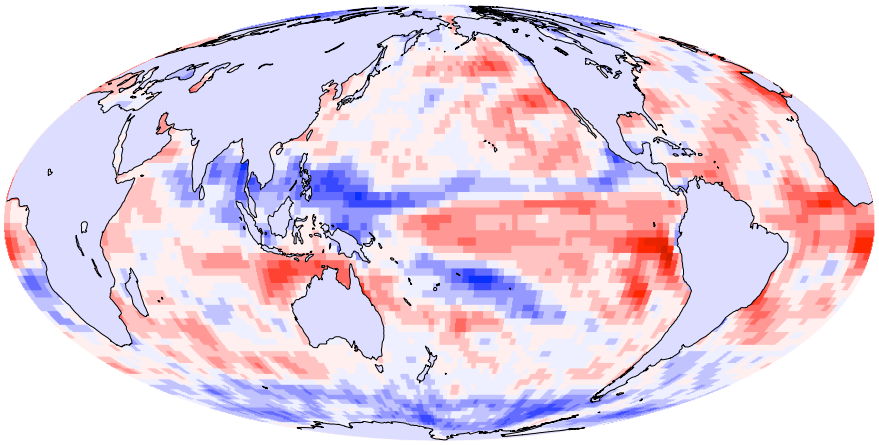


Medeiros, Stevens *et al.,* 2006

NCAR CAM

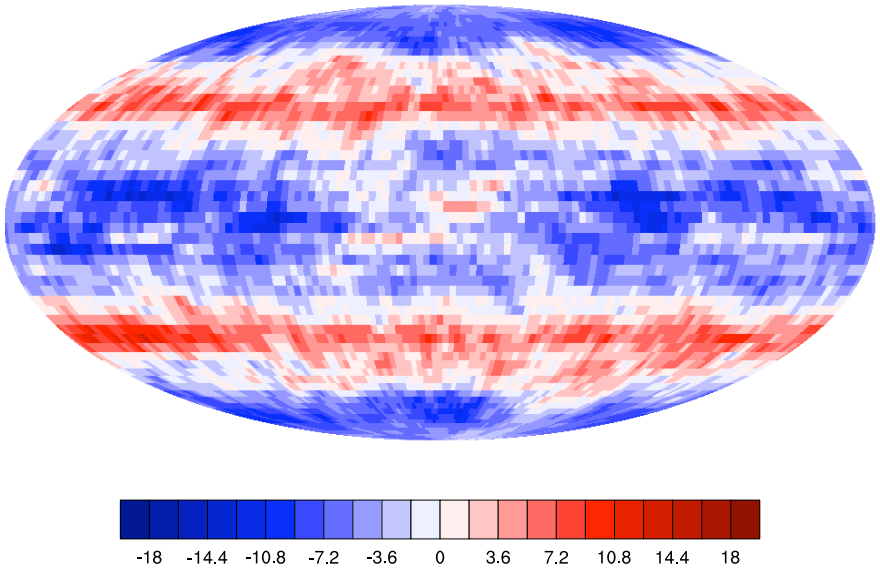


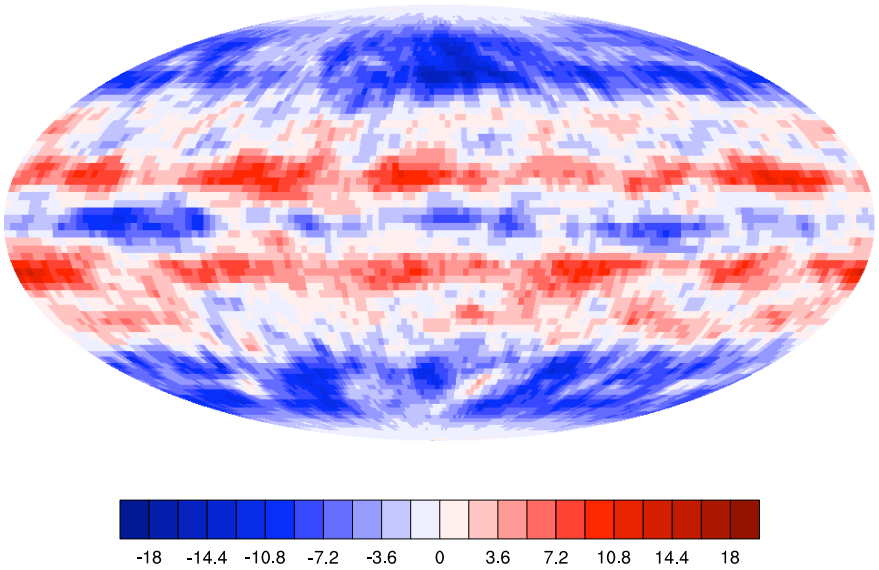
GFDL AM



Medeiros, Stevens *et al.,* 2006

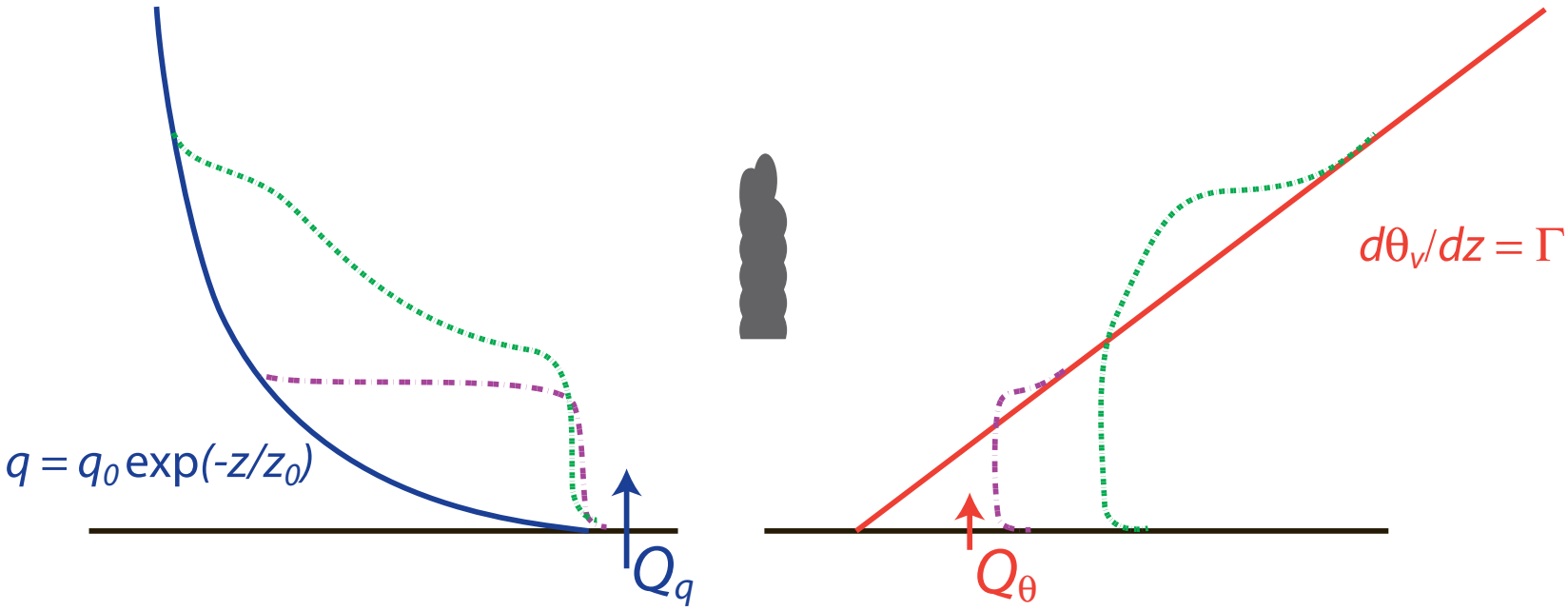
... in an Aqua Planet (APE-Aqua)





Medeiros, Stevens *et al.,* 2006

A prototype problem for shallow moist convection.



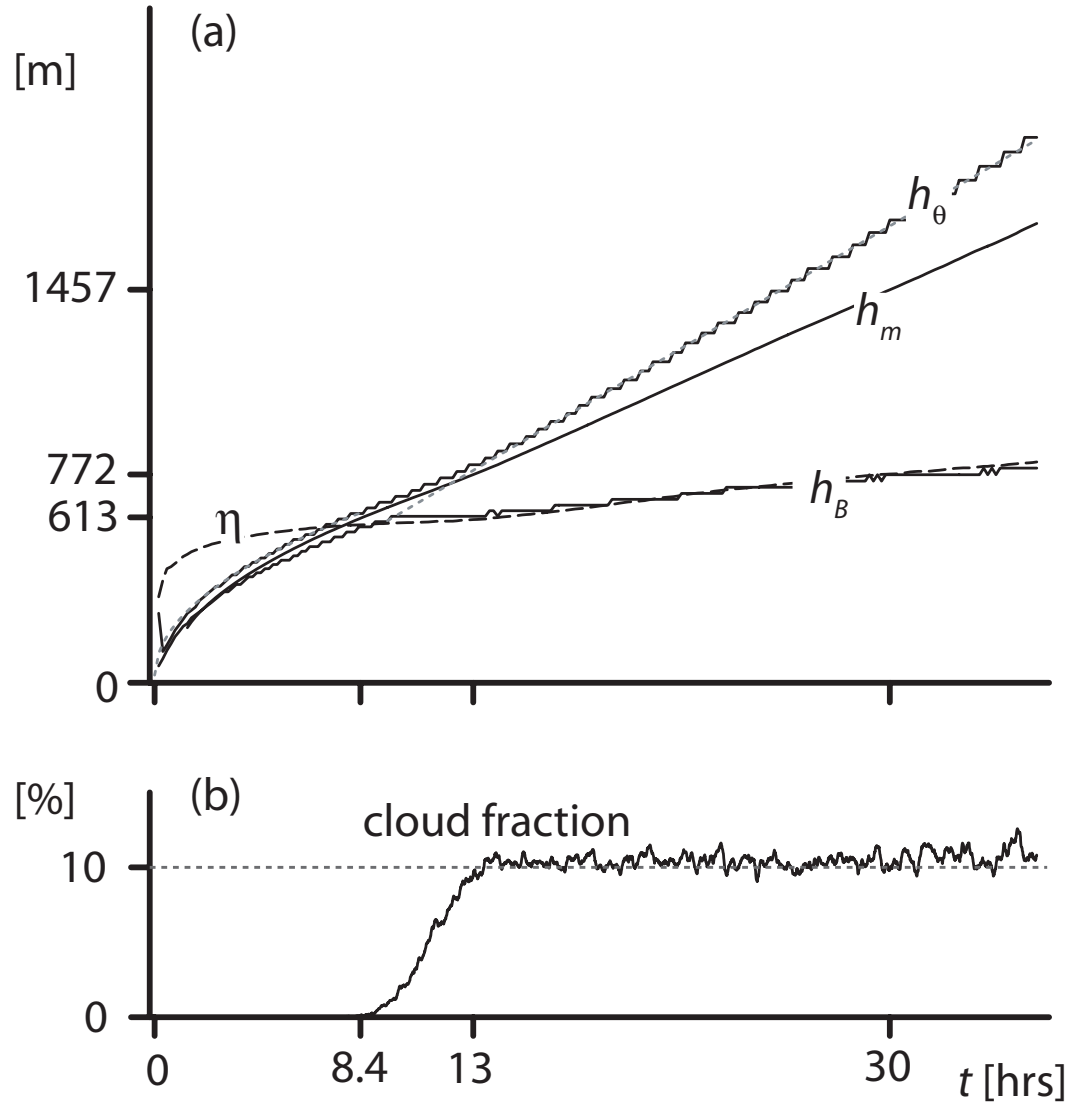
- ***what determines growth rate of layer?***
- ***cloud fraction?***
- ***mass flux at cloud base?***
- ***velocity scales?***

Remarks

- Trade wind clouds are a surprisingly large and uncertain player in cloud feedbacks. (yes they are important)
- They embody many other mysteries (What determines their precipitation efficiency? How do they mix momentum?)
- More profoundly, they are a remarkably pure form of moist convection about which relatively little is known.

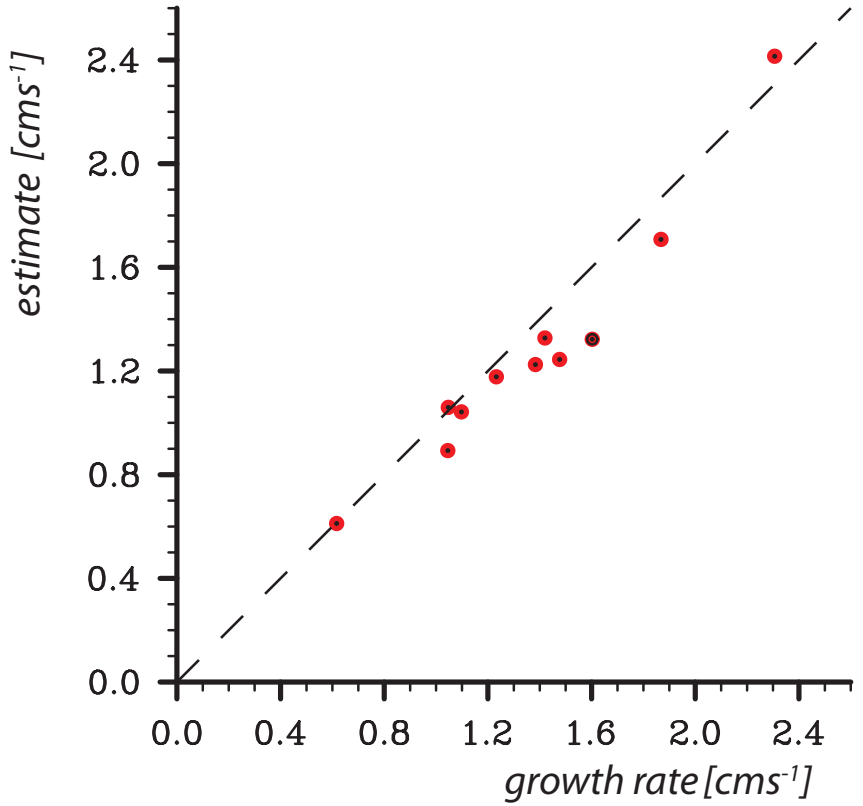
Flow visualization

Temporal evolution of distinguished layers



Predicted versus actual growth rates

- ***stationary cloud water***
- ***theta_v in cloud layer tracks subcloud layer***
- ***subcloud behaves like a dry convective boundary layer***



Remarks

- The analysis step provides a useful laboratory for exploring basic physical issues.
- The synthesis step is tough --- and open.
- While shallow convection is a weakness of MMF, it need not be a weakness of MMAP.

MMAP

at UCLA