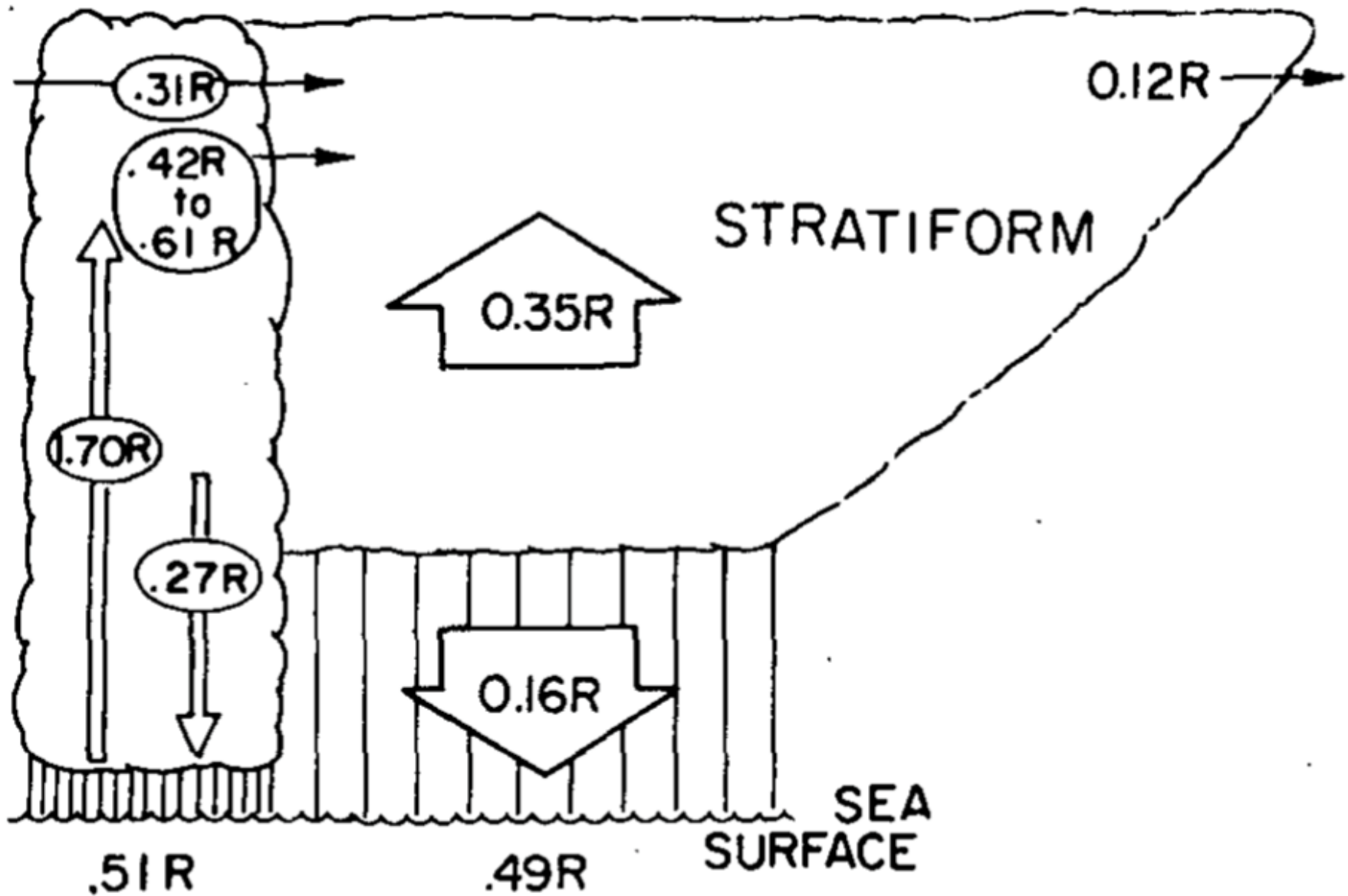


Water Balances of Deep Convection

Rachel Storer
Derek Posselt
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GEWEX UTCC PROES Meeting
March 29, 2017

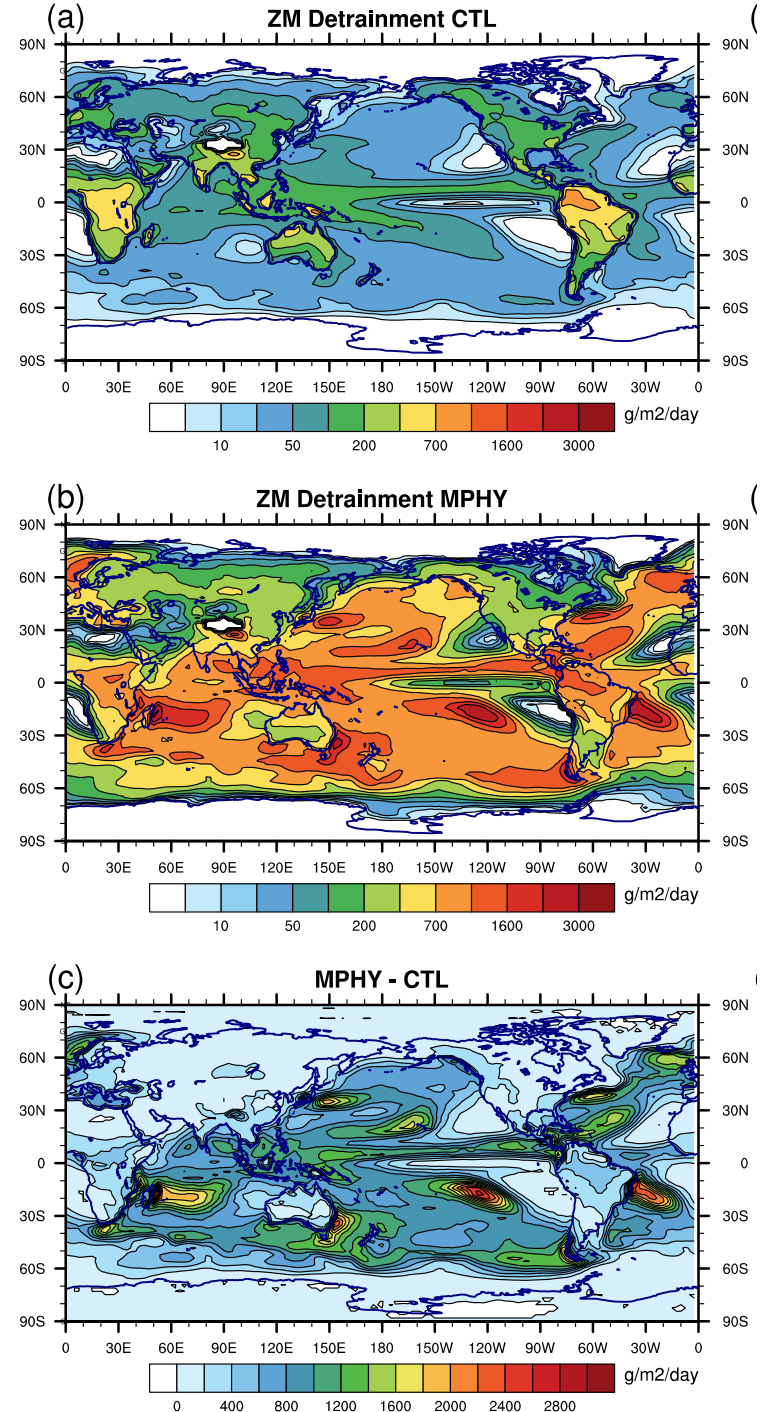


from Gamache and Houze, 1983

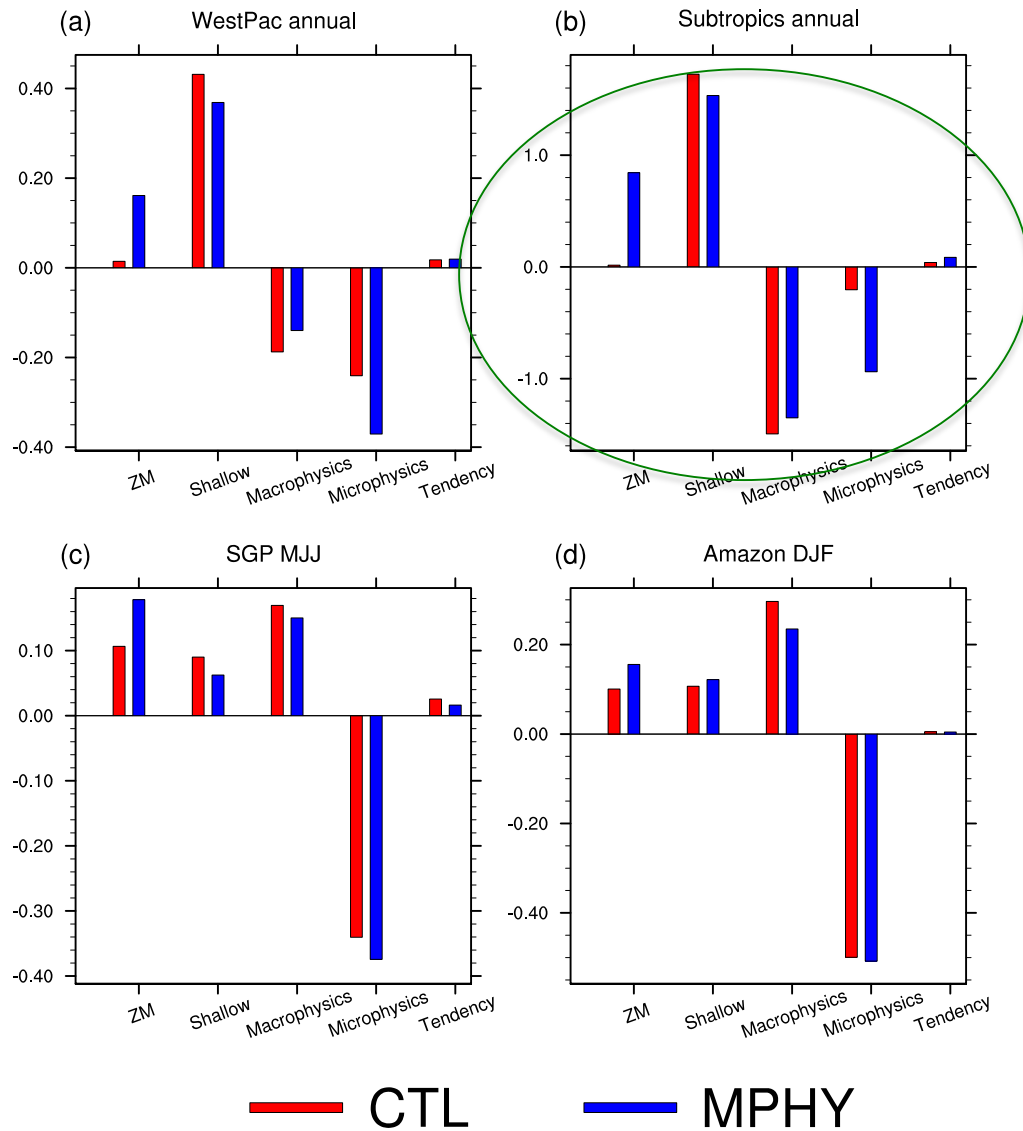
CAM5 simulations showing the effects of including Song and Zhang convective microphysics

CTL simulation contains simple land/ocean split of precipitation efficiency

Decreases in convective oceanic precipitation efficiency lead to huge increases in detrainment



Water Budgets

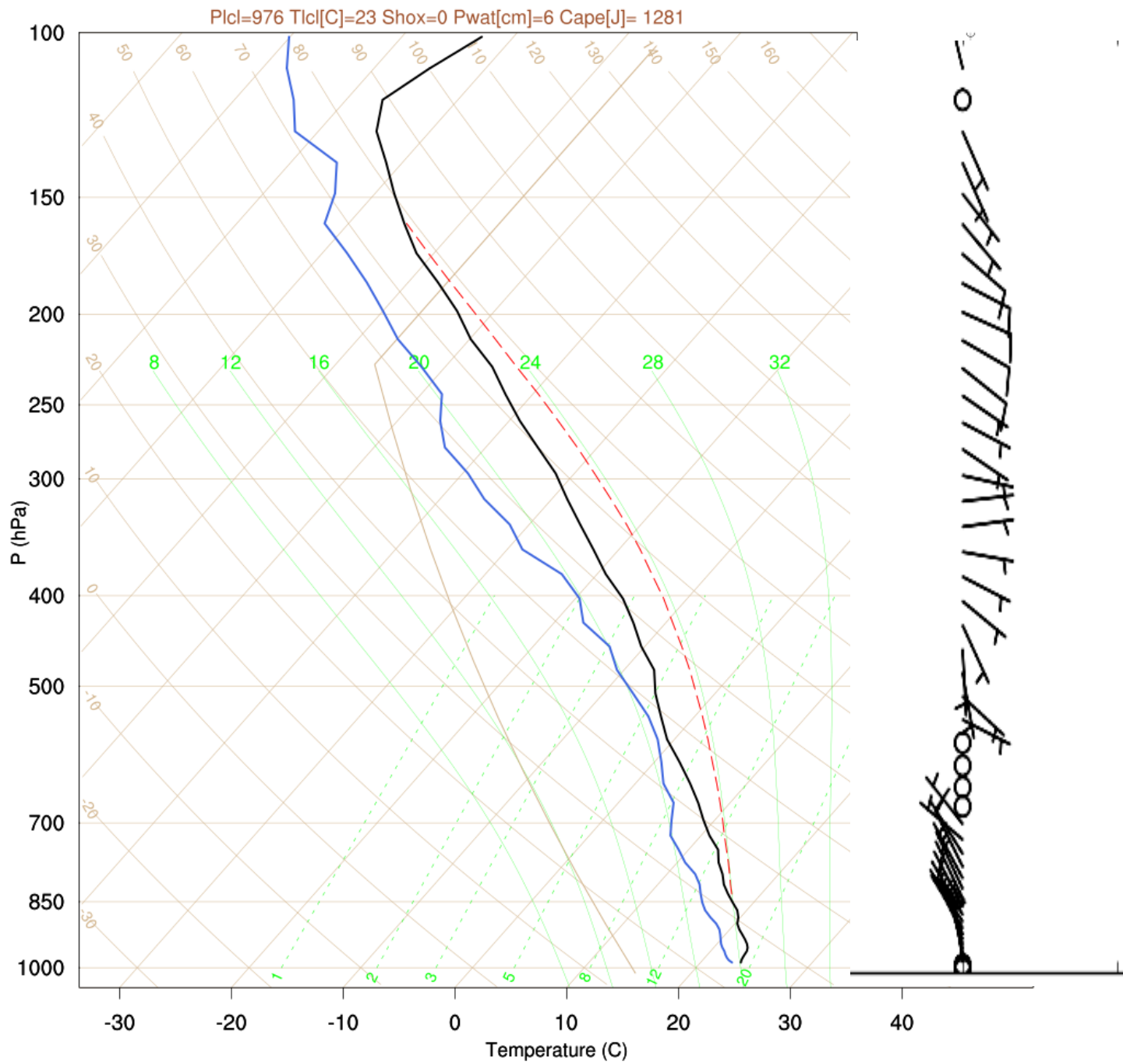


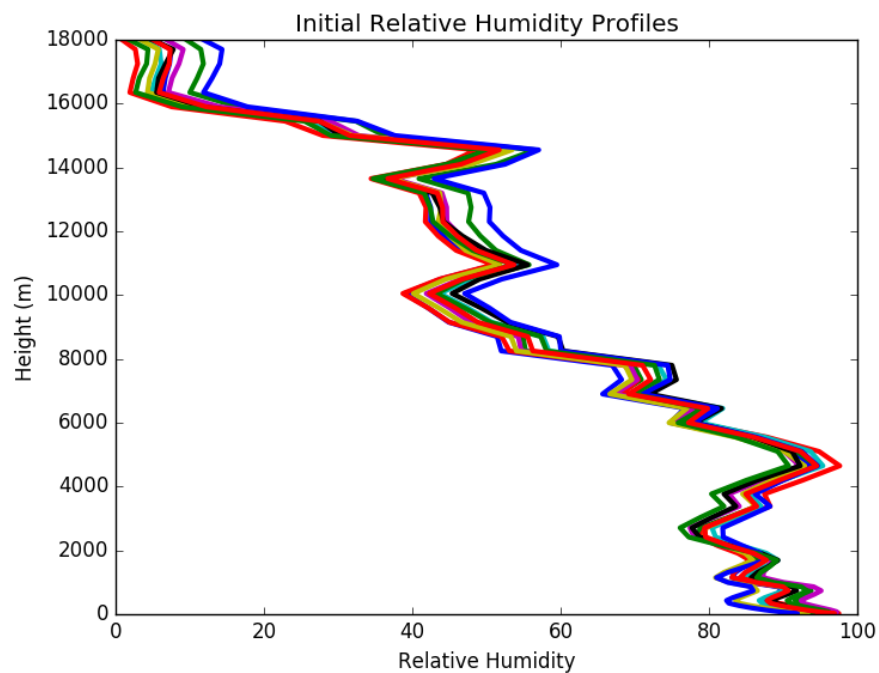
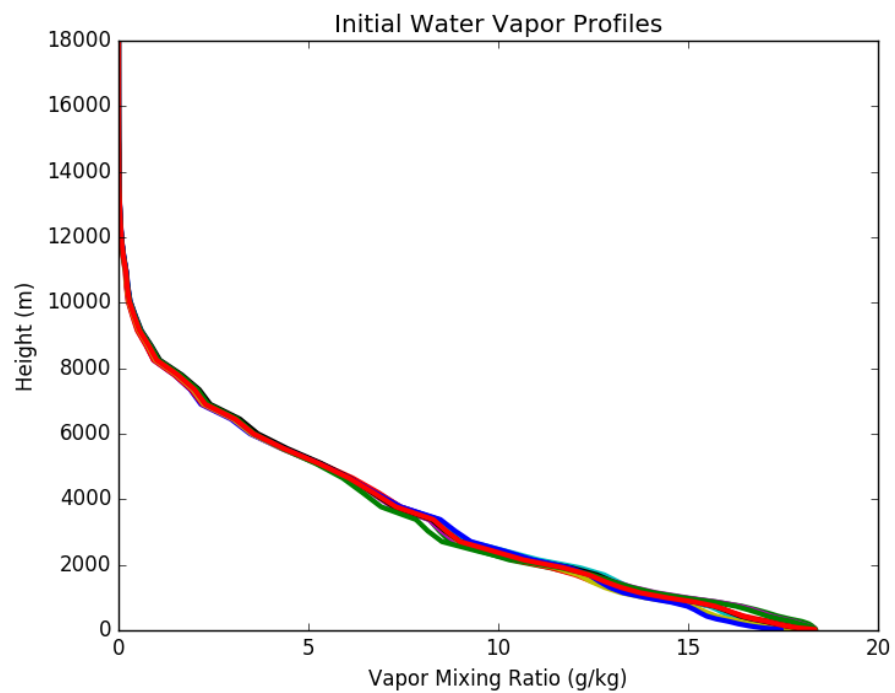
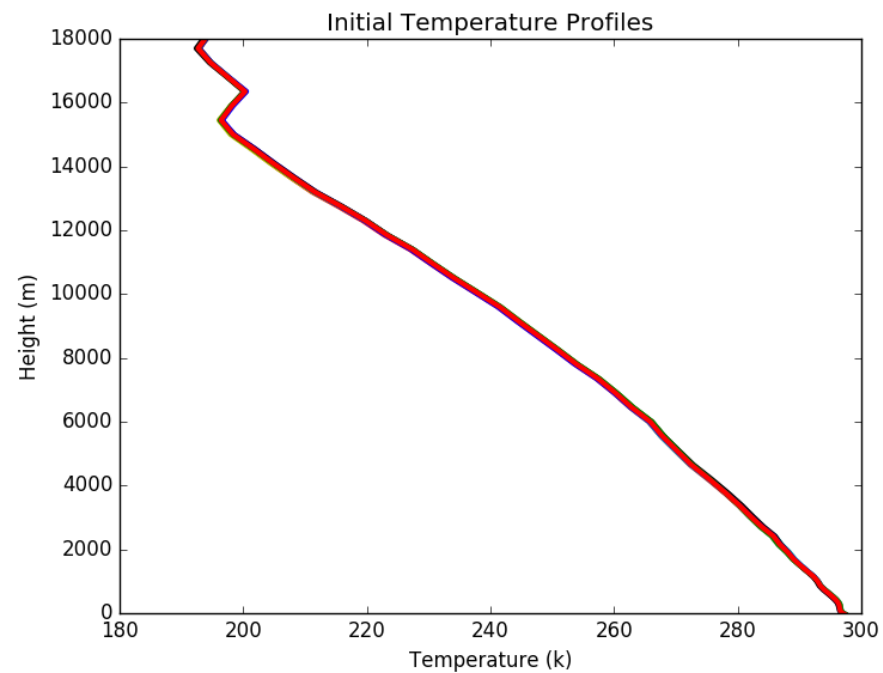
Questions

- Can we use a CRM to help quantify the water mass budget of a deep convective system?
- How do detrainment and precipitation relate?
- How does the water budget depend on the environment in which convection forms?
- What can we learn about the processes controlling convective detrainment?

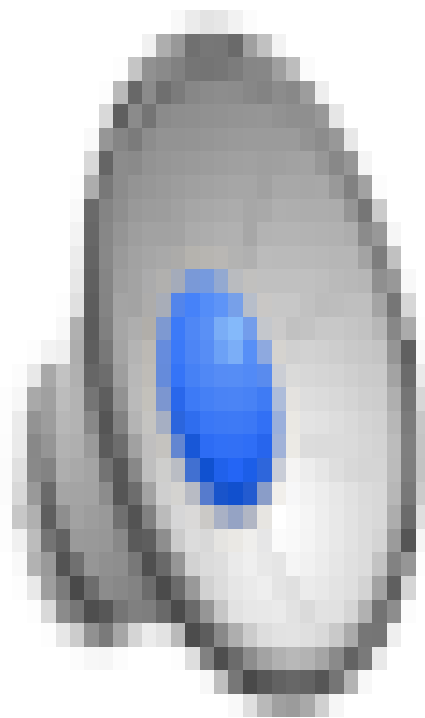
Model Simulations

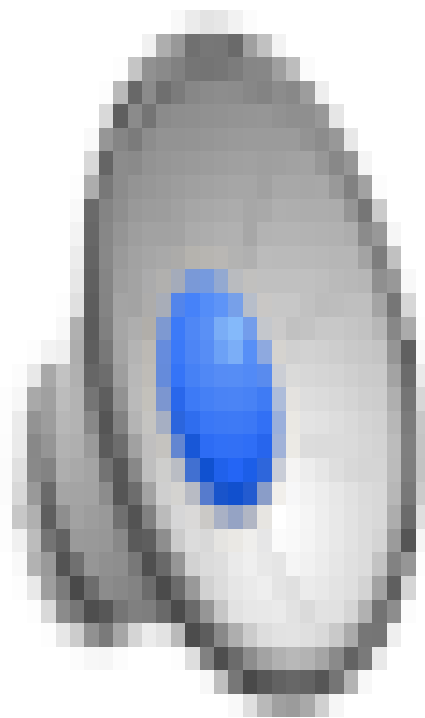
- Control simulation: Sounding from Feb 23, 1999 LBA deep convective case
- RAMS model version 6.2.01 with 2 moment microphysics
- 100 x 100 km domain, 250m grid spacing
- Initialized homogeneously over ocean
- Convection initiated with a convergence line
- Convergence turned on for 3 hours, model run for 5 hours
- Control sounding perturbed 9x for 10 total iterations



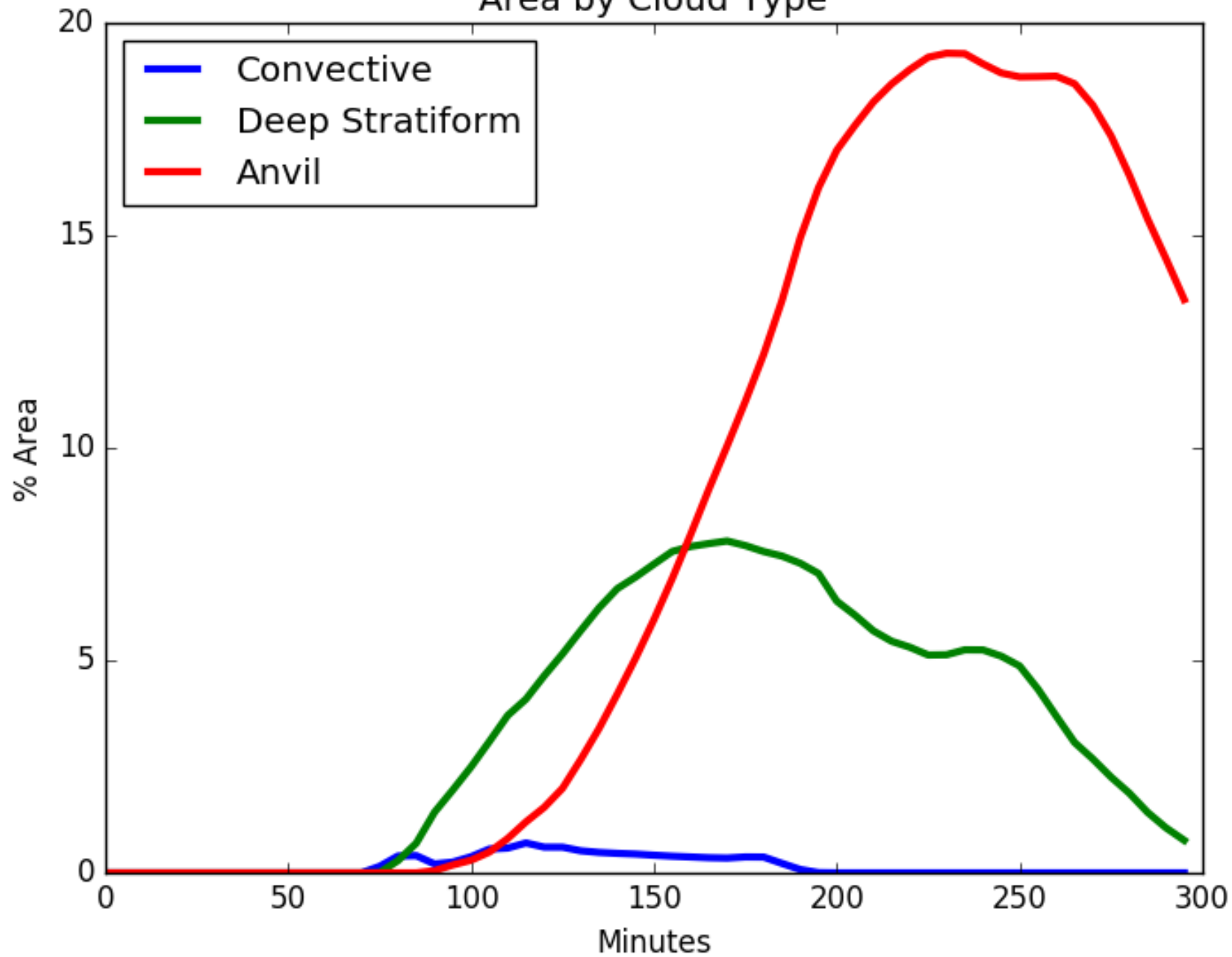


Run	CAPE (J/kg)	RH Low	RH Mid	RH High
Control	1281	88.9	85.4	67.5
1	1035	88.1	84.8	64.3
2	1155	91.4	85.1	66.8
3	1249	89.1	85.8	66.4
4	879	88.5	86.5	69.3
5	1229	92.6	84.2	65.9
6	1017	84.2	84.6	65.1
7	1153	89.9	84.5	70.1
8	771	84.4	86.5	69.9
9	1027	91.2	83.3	67.8

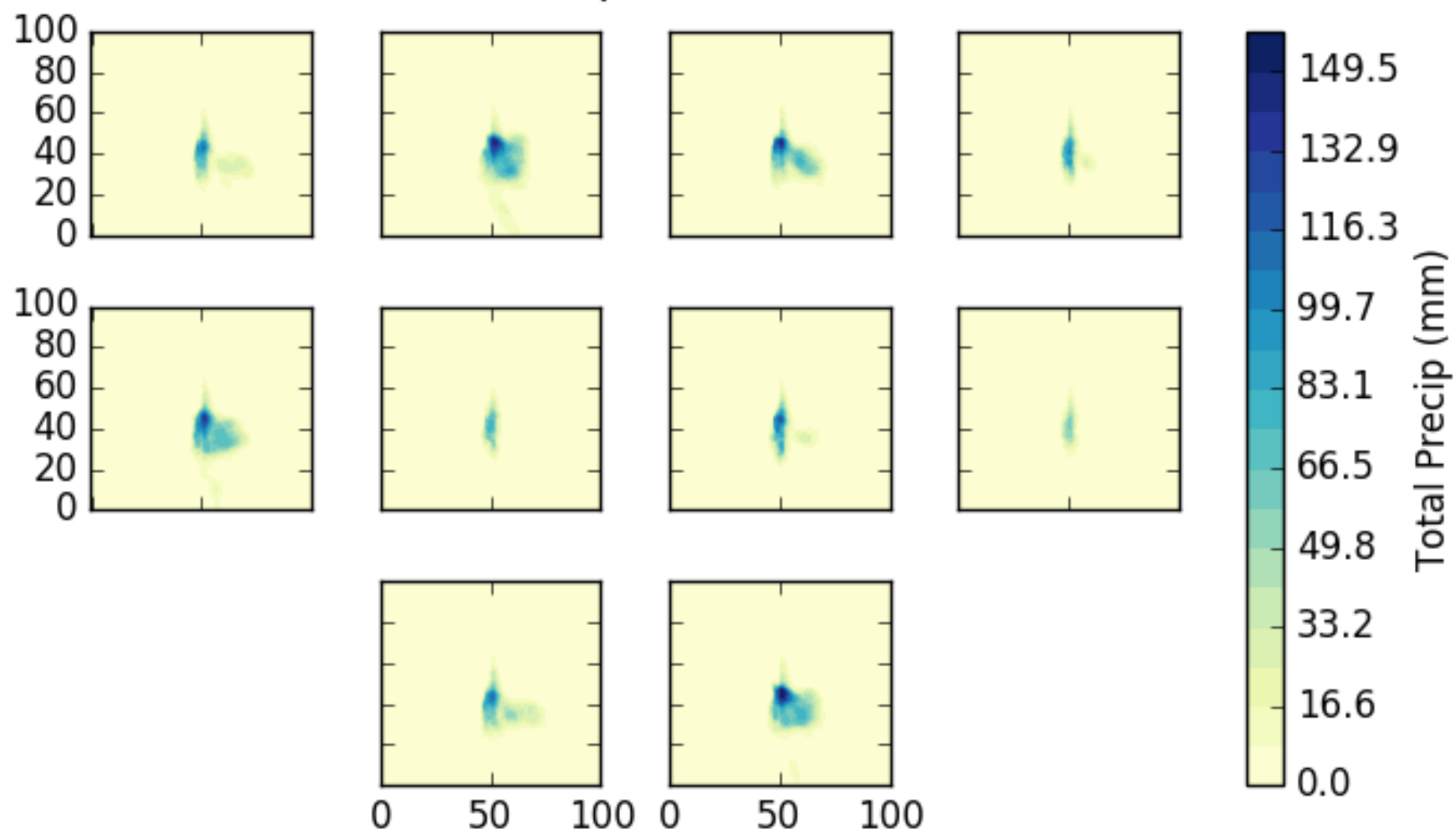


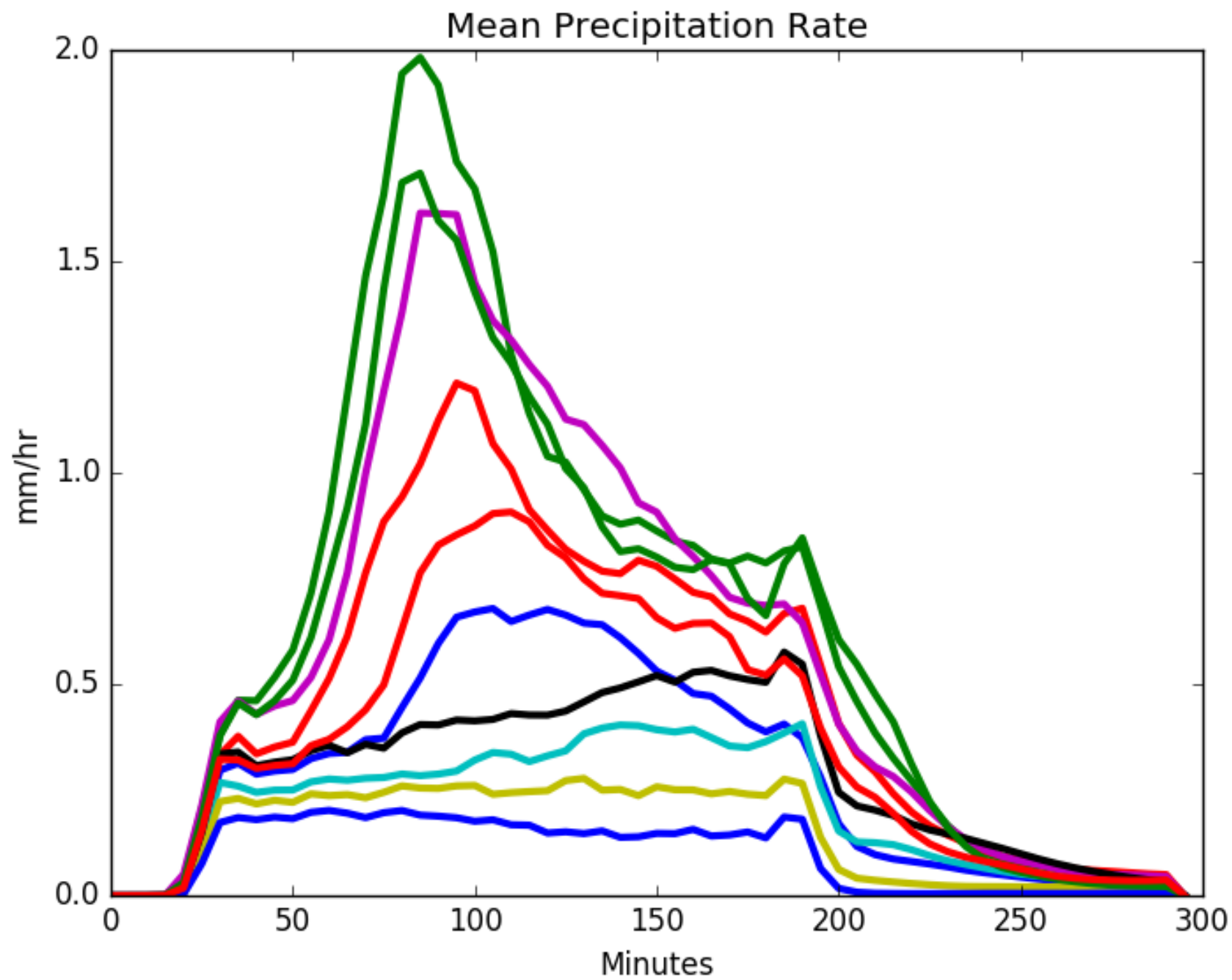


Area by Cloud Type

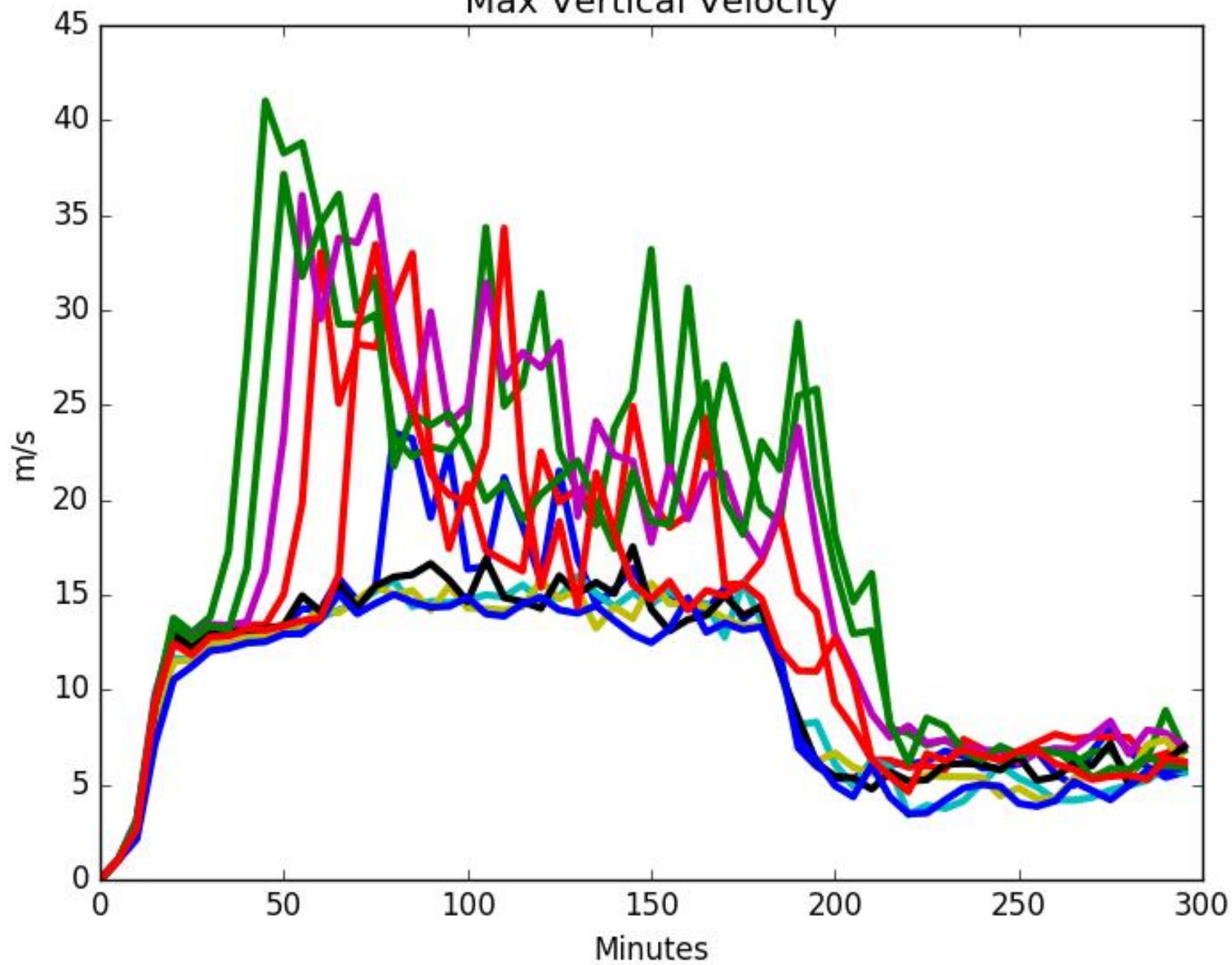


Total Precipitation After 5 Hours

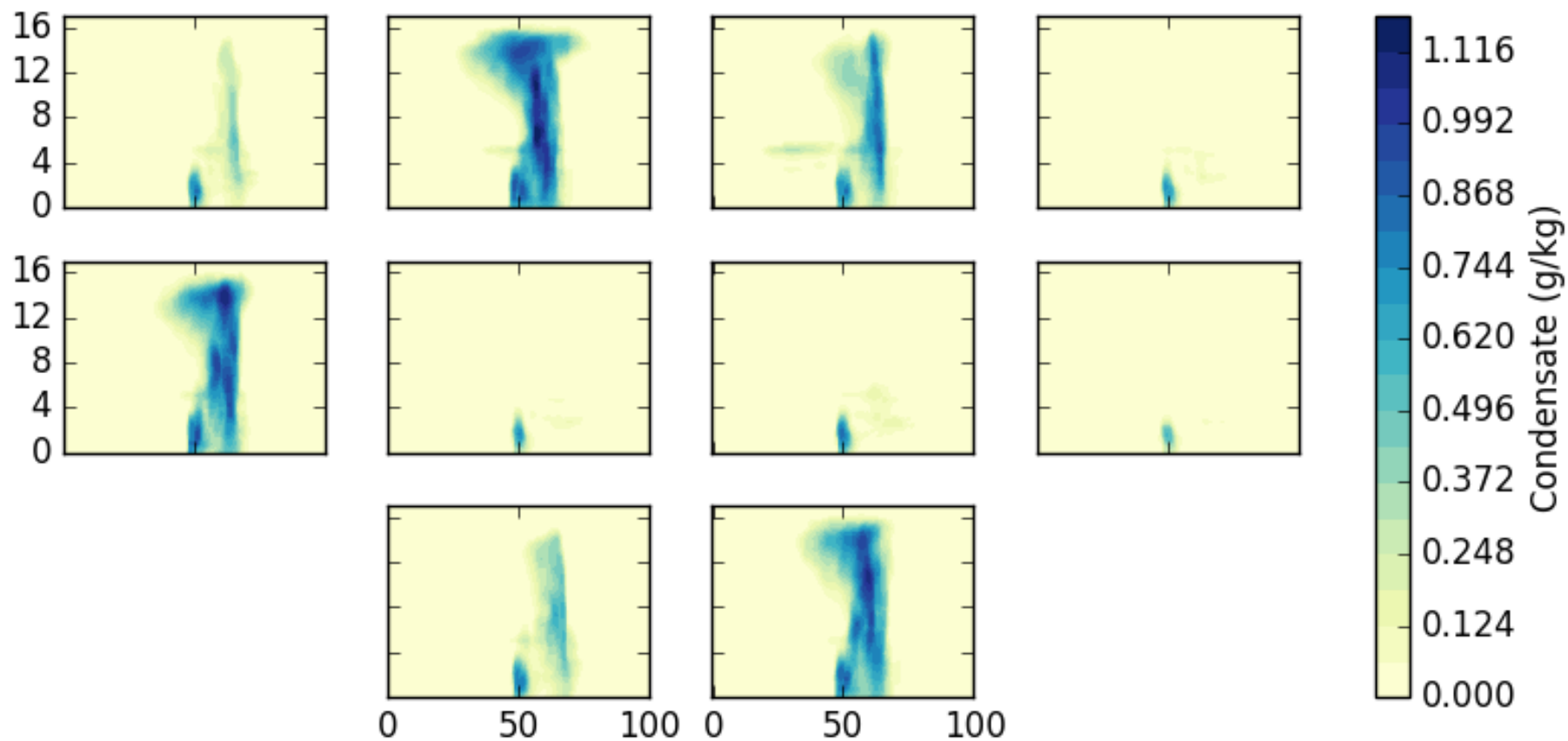


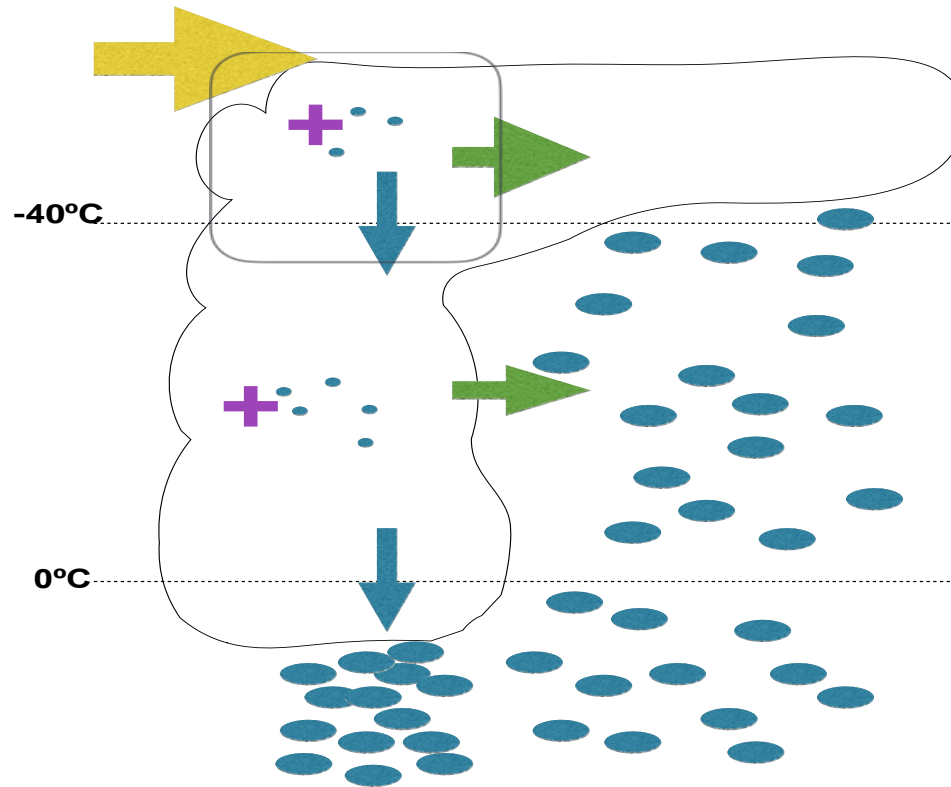


Max Vertical Velocity



NS Average Condensate, T=80 min



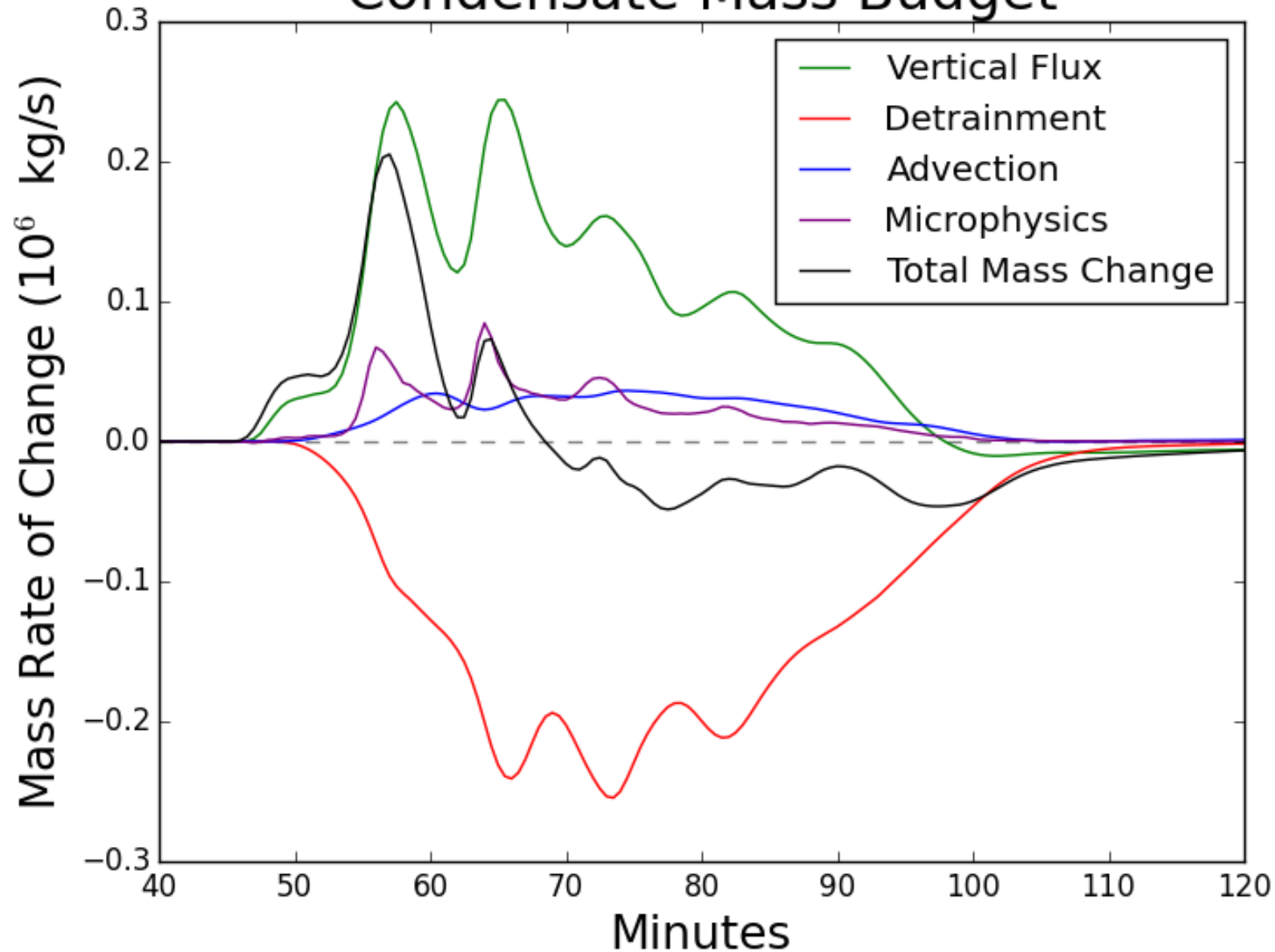


Convective Water Budget:

$$\begin{aligned}
 \frac{dM}{dt} = & \text{Vertical Flux (Updraft Flux} - \text{Precipitation)} \\
 & + \text{Microphysics (Vapor transfer to/from Liquid/Ice)} \\
 & + \text{Advection (Horizontal Flux of } \bar{p}uq) \\
 & + \text{Detrainment (Horizontal Flux of } \bar{p}u'q)
 \end{aligned}$$

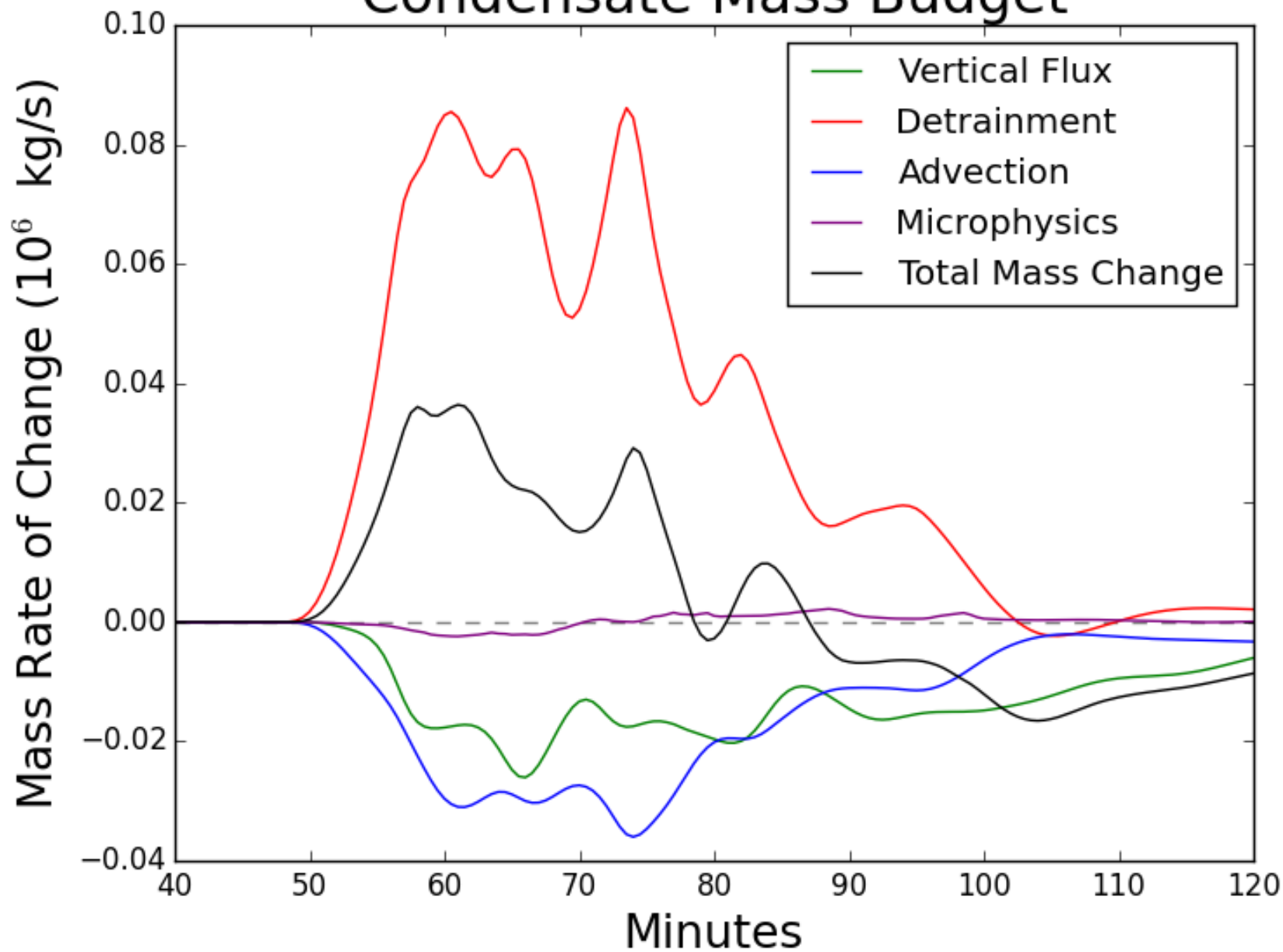
Convective Core

Condensate Mass Budget

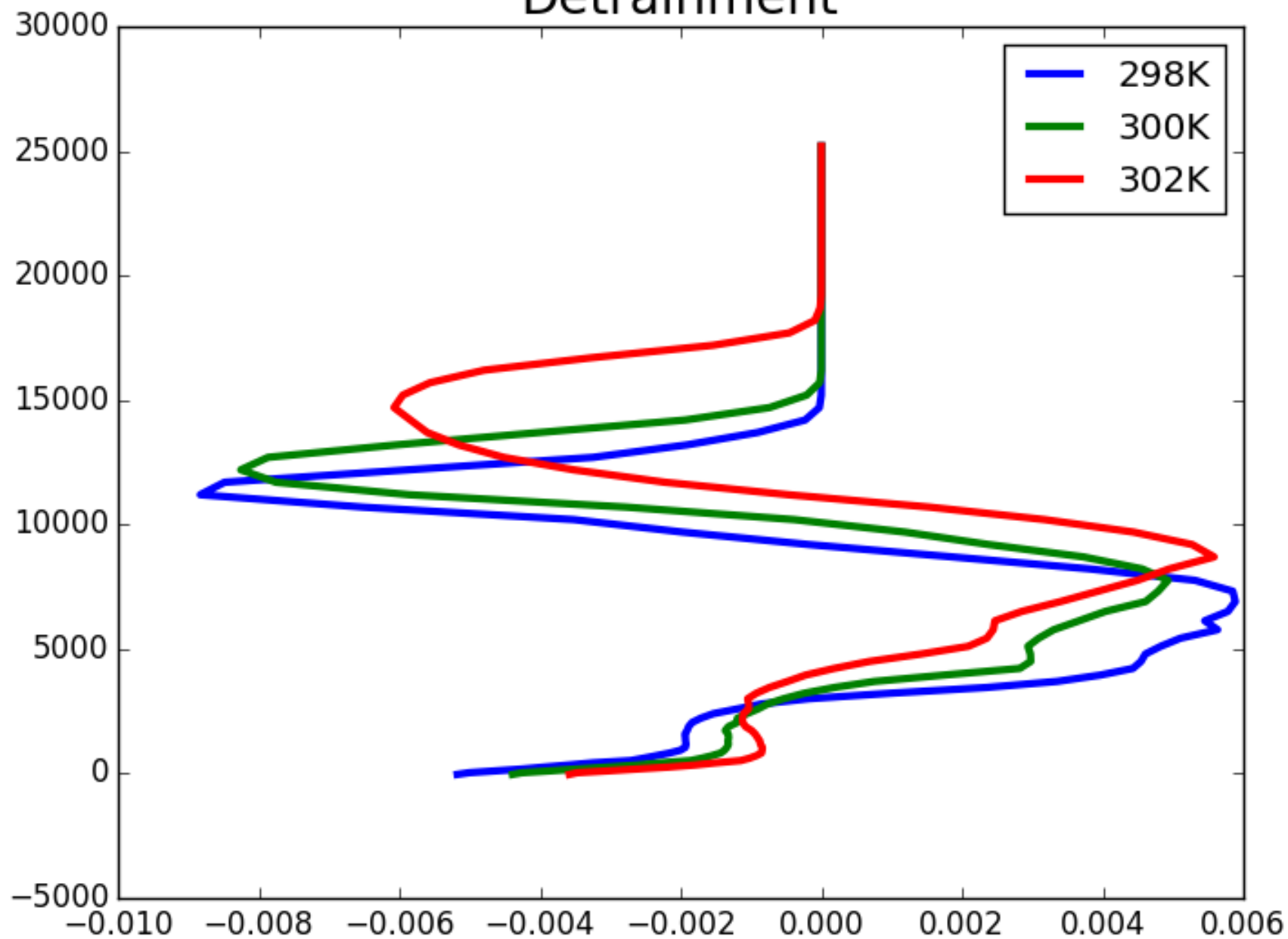


Deep Stratiform

Condensate Mass Budget



Detrainment



Comments/Questions?