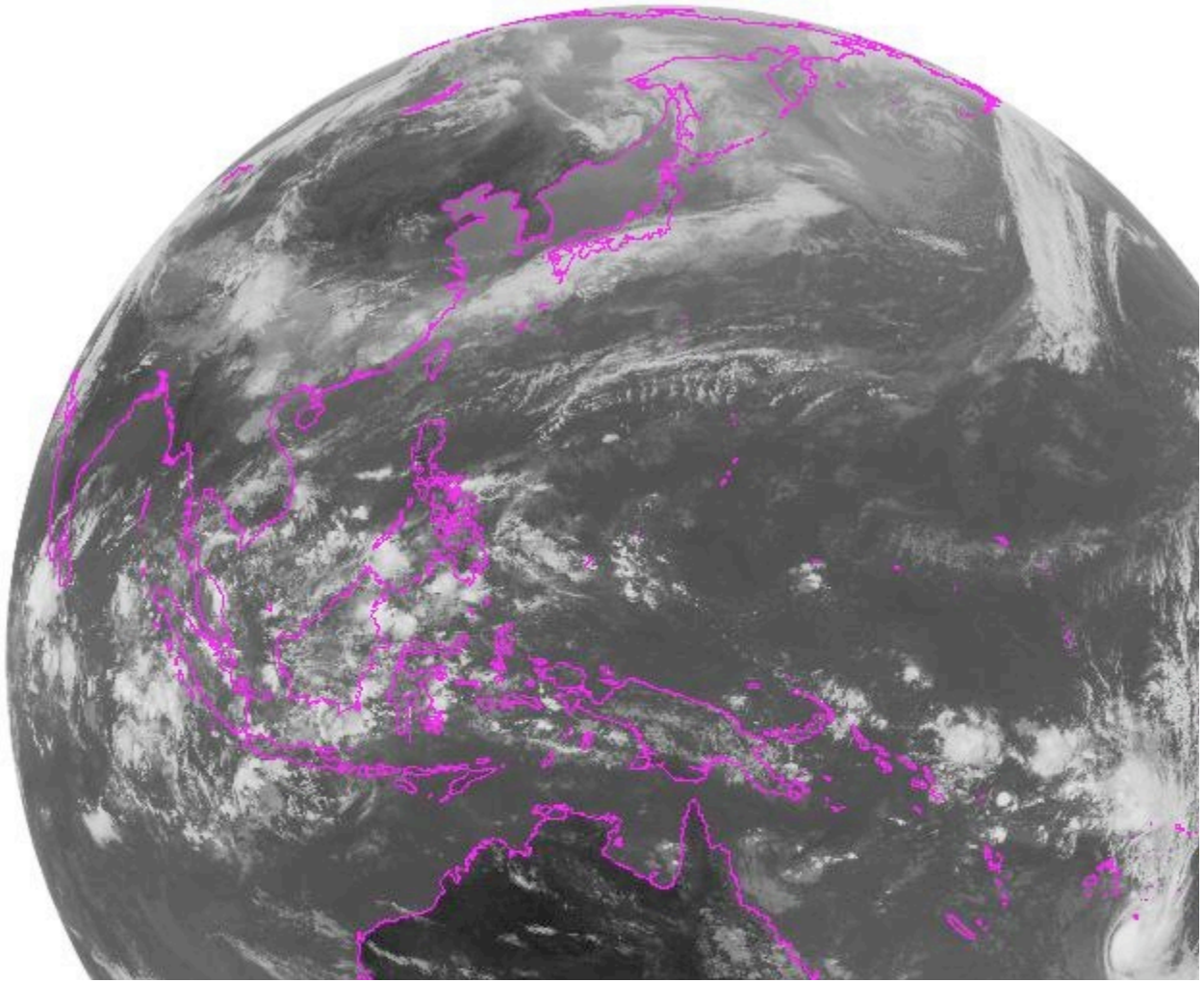
The Sensitivity of a Simulated MJO to the Tokioka Trigger

Walter Hannah



What is the MJO?

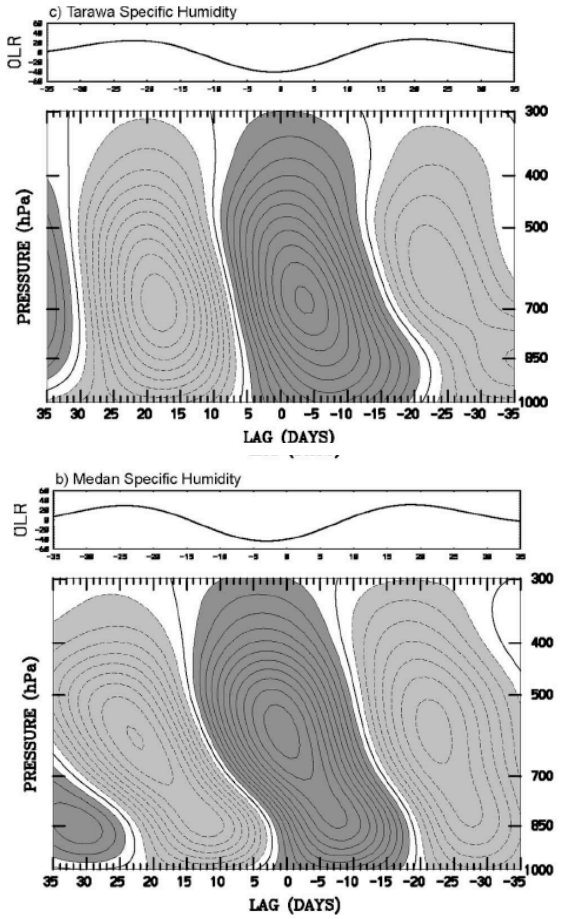
- A wave-like disturbance in tropical convection and large-scale circulation
  - Eastward propagating
  - Periodicity of 30 to 90 days (roughly)
  - Planetary scale (wavenumbers 1-3)
- The convective signal appears over the Indian ocean and dies out near the dateline
- Activity varies between seasons as well with the phase of ENSO

Why do we study it?

- The MJO is not very well understood
  - No theory can explain all of its features
- The MJO is poorly simulated in many climate models
  - Many models have very weak intraseasonal variability or have an MJO-like feature which propagates much faster than the observed MJO

From the ground up…

- Discharge-Recharge theory
  - Instability is built up gradually through low-level heating and moistening
  - Drying aloft due to subsidence from the wake of the previous MJO

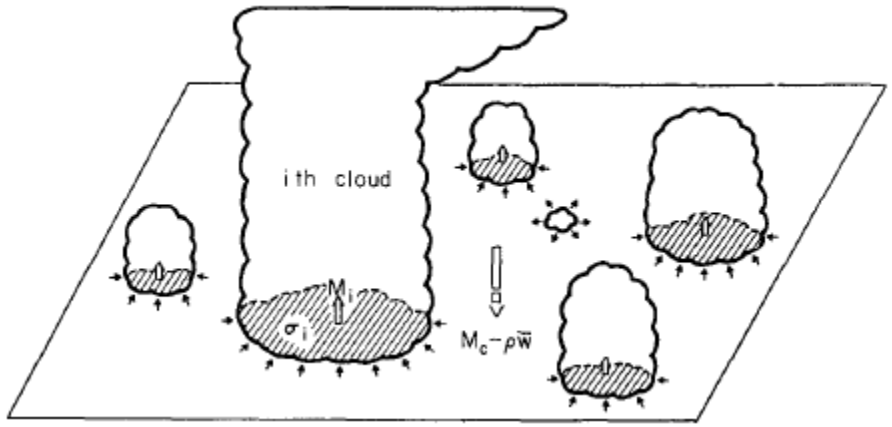


From Kiladis et al. 2005

Improving Model Variability

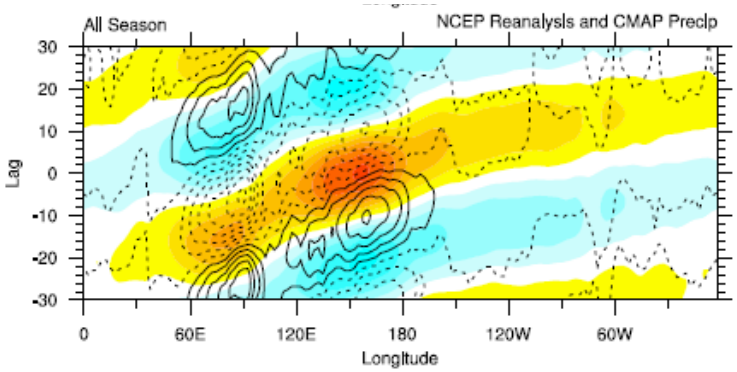
- Convective triggers
  - Inhibiting convection has been shown to improve model intraseasonal variability
- Tokioka et al. (1988) modified the Relaxed Arakawa-Schubert convective scheme include a minimum entrainment parameter

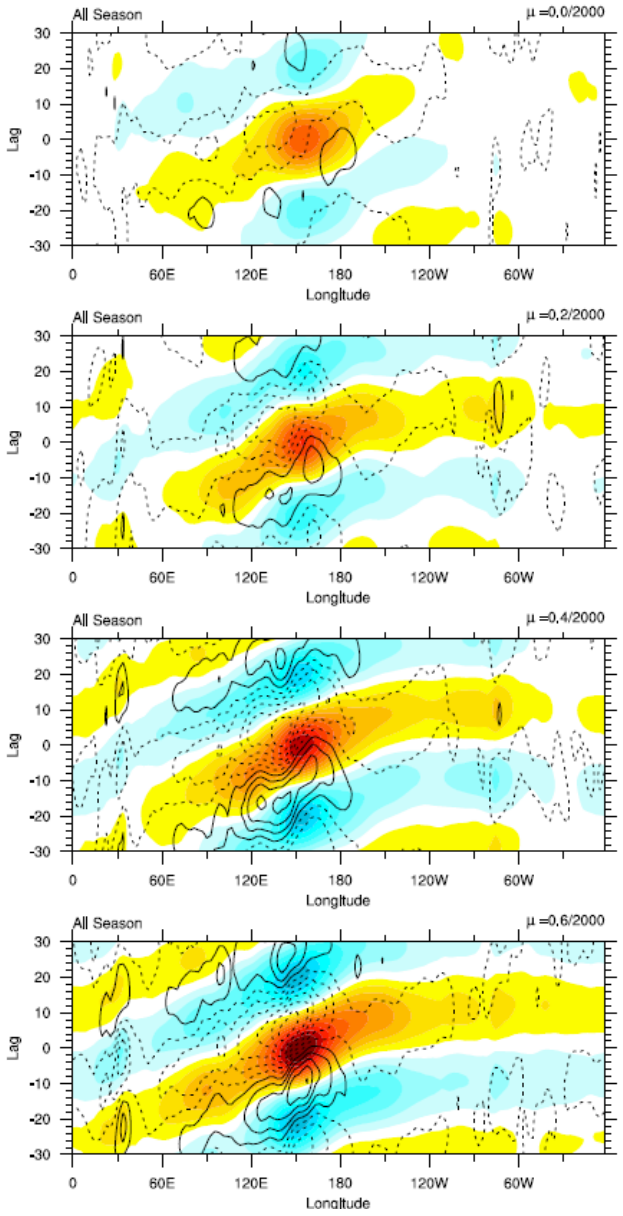
$$\mu = \frac{\alpha}{D}$$



Composites

- Improved propagation
- Enhanced variance

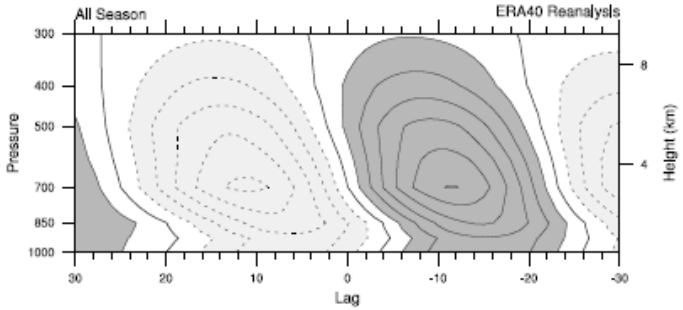


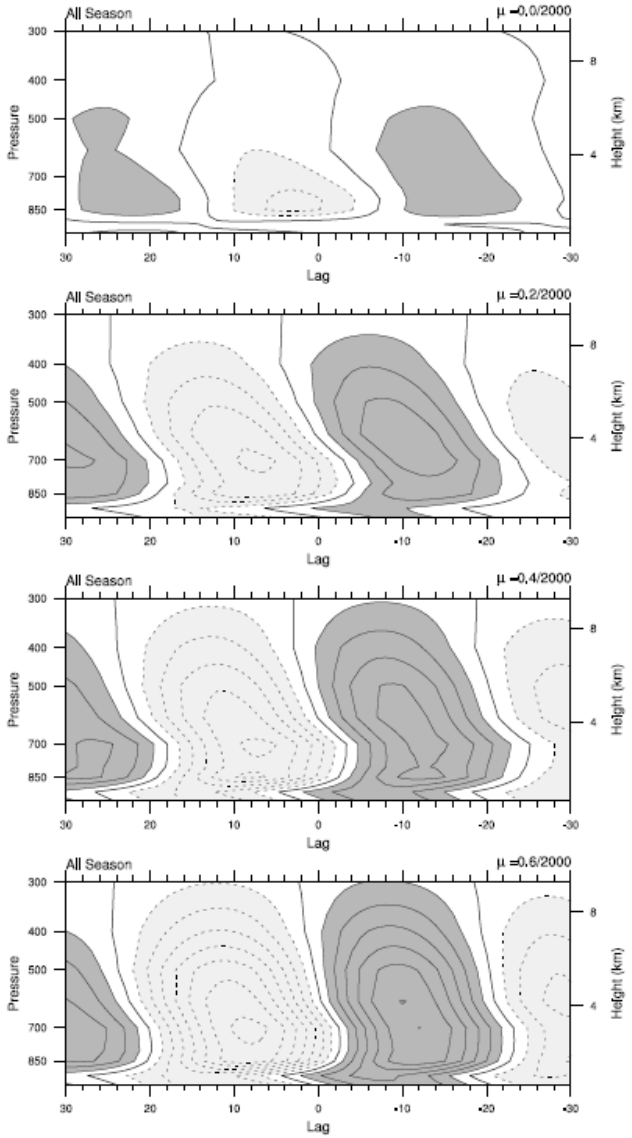


- Amplitude is too strong
- Missing precip max in Indian ocean

Composites

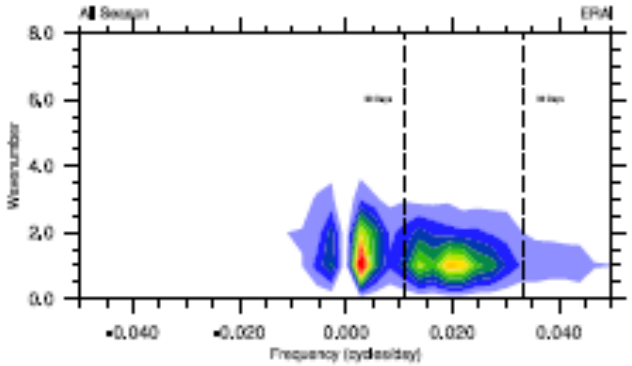
- Tilted structure similar to observations

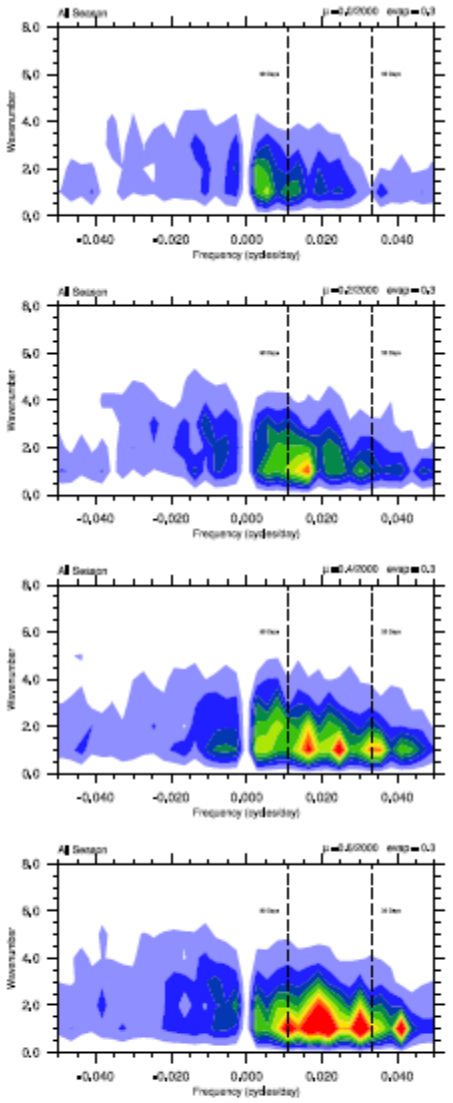




Space-Time Spectra

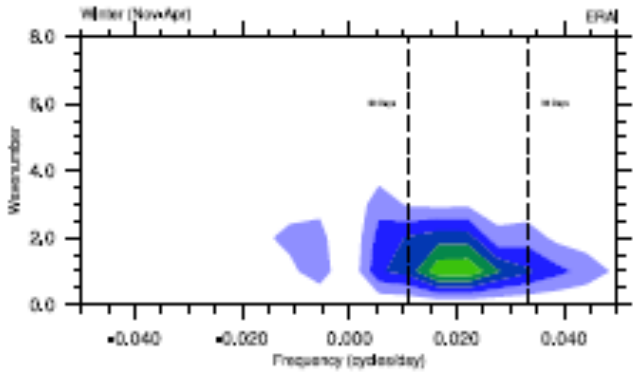
- All Season

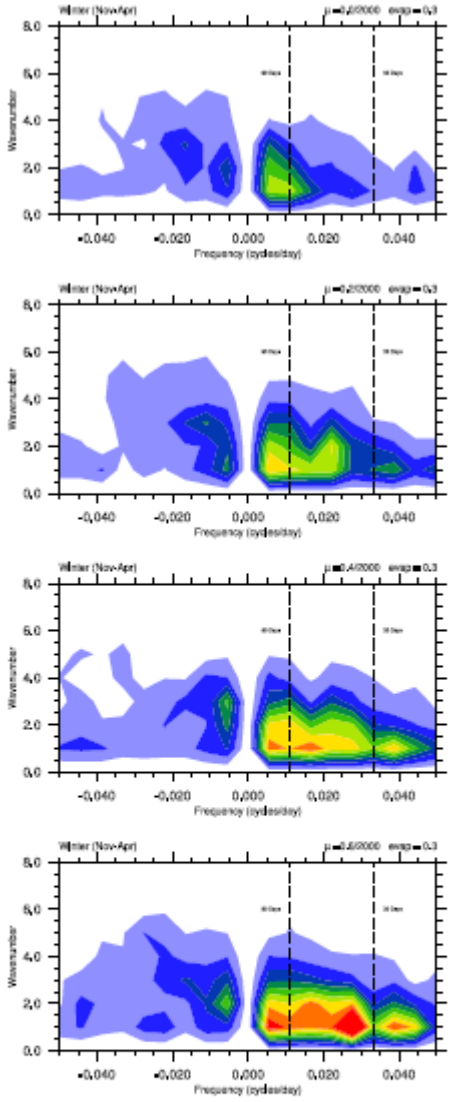




Space-Time Spectra

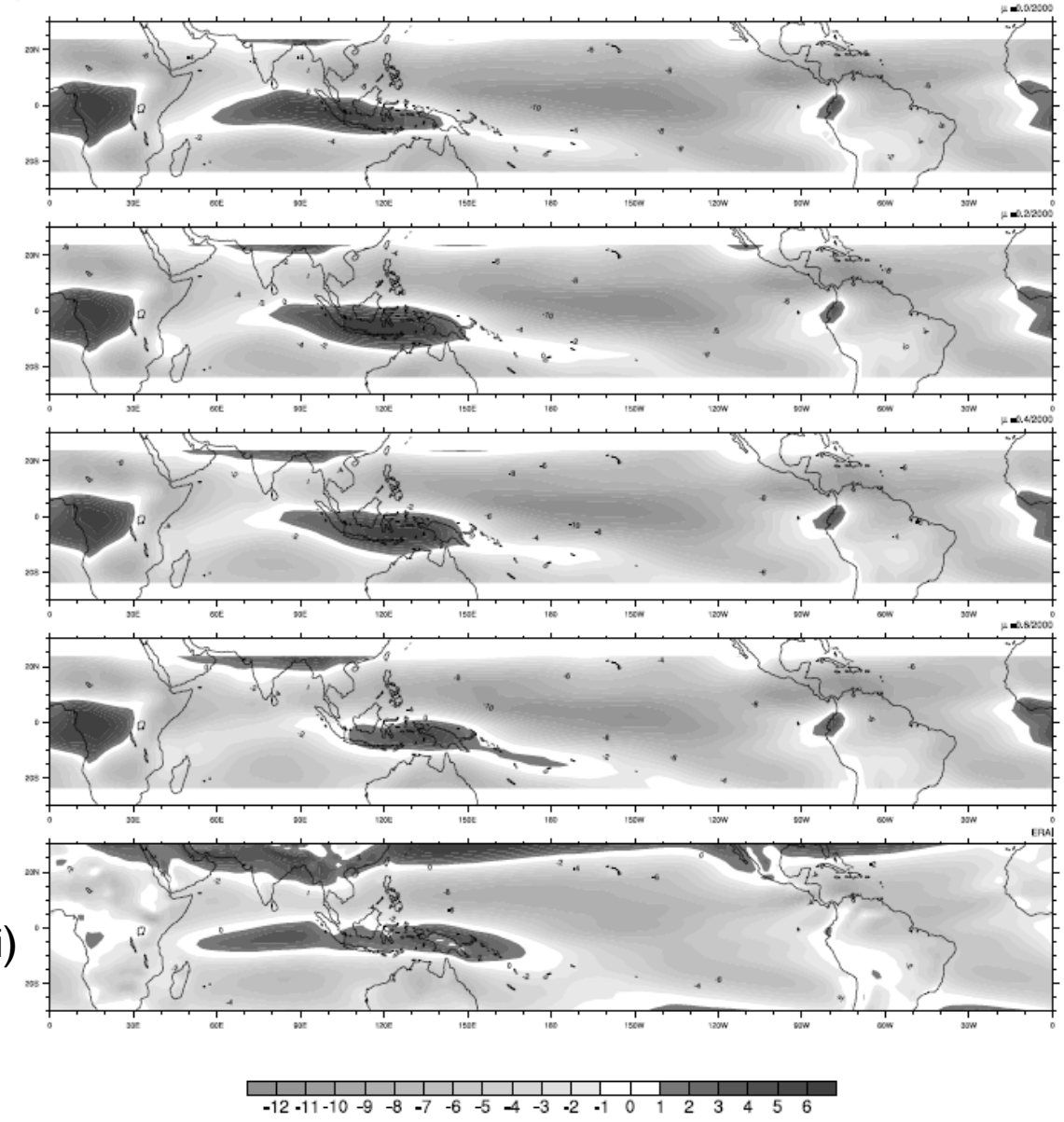
- Winter (Nov-Apr)





Climate

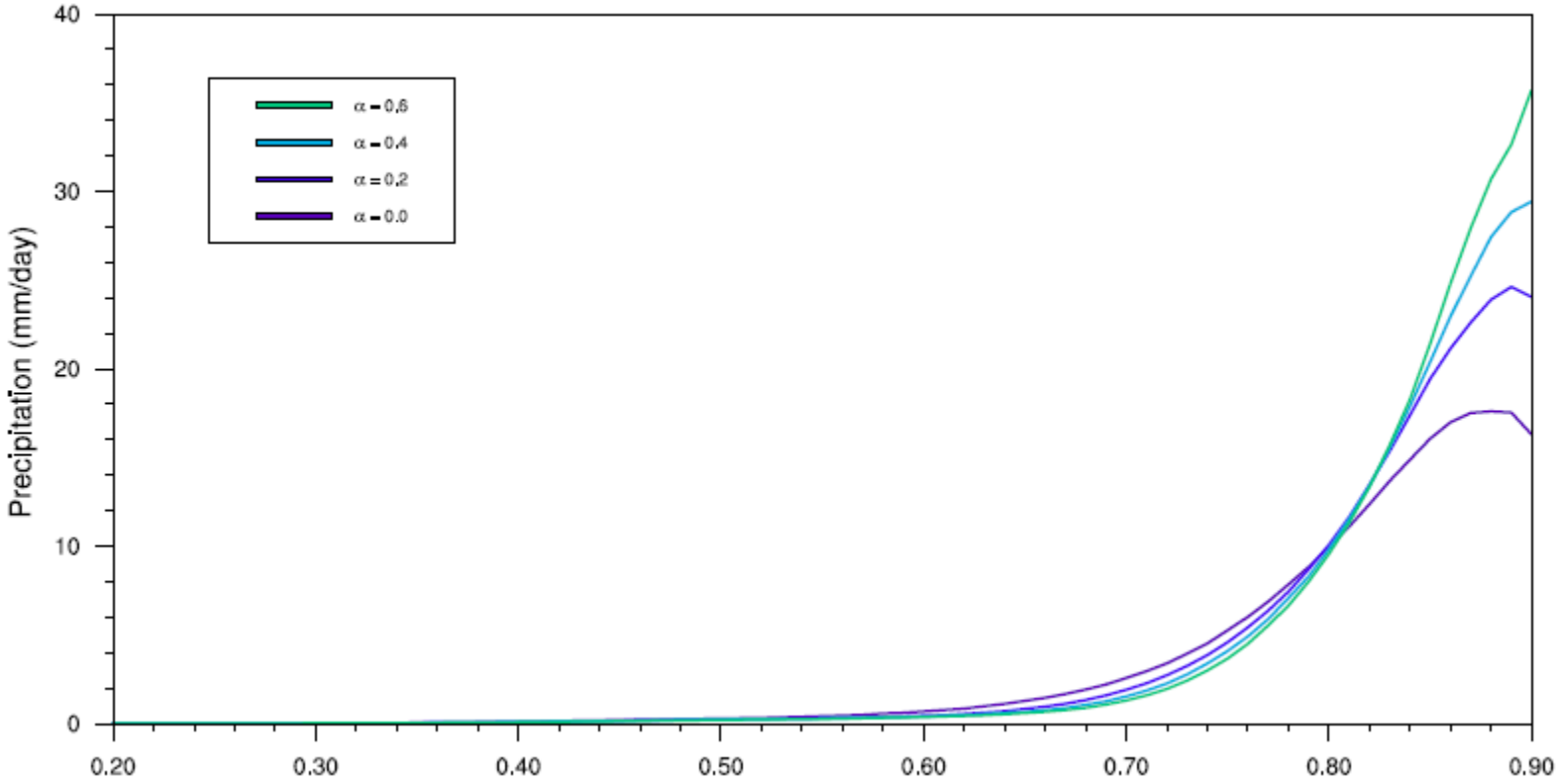
Increasing minimum entrainment



Obs (ERAi)

Climate

- Increased sensitivity to environmental humidity
  - Decreased rainrate for lower saturation fraction
  - Increased rainrate for higher saturation fraction



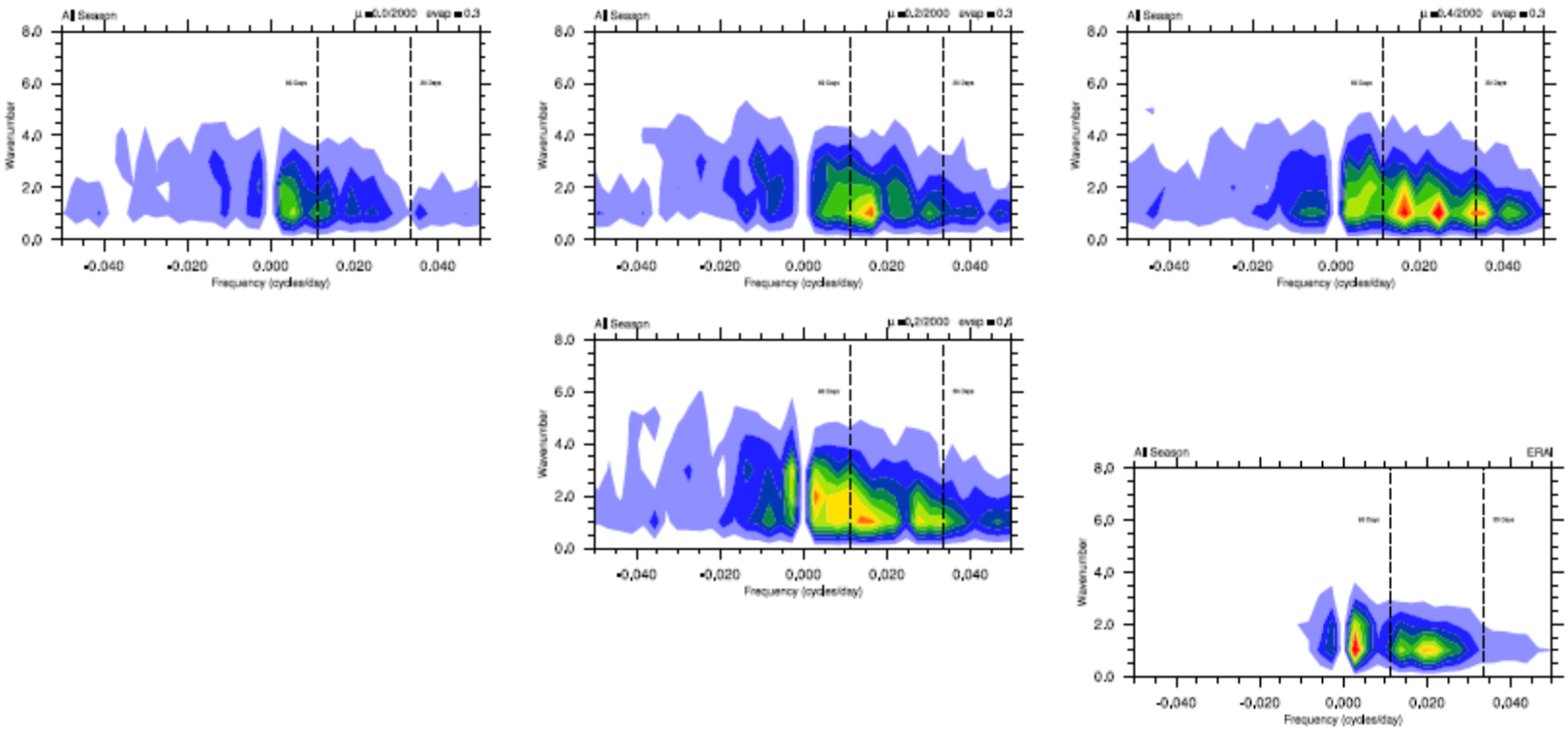
Alternate Methods

- Similar efforts have shown that increasing the rate of rain re-evaporation can increase intraseasonal variability as well

Space-Time Spectra (All Season)

Entrainment

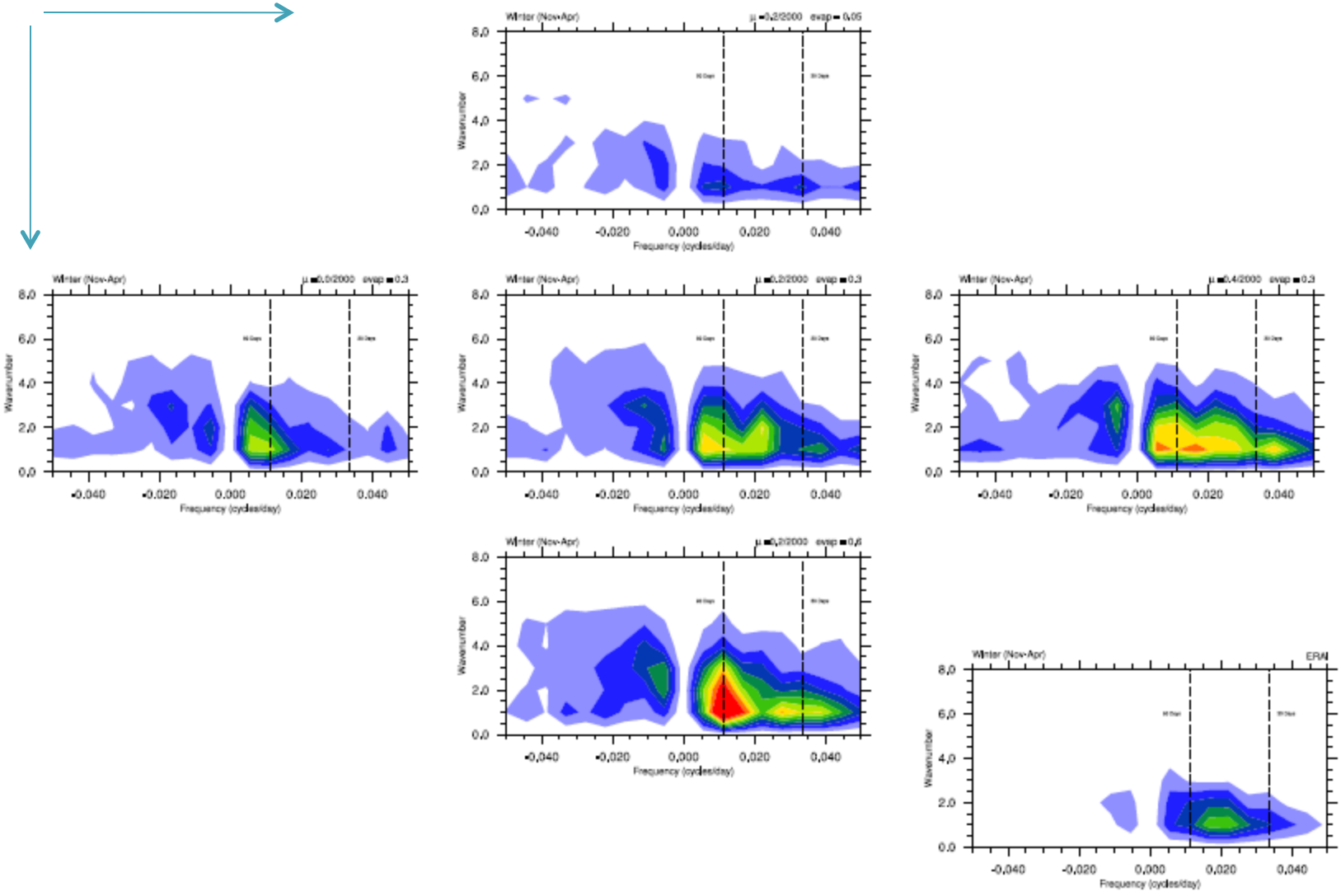
Re-Evaporation



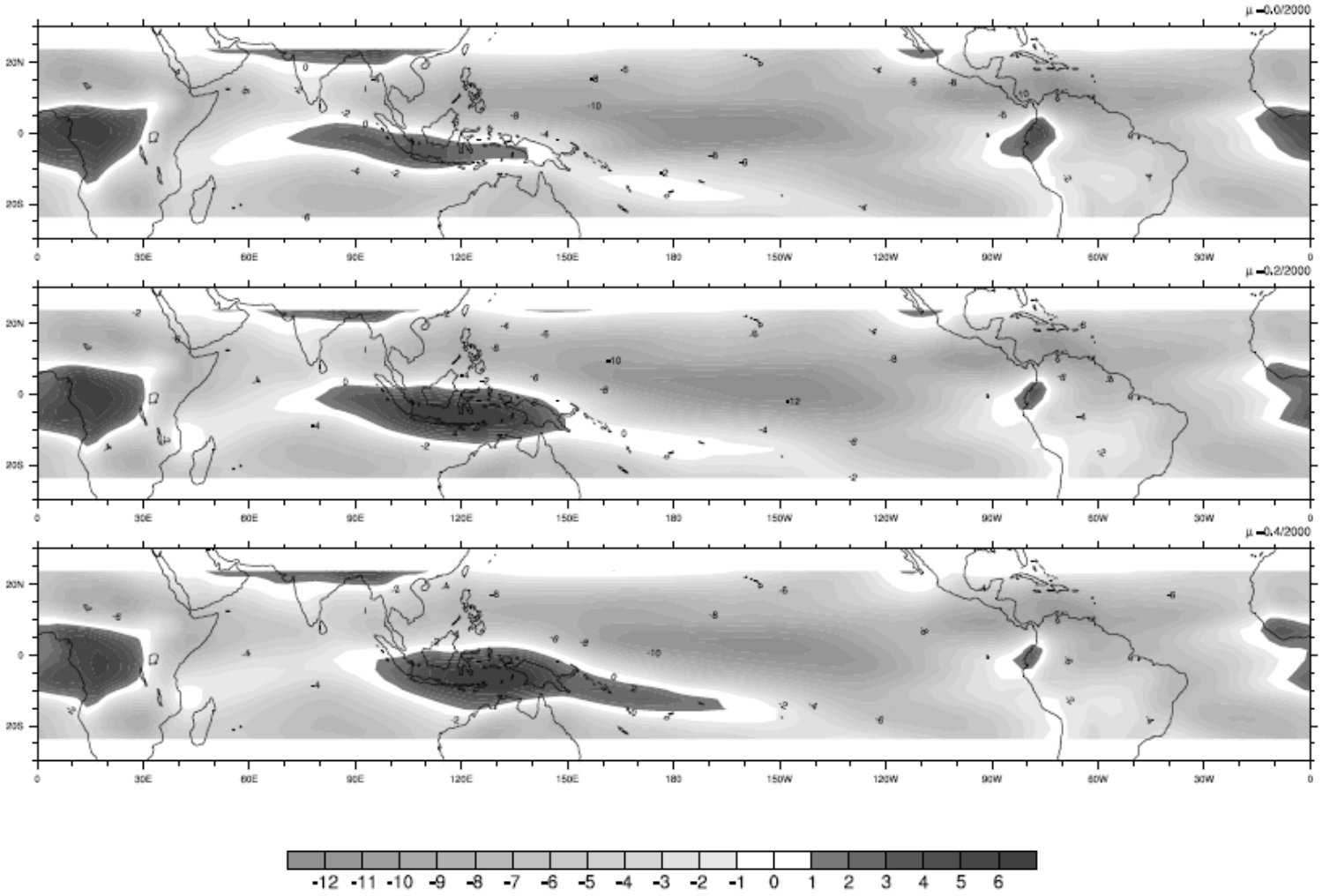
Space-Time Spectra (Winter)

Entrainment

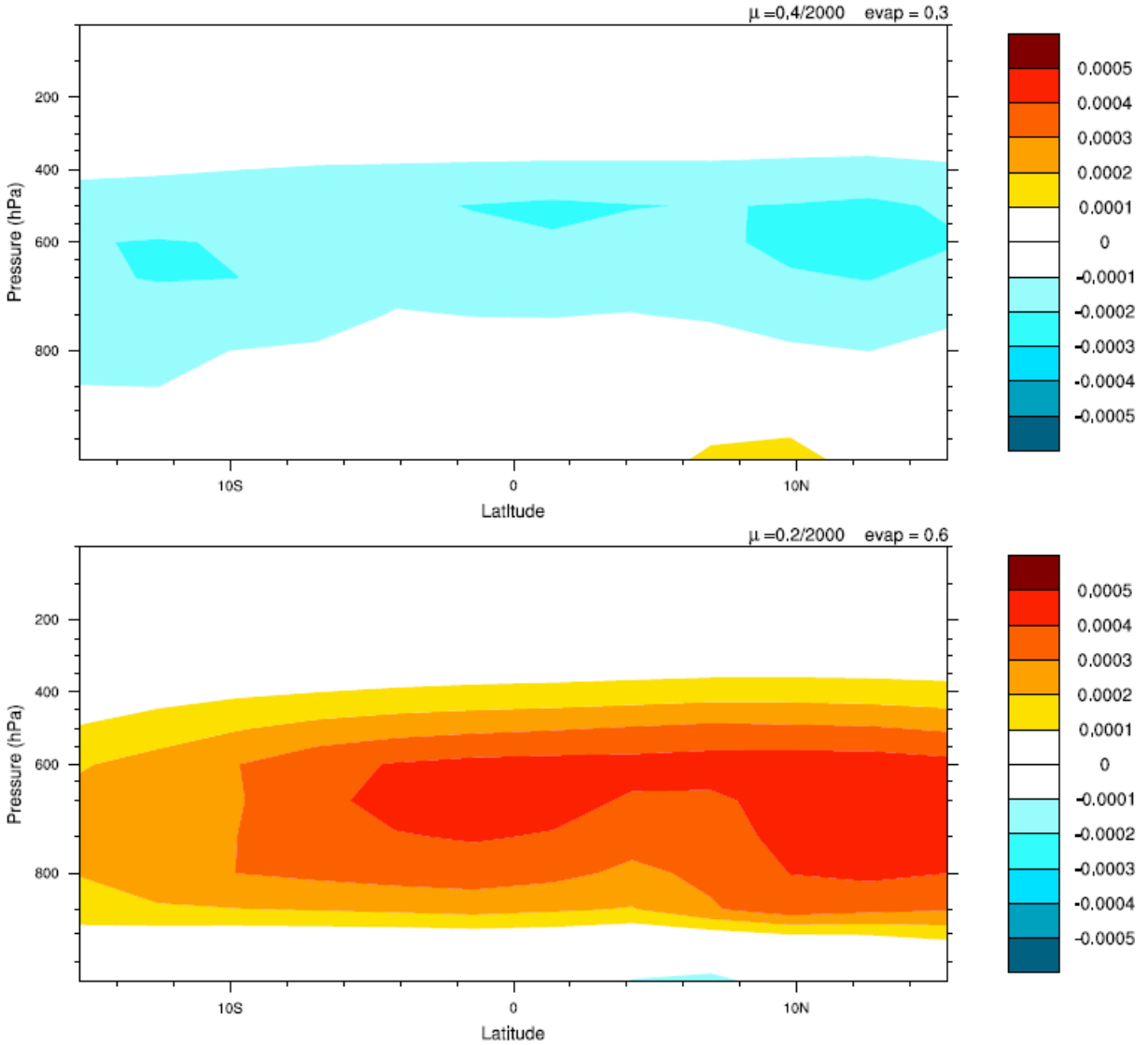
Re-Evaporation



Climate

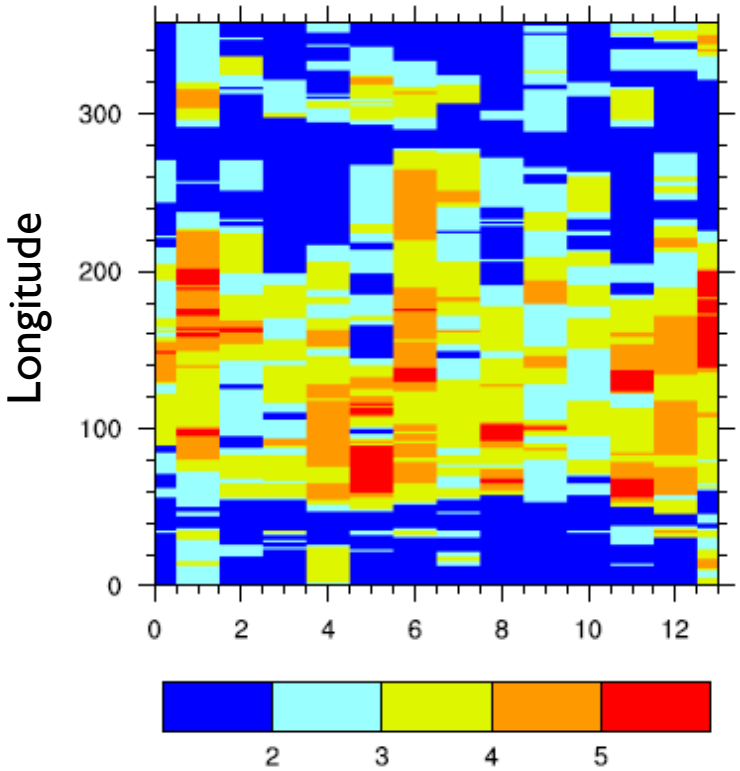

μ =0.0/2000
μ =0.2/2000
μ =0.4/2000
20N
0
20S
0
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
-12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6

Climate Changes

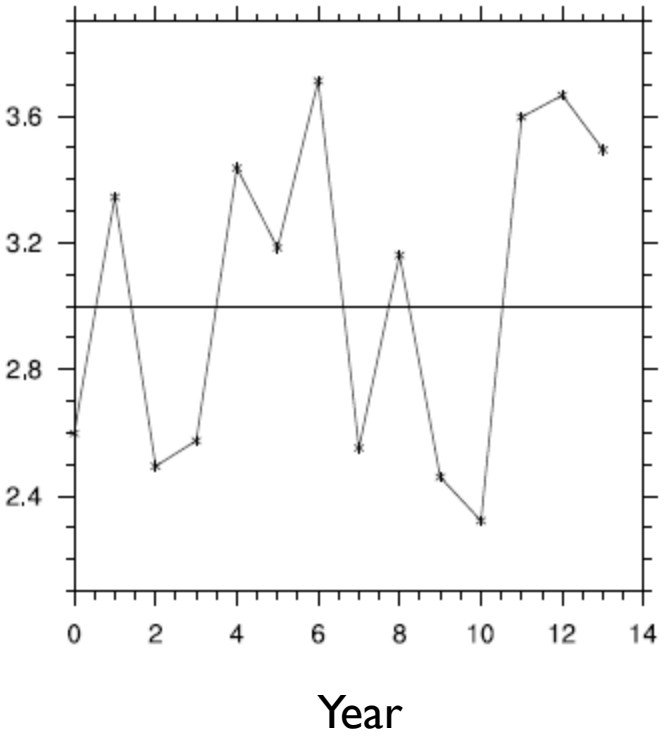


What about the Obs?

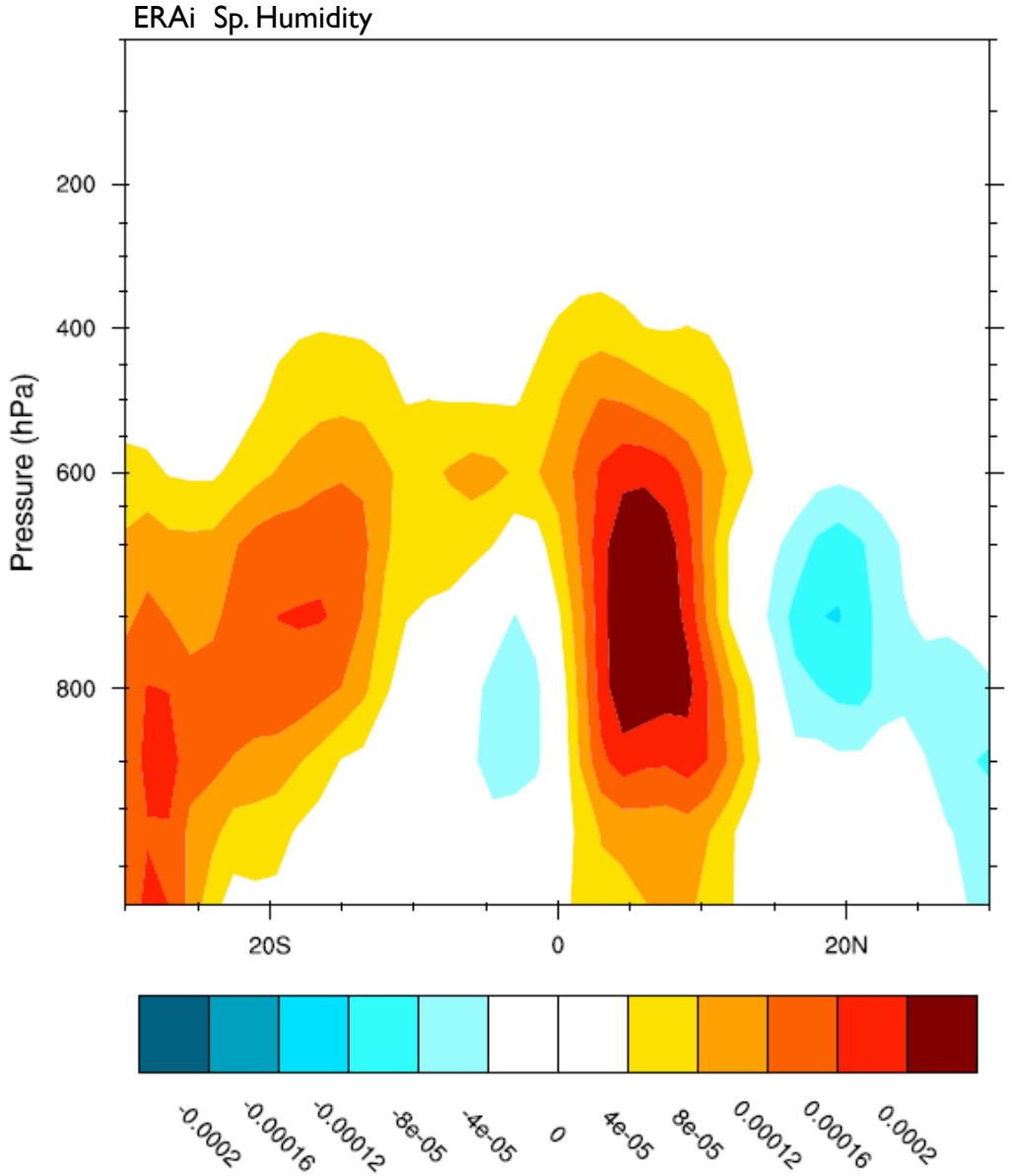
Average Number of Winter Events



Indo-Pac Region



Active – Inactive Seasons



Future Work

- Find a way to show if changes in the mean state are responsible for enhanced intraseasonal variability
- Add SP-CAM analysis for comparison
- Write a thesis?