

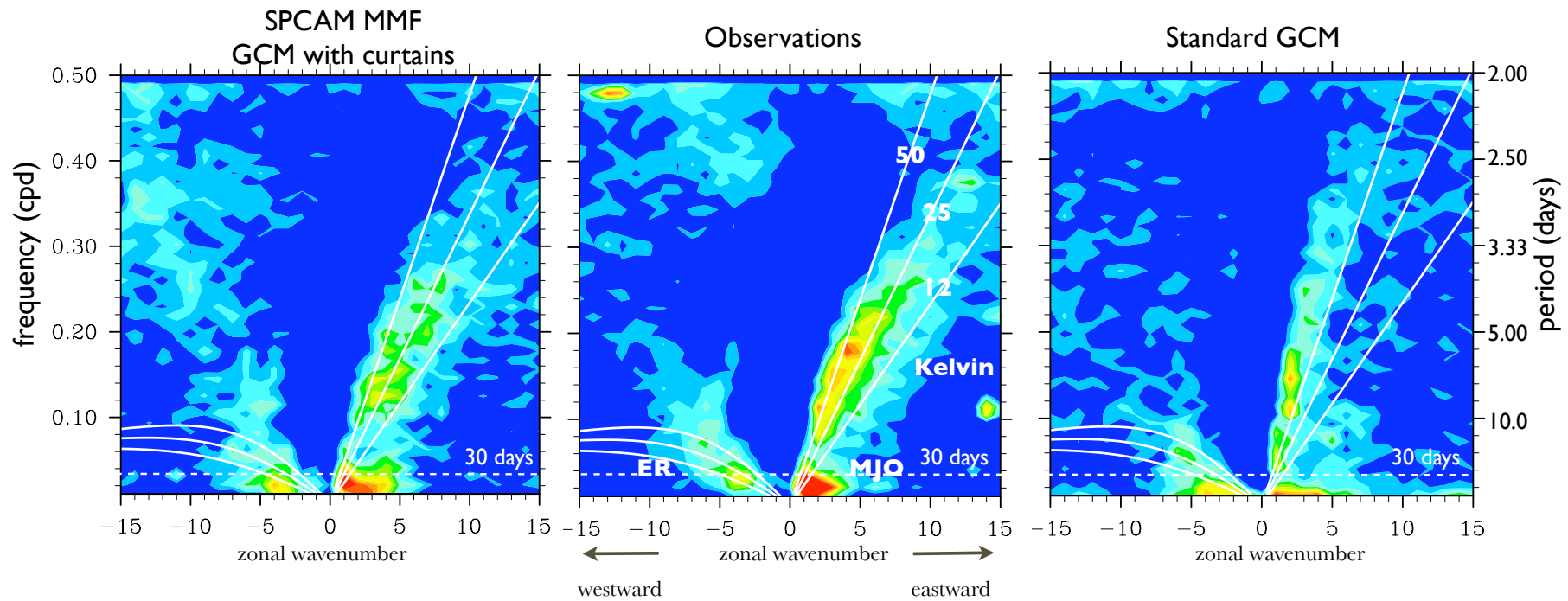


**MJO sensitivities on aquaplanet  
as simulated by SP-CAM**

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Long Island, NY**

# Simulated sub seasonal tropical variability OLR

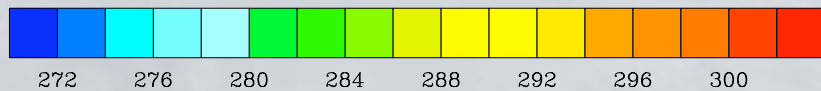
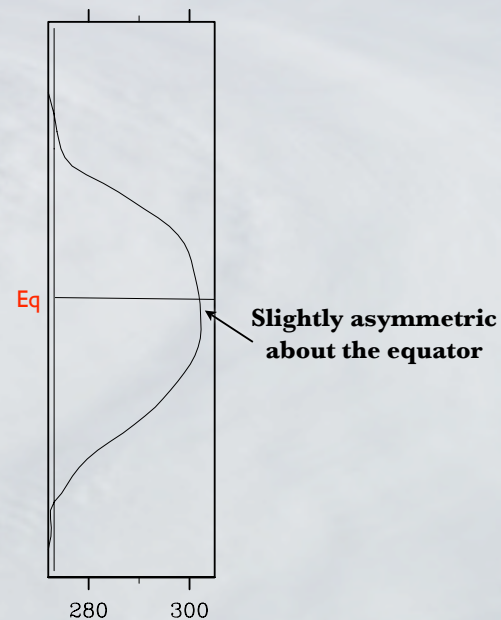
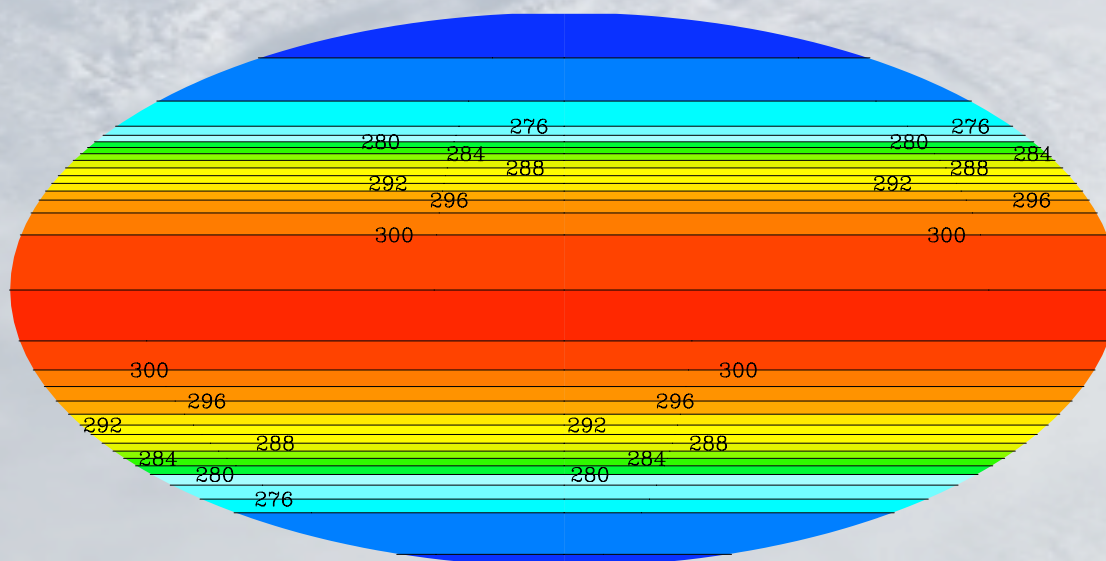


# MJO on Aquaplanet/Water World

## Why Aquaplanet? Simplicity!

- no polar ice, no land/soil/terrain complications
- heat and vapor fluxes over water - we know how
- zonally symmetric (zonal means direction of latitude circle)
- perpetual equinox - no seasons
- Mean climate resembles the Earth's
- Still has MJO and main equatorial waves

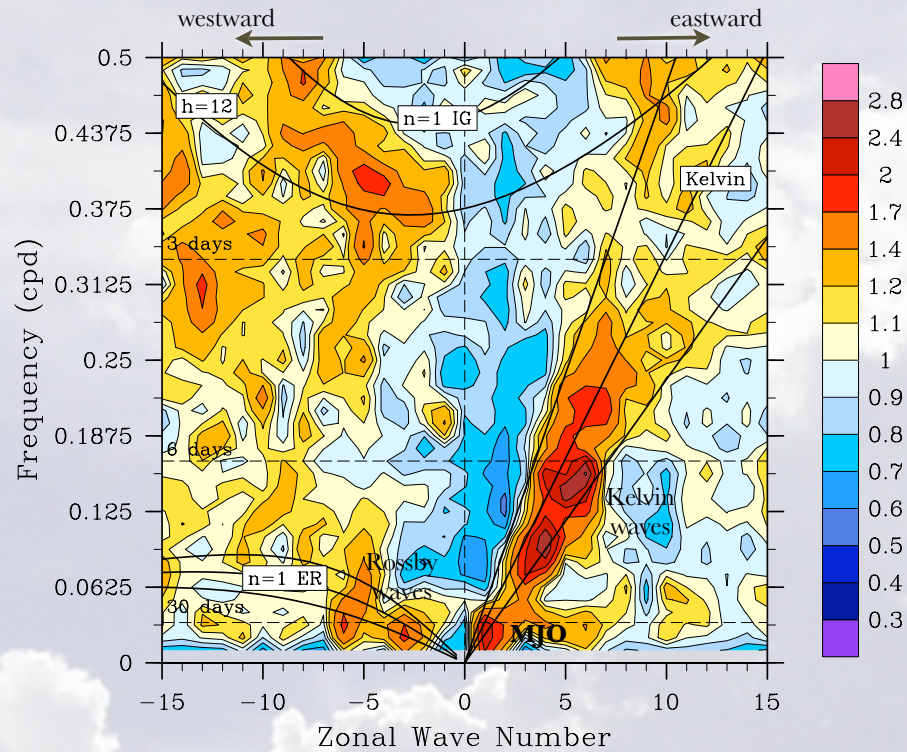
Sea Surface Temperature (prescribed)





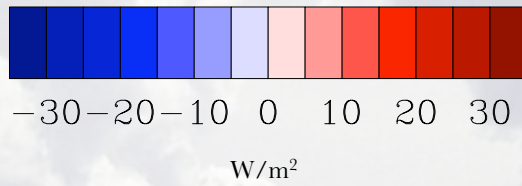
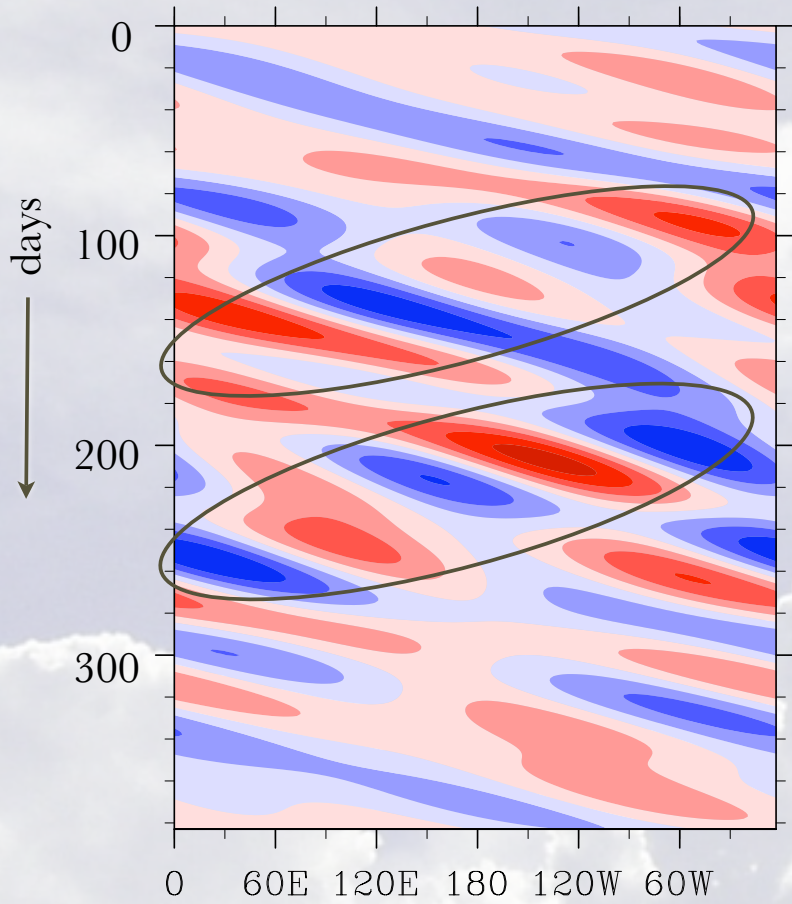
Simulated tropical variability on Aquaplanet looks similar  
to subseasonal tropical variability on Earth

### OLR

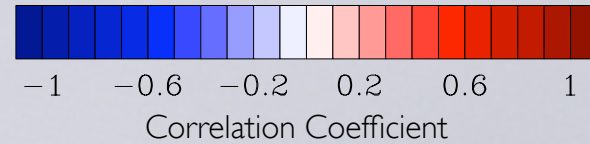
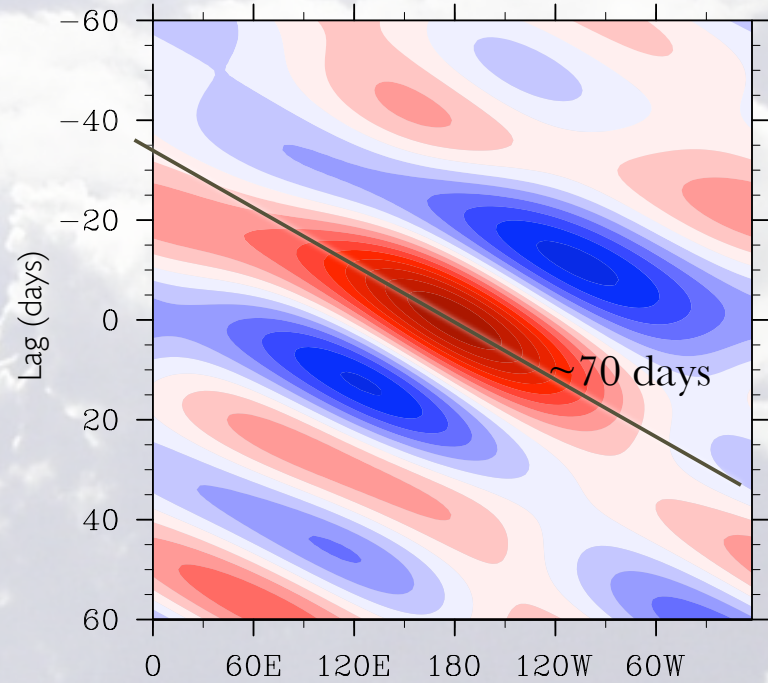


# MJO forms 'wave packets' on Aquaplanet

384-day sample



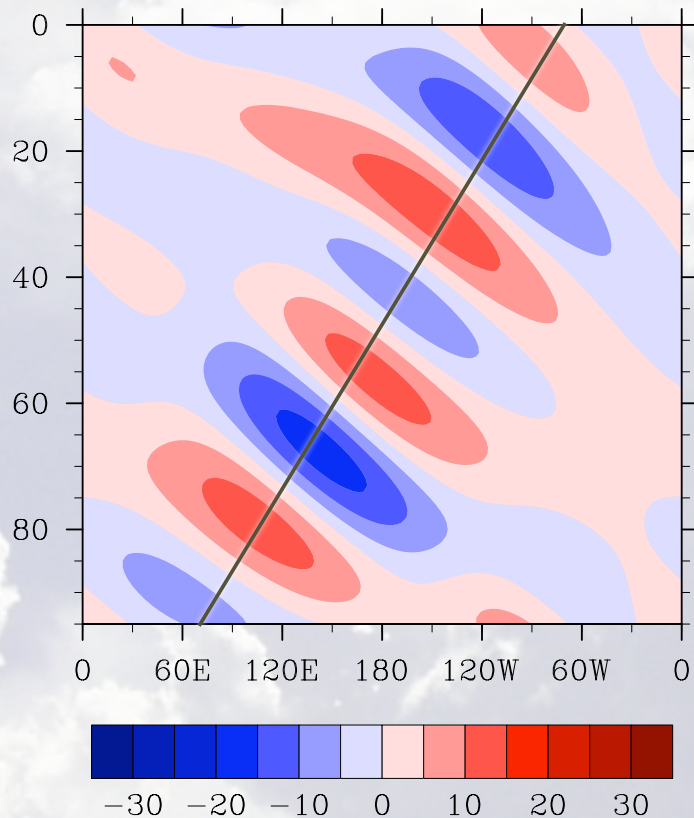
Aquaplanet MJO-filtered OLR



$W/m^2$

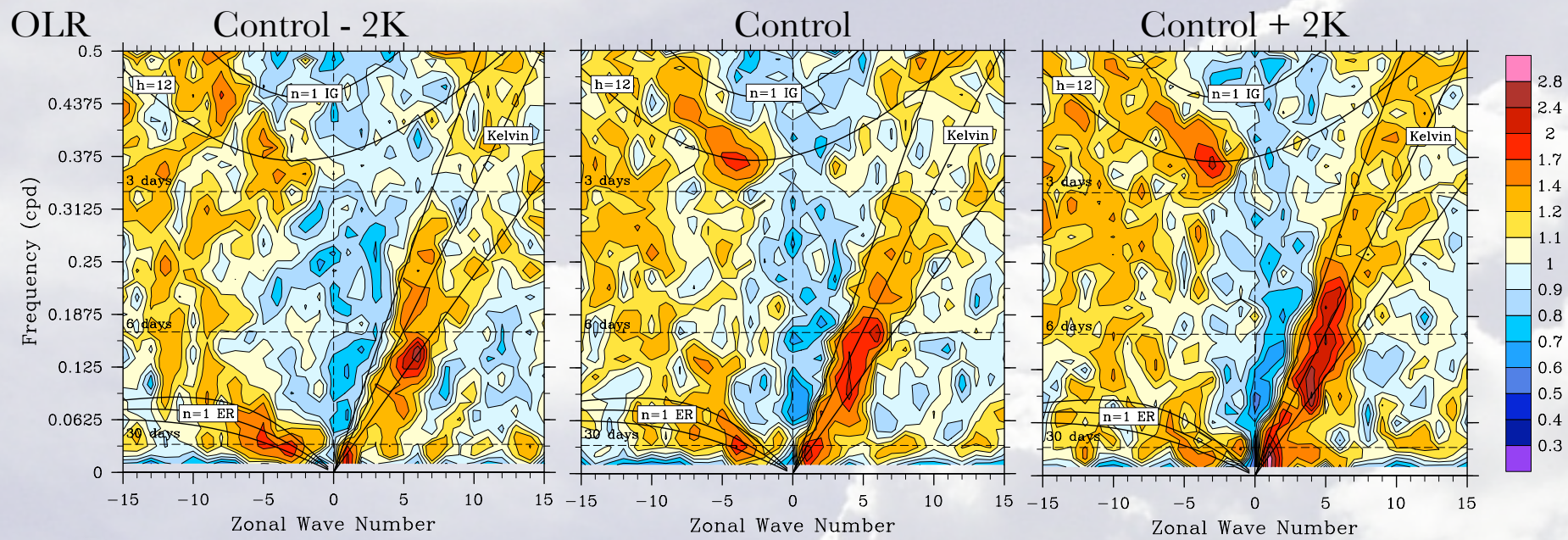
on Earth too  
NOAA OLR  
(Satellite observations, not a model)

Strong El Nino year  
1997.81

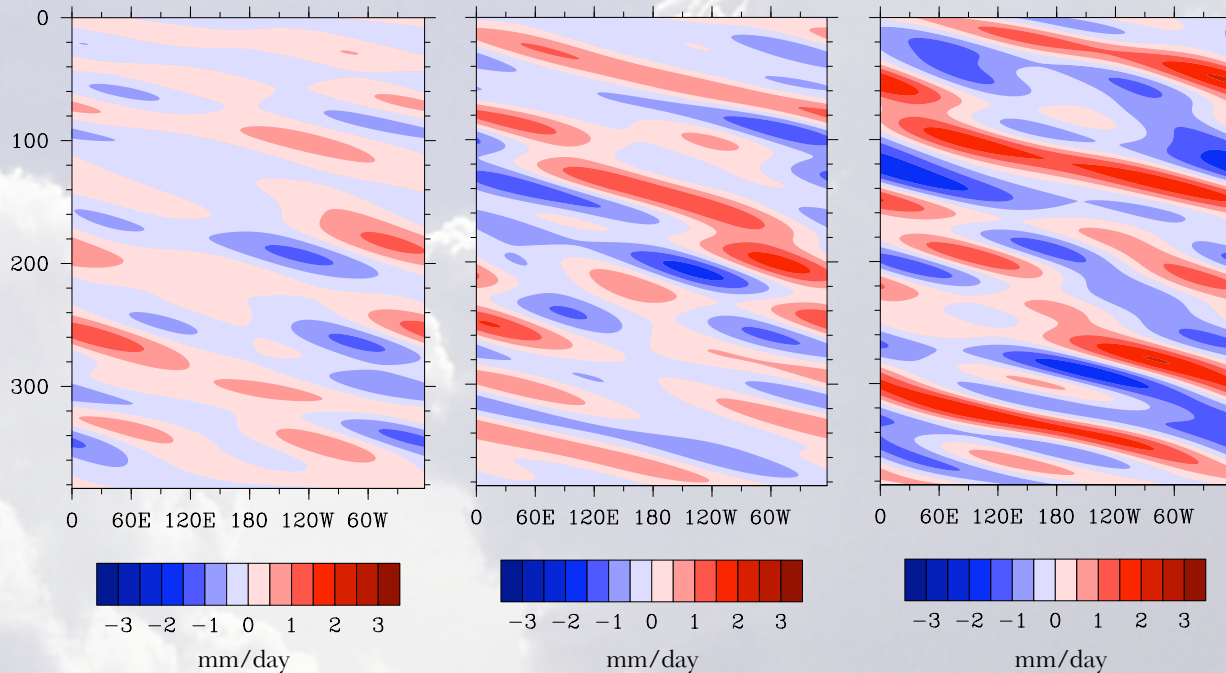




# Sensitivity to Aquaplanet Sea Surface Temperature



MJO-mode  
Precipitation



**Positive SST  
perturbation  
causes stronger MJO  
and Kelvin modes,  
but weaker Rossby  
mode.**

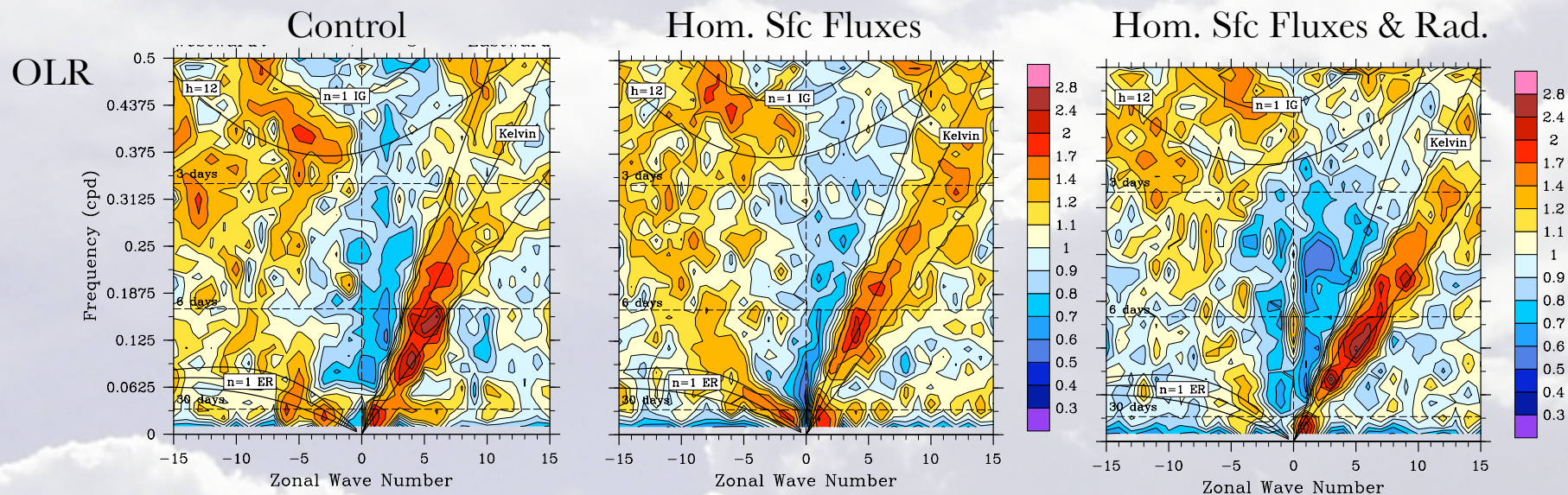
**Rising CO<sub>2</sub>**

**Warmer  
Tropical SST**

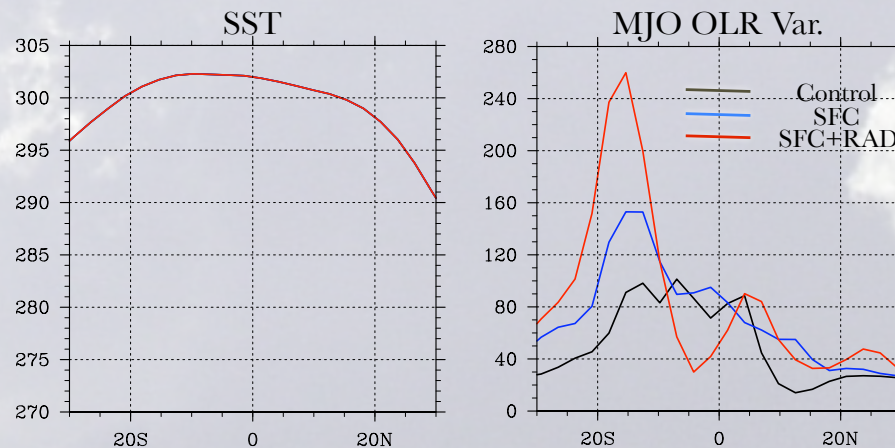
**More extreme  
rain associated  
with MJO in the  
future?**

## Sensitivity to Zonally Homogenized Surface fluxes and Radiative Heating

- Zonal Homogenization: Compute surface fluxes and radiation heating rates as usual but apply them zonally averaged (no WISHE, no anomaly damping).



- Homogenization shifts MJO towards warmer SSTs and concentrates MJO into narrower band;
- Zonal variation of surface fluxes and radiative heating doesn't seem to be essential for maintaining simulated MJO;

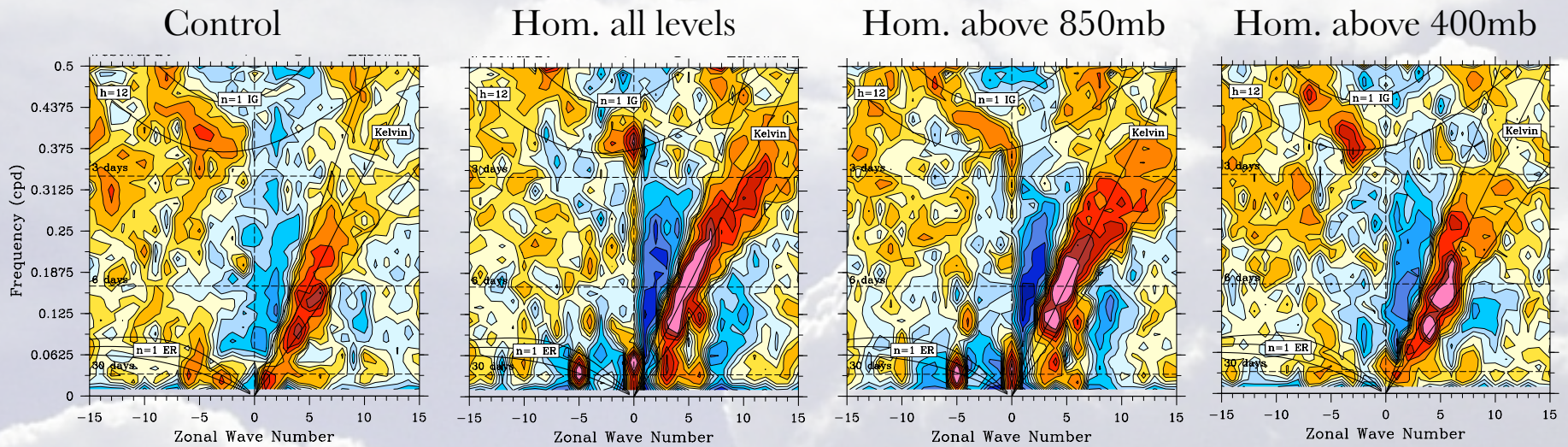




## Sensitivity to Zonally Homogenized Water Vapor

- Zonal Homogenization: Nudge (relax) water vapor to zonally averaged values over diurnal time scale;

OLR



- **The existence of mid-to-low troposphere (but above PBL) water-vapor anomalies is the key for the existence of simulated MJO.**
- **The anomalies are associated with the shallow and congestus cloud activity - hence, representation of those cloud types in GCMs is the key for MJO simulation**

## Conclusions

- **Simulated tropical variability on Aquaplanet looks similar to subseasonal tropical variability on Earth;**
- **On aquaplanet, MJO forms westward propagating packets - SuperMJO ?; (how about Earth?)**
- **+2K SST perturbation experiments suggest that warmer SSTs can cause stronger MJO and stronger Kelvin waves, but weaker Eq. Rossby waves;**
- **Zonal variation of surface fluxes and radiative heating may not be essential for maintaining simulated MJO;**
- **The existence of mid-to-low troposphere (but above PBL) water-vapor anomalies is the key for the existence of simulated MJO.**