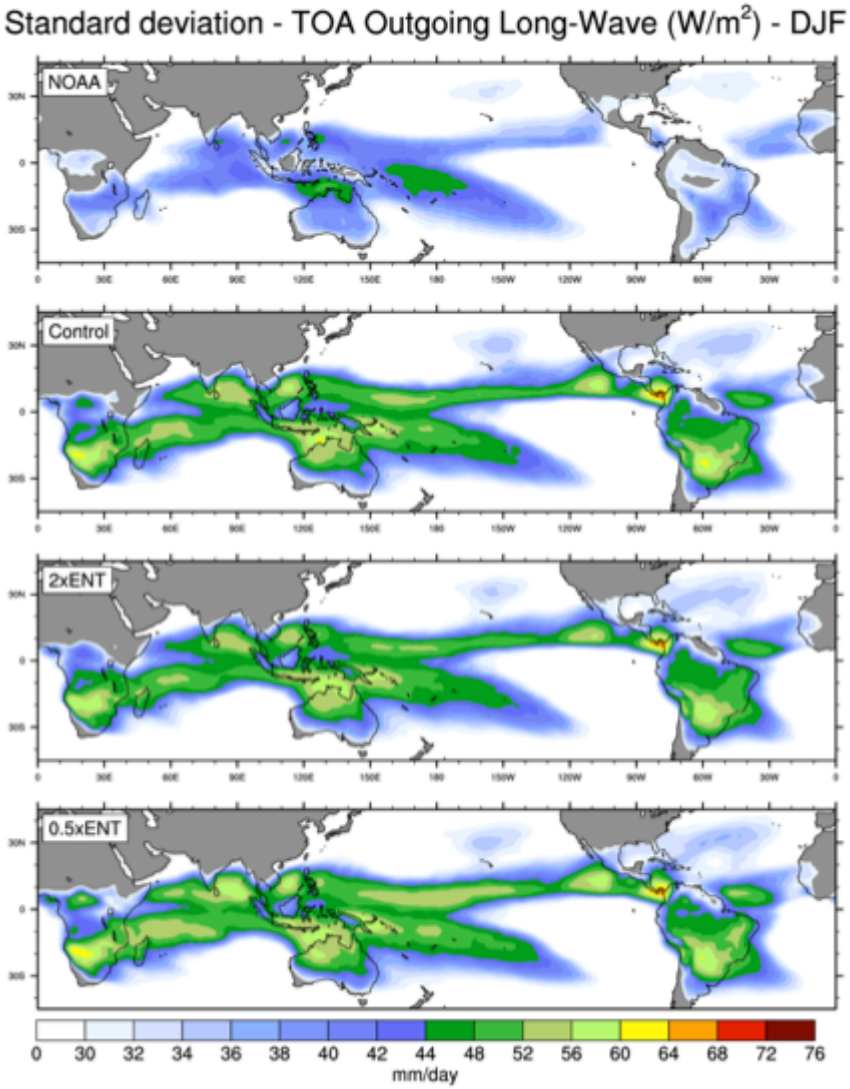
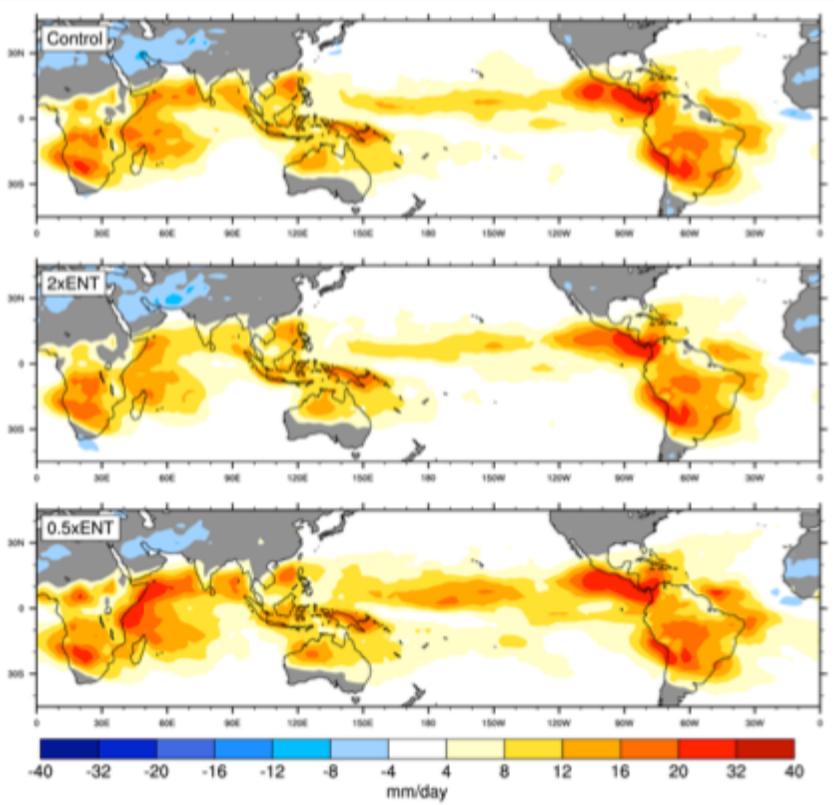
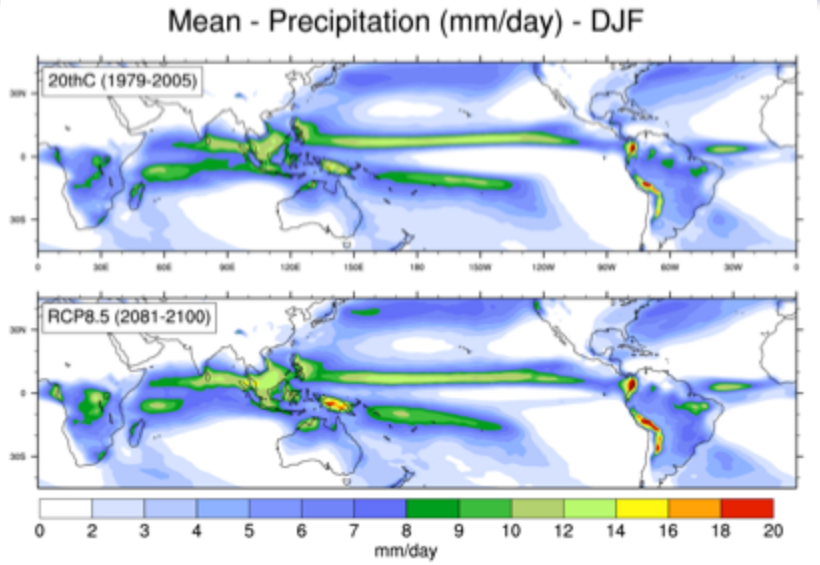
Variability (daily data) AMIP simulations: Entrainment (ENT)



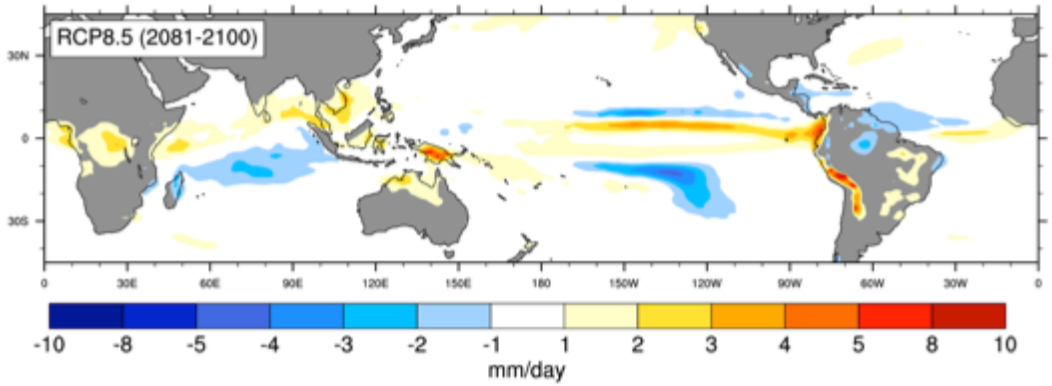
Model minus Observed

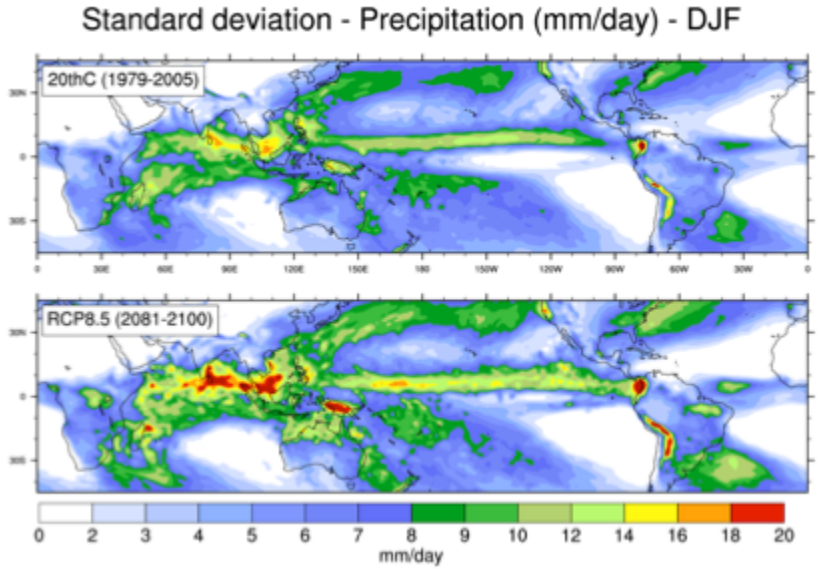


Future changes mean and variability: CAM5 coupled

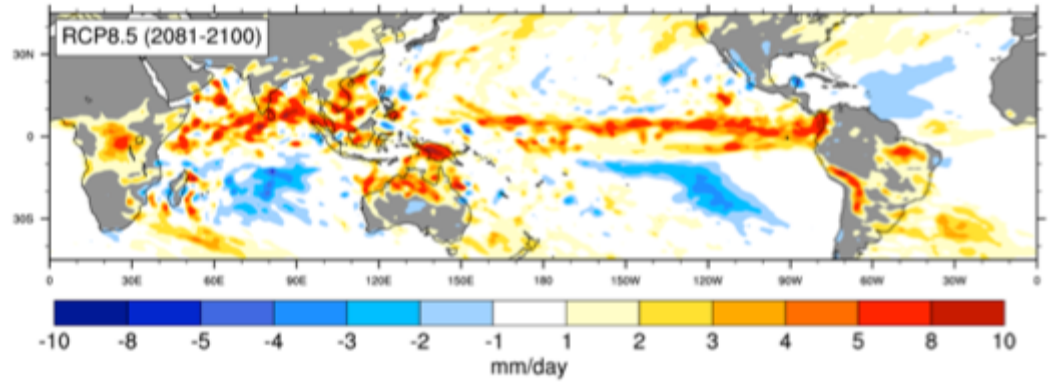


Mean Change

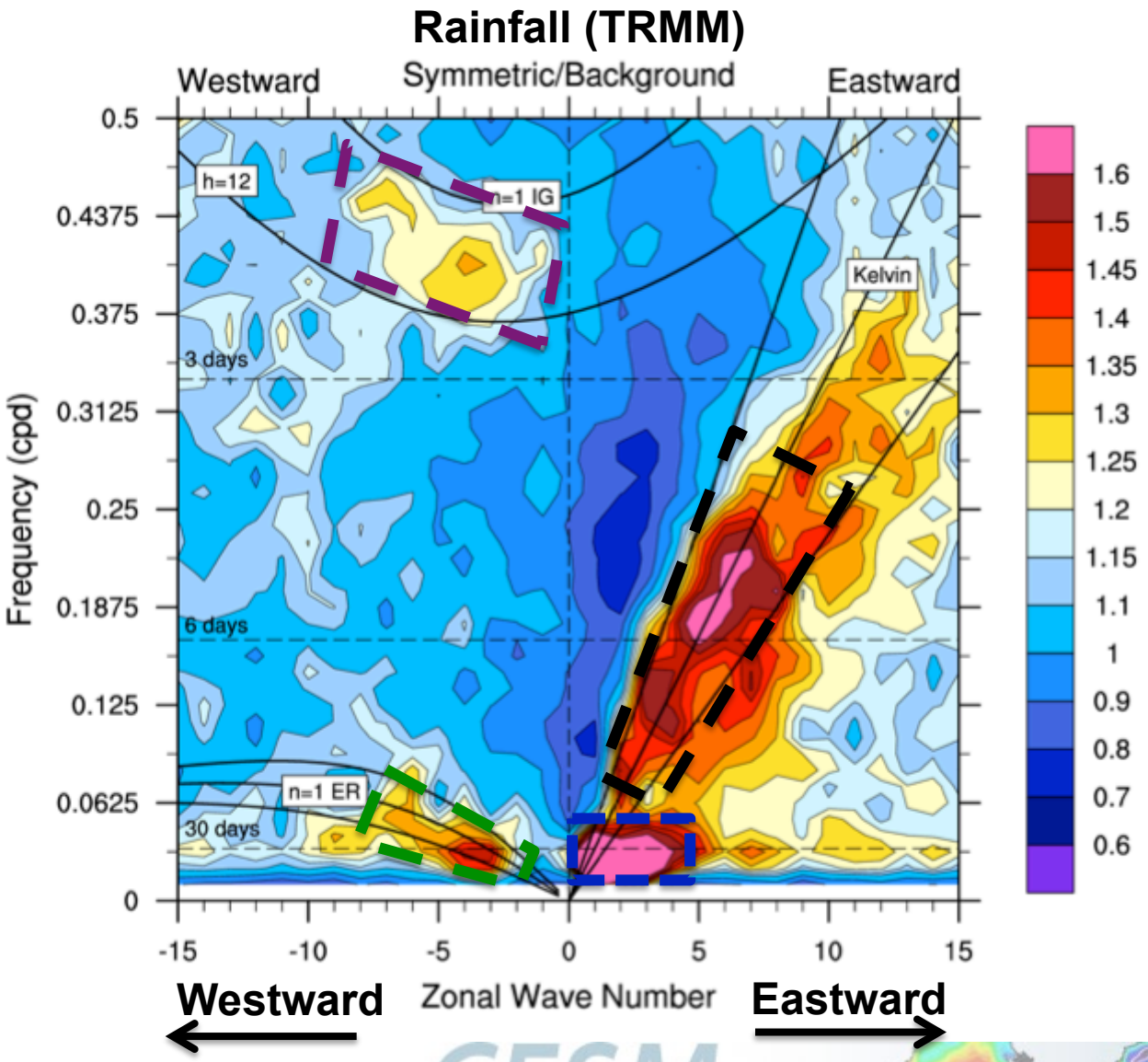




Standard Dev. Change

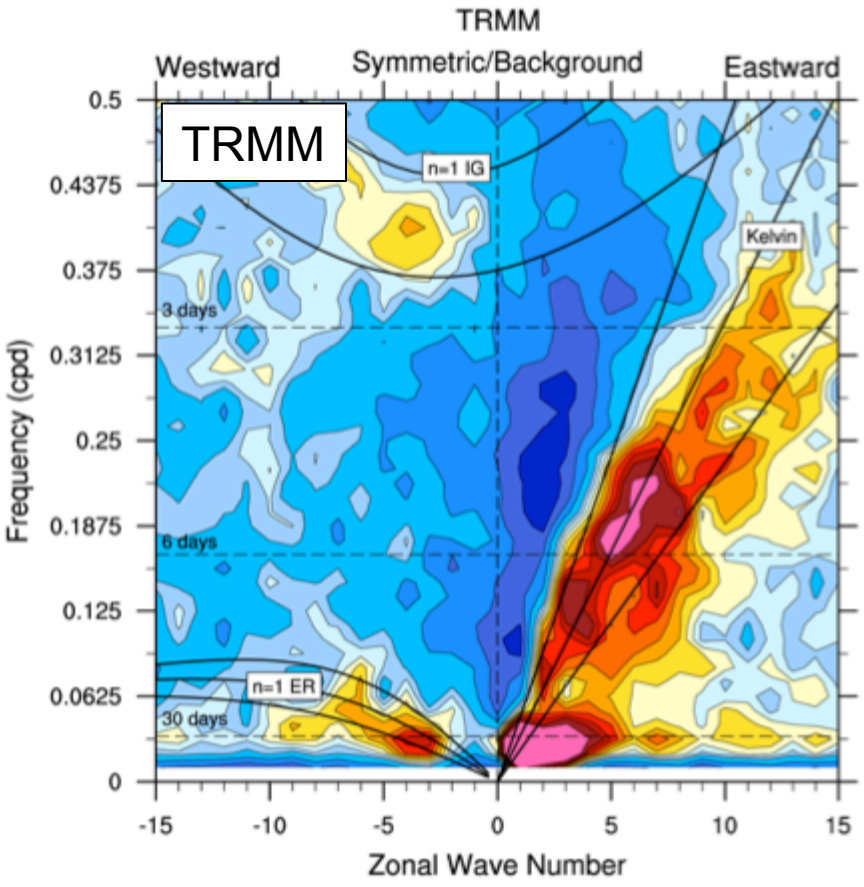


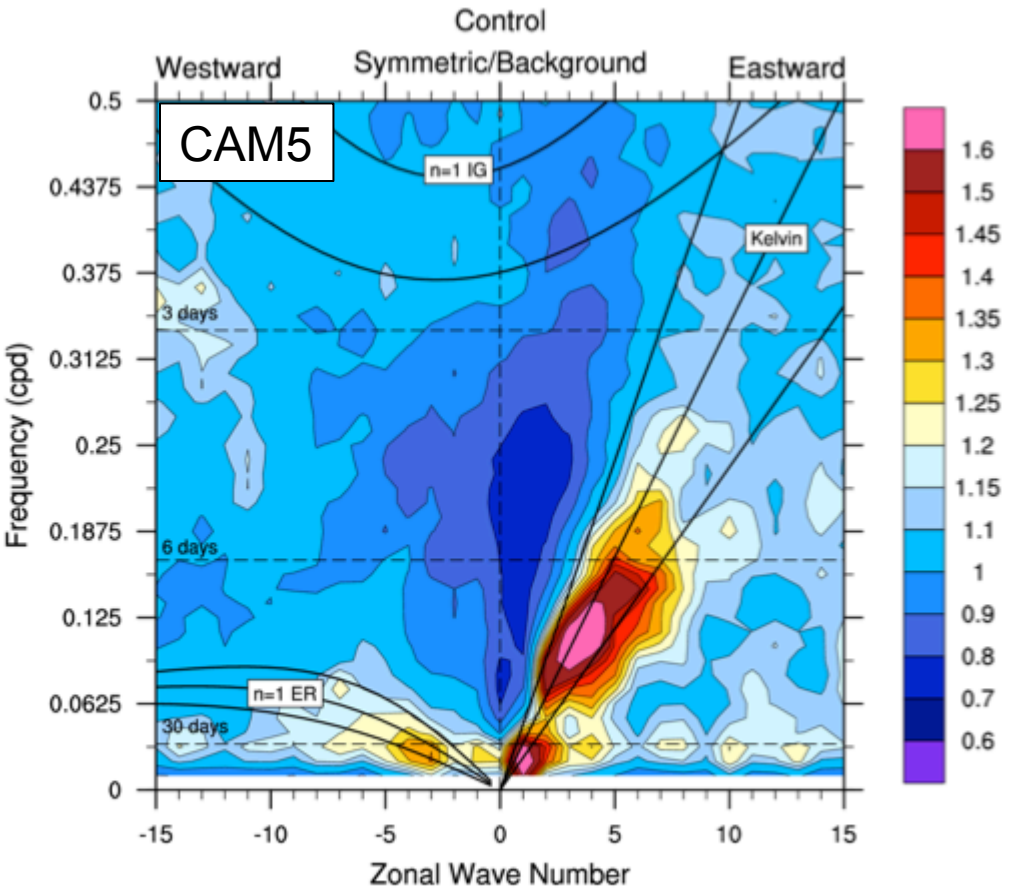
Equatorially trapped wave modes (symmetric)



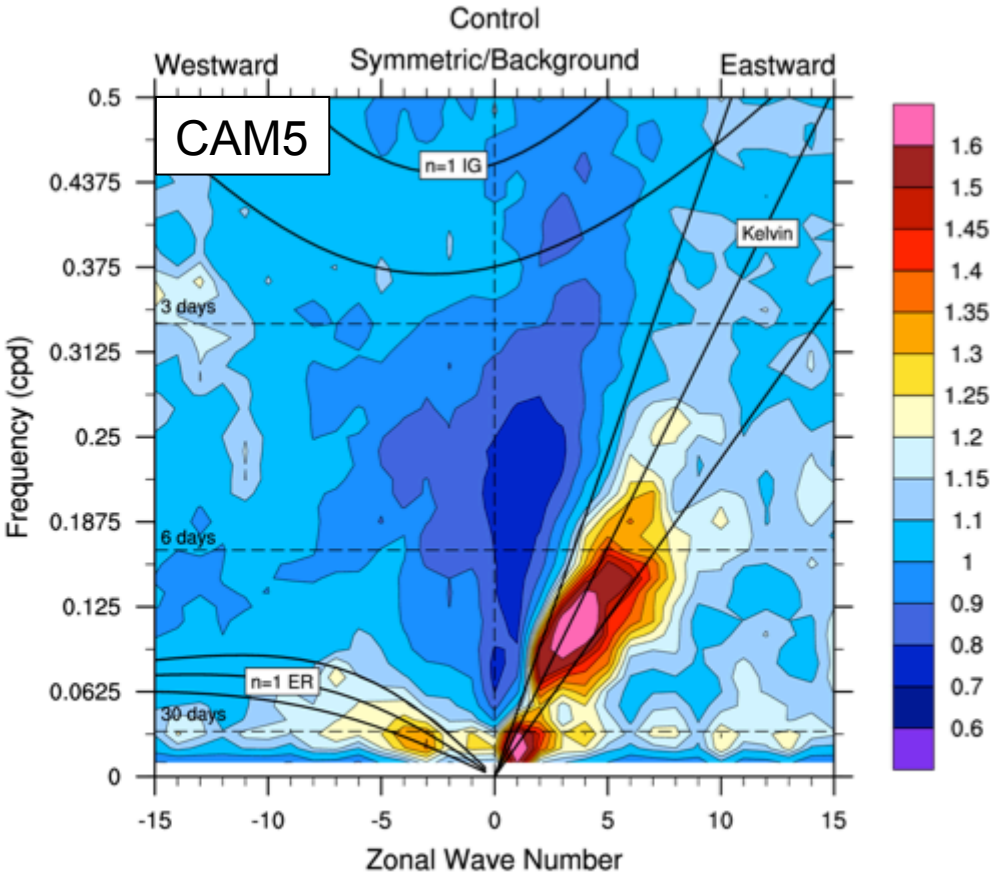
Kelvin Waves
Rossby Waves
Inertio-Gravity Waves
Madden Julian Oscillation

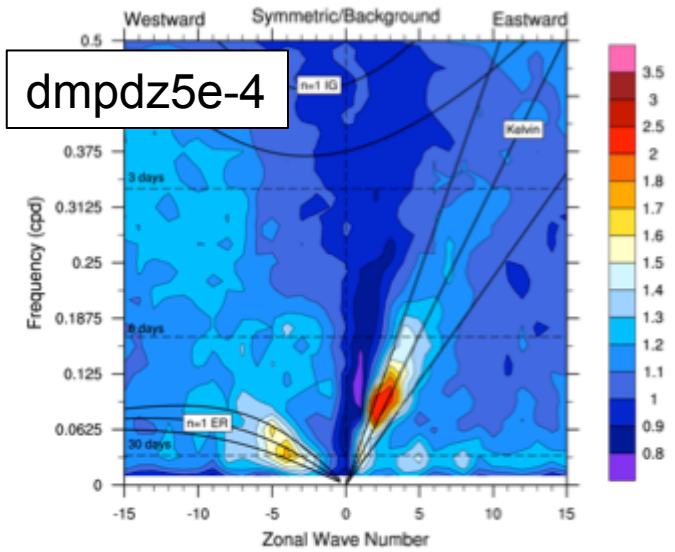
Daily to monthly variability: Precipitation (~CAM5)

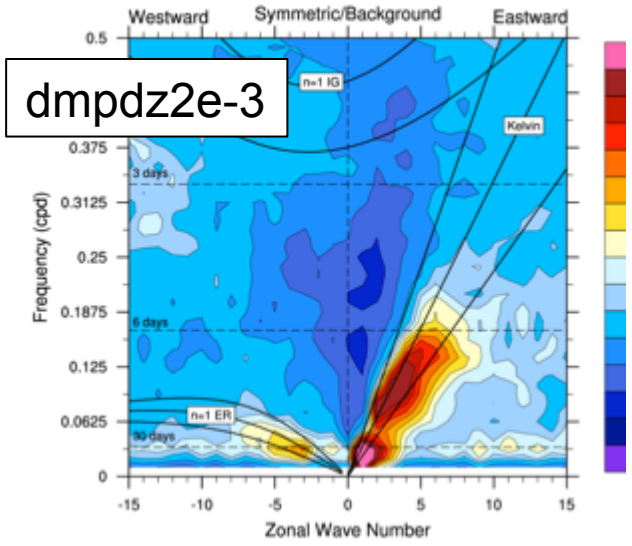




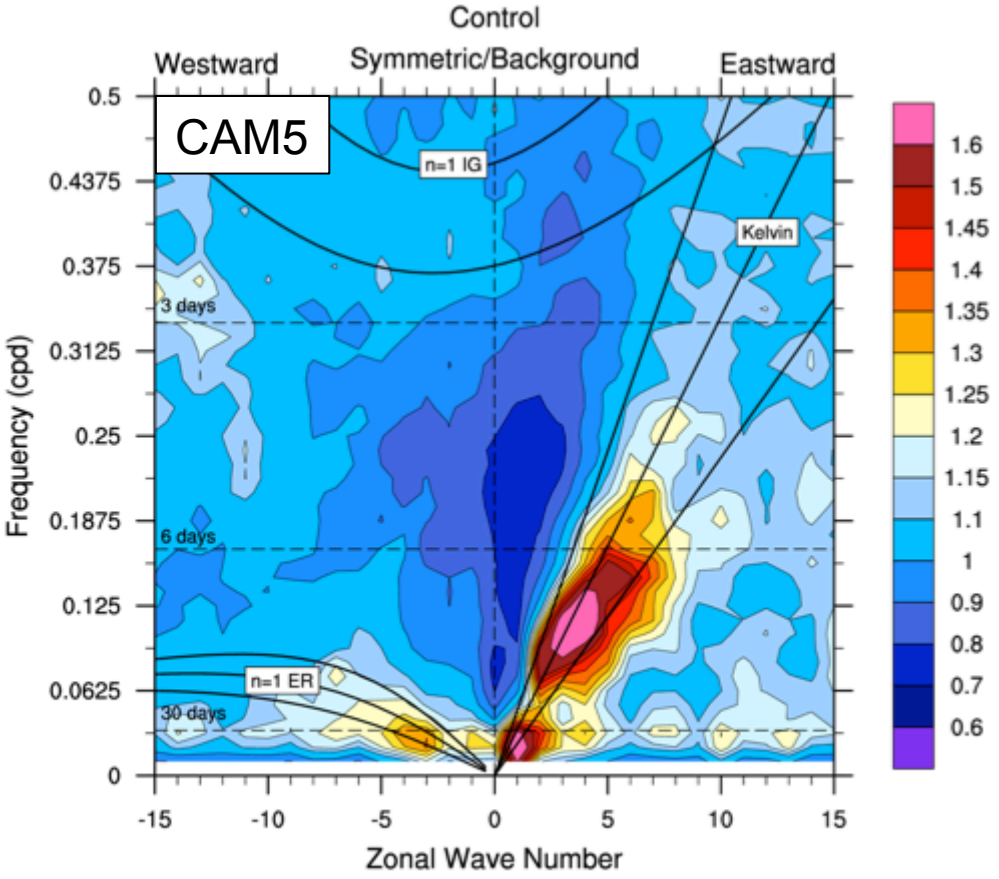
Daily to monthly variability: Precipitation (dmpdz 2e-3)

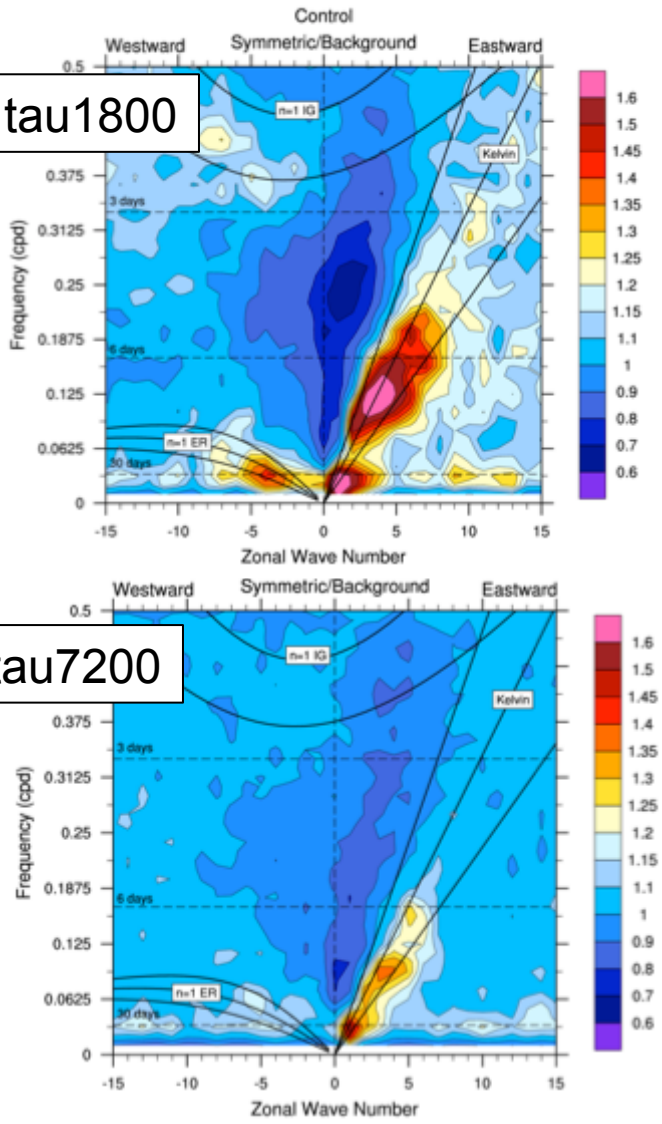






Daily to monthly variability: Precipitation (tau7200s)

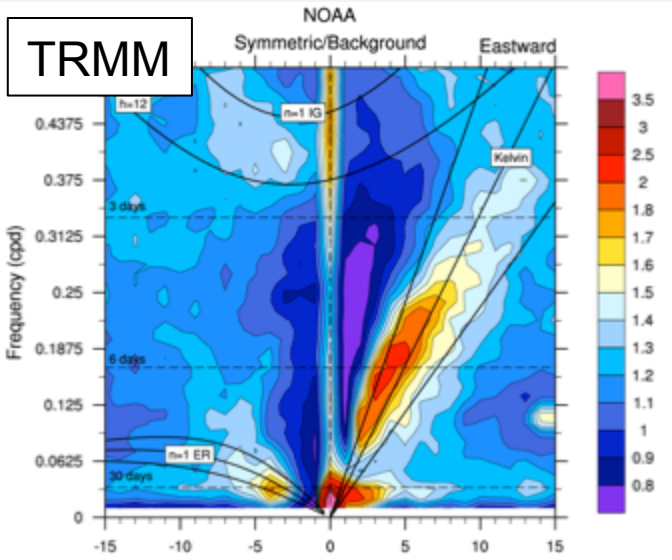




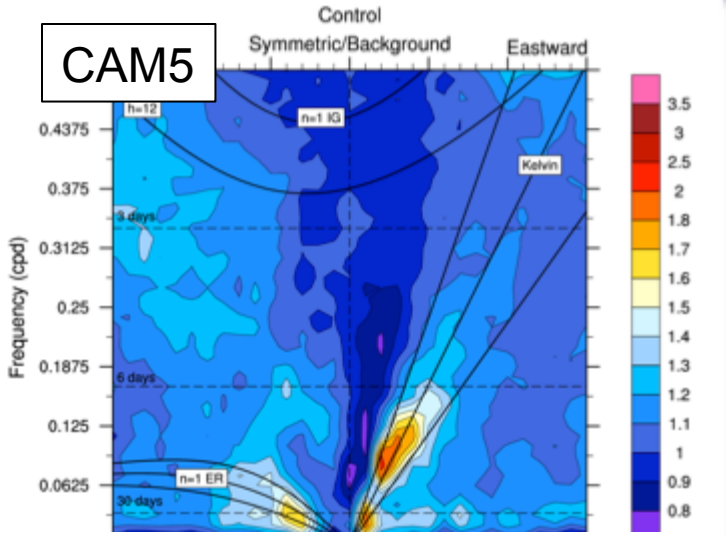
Canadian model used tau=15400

Daily to monthly variability: OLR (~CAM5)

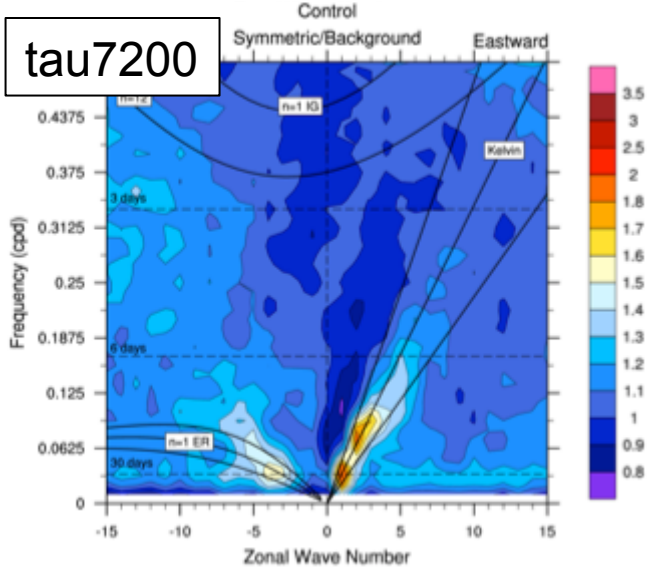
TRMM



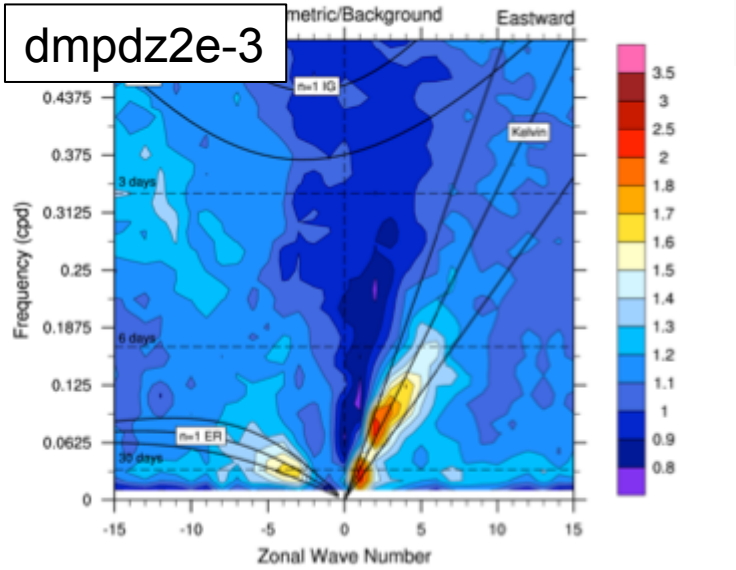
CAM5



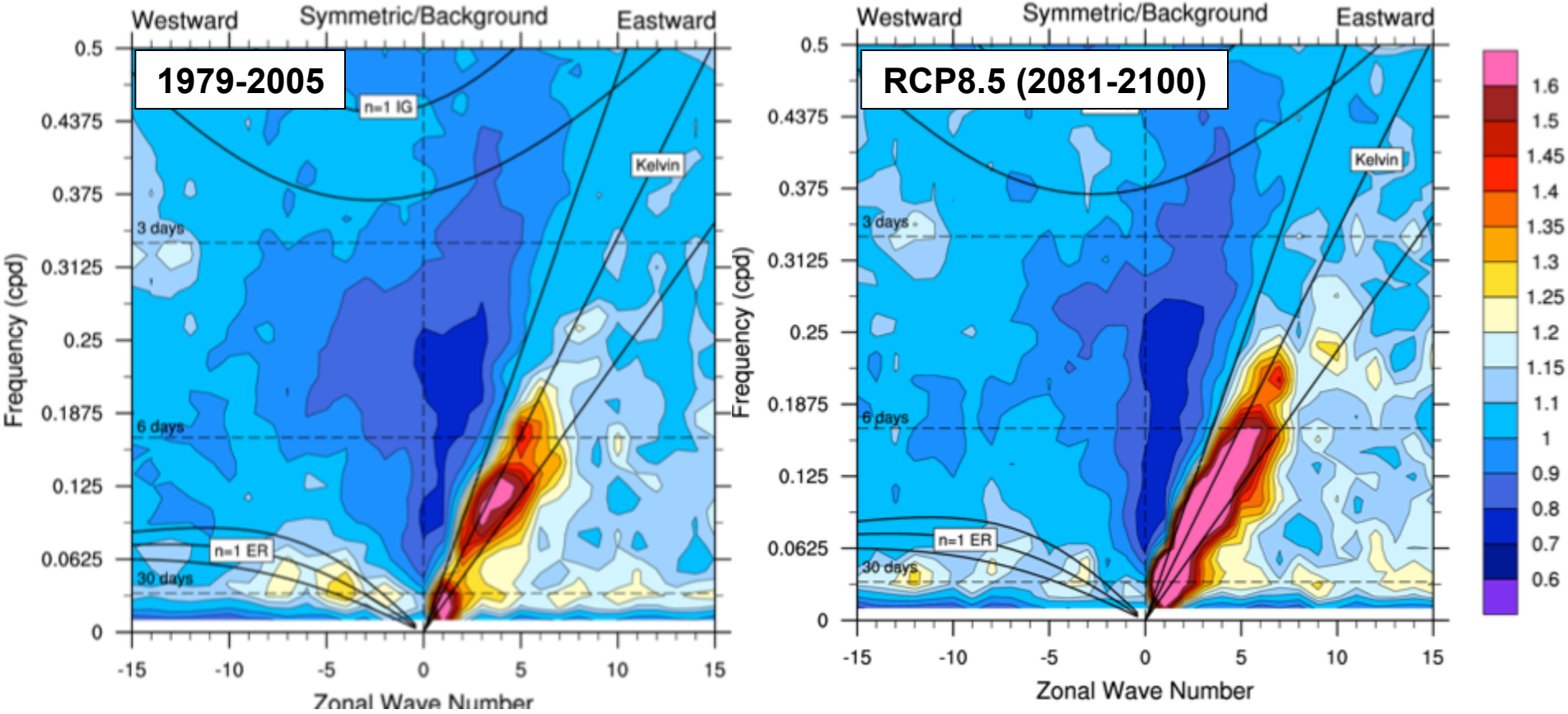
tau7200



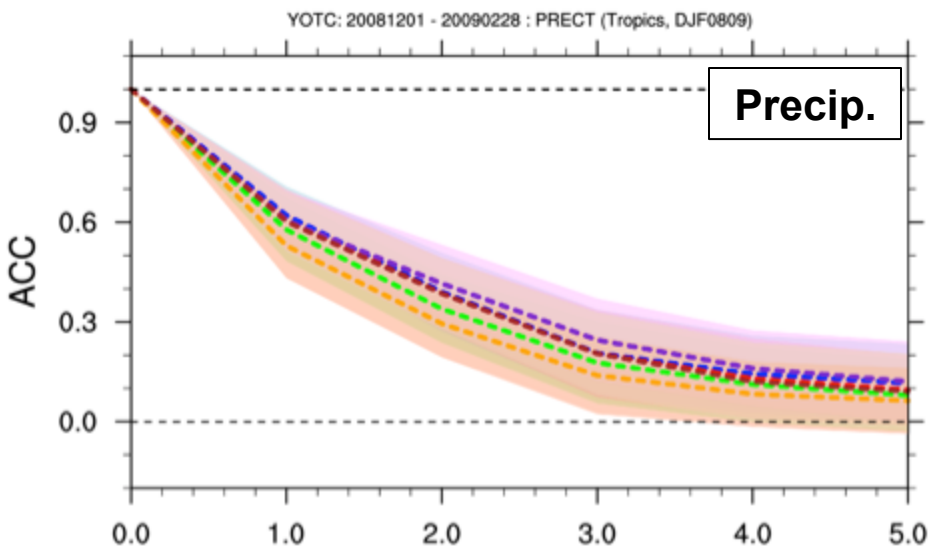
dmpdz2e-3

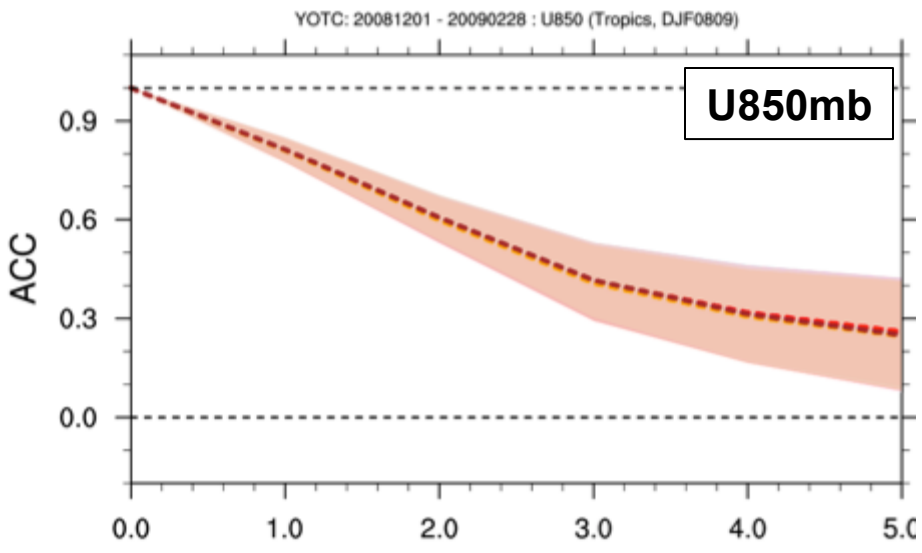


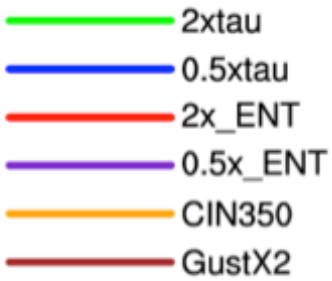
Future climate MJO: CAM5 precip. (coupled)



Model Skill in Hindcast Simulations: CAPT (tropics)



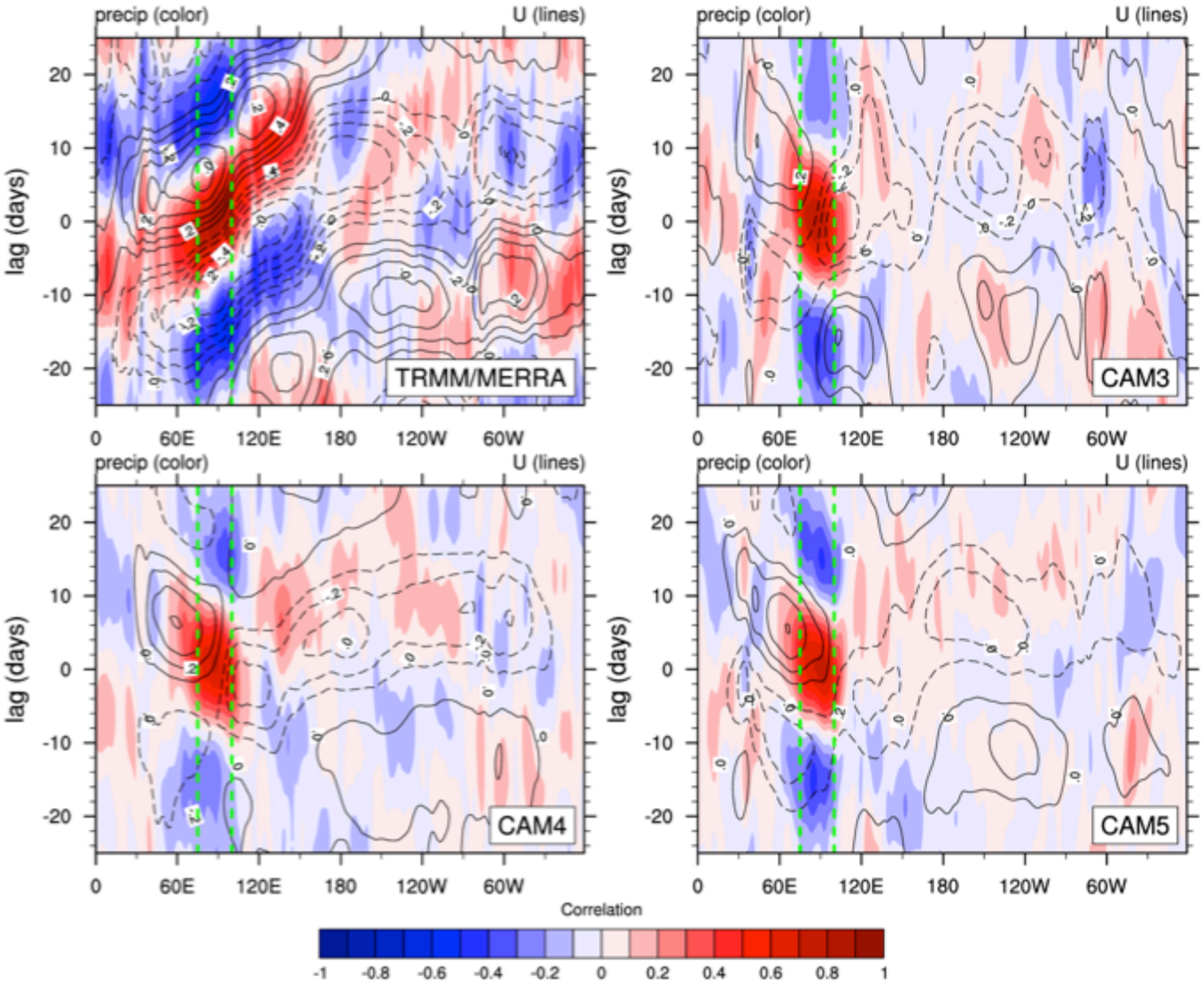




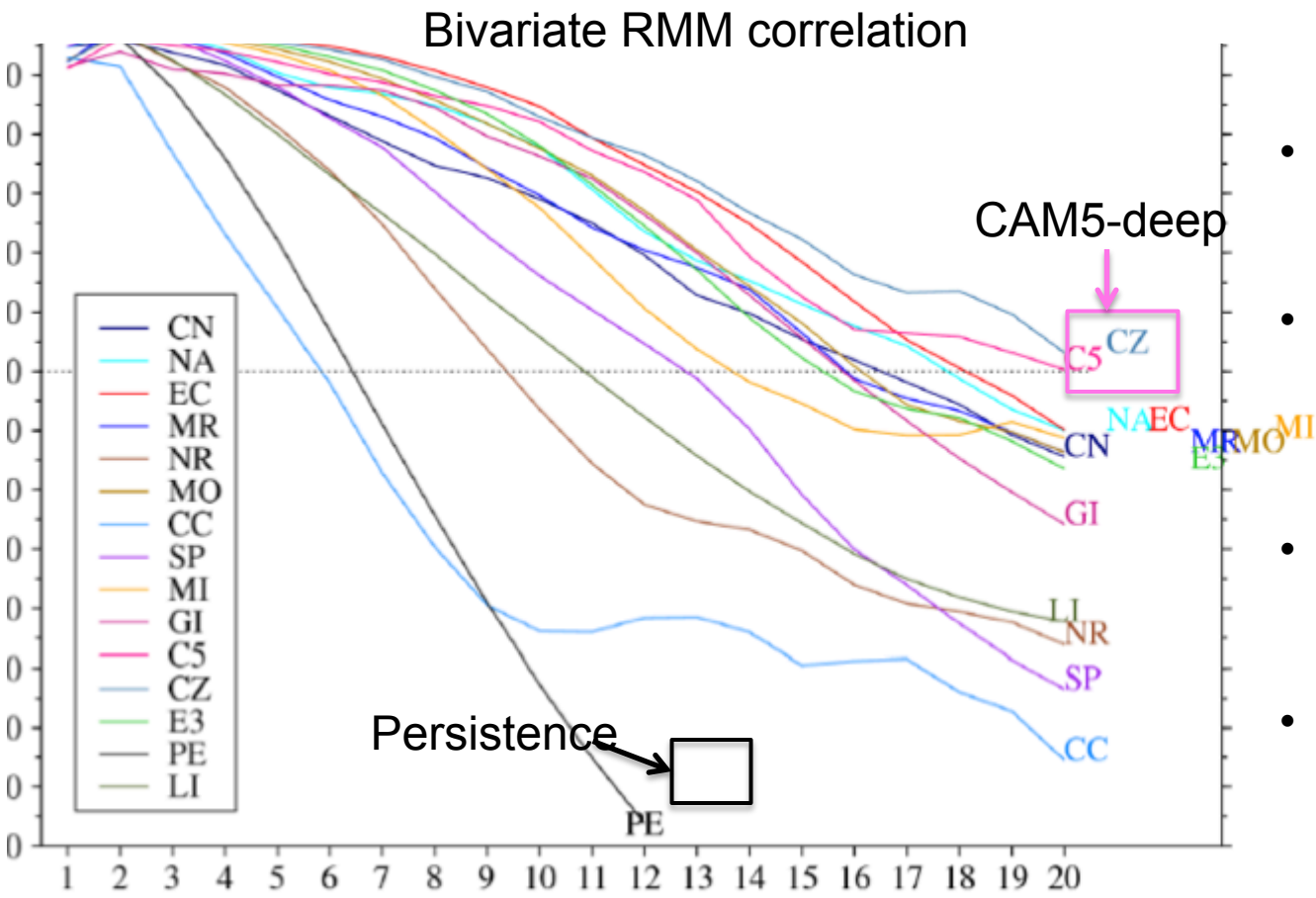
Winter 2008/2009 hindcast every day (~90 days)
Initialized with Era-interim analyses
10-day hindcasts

0.5 ENT is best model for tropical precip., CIN350 worst
For U 850mb similar performance across versions

CAM MJO Signal: Winter (AMIP)

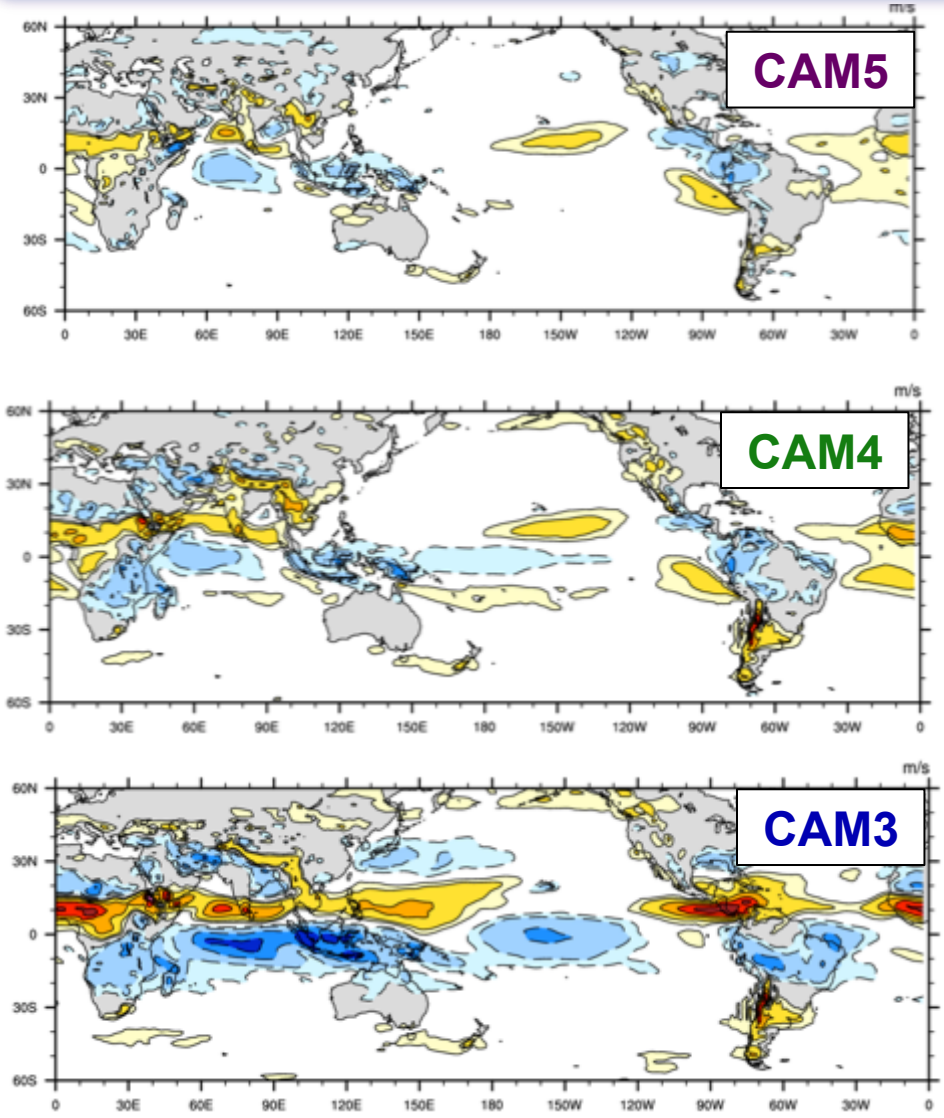


Hindcast Simulation Skill (CAM5, 1 deg)



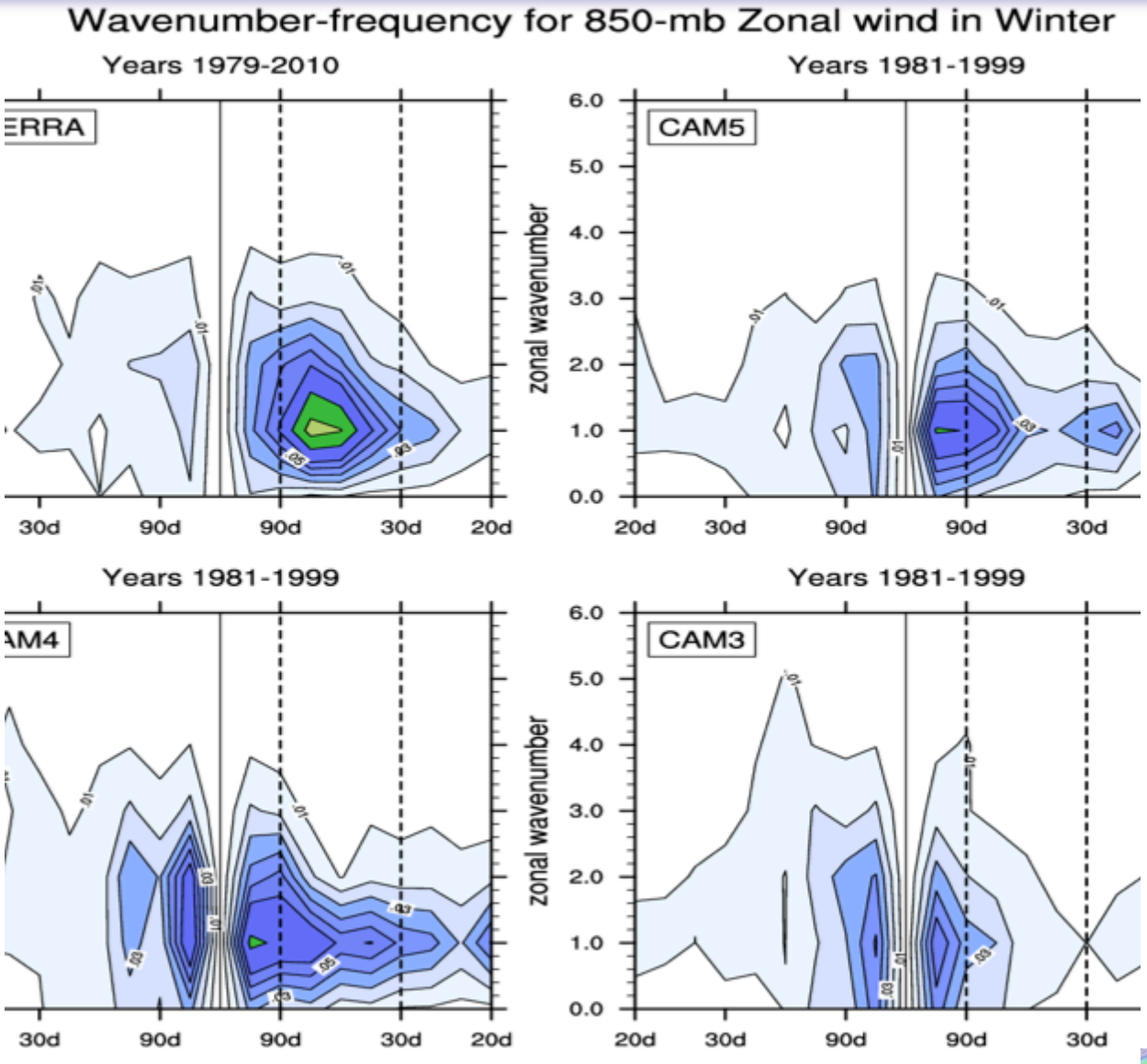
- Initial forecast mode (CAPT)
- Mean of daily forecasts During MJO-DYNAMO Campaign(2011-12)
- Combined bivariate mode of MJO variability (RMM)
- CAM5-deep only models to retain skill out to 20 days

Hindcast error improvements



- CAPT Hindcast simulations initialized from re-analyses
- Daily forecasts during Summer 2008
- 850-mb Zonal Wind
- Average **day 2** errors progressively reduced with atmosphere model version
- Alternative model validation to climate simulations
- Improves potential for intraseasonal hindcast utility

AMIP Simulations (MJO): Coupling Dependence



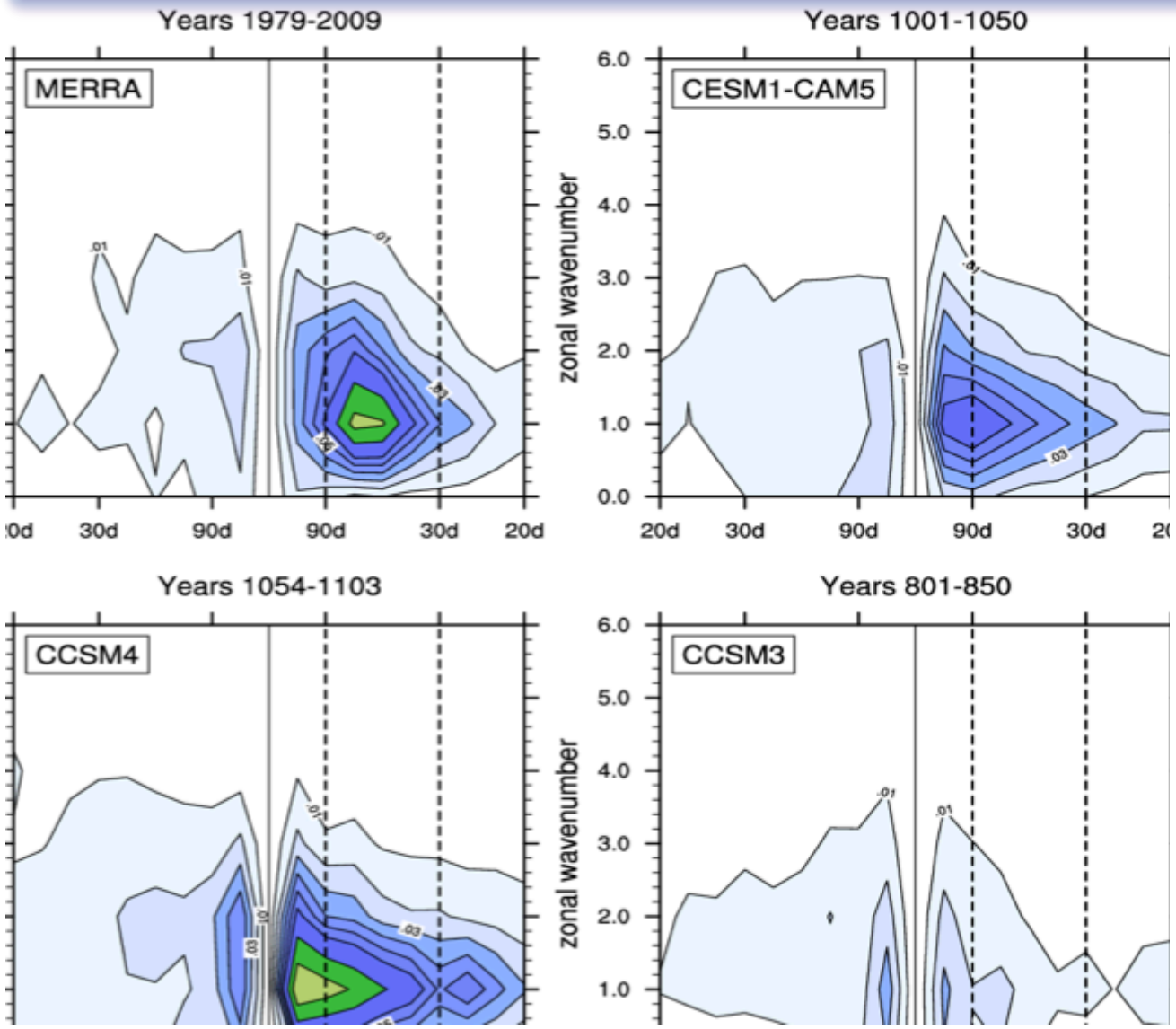
Model Physics

CAM3 poor MJO

CAM4 better MJO (convection changes)

CAM5 degrades MJO a little (non-convective cloud changes)

Coupled Simulations (MJO): Coupling Dependencies



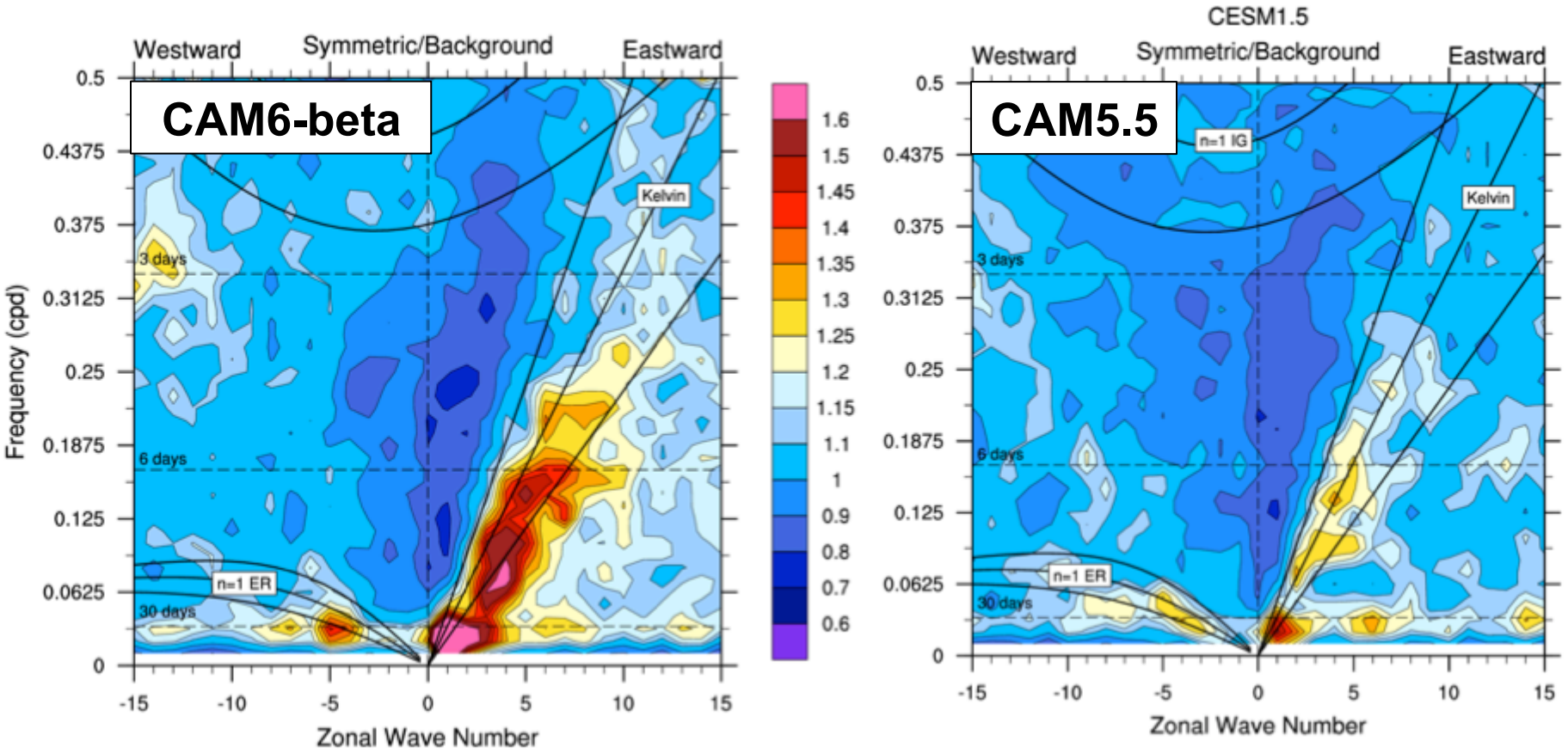
Coupling response

CCSM3 worsens

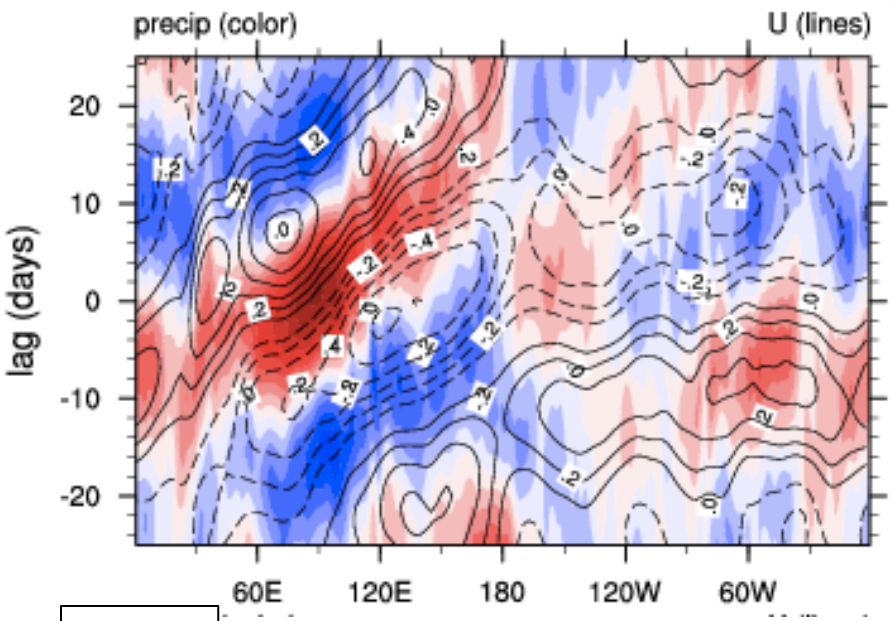
CCSM4/CESM1 improves

Reasons.
-Air-sea interaction?
-Background state shifts?

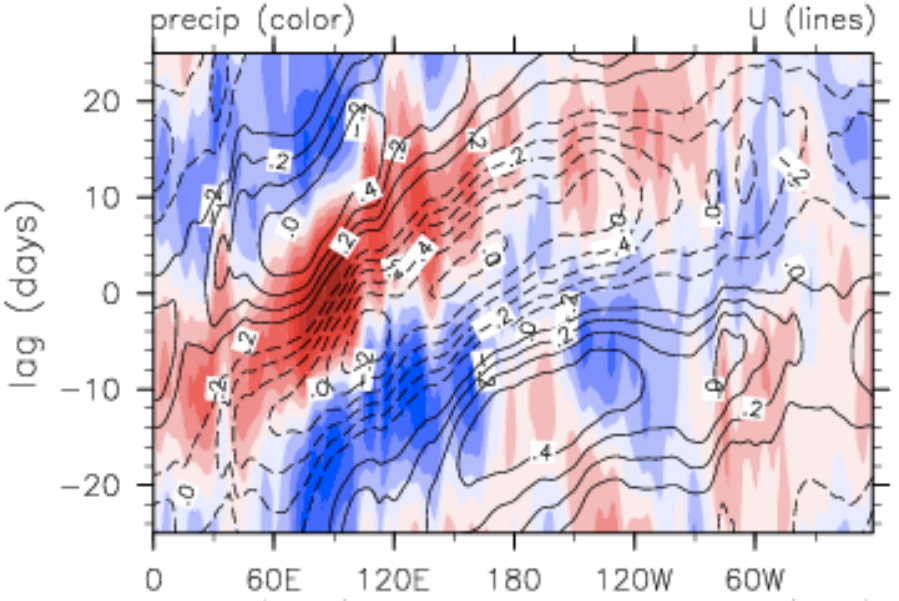
MJO Signal: Summer (MJO): CAM6, Stability sensitivity



MJO Signal: Summer (MJO): CAM6 Development



Obs.



CAM6-beta

Reasons?

- Deep convection stability
- Surface stress changes
- PBL momentum transport

Some Conclusions

Response of physics changes or perturbations not consistent across CAM's model hierarchy

Particularly the case for tropical variability versus mean climate

Parameter range sensitivity is different for each model configuration

Coupling matters and boundary vs. initial value forcing matters

There are of course identifiable reasons for all these dependencies

- SCAM constraints
- Errors grow slowly in CAPT simulations
- Coupling changes response (MJO mean state or high-frequency SST coupling)

All model configurations have to be tested in model development

The hierarchy?