Intraseasonal Variations in an Aqua-Planet GCM

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Introduction

- Madden-Julian Oscillations (MJO): 30-60 day oscillations in tropics associated with eastward propagating cloud bands
- Simulation of Madden – Julian Oscillations is a challenging problem
- Maloney et al (2010, M10) showed reasonable simulation of MJO in aqua-planet CAM3
- Maloney (2009) emphasized the role of meridional eddy transport of moisture to be important in MJO simulation
- M10 showed that reduced meridional gradient of SST improves MJO simulation

Objectives

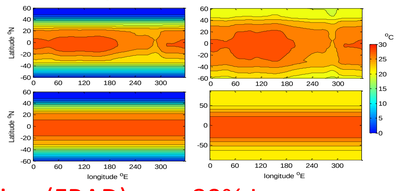
- Effect of zonal asymmetry in SST on MJO simulation
- Effect of Longwave radiation in MJO simulation

Model Description

- Aqua-planet GCM with Relaxed Arakawa-Schubert scheme, 16 years run

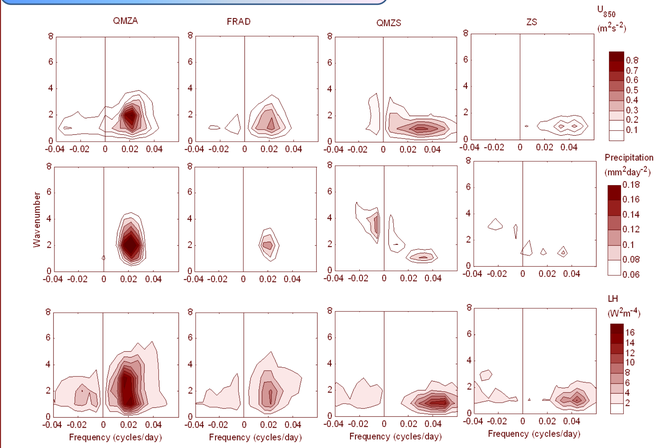
Different SST gradients

- Zonally asymmetric with meridional temperature gradient equal to 155^{o}E (ZA)
- Zonally symmetric with SST equal to 155^{o}E (ZS)
- Quarterly meridional gradient with meridional gradient of 1/4th that at1550 poleward of10^{o}E (QMZA and QMZS)



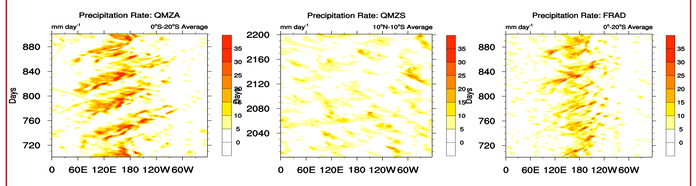
- Fixed radiation (FRAD) run: 80% Longwave radiation fixed to climatology and 20% interactive

Spectral Analysis



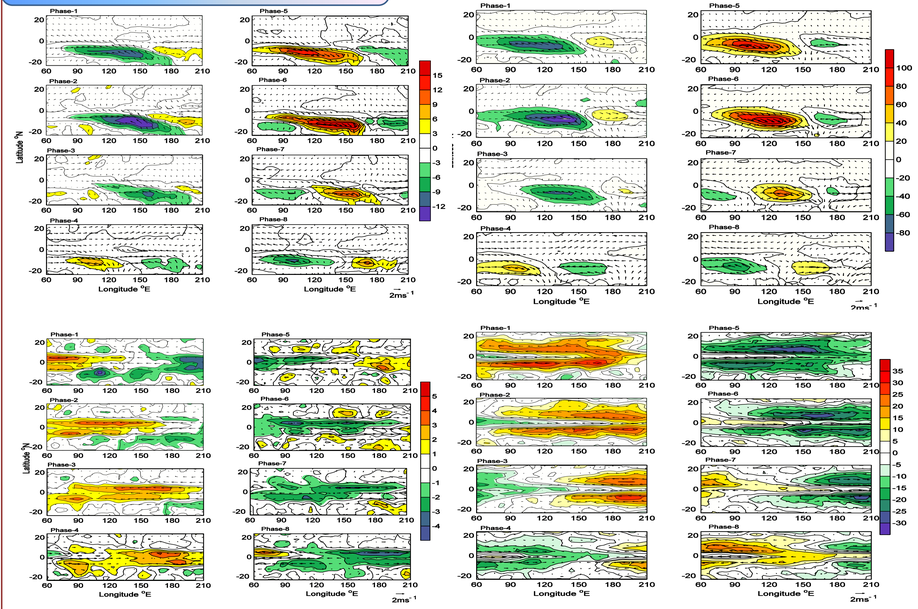
- Similar Wavenumber – frequency distribution in QMZA and FRAD
- Faster propagation in symmetric simulations
- Reduced MJO in FRAD, ZS, QMZS
- MJO increased in QMZS compared to ZS

Hovmoller Diagrams



- Organized eastward propagation in QMZS
- Weak eastward propagation in FRAD
- No clear organization in QMZS

Composites



- Eastward propagation of precipitation anomalies
- Double precipitation zone in ZS
- Latent heat peak coincident with increased winds indicating wind induced latent heat exchange
- Latent heat peak to the west (east) of precipitation peak in asymmetric (symmetric) simulations

Conclusions

- Zonal asymmetry and background westerlies important
- Longwave interactions improves MJO simulation
- Reduced meridional gradient improves MJO simulation
- Removal of Zonal asymmetries increases propagation speed
- MJO in symmetric SST simulation resembles WISHE mode with anomalous westerlies to the west increasing latent heat flux and convergence

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References:

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