The Maddening-Julian Oscillation in GCMs

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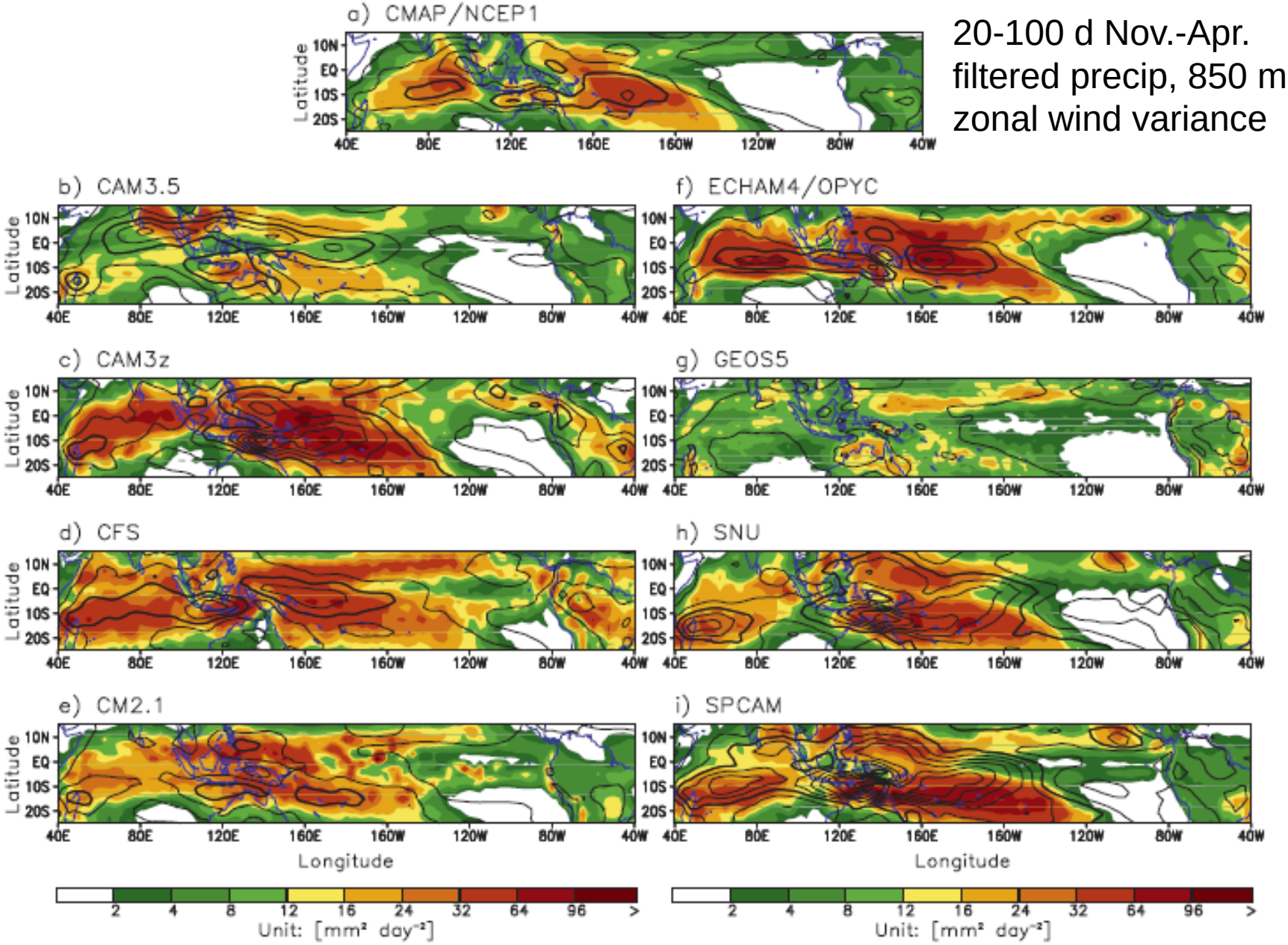
ASR AMIE Breakout 3/17/10

Problems with MJOs in GCMs

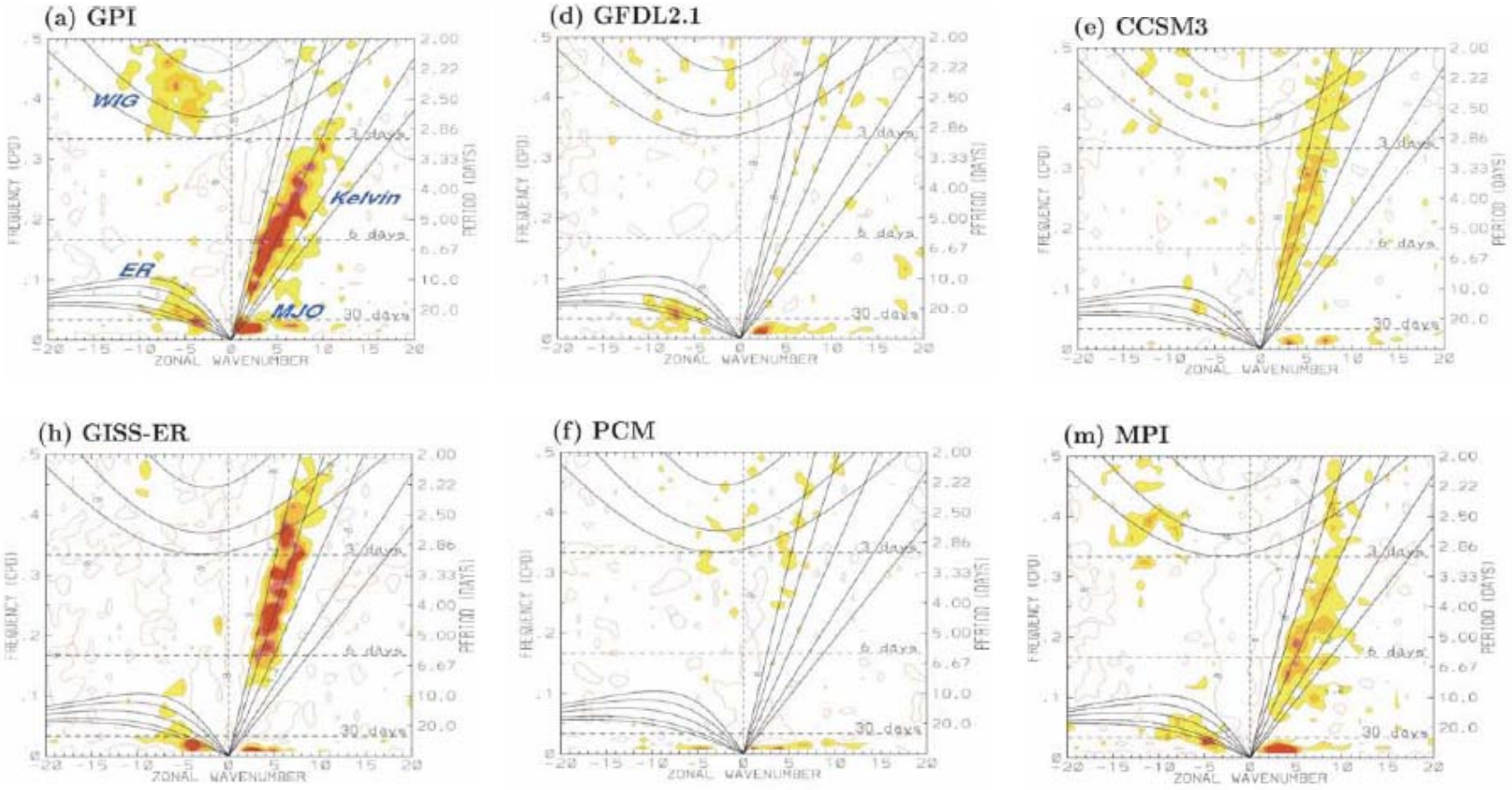
- **Strength**
- **Propagation direction**
- **Propagation speed**
- **Lifetime**
- **Indian Ocean vs. Maritime Continent origin**
- **Effect of Maritime Continent on strength (topography, surface fluxes)**
- **Sensitivity to changes in model**

Current status of models (Kim et al. 2009)

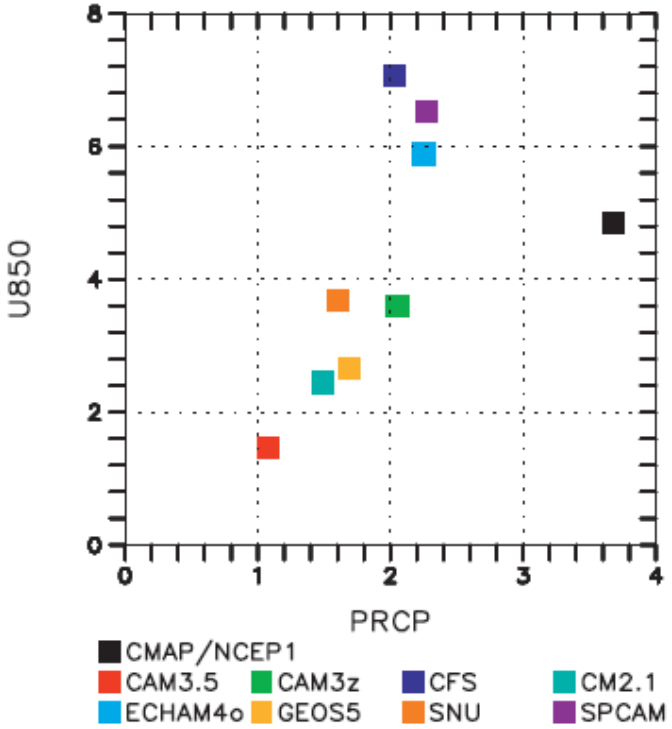


20-100 d Nov.-Apr. filtered precip, 850 mb zonal wind variance

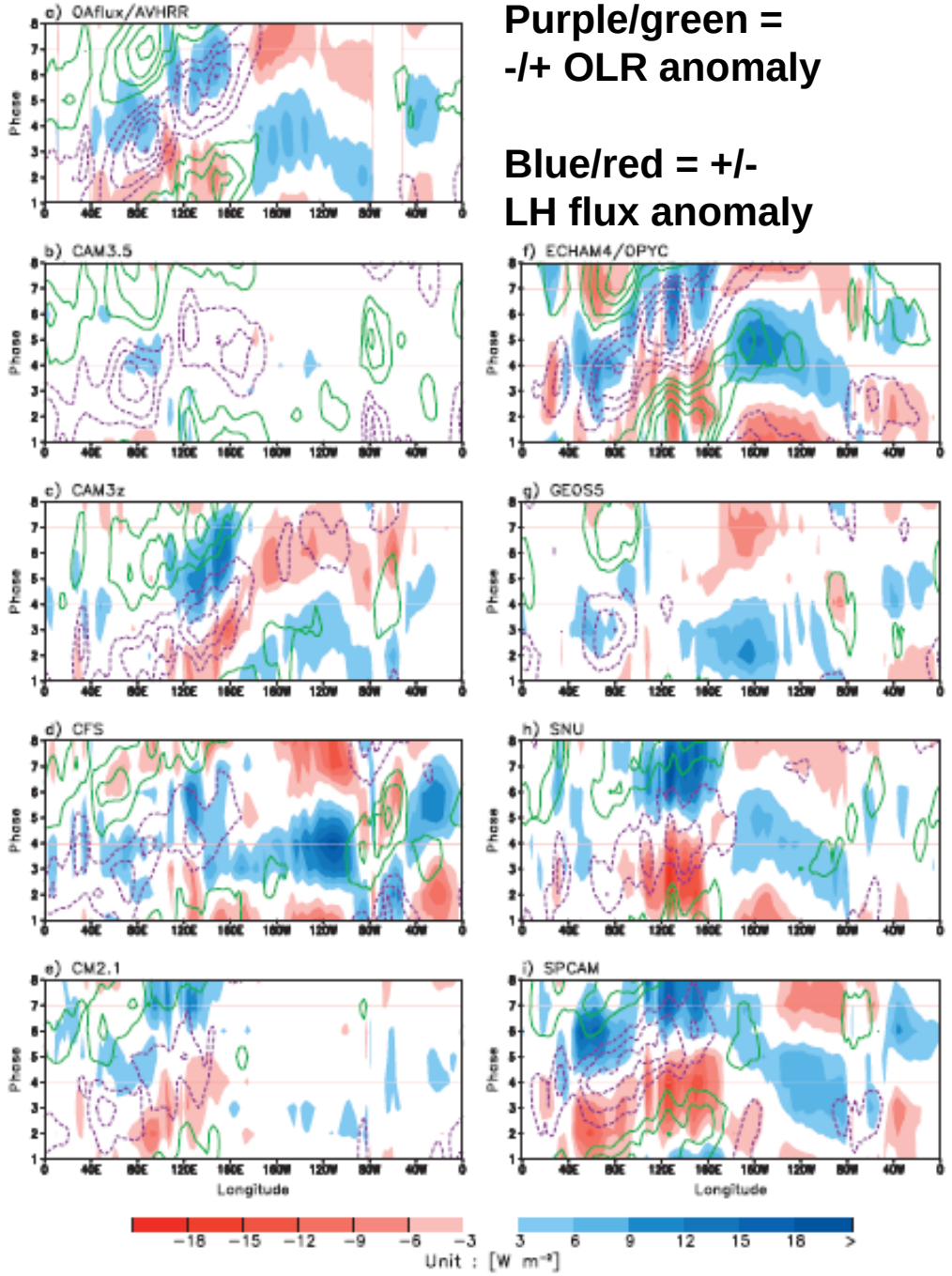
Frequency-wavenumber spectra identify convectively coupled waves



Lin et al. (2006)



E-W propagating power ratio weaker in models than observed; worst models have weak/nonexistent negative surface latent heat flux anomaly east of convection

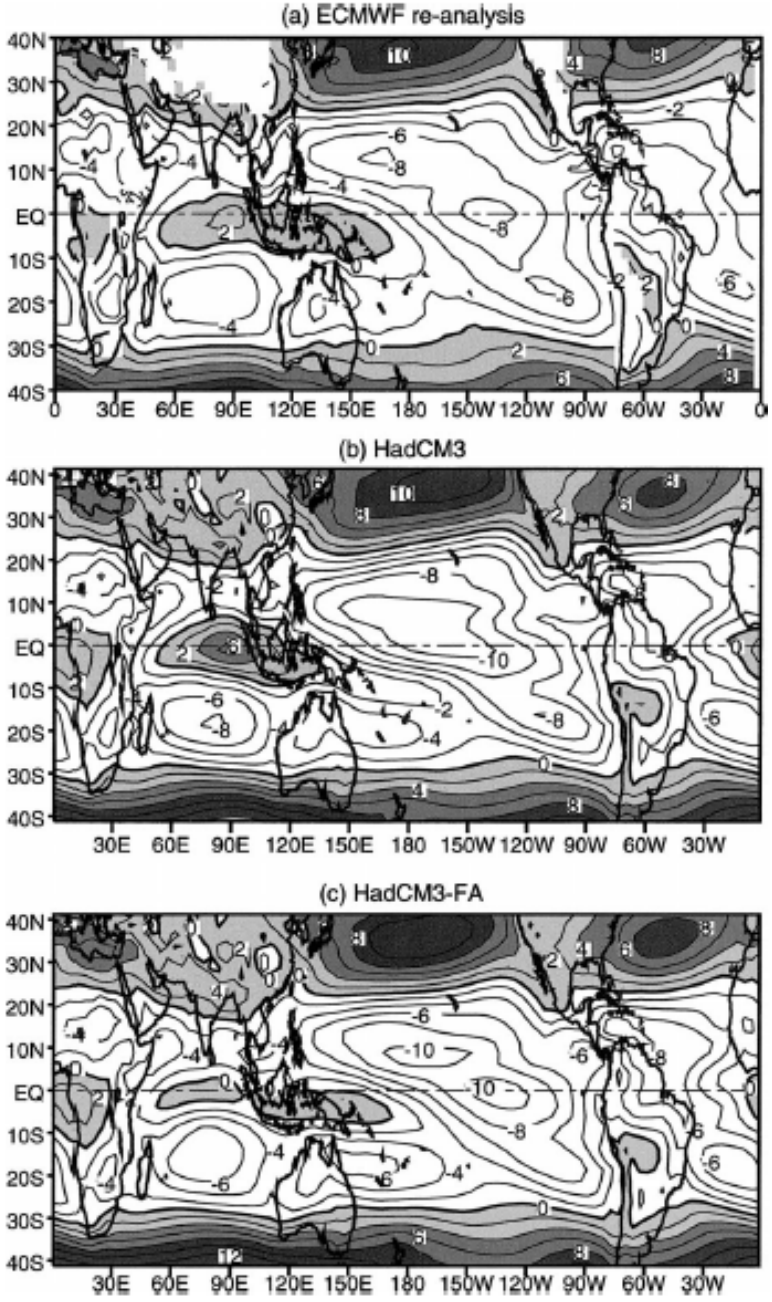


Purple/green = -/+ OLR anomaly

Blue/red = +/- LH flux anomaly

TABLE 2. Average of *e*-folding time scale over all initial phases.

Model	*e*-folding day
Observation	31.2
CAM3.5	20.5
CAM3z	21.5
CFS	24.9
CM2.1	20.7
ECHAM4/OPYC	28.9
GEOS	20.7
SNU	22.8
SPCAM	24.5
Model average	23.0



850 mb zonal wind

TABLE 1. Summary of the number of eastward propagating convective events that occurred during Oct–Apr at four selected longitudes in observed OLR and convective precipitation from the standard and flux-adjusted coupled GCMs. Events are also stratified by the sign of the monthly mean zonal wind at the base longitude at the time of occurrence.

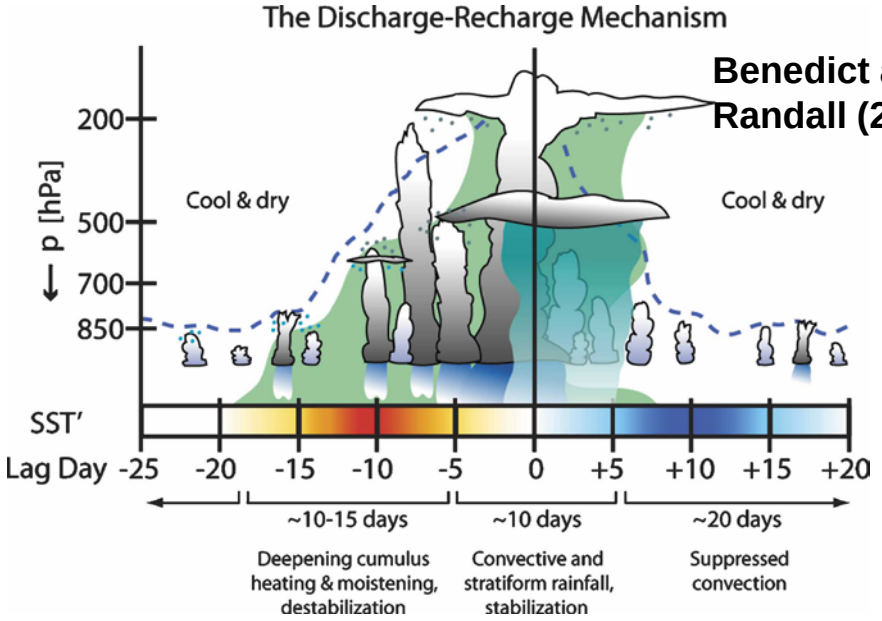
Method	No. of eastward propagating events at each base longitude			
	60°E	90°E	120°E	150°E
AVHRR OLR (16 yr)	30	37	34	32
(westerly:easterly)	(23:7)	(35:2)	(24:10)	(24:8)
HadCM3 (19 yr)	17	21	11	3
(westerly:easterly)	(14:3)	(21:0)	(5:6)	(0:3)
HadCM3-FA (19 yr)	21	13	15	13
(westerly:easterly)	(15:6)	(10:3)	(4:11)	(8:5)

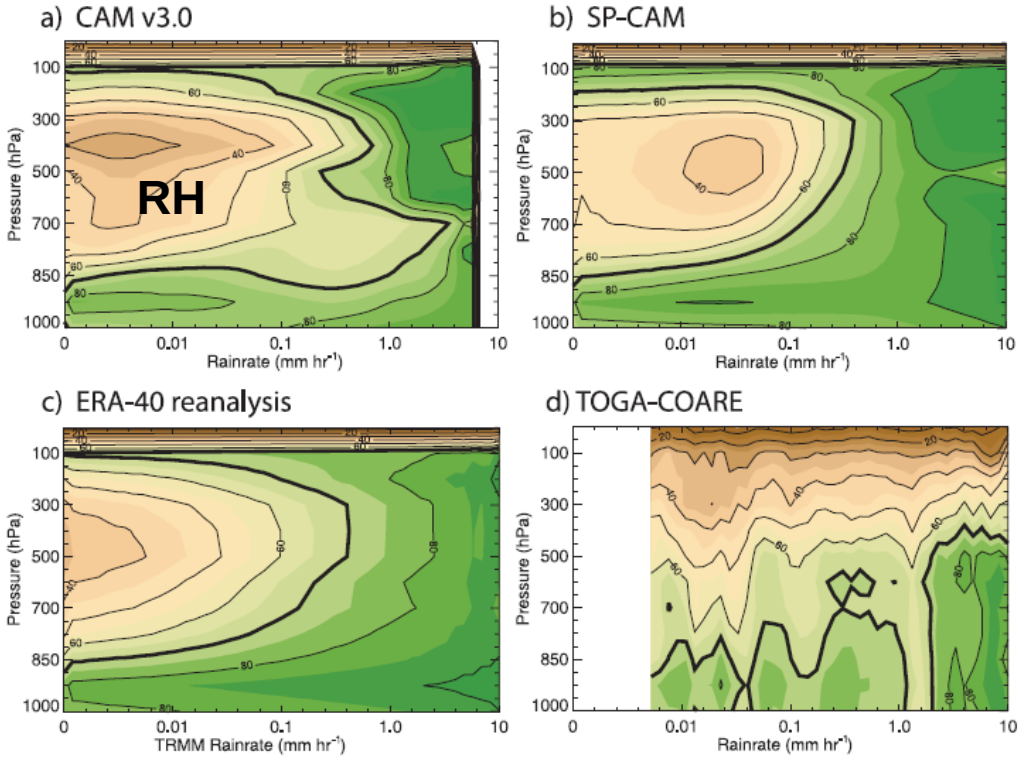
Basic state makes a difference in whether wind anomaly east of convection reduces or increases surface LH flux

Inness et al. (2003)

Moistening of lower troposphere (shallower convective detrainment, rain evaporation) – one reason SP-CAM has a good MJO?

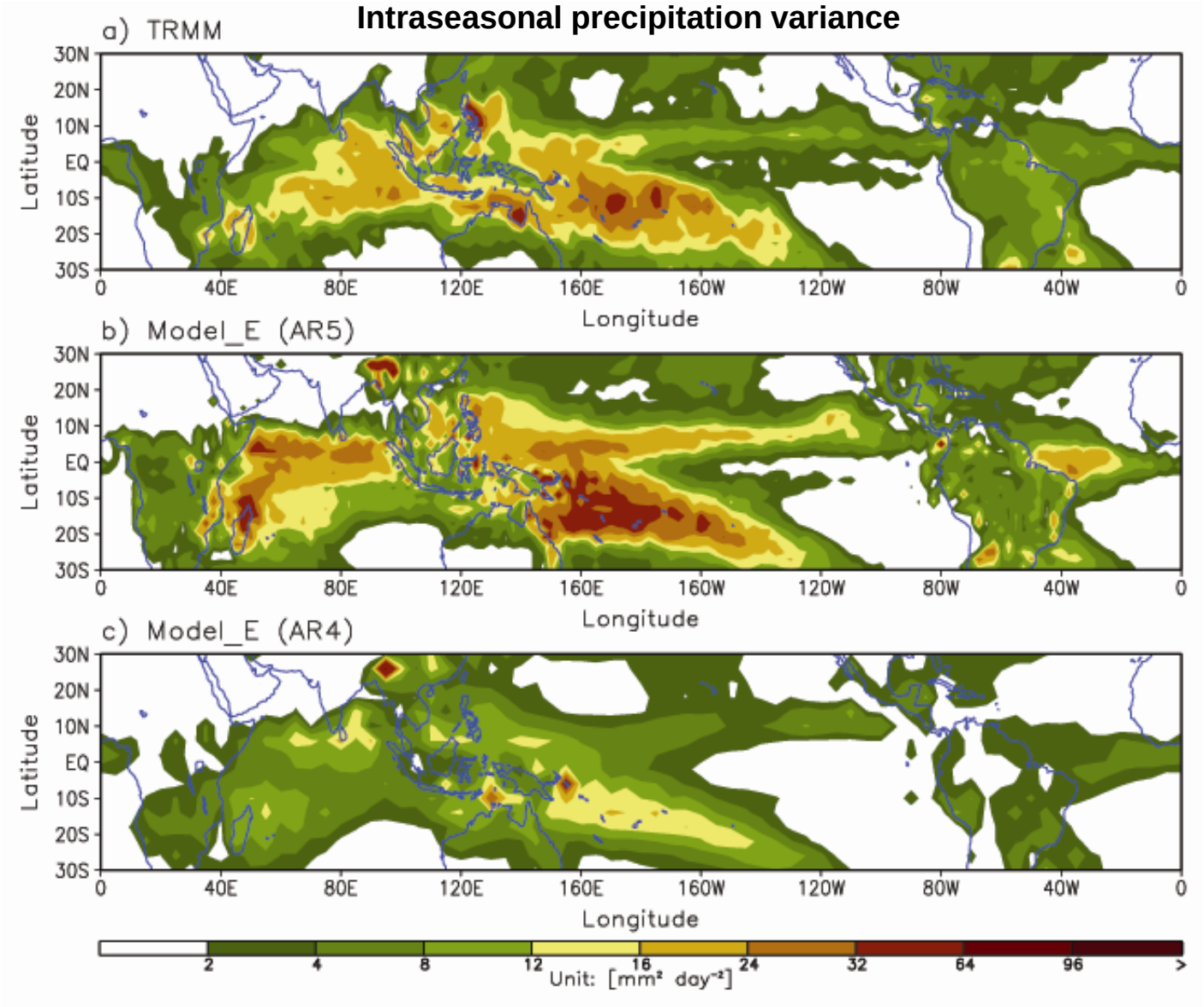
Or stochastic aspects of convection lacking in conventional GCMs?





Thayer-Calder and Randall (2009)

Improvement in GISS model!



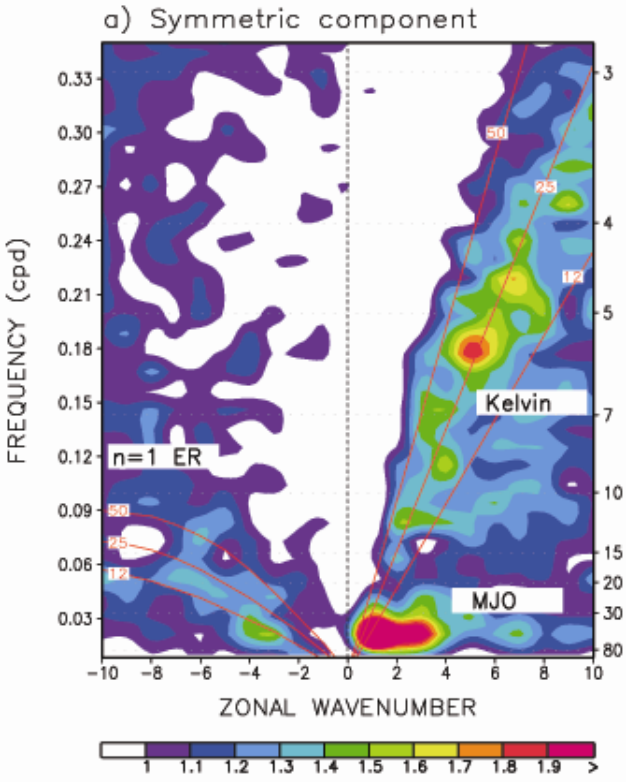
Observed

New model (IPCC AR5)

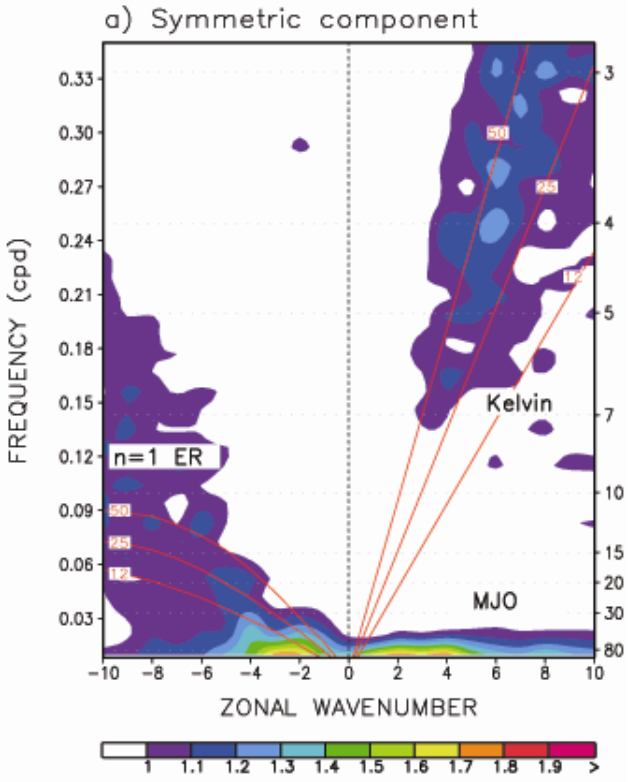
Old model (IPCC AR4)

From D. Kim

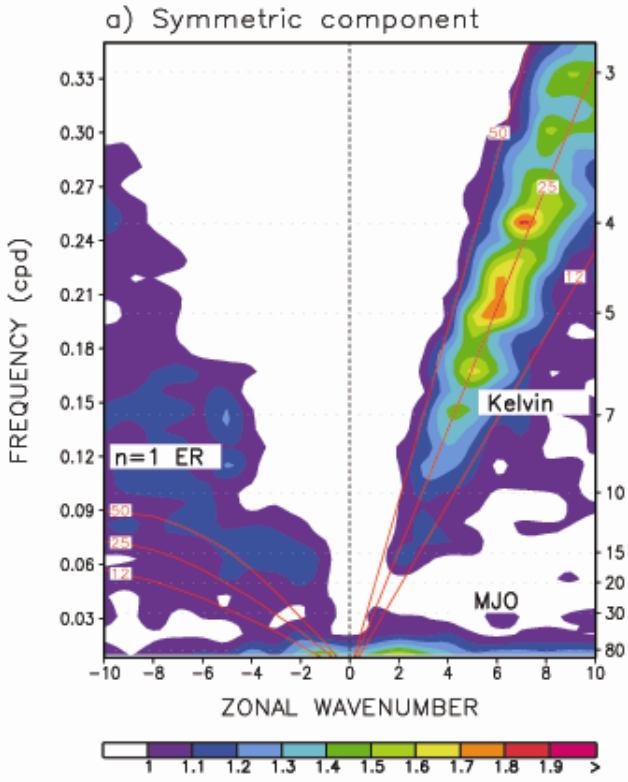
Well, maybe not…



TRMM



Old (AR4)



New (AR5)

Modelling the MJO

"It is a truth, universally acknowledged, that a GCM in possession of a good MJO simulation will lose it as soon as ANYTHING at all is changed in the model formulation."

Jane Austen (mostly), *Pride and Prejudice*, (1818)

From Pete Inness