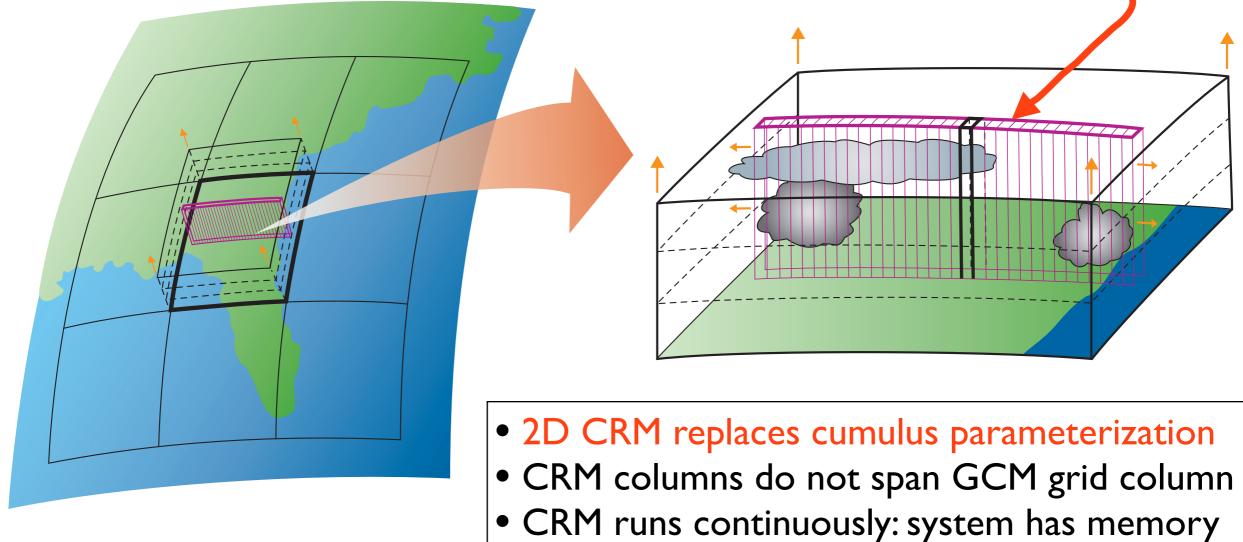
The Asian Monsoon in the Super-Parameterized Community Climate System Model

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"SP" Model Framework

32 4km x 4km grid columns -



Schematic illustration of "super-parameterization"

The Simulations

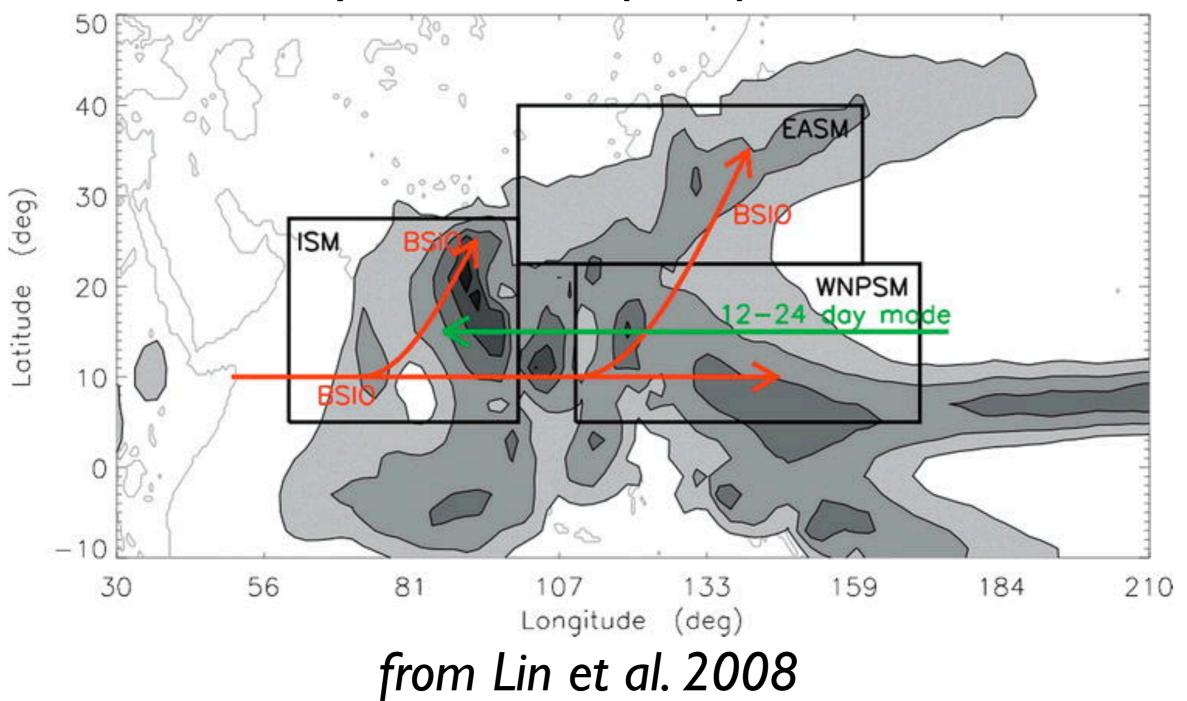
	Atmosphere only	Ocean coupling
Traditional cumulus parameterization	CAM (not shown)	CCSM (years 4-23)
Super- parameterization	SpCAM (14 year AMIP)	SpCCSM (years 4-23)

CAM = Community Atmospheric Model (v3.0)

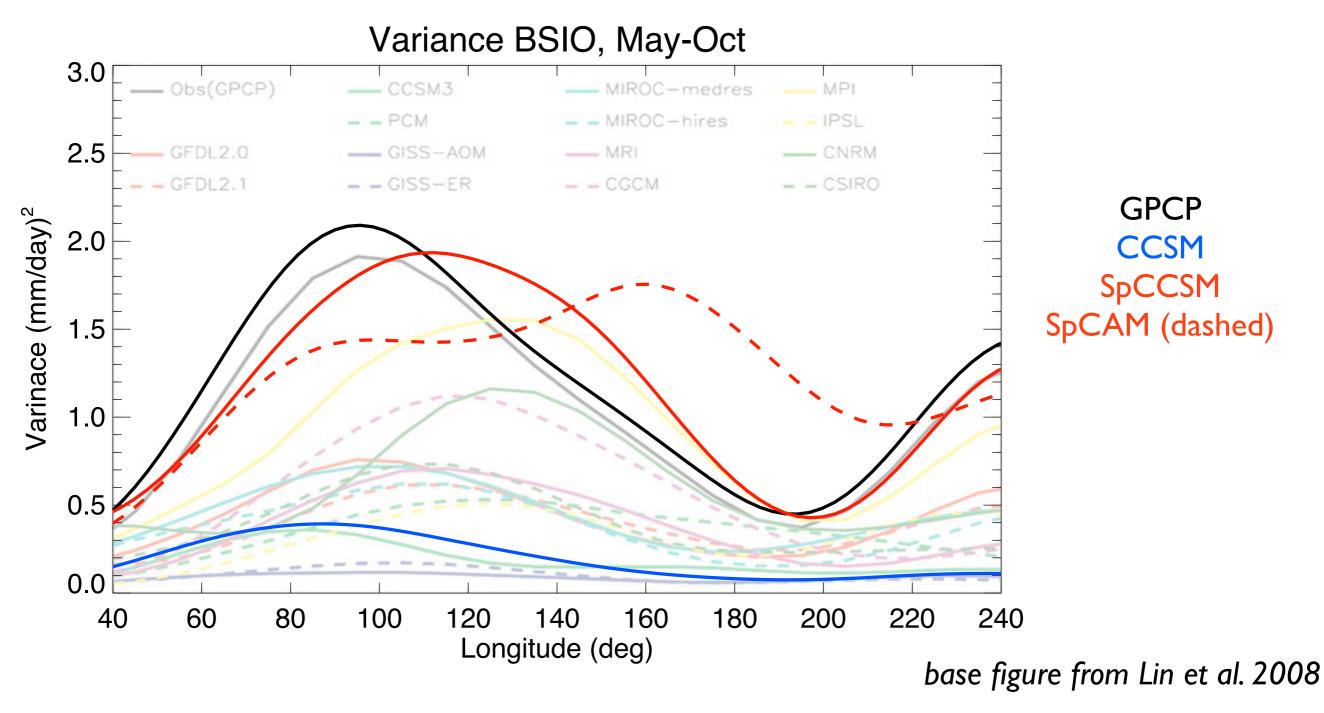
- CCSM = Community Climate System Model
- Coupled to POP ocean model gx3x5 for coupled runs
- T42 atmospheric resolution

Asian Monsoon

May-Oct mean precipitation

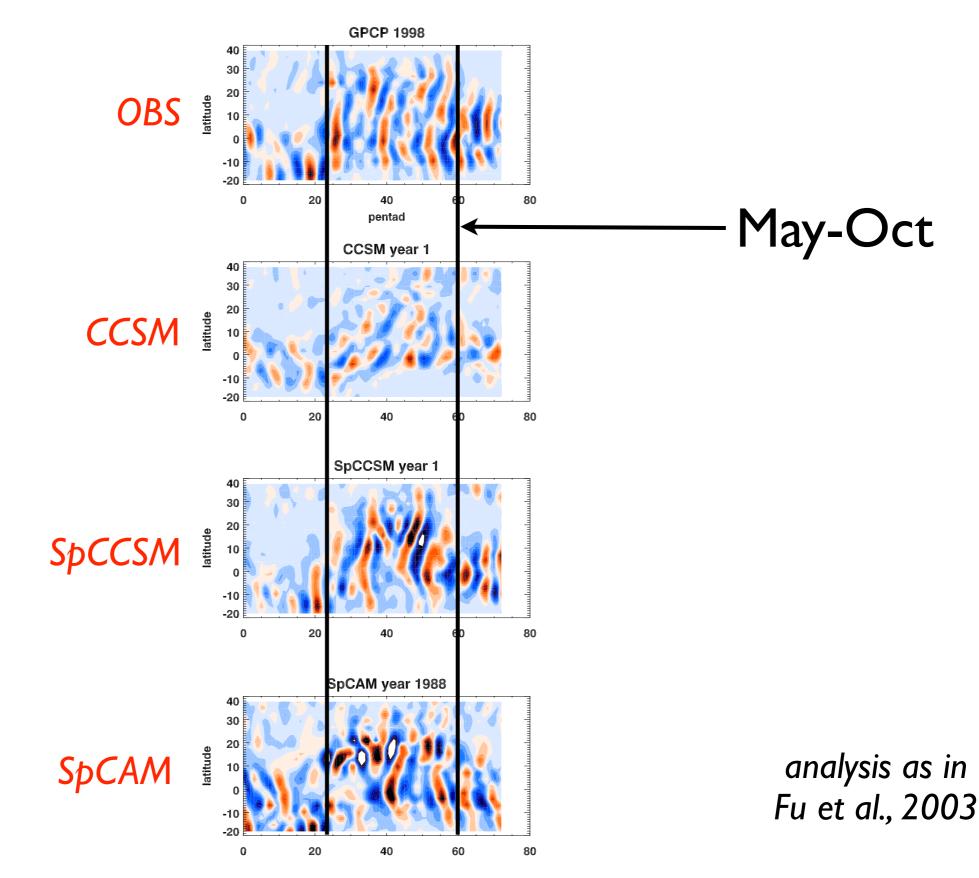


Eastward-propagating precipitation

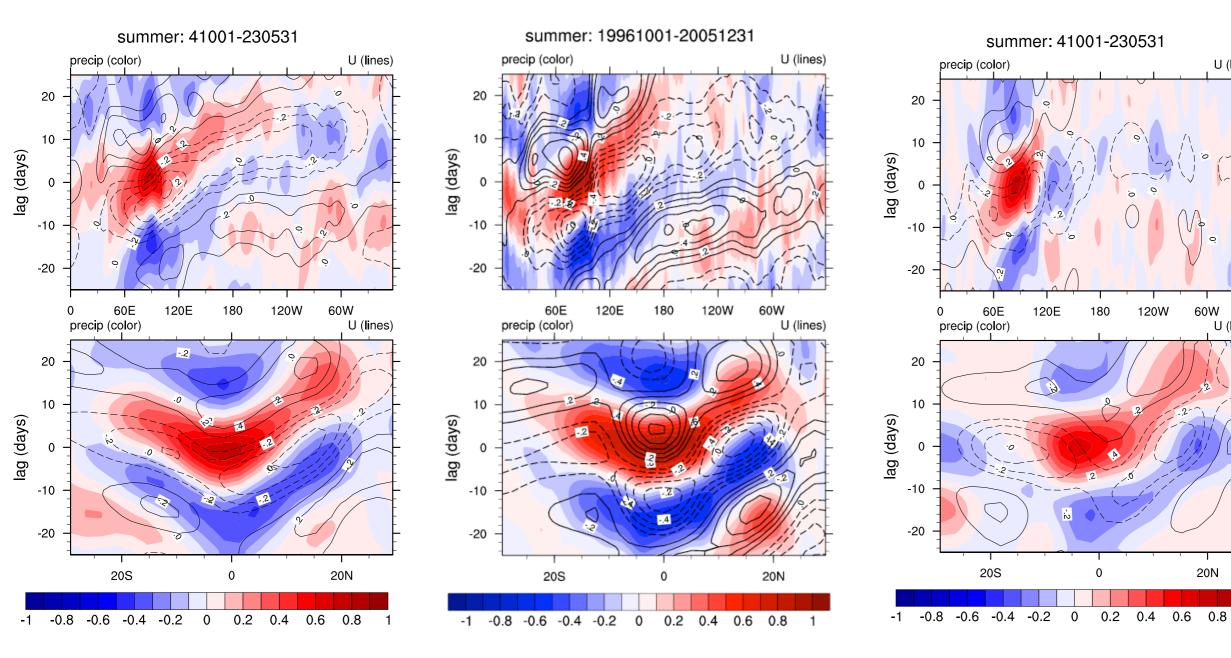


5N-25N, eastward wave #s 1-6, periods 24-70 days

Northward-propagating precipitation



Variability: summer ISO



SpCCSM

OBS



U (lines)

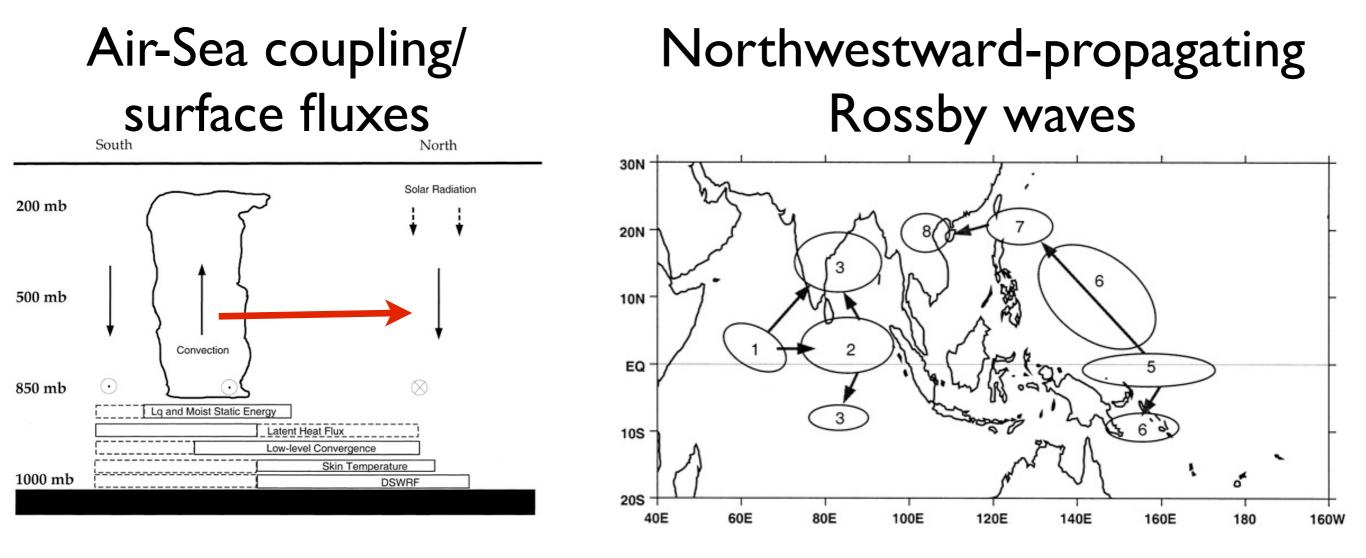
60W

20N

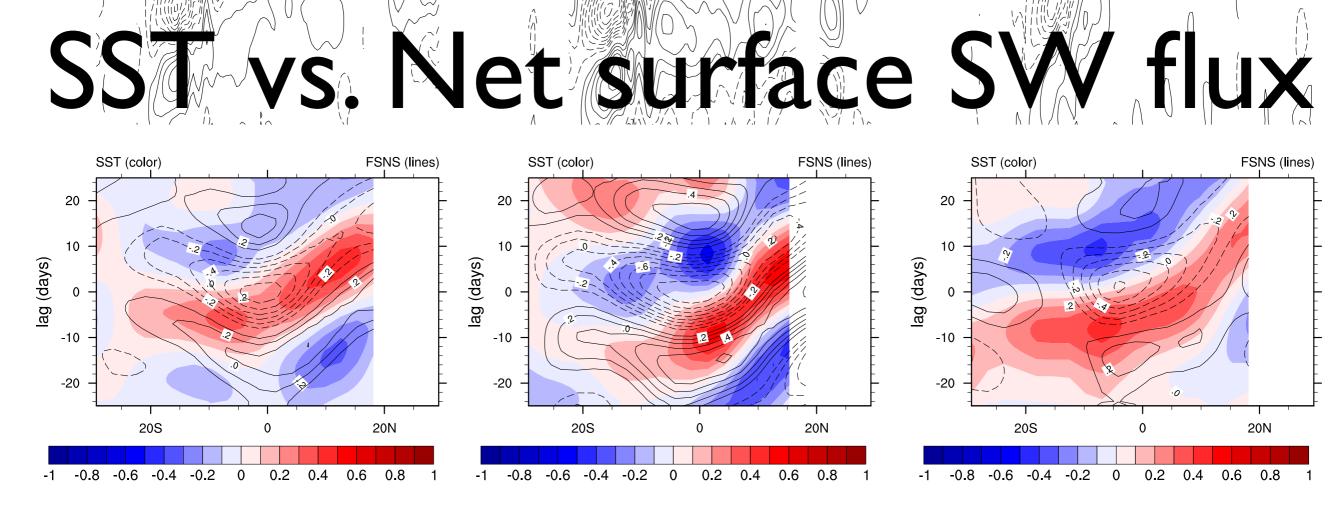
- 1

U (lines)

Factors with potential relevance for northward propagation:



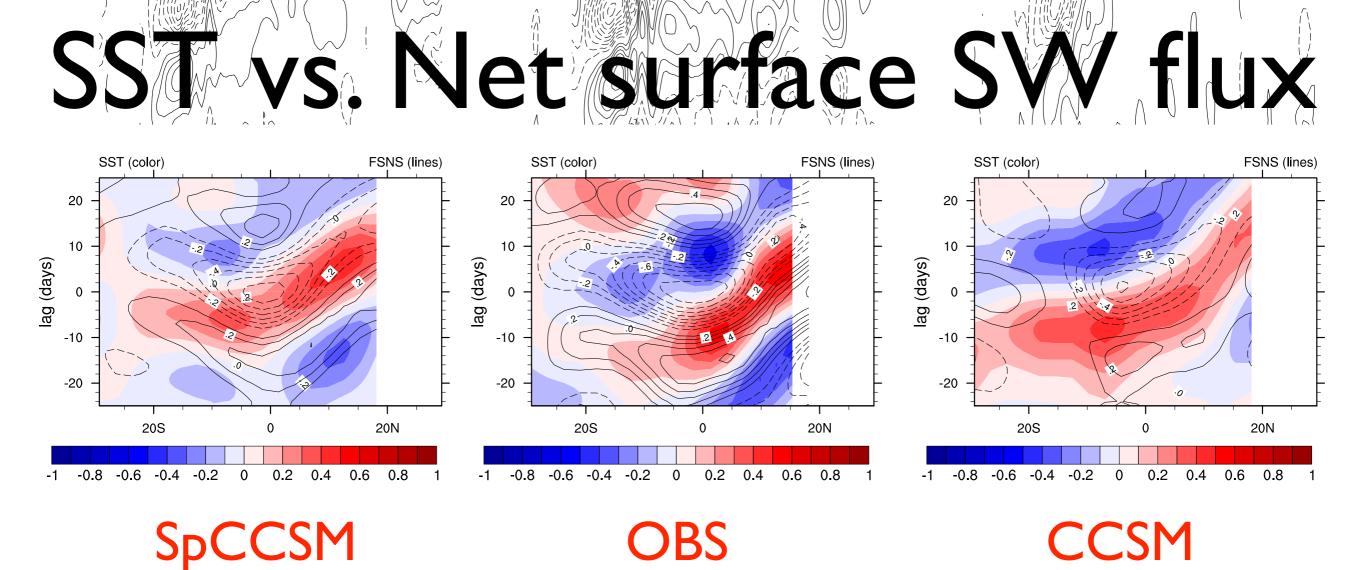
Figures from Kemball-Cook and Wang, 2001







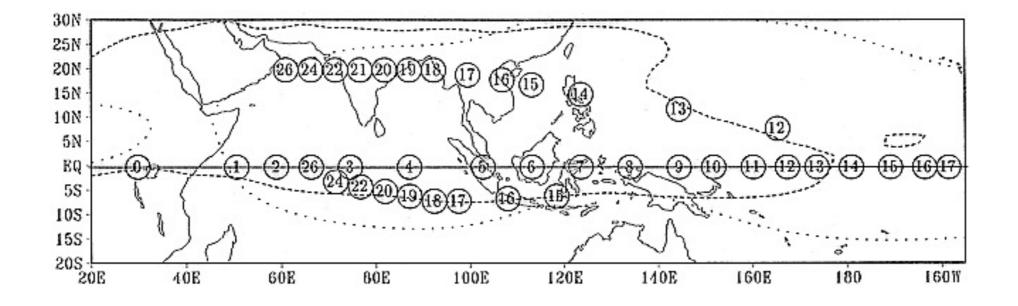




- •Both models capture the general behavior.
- •Each model produces different details.
- •Neither model is more successful than the other.

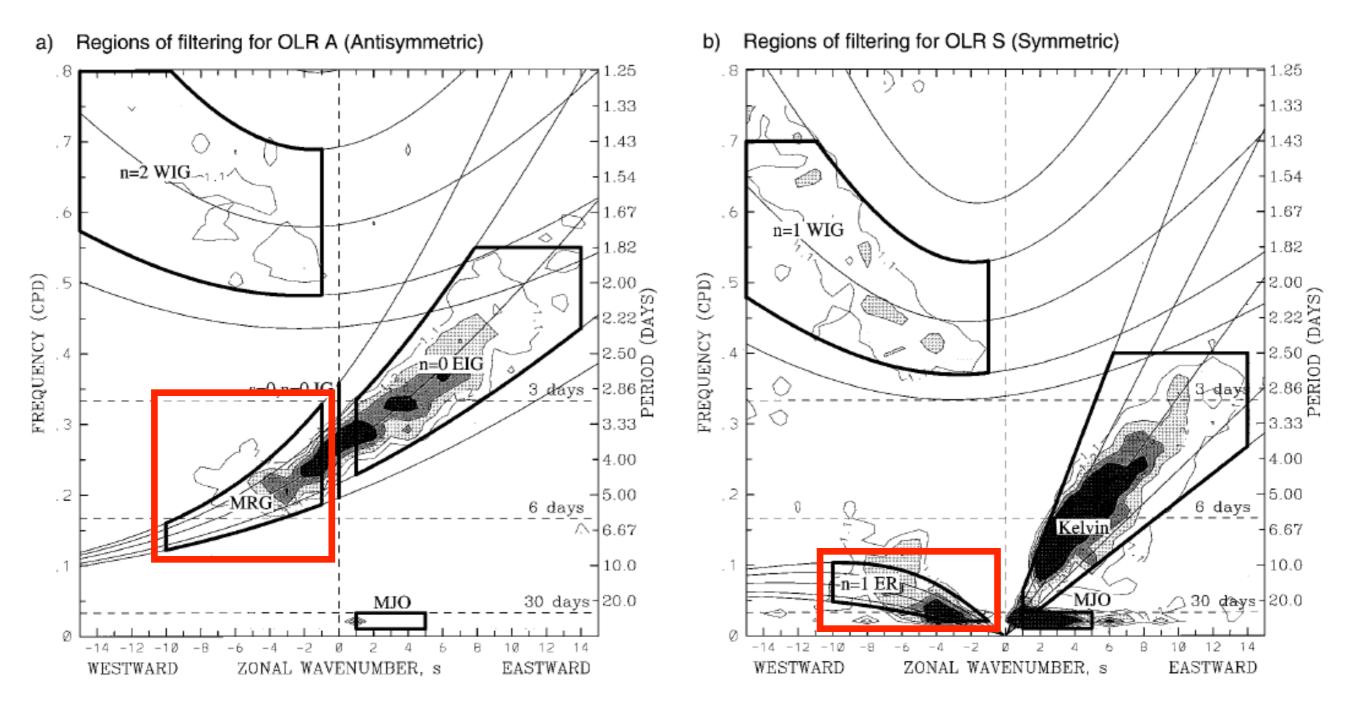
Northward propagation and equatorial Rossby waves:

 Westward-propagating equatorial Rossby waves (Wang and Xie, 1997, Lawrence and Webster, 2002)



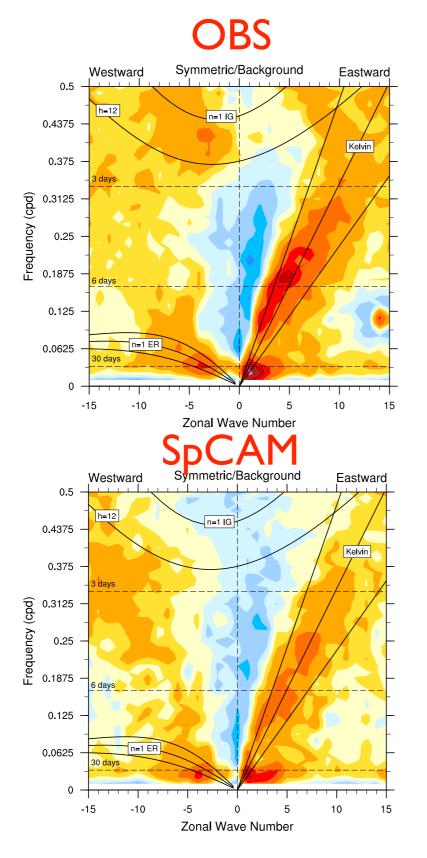
Wang & Xie, 1997

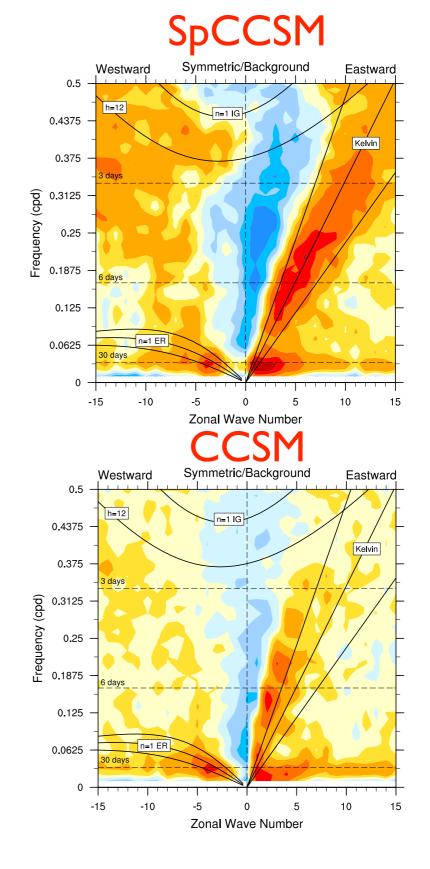
Filtering Equatorial Waves

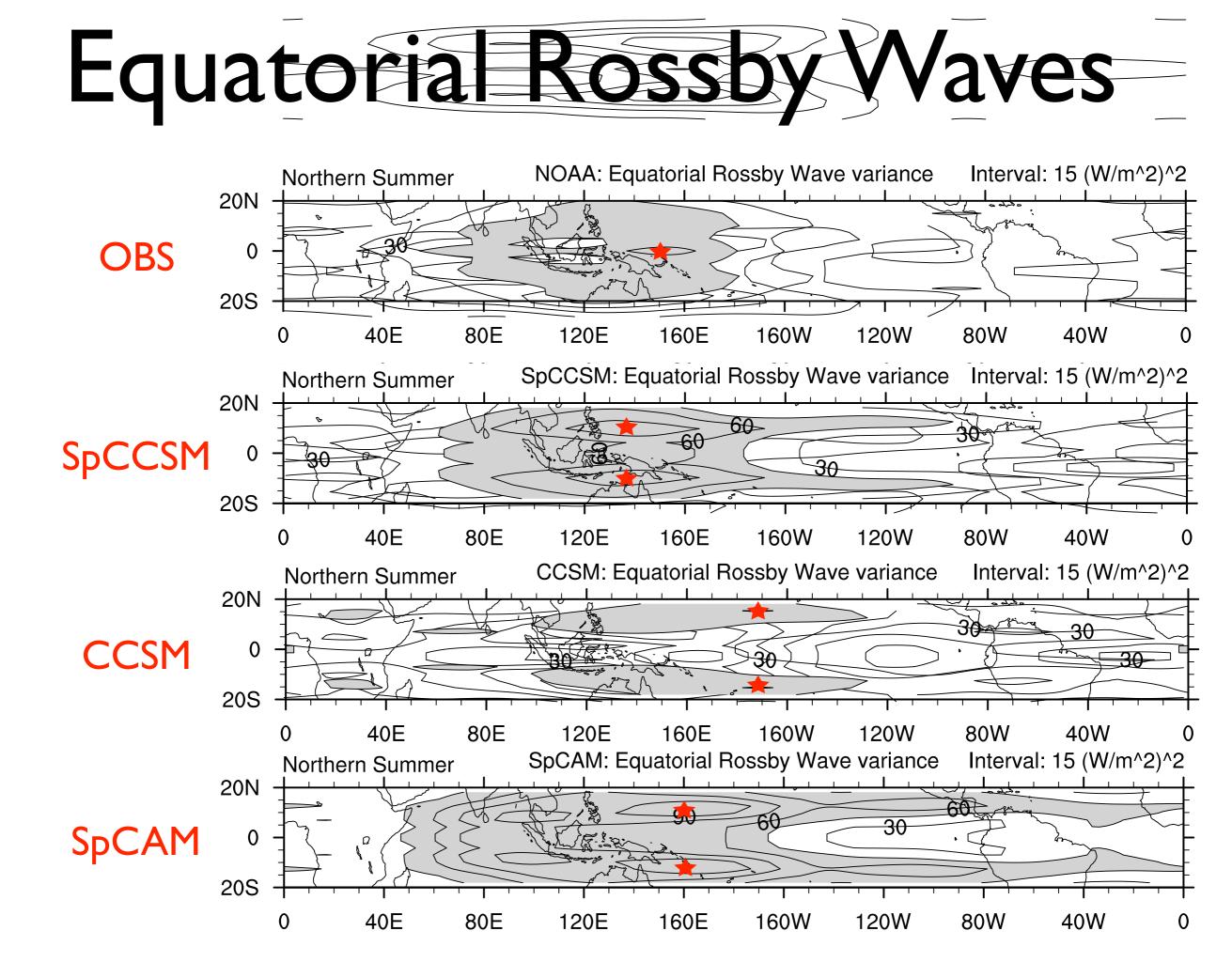


from Wheeler & Kiladis, 1999

Equatorial Waves (sym)

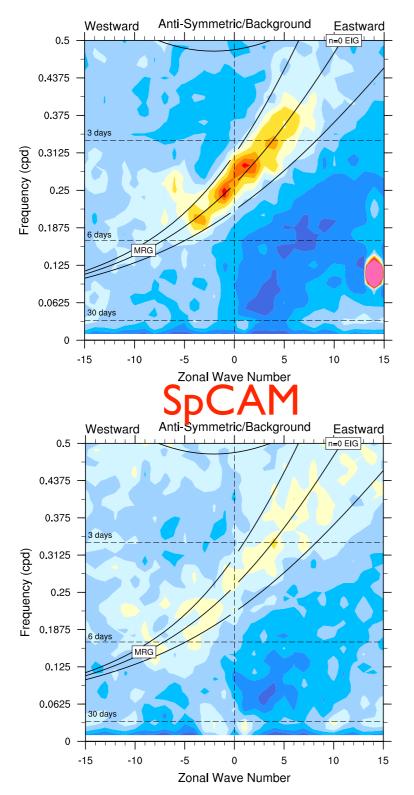


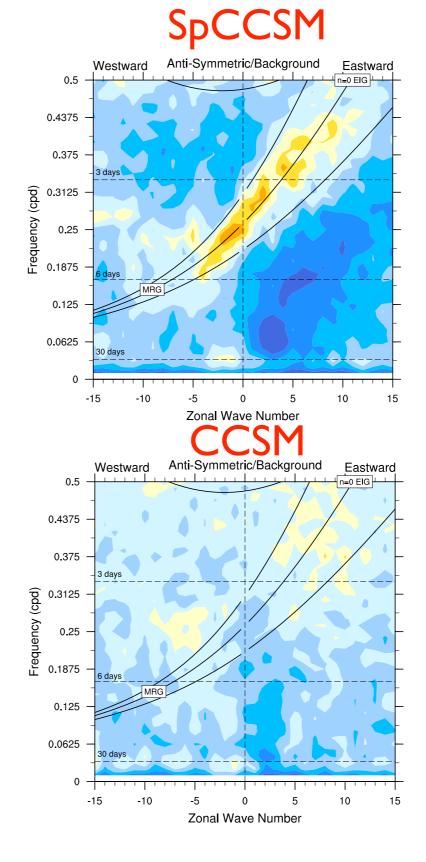




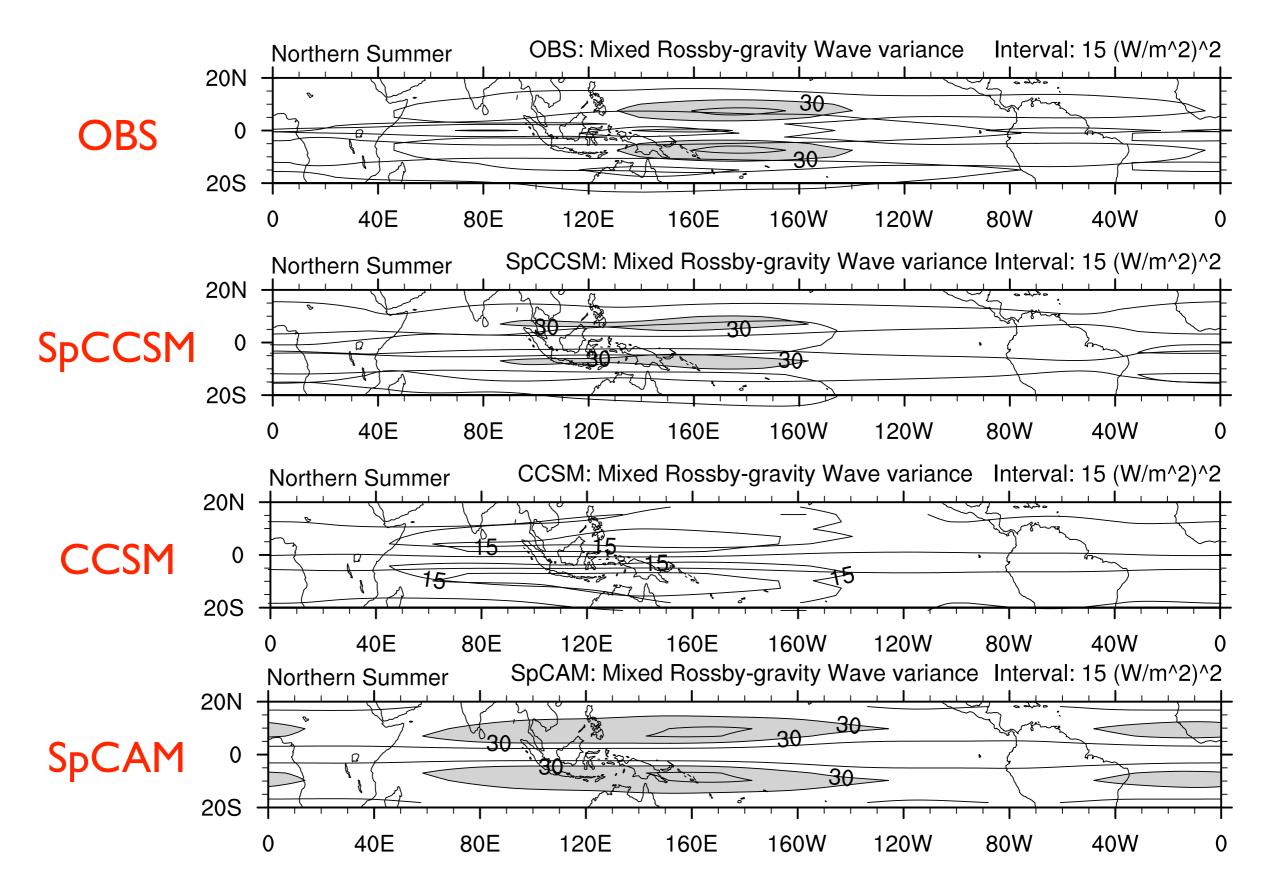
Equatorial Waves (asym)

OBS





Mixed Rossby-Gravity Waves



Factors influencing ER, MRG wave simulation:

- explicit convection AND coupling results in the most realistic distribution of n=1 ER and MRG variance.
- MRG variance is weaker than ER variance, and concentrated in central Pacific.
 - what role might these waves play in the monsoon?

How to composite the monsoon?

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May-Oct

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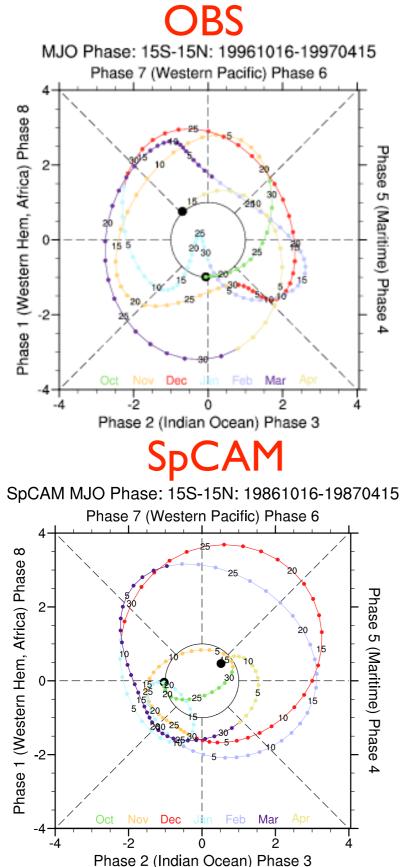
120E

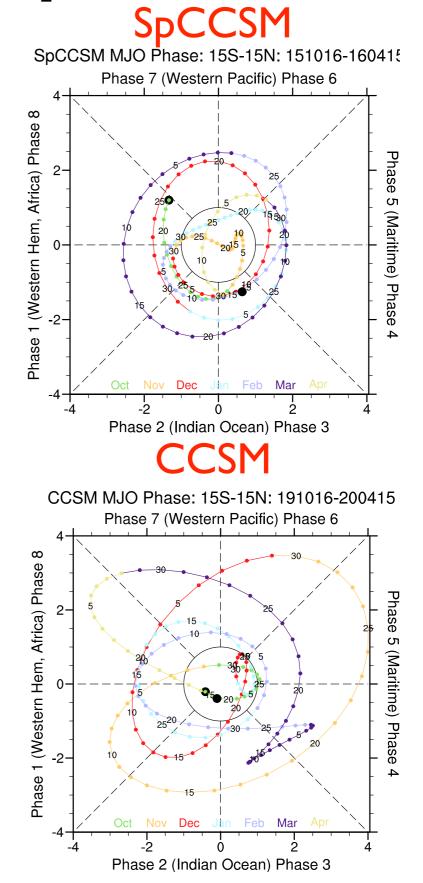
180

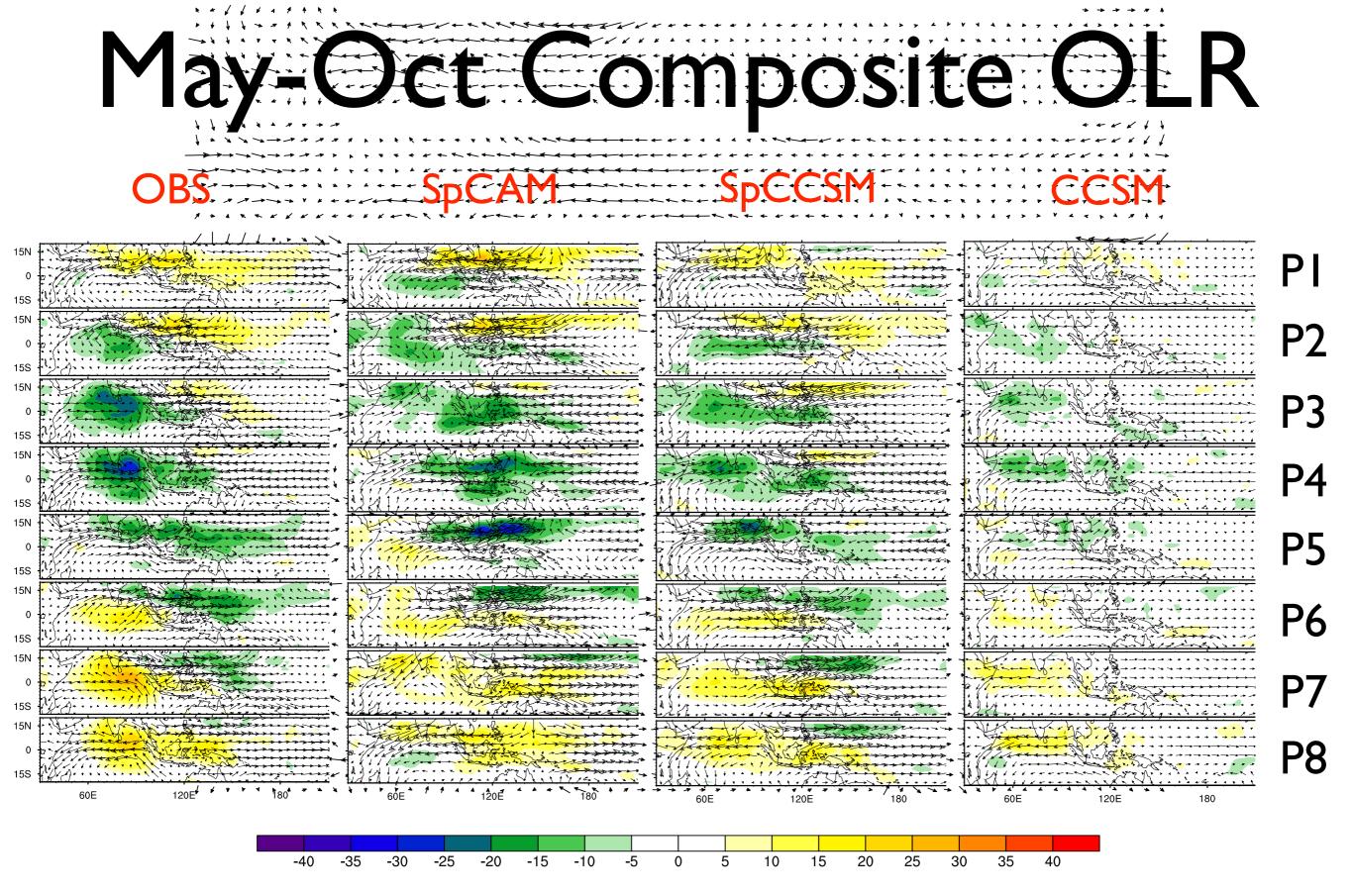
60E

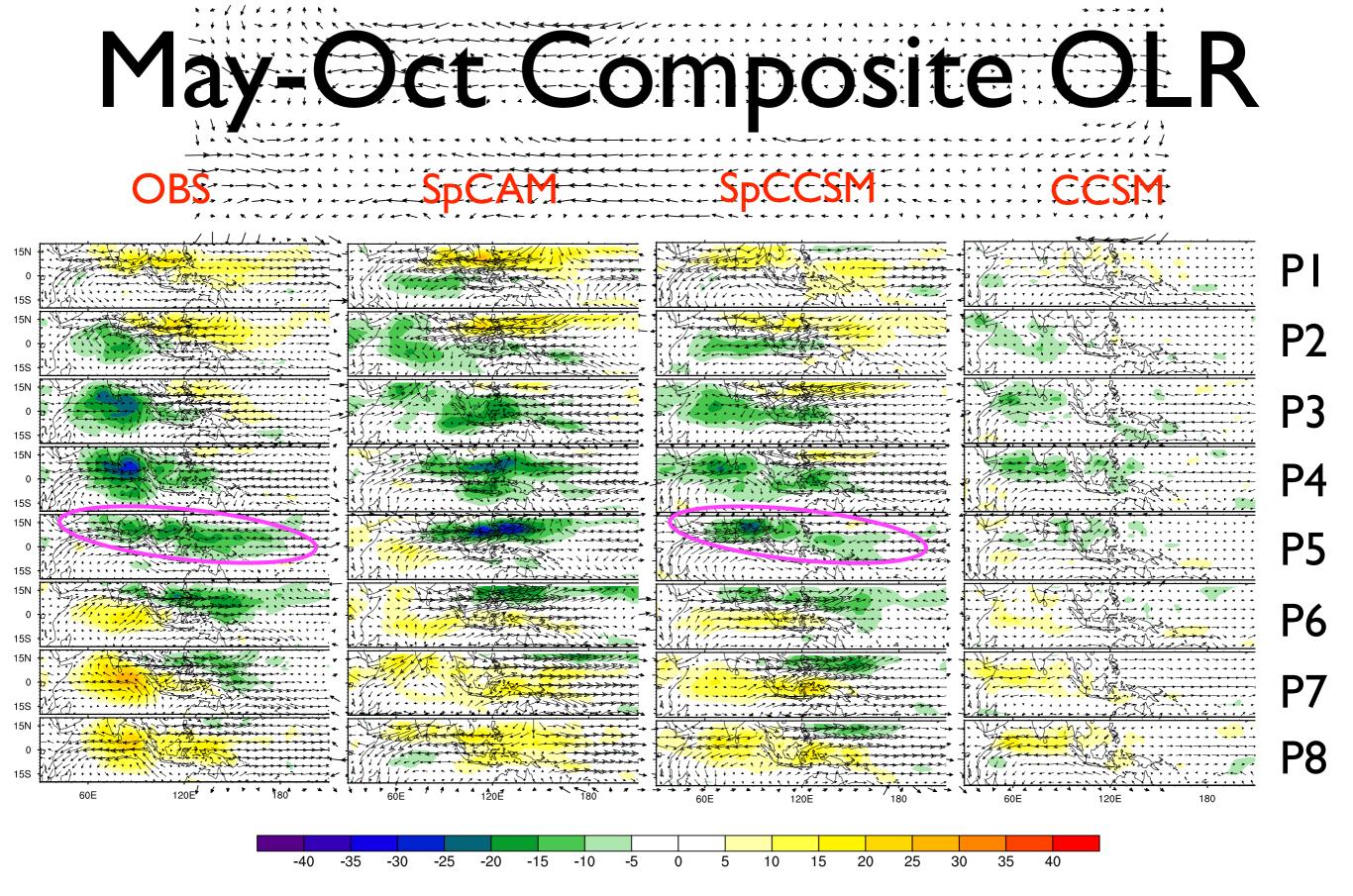
May-Oct

ISO Phase Space





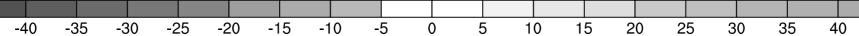


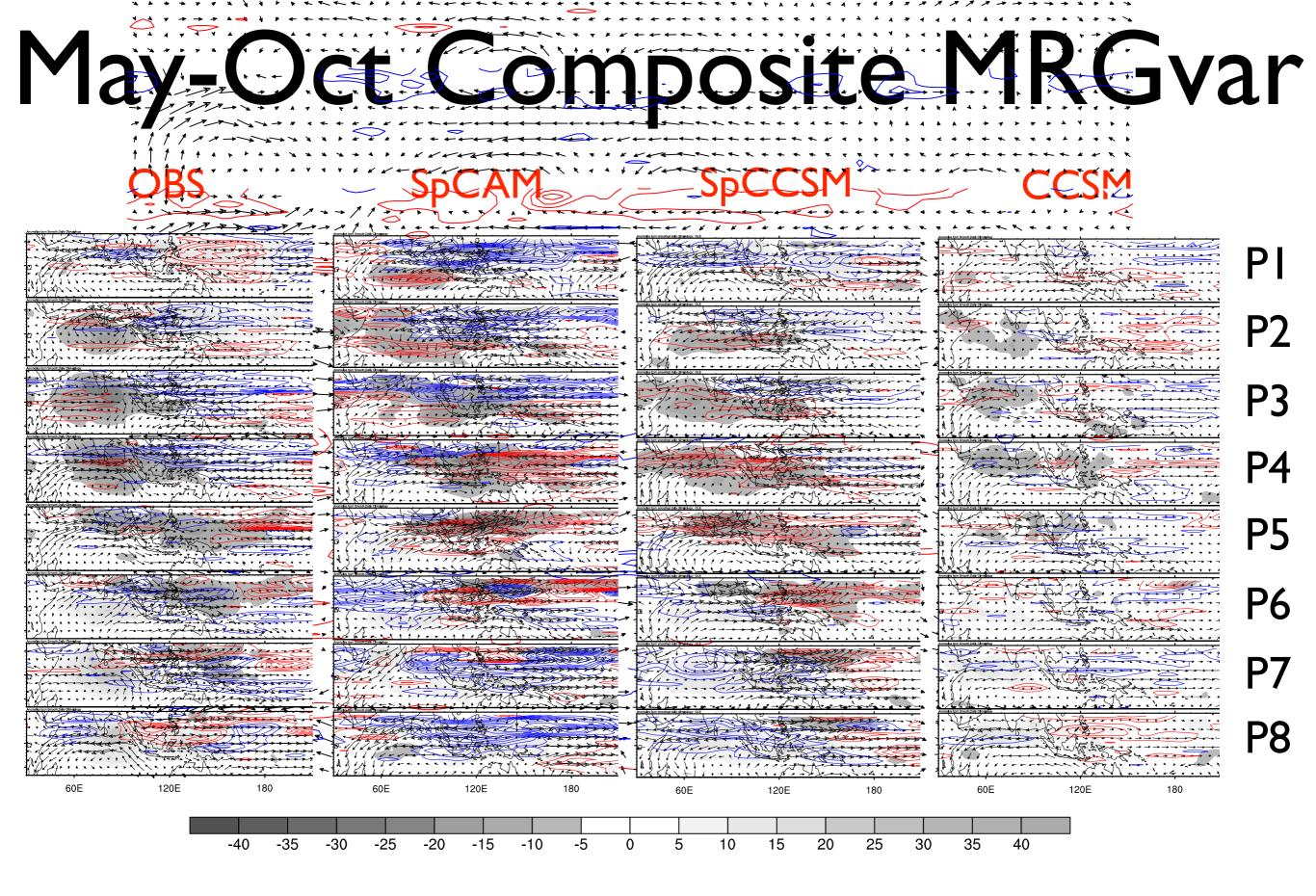


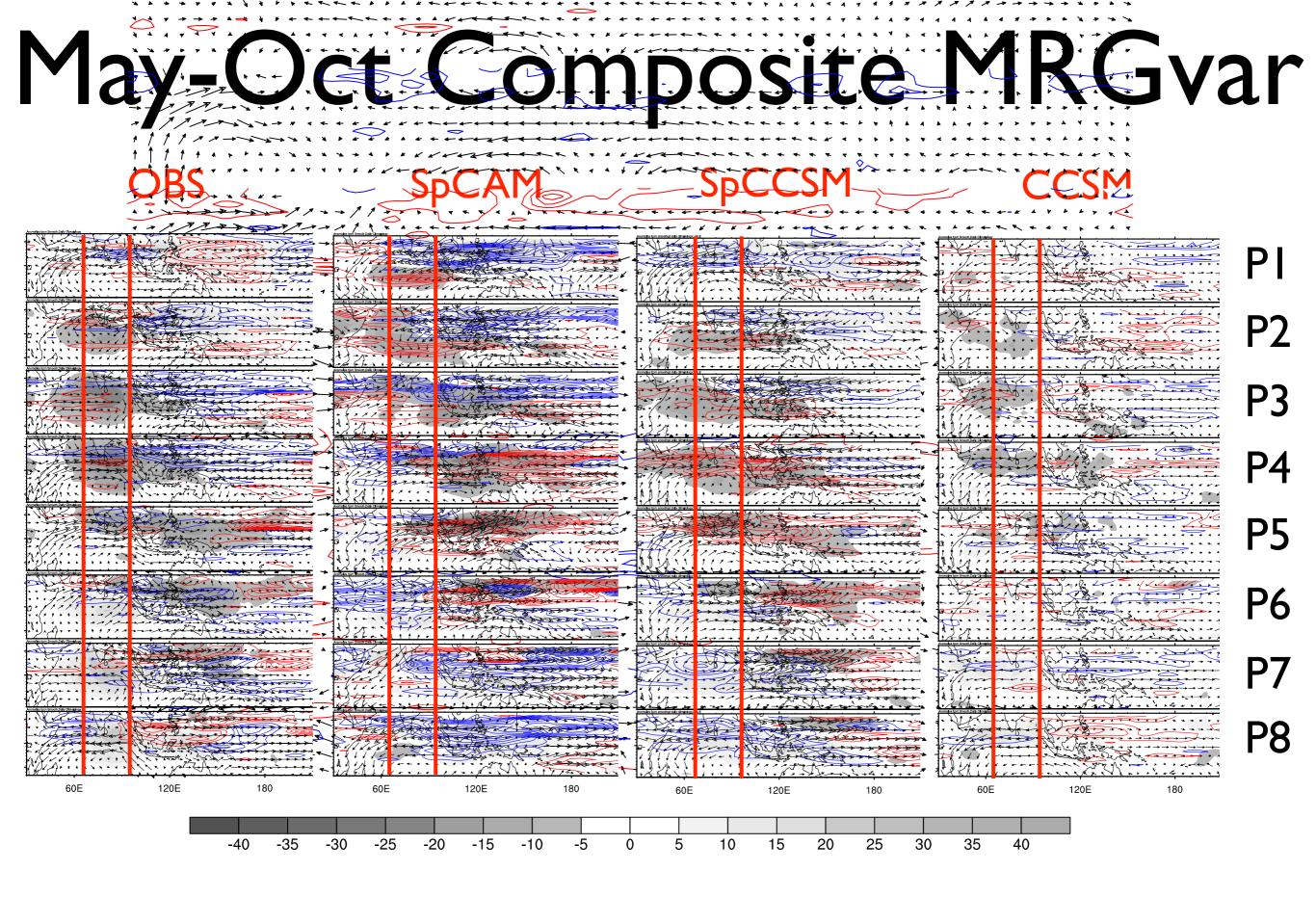
How to composite n=1 ER and MRG wave activity?

- Compute wave type OLR *variance*, rather than OLR mean, for each ISO phase.
- Better yet, plot departure of phase variance from season-mean variance.

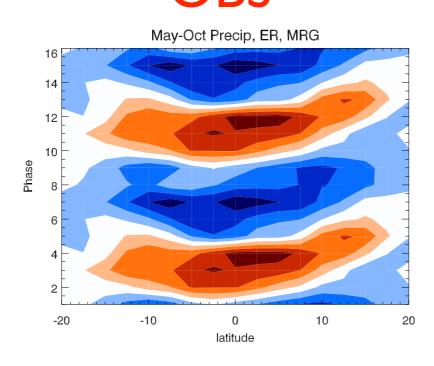
)mposite var ----~~~~~~~~~ 4 Ť * * * * * * AND IN When the the the state of the s 15N The post of the second KAS A KAKAKAKA 111 7 PI the & read , and a start " white 0 1 con her her the state of the state 30 All have a stander 1 1 1 1 1 - 1 3 - 5-5 A A KAKA ANT A 15S tent for the second hard - har The state of the s And the second sec 15N **P2** Contration 0 Contractor A Carl 15S Anne the states 1 & at all as & (you K ale W? & a de det to be and 2 A BARA 15N **P3** 0 the sale 15S the second a second 15N 222 - + - + **P4** the state of the second states 0 A start and a start and a start and a start and a start a star 15S 15N **P5** Start Warres 0 4444 A MANNER ++ 1 ARE 127-1 ----15S 15N brx is **P6** 0 No all all all K TAT AS AN K-********** Arriver 1 1 2 to the state of t 15S K C L L 15N the state of the s *** A Carrow A CONTRACTOR **P7** 0 ET TREESE CONTRACTOR 15S D. N. C. D. +, F. F. P. D. X. S. R. A REAL RANGE the state of the s 15N 2.2.2 AT TO THE alter for the A A A A Adam **P8** 0 The second of the second of the Alter a be a set of the set *** ----A the state of the state 15S 1 1 AT + T + H + + + T + A - · · · · · · · · · -* ** * * * * 120E120E 60E 120Ē 180 60E 180 60E







Indian Ocean meridional composite by MJO PCI+PC2 phase (2 cycles shown) OBS SDCCSM



SpCAM

16

14

12

10

8

6

4

2

-20

-10

Phase

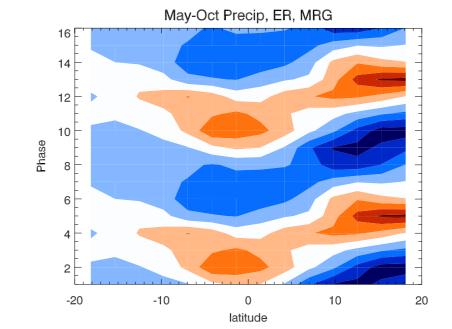
May-Oct Precip, ER, MRG

0

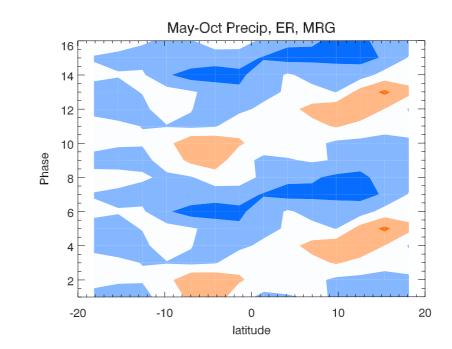
latitude

10

20

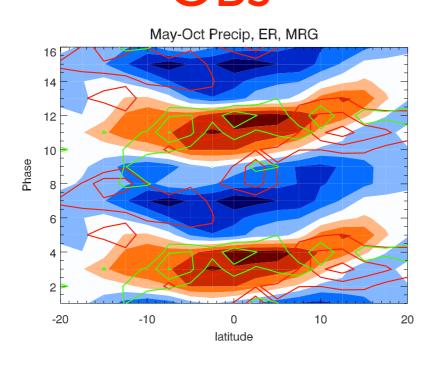


CCSM



Precip' (red = positive anomaly)

Indian Ocean meridional composite by MJO PCI+PC2 phase (2 cycles shown) OBS SDCCSM



SpCAM

16

14

12

10

8

6

4

2

-20

-10

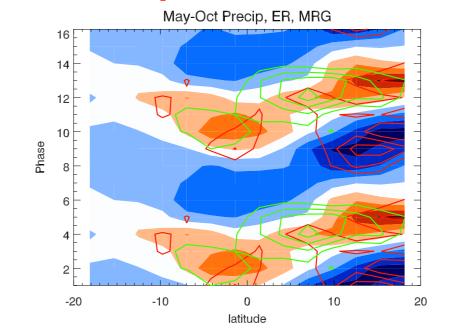
Phase

May-Oct Precip, ER, MRG

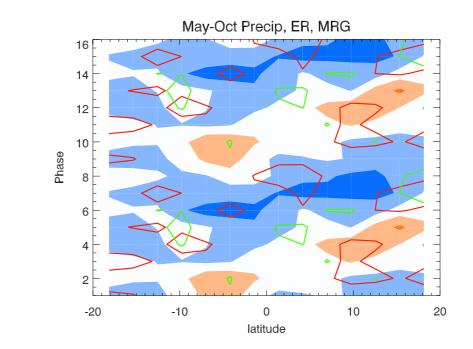
0

latitude

10



CCSM



Precip' (shaded), +MRG', +ER'

20

Conclusions (Processes)

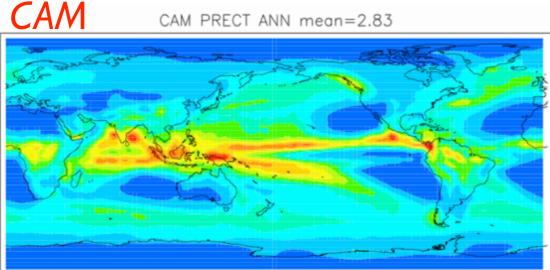
- n=I ER wave may "pre-condition" the atmosphere for northward-propagating convection.
- n=I ER wave is primarily improved by "Sp" but is further improved with coupling.
- MRG waves are associated with low-latitude (0~12N) northward propagation.
- MRG waves are best represented with "Sp" AND coupling.

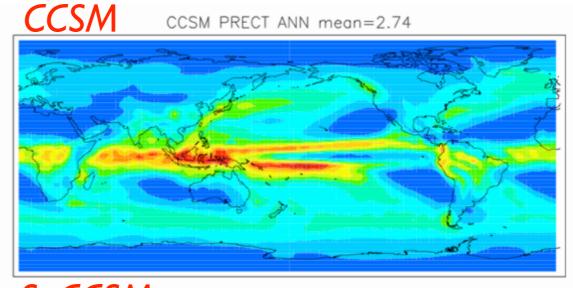
CLIVAR EOF compositing

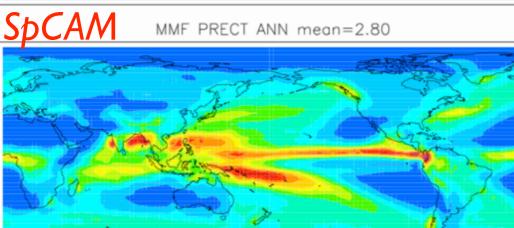
- captures some elements of northward- and westward-propagating elements of monsoon.
- can be used to study phenomena that span a variety of space and time scales.
- appears to miss some northward events, especially in models.
- notes on northward EOF composite.

End

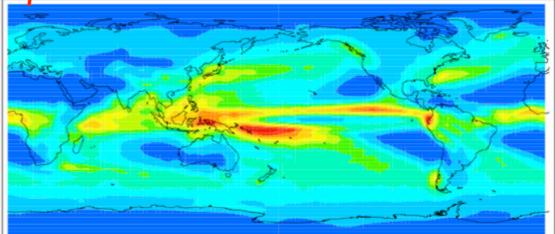
Annual Rainfall





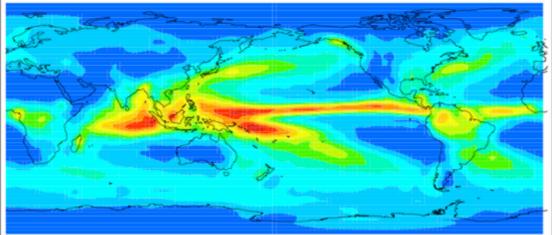


SpCCSM CMMF PRECT ANN mean=2.79



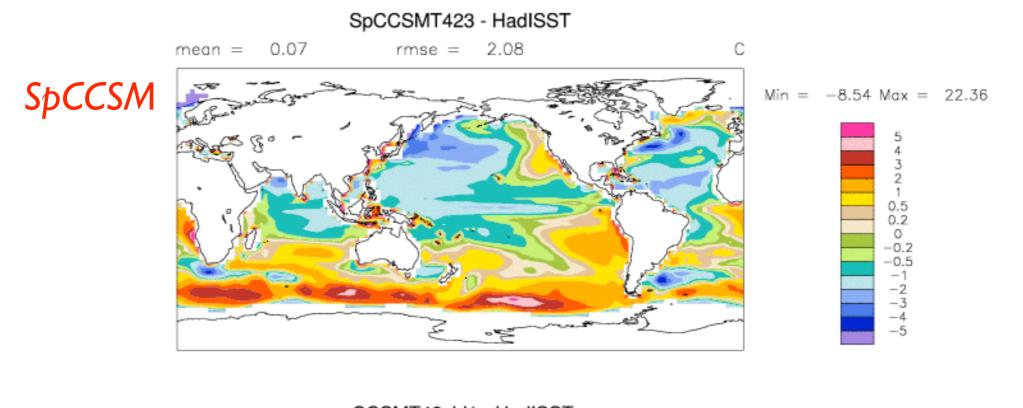
OBS

CMAP PRECT ANN mean=2.69



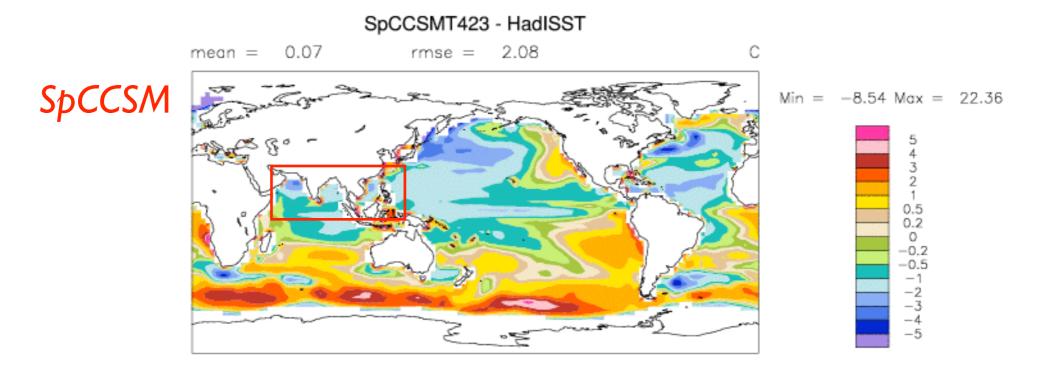


SST



CCSMT42sld1 - HadISST mean = 0.05 rmse = 2.14 C CCSM in = -8.30 Max = 22.96 in = -8.30 Max = 22.96 in = -8.30 Max = -22.96in = -8.30 Max = -22.96

SST



CCSMT42sld1 - HadISSTmean = 0.05 mse = 2.14 C Min = -8.30 Max = 22.96