Intertropical Convergence Zones
and
Madden-Julian Oscillation

but first …

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Thanks to: Boutheina Oueslati

Sensitivity of equilibrium non-precipitating shallow convection

- ✓ **UCLA/MPI LES (non-precipitating, fixed radiation)**
- ✓ **Forcing/boundary conditions :**

$$w(z) = -w_0\left(1 - e^{-\frac{z}{z_w}}\right),$$

$$q_{ft}(z) = q_0$$

$$\partial_z \theta_{ft} = \frac{R}{w_0\left(1-e^{-\frac{z}{z_w}}\right)},$$

$$\theta_{ft}(z) = \frac{R}{w_0} z_w ln\left(e^{\frac{z}{z_w}} - 1\right) + \theta_0$$

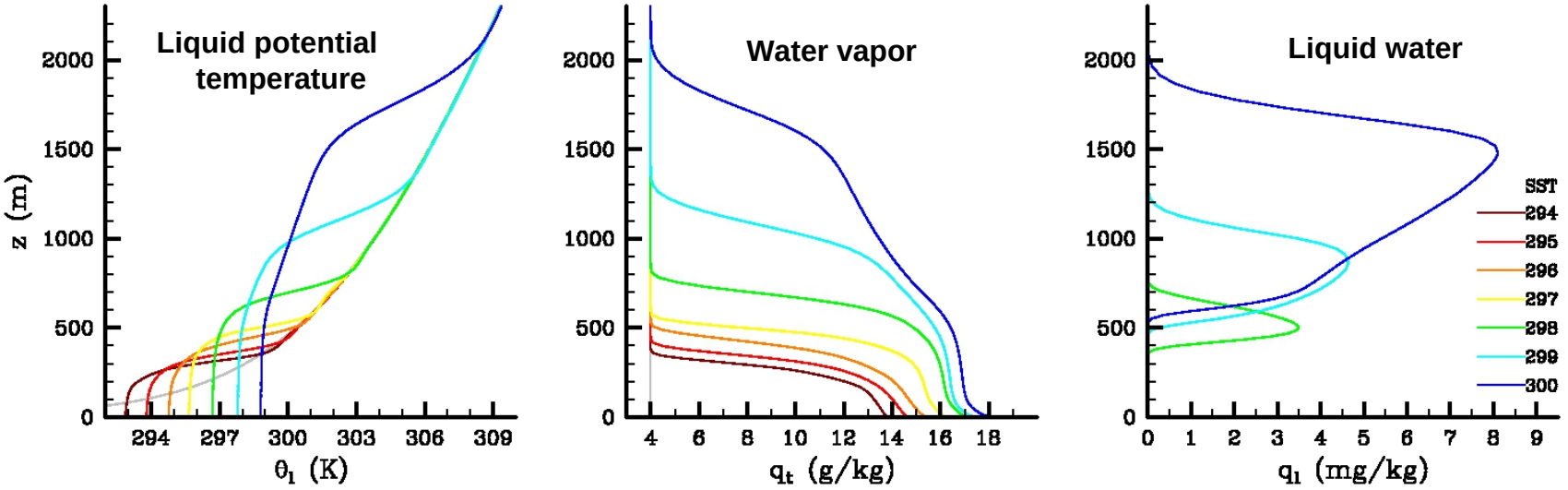
$u_{ft} = U$

SST

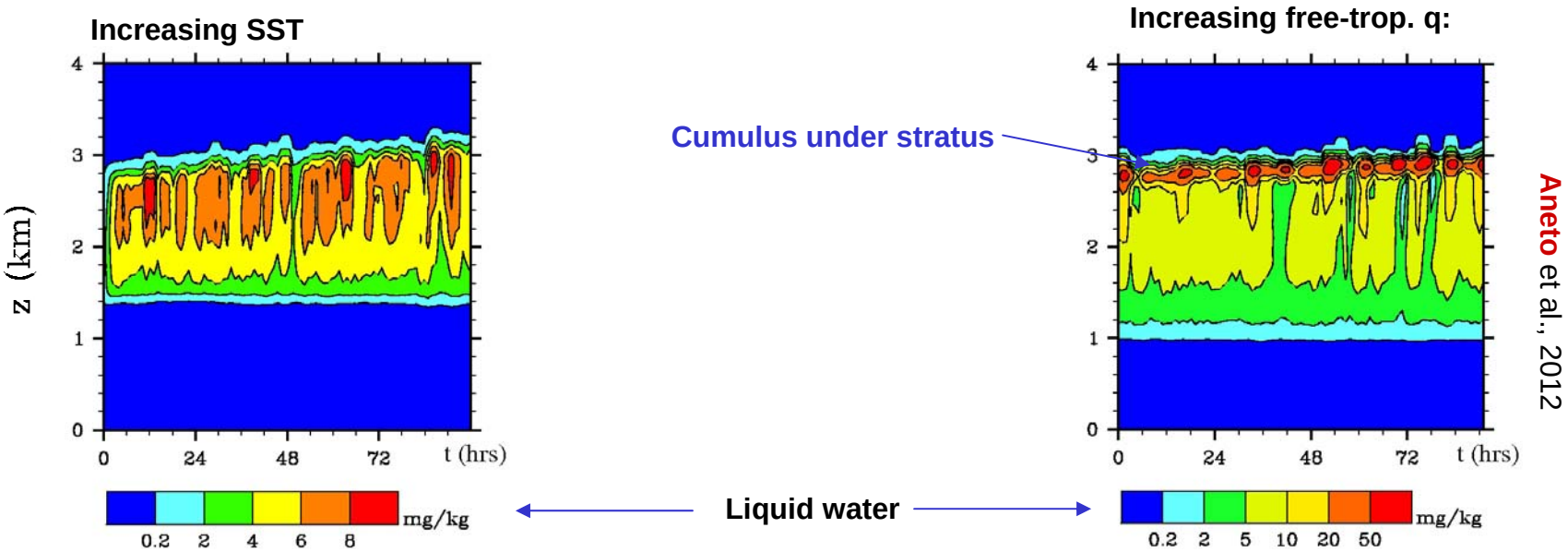
- ✓ **Run to equilibrium (2 weeks if necessary)**

Sensitivity of equilibrium non-precipitating shallow convection

✓ Sensitivity to SST

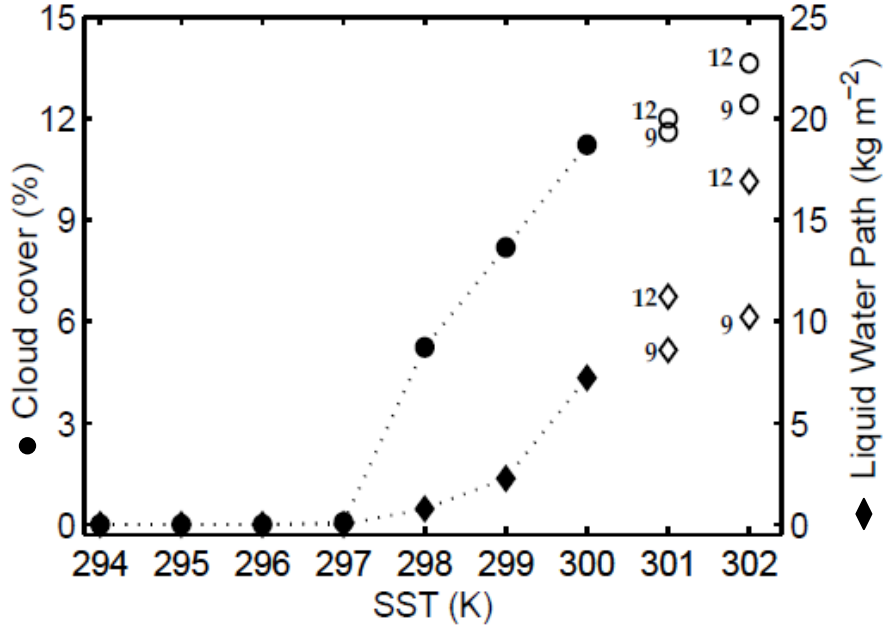


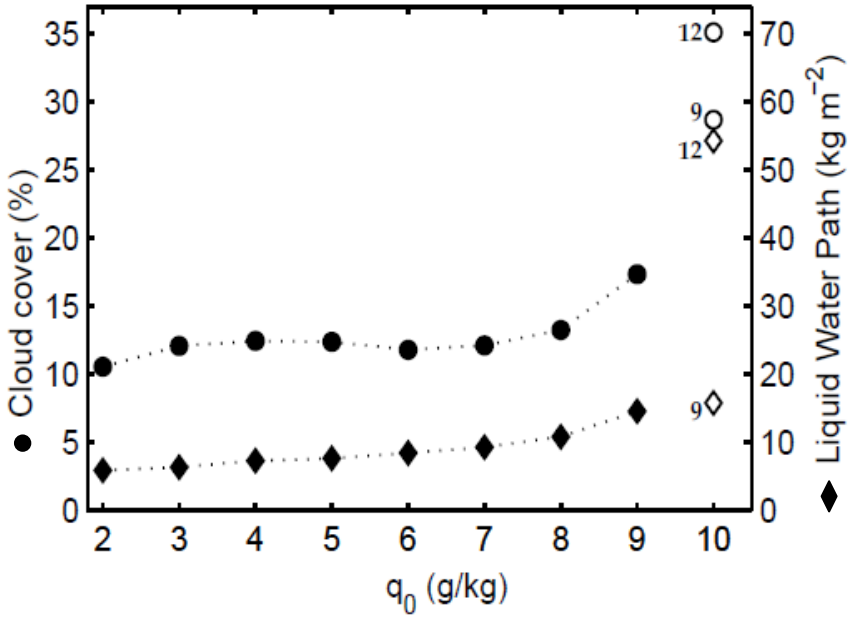
✓ Instability :



Sensitivity of equilibrium non-precipitating shallow convection

✓ **Sensitivity of cloud cover / LWP**



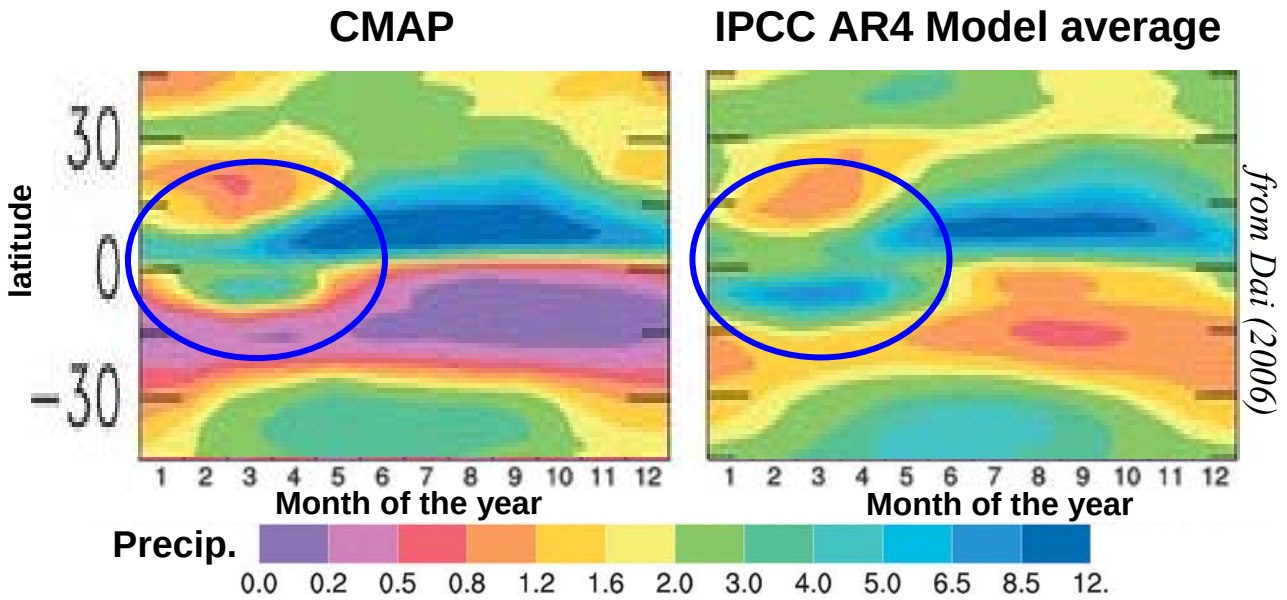


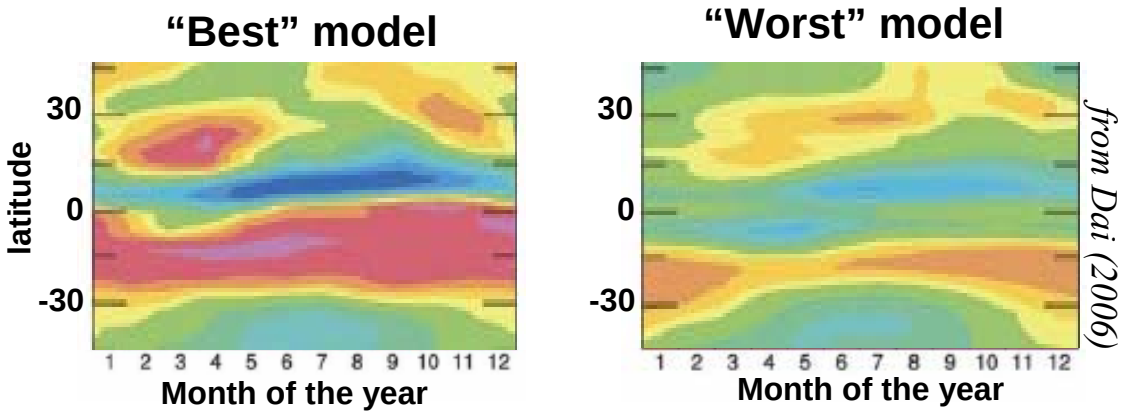
✓ **Dataset constitutes a nice framework to test SCMs' sensitivities**

ITCZ
GCM precipitation regimes

Double ITCZ ‘syndrom’

Average seasonal cycle of precipitation in the Eastern Pacific (80W-120W)



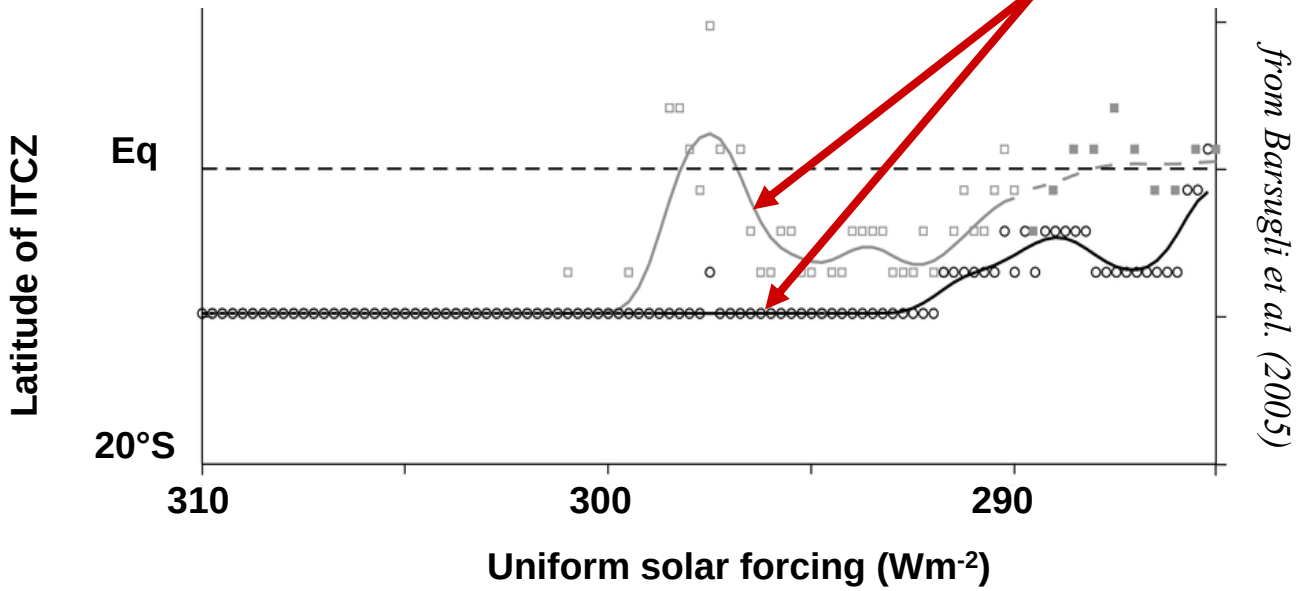


Our models should be able to simulate both a double ITCZ and a single ITCZ regime

Some GCMs do simulate different regimes in aquaplanet configurations

NCAR AGCM over a slab ocean

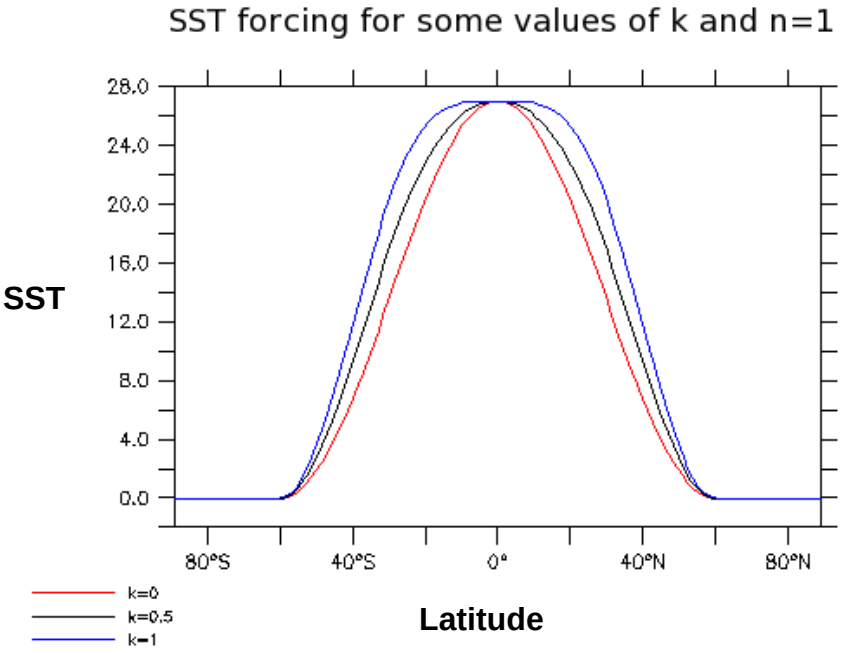
Even multiple equilibria!

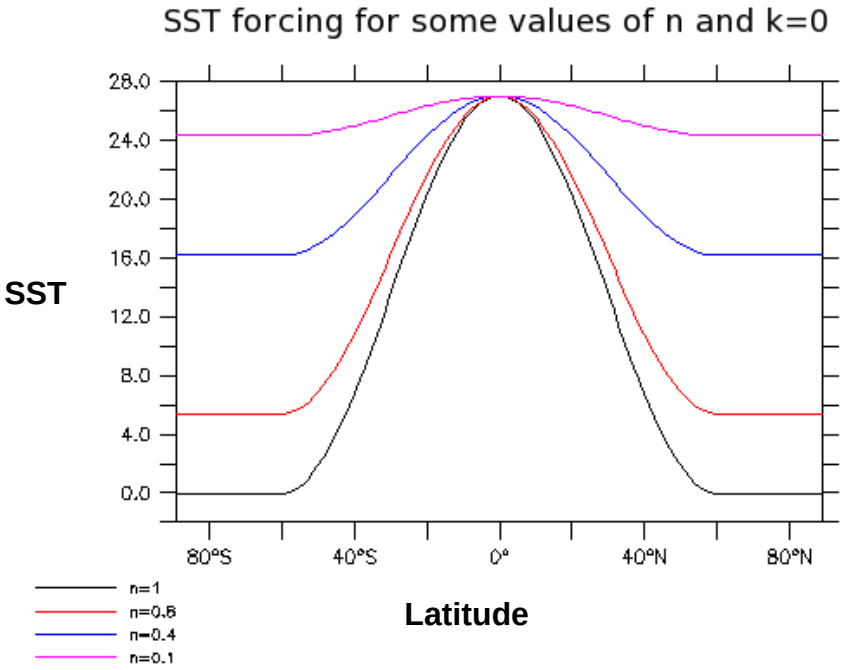


It might help to improve our understanding of these regimes to address the double ITCZ problem

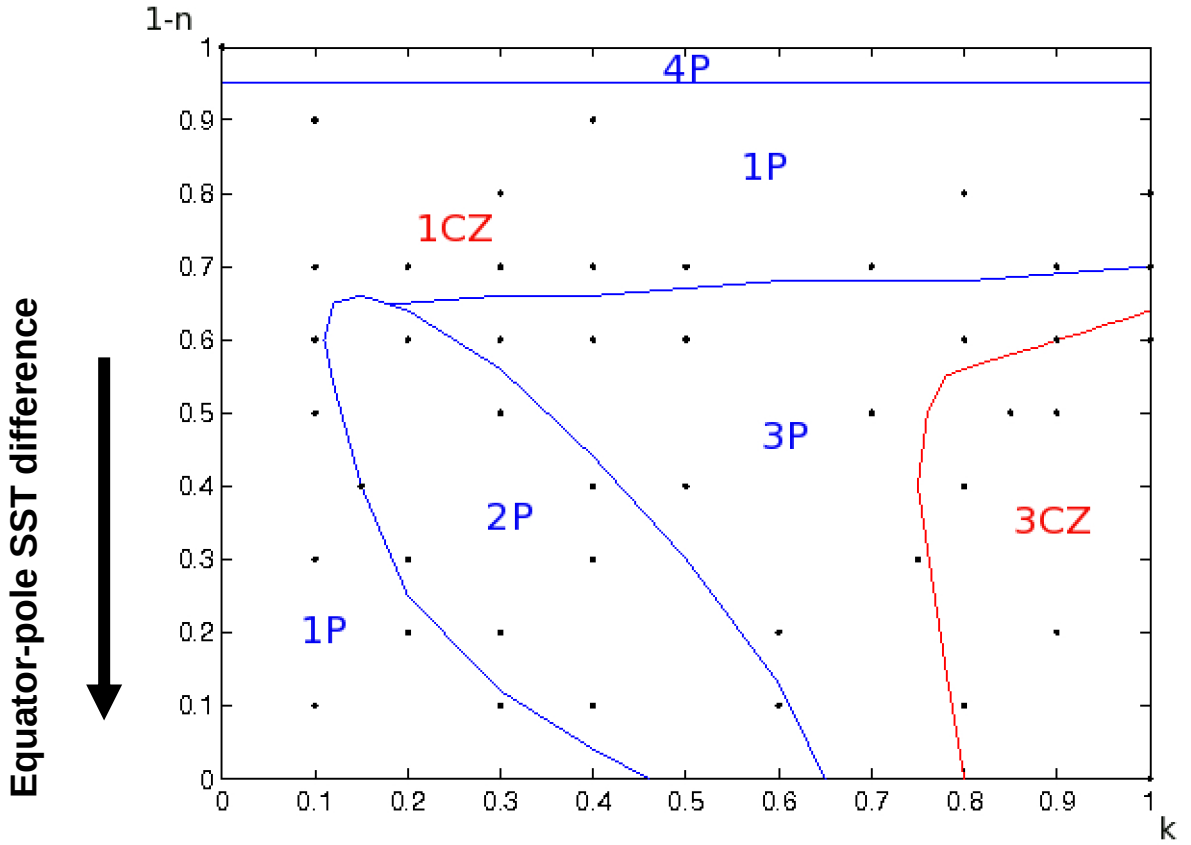
APE-type forcing

$$SST(\phi) = \begin{cases} 27 - 27n\left[(1-k)\sin^2\left(\frac{3\phi}{2}\right) - k\sin^4\left(\frac{3\phi}{2}\right)\right] & if\ -\frac{\Pi}{3} < \varphi < \frac{\Pi}{3} \\ 27\,(1-n) & otherwise \end{cases}$$





Regimes of precipitation and moisture convergence



Oueslati et al. (2011)

No multiple equilibria
Inter-hemispheric symmetry in all cases

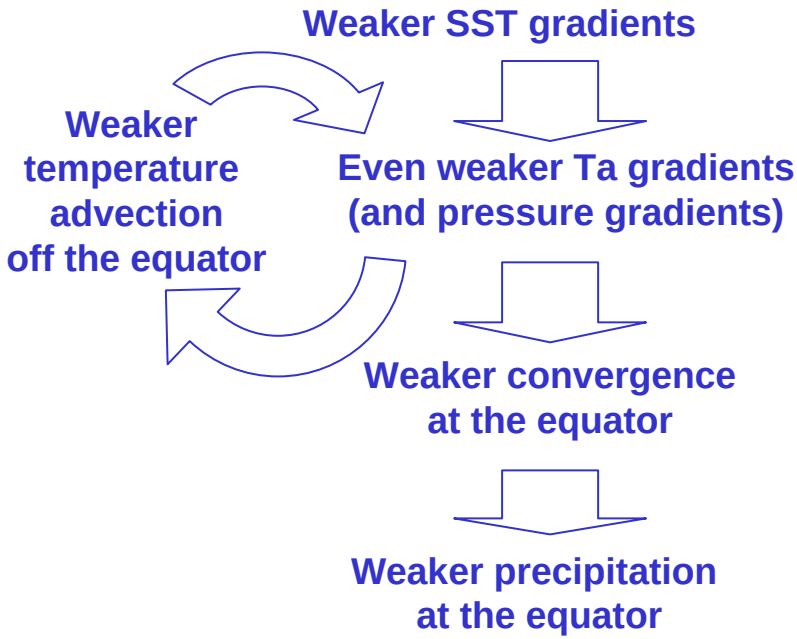
nP → n maxima of precipitation

nCZ → n ITCZ

Difference with C(F)MIP runs: no daily cycle of insolation

- ✓ **Characterization of regime transitions and associated feedbacks, in particular the transition 1P – 2P.**

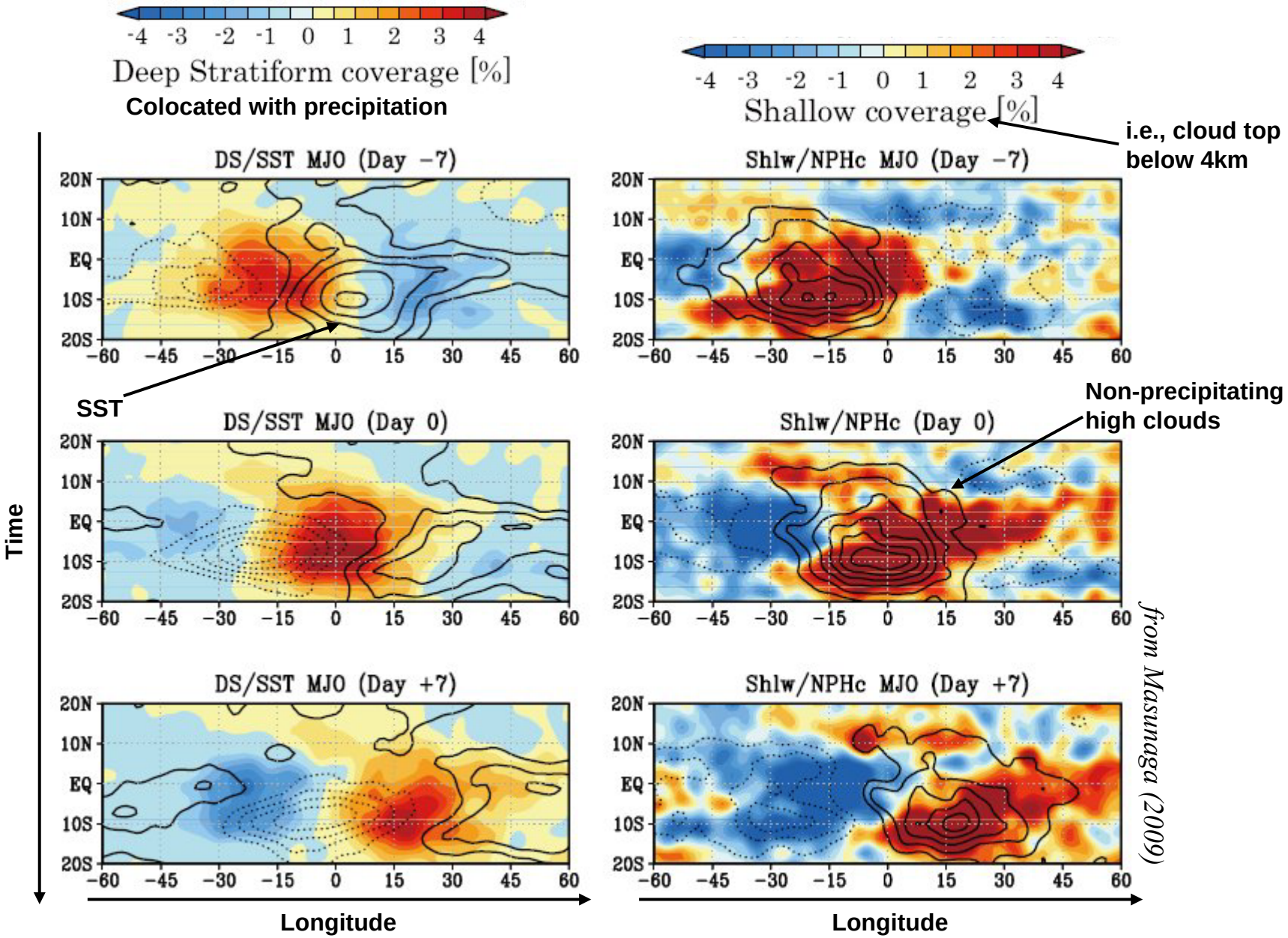
Precipitation controlled by convergence:



- ✓ **Characterization of associated cloud fields and cloud feedbacks.**
- ✓ **Sensitivity studies to the parameters of the convection scheme.**
- ✓ **Intercomparison of models: precipitation regimes, cloud fields…**

MJO
Cloud signature in GCMs and cloud mechanisms

Observed MJO : TRMM radar + IR



Multiple mechanisms

- ✓ **Cloud-radiative forcing changes the scale selection of tropical disturbances;**

  Fuchs and Raymond (2002), Bony and Emanuel (2005), Zurovac-Jevtić et al. (2007)

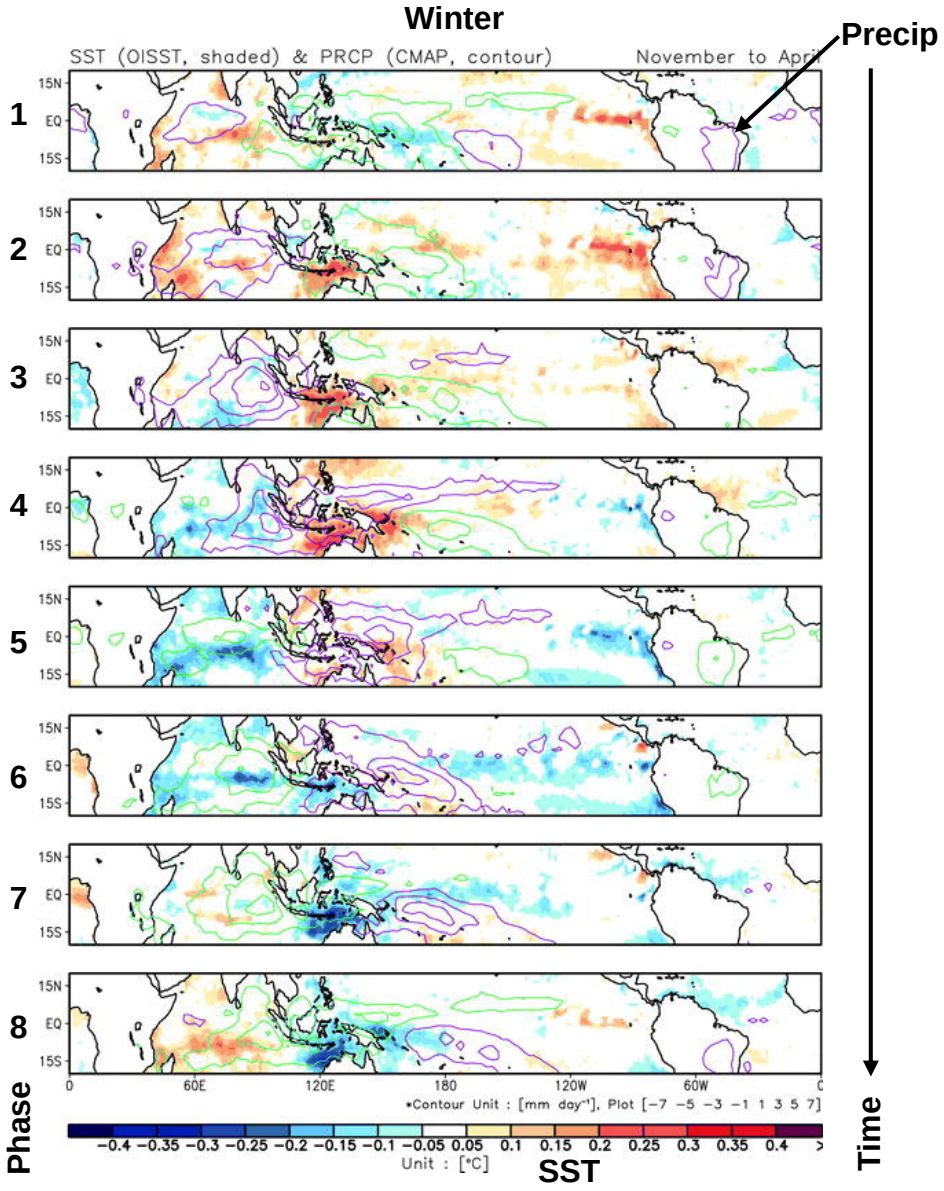
- ✓ **Moistening by shallow convection east of the MJO deep convection;**

  Mapes (2010)

- ✓ **Surface cloud radiative forcing intervenes in the ocean-atmosphere coupling;**

  Sobel and Gildor (2003)

Life cycle composites



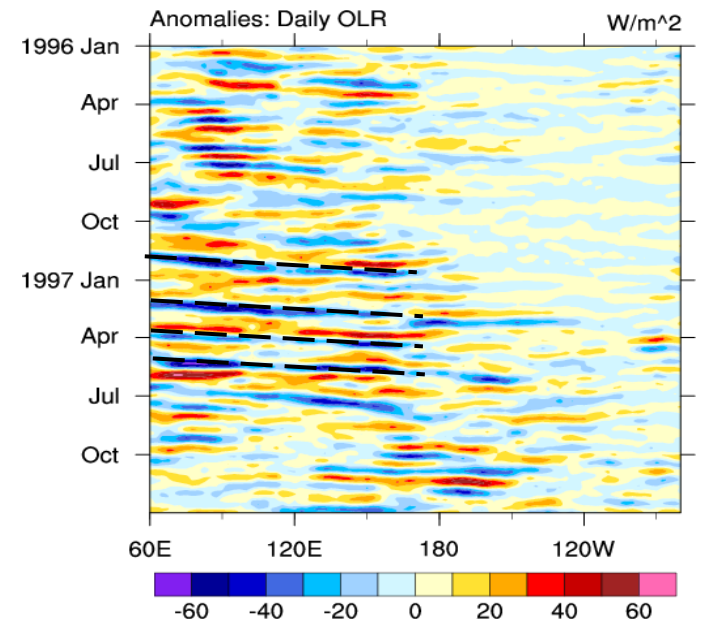
from MJO CLIVAR WG (2009)

Things we'd like to do

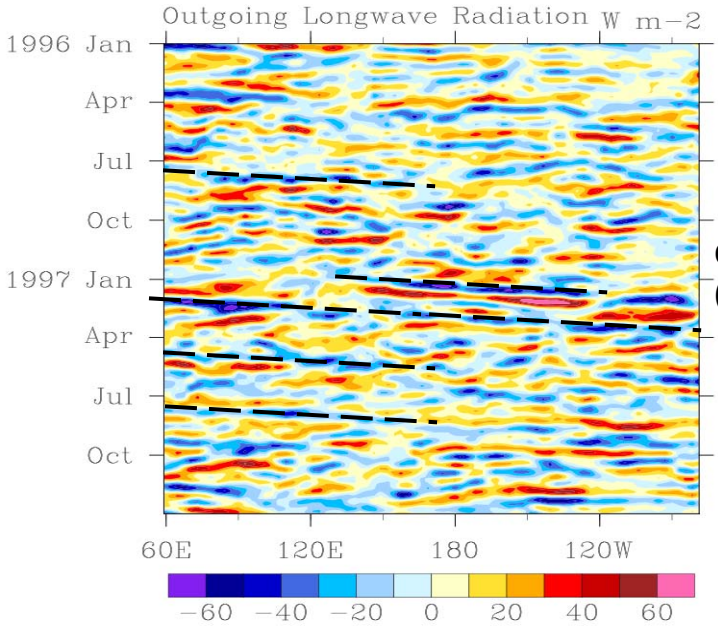
- ✓ **Use modified CLIVAR diagnostics to document the cloud signal associated to GCM MJOs;**
- ✓ **Dig in for insights in the biases.**

Does GCM simulation of MJO get better?

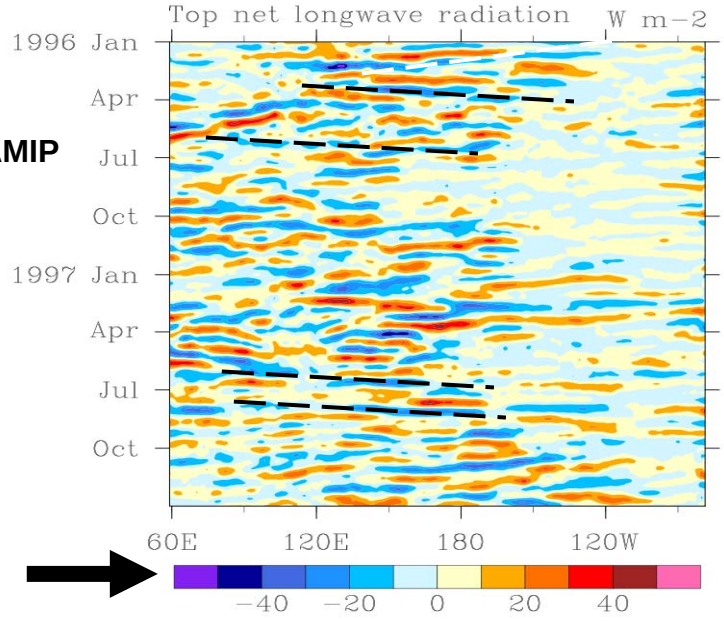
OBS



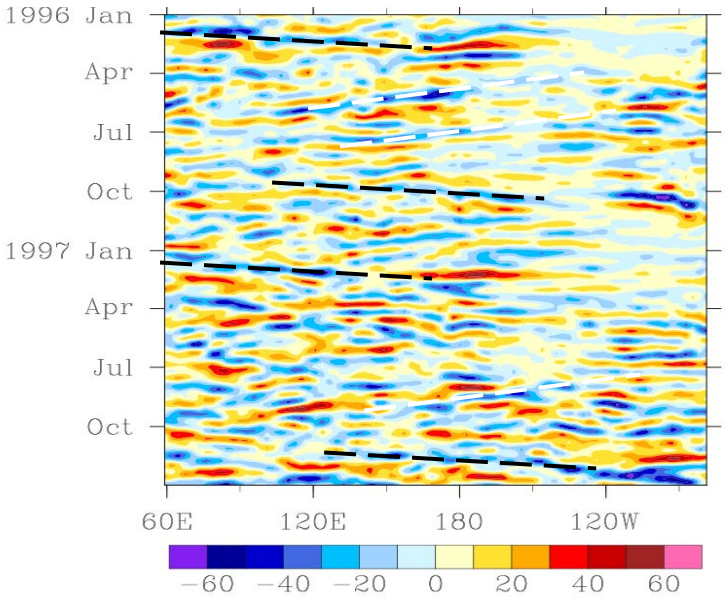
CNRM-CM3 (AR4)



CNRM-AMIP (AR5)



CNRM-AMIP (AR4)




Thank you