

# Classification of Double Inter-Tropical Convergence Zones over the Indian Ocean and their Relation to the Indian Summer Monsoon

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PORSEC 2016

Gad Levy

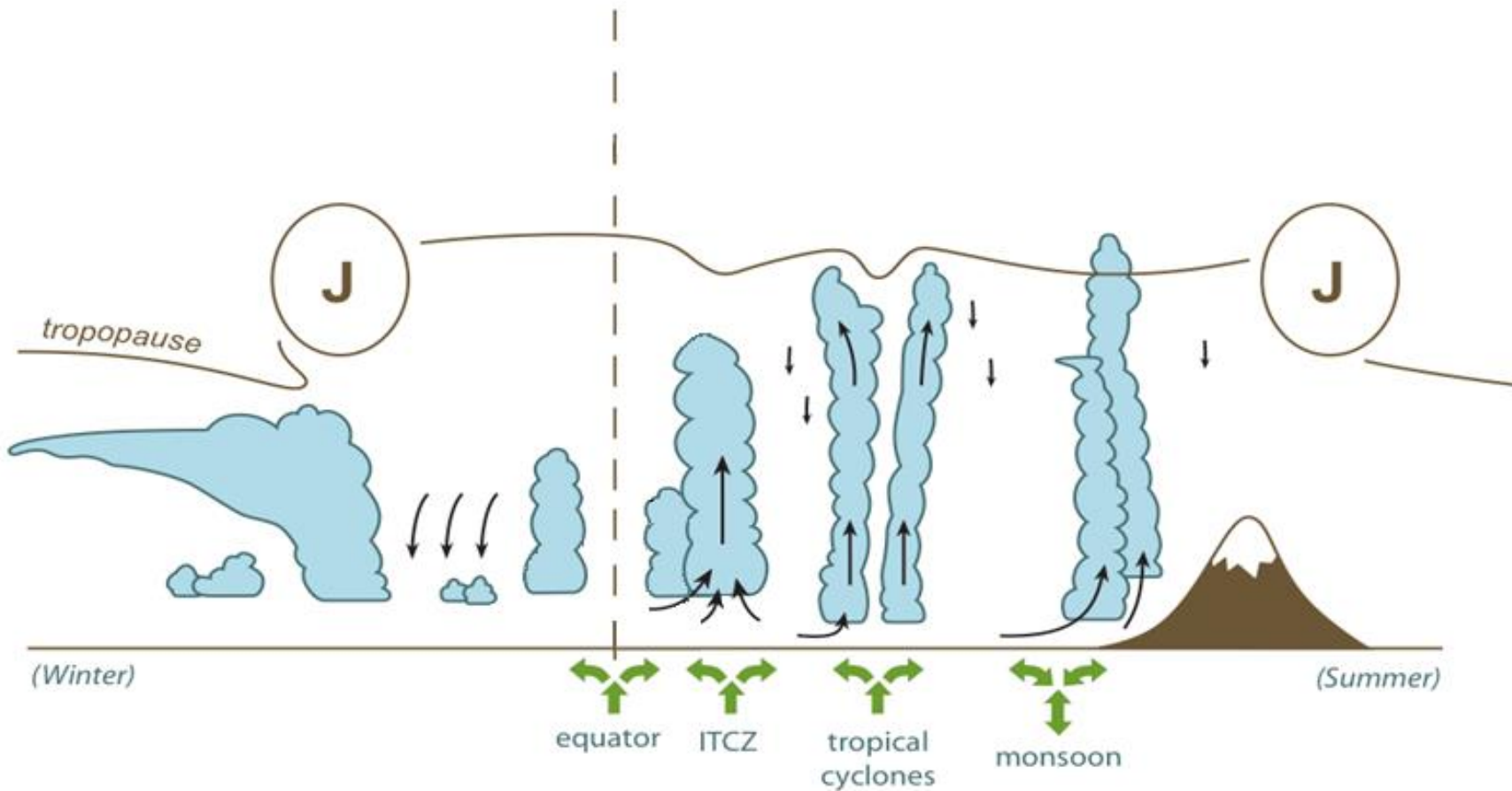
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# Background: IO Convective Regimes



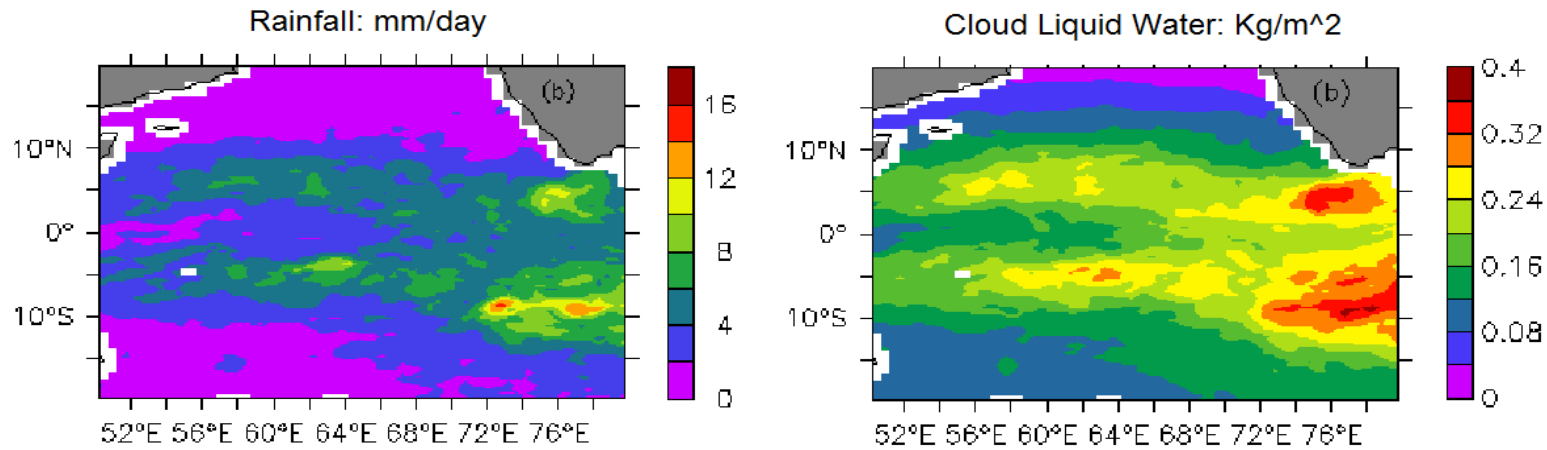
Double ITCZ's occur frequently over the equatorial Pacific, strong link to SST, mechanism is well understood

Occasionally DITCZs form over the Indian Ocean (IO). Mechanism is not known. The IO ITCZ is much less organized



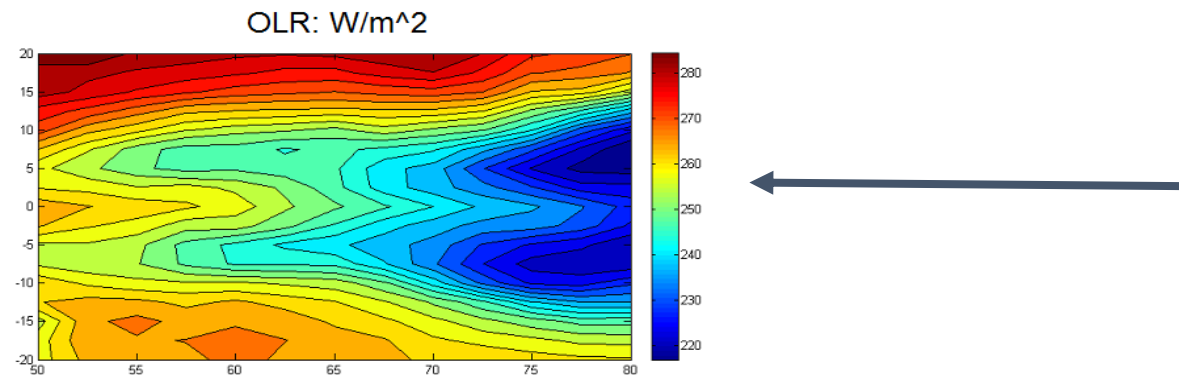
# Background: DITCZs in RS data

**Climatological 18-year Mean: Nov 16-30 1988-2005**



Indian Ocean DITCZs can be seen in climatological and in 5-15 day means of RS data.

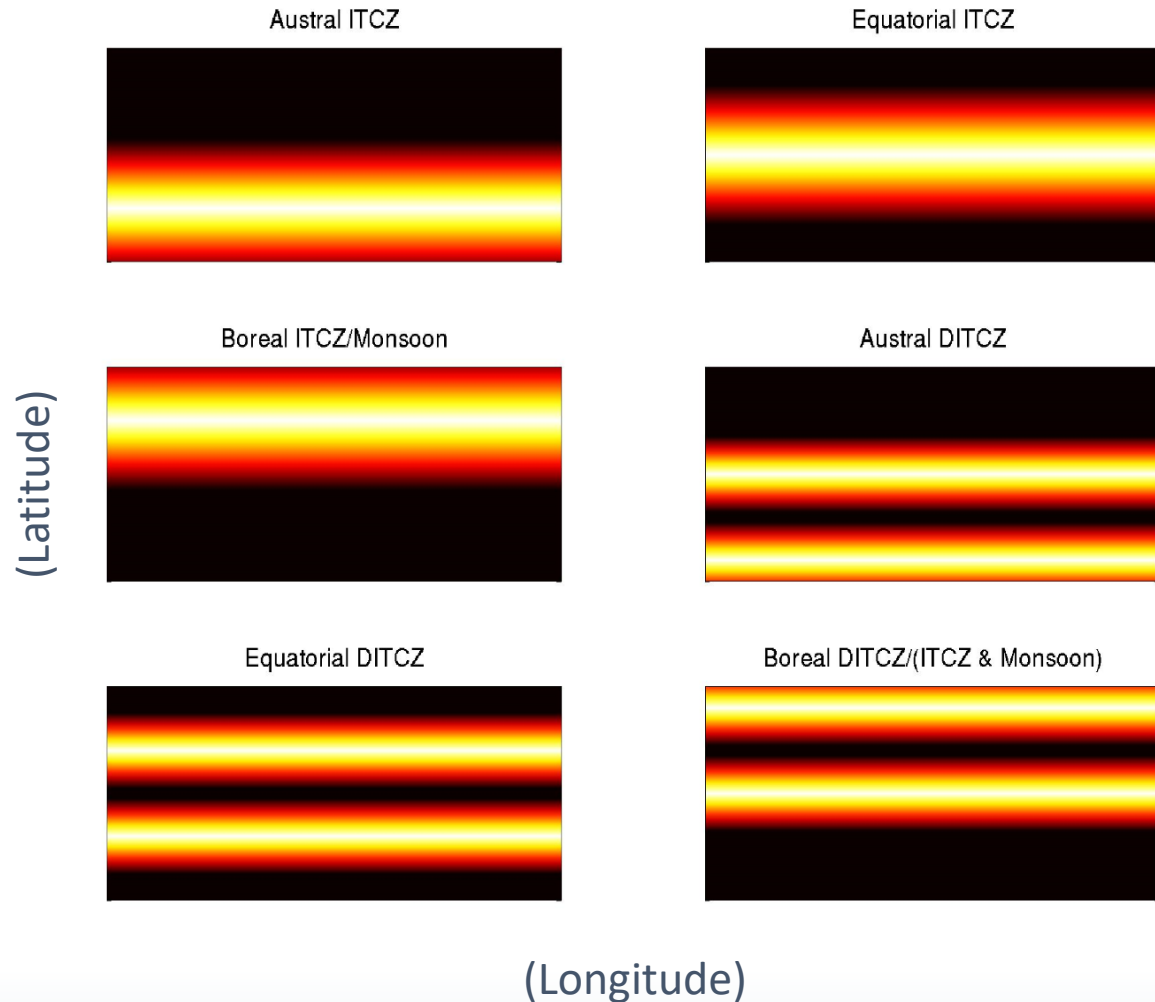
On shorter time-scales convection is too disorganized



We use 8-day windowed means of Outgoing Longwave Radiation as a proxy for convection



# DITCZ Classification



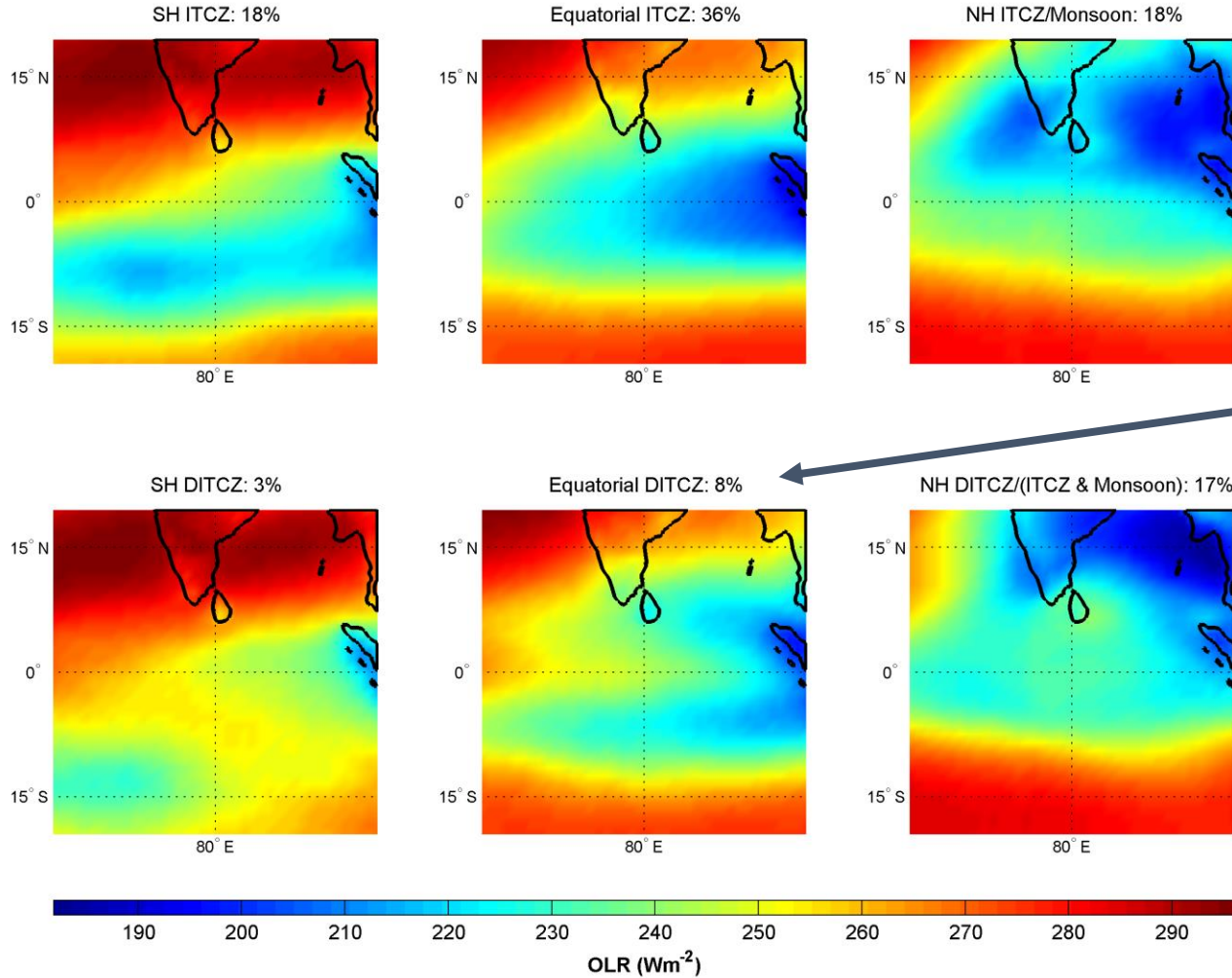
We compare 8-day windowed means of OLR to each of these filters via:

$$\frac{\sum \min(\overline{-OLR}, filter)}{\sum \max(\overline{-OLR}, filter)}$$

(Where  $\overline{\quad}$  represents normalization to a 0-1 scale)



# DITCZ Classification



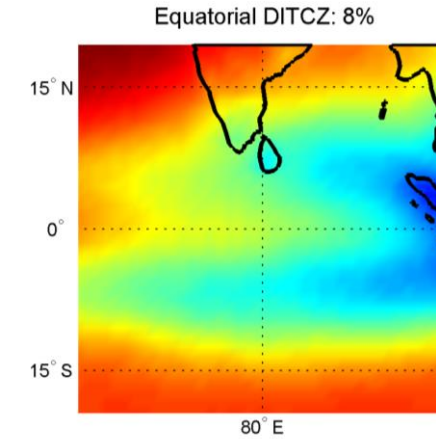
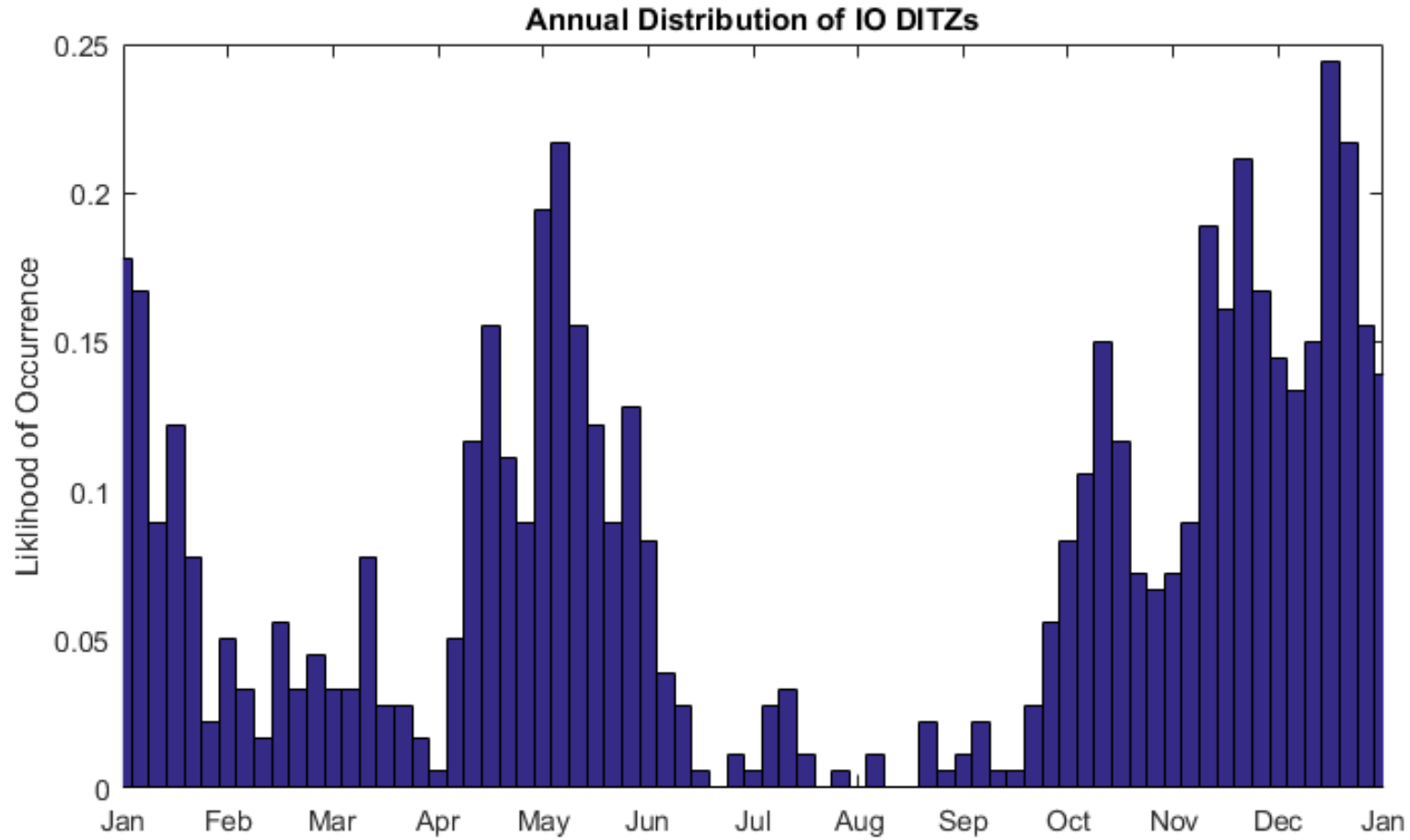
These are composites of OLR for each of the 6 classifications using about 30yrs of daily data

We are particularly interested in the 8% of cases of equatorially symmetric DITCZs

...and the 17% of cases when dual bands of convection form in the northern hemisphere



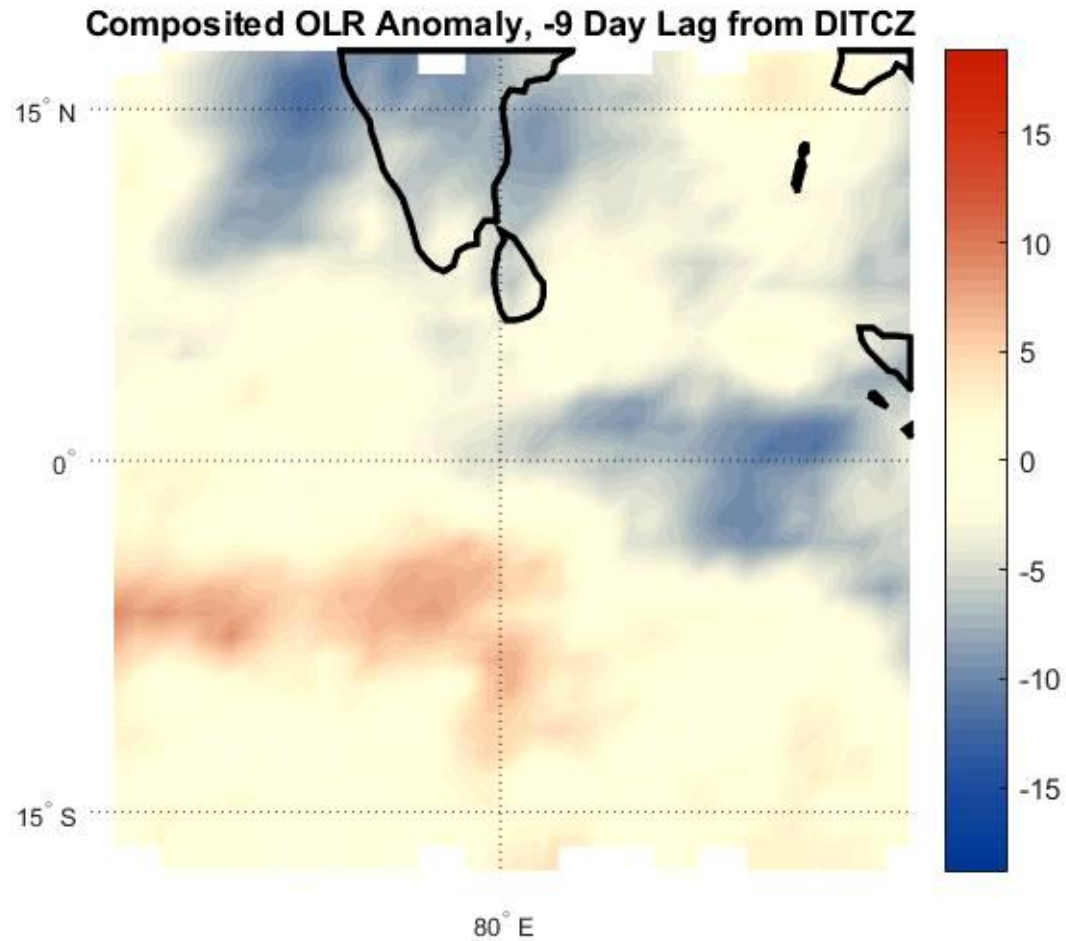
# Equatorial DITCZs



Equatorially symmetric DITCZs tend to occur during the transition seasons and early winter.



# Equatorial DITCZs



Here we have composited OLR anomaly lagged before and after DITCZ events

The red near the equator corresponds with suppressed convection

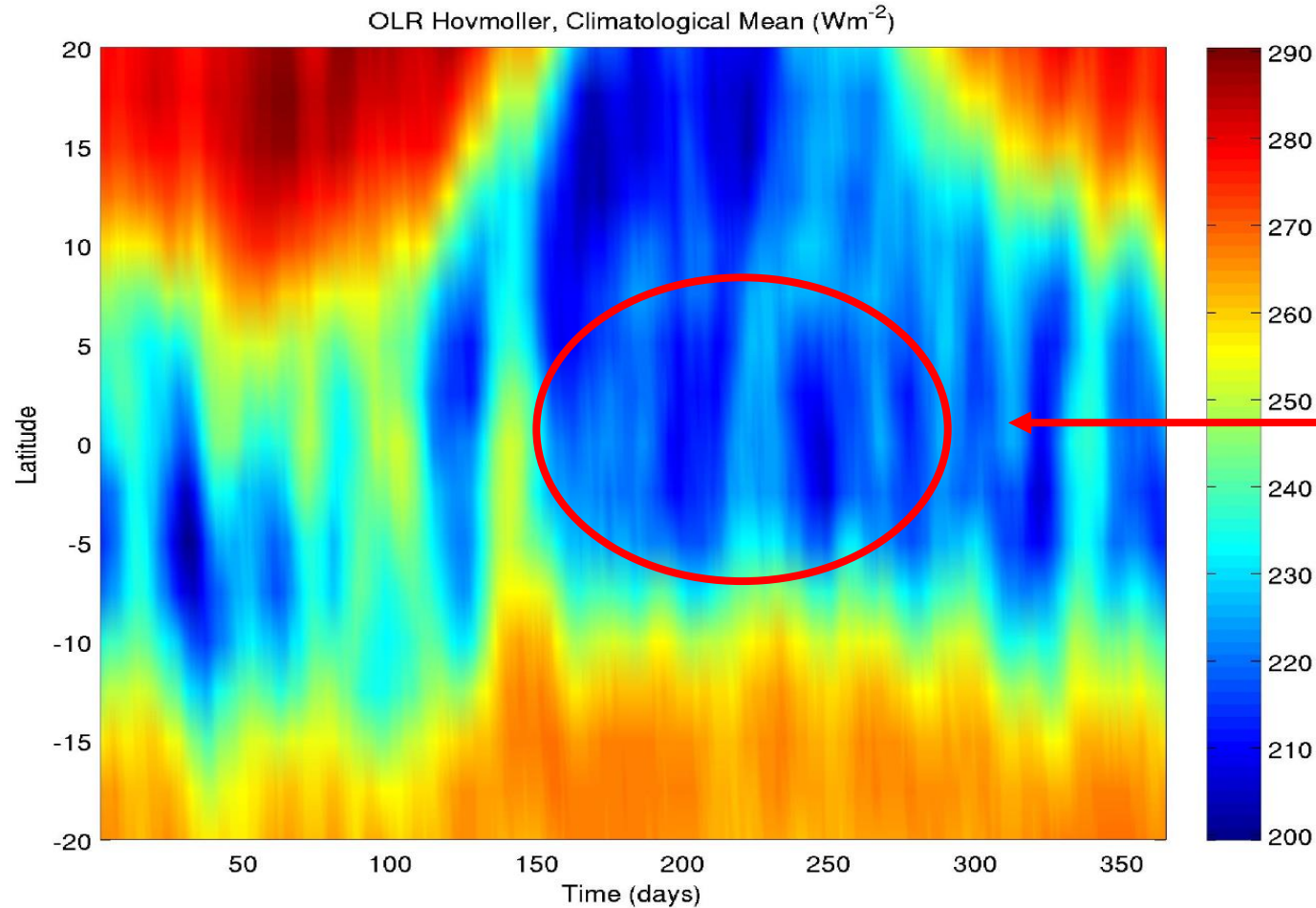
The region of suppressed convection propagates eastward, maybe related to equatorial Kelvin wave?







# DITCZs and the Summer Monsoon



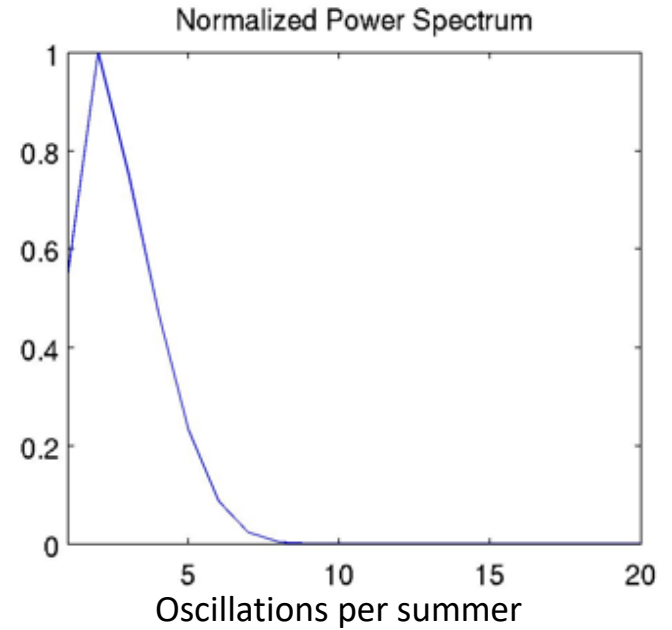
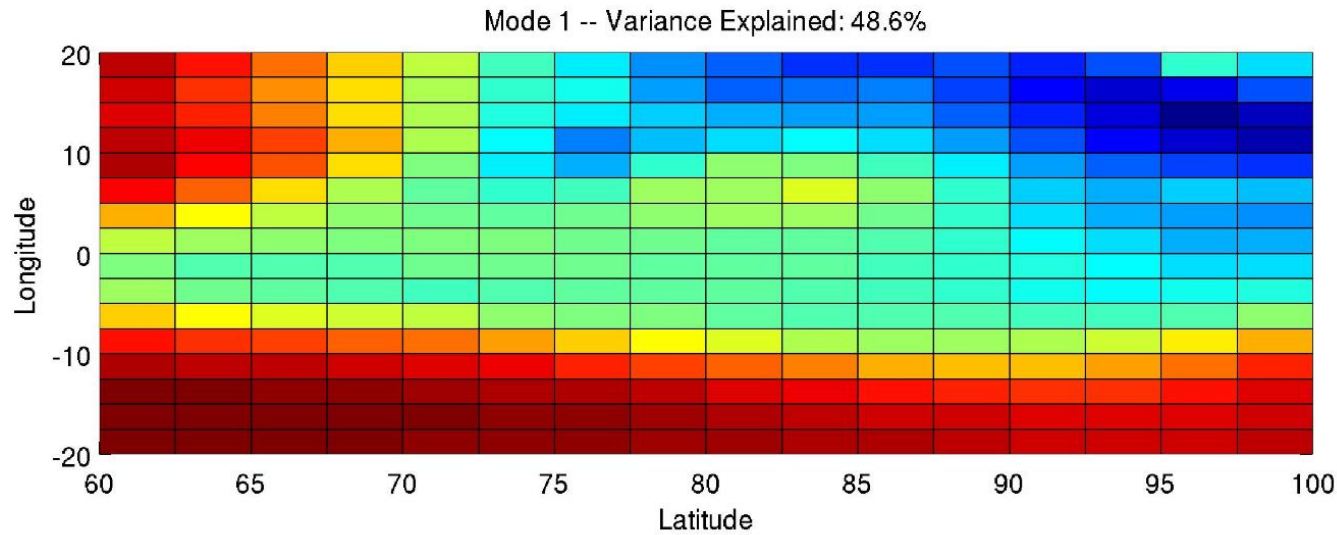
This is the mean annual time-latitude plot of OLR (averaged zonally over the Indian Ocean).

Convection frequently organizes over the equator even during the summer monsoon

Maybe this is related to breaks in the monsoon?



# DITCZs and the Summer Monsoon



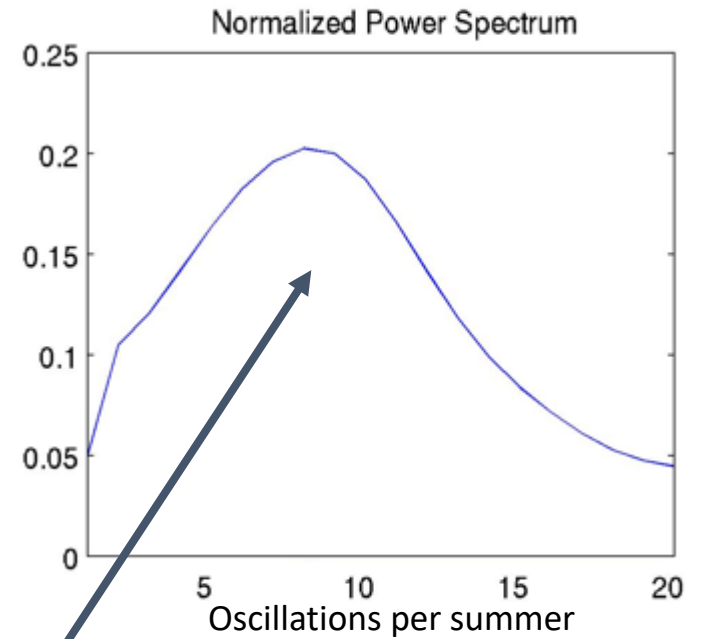
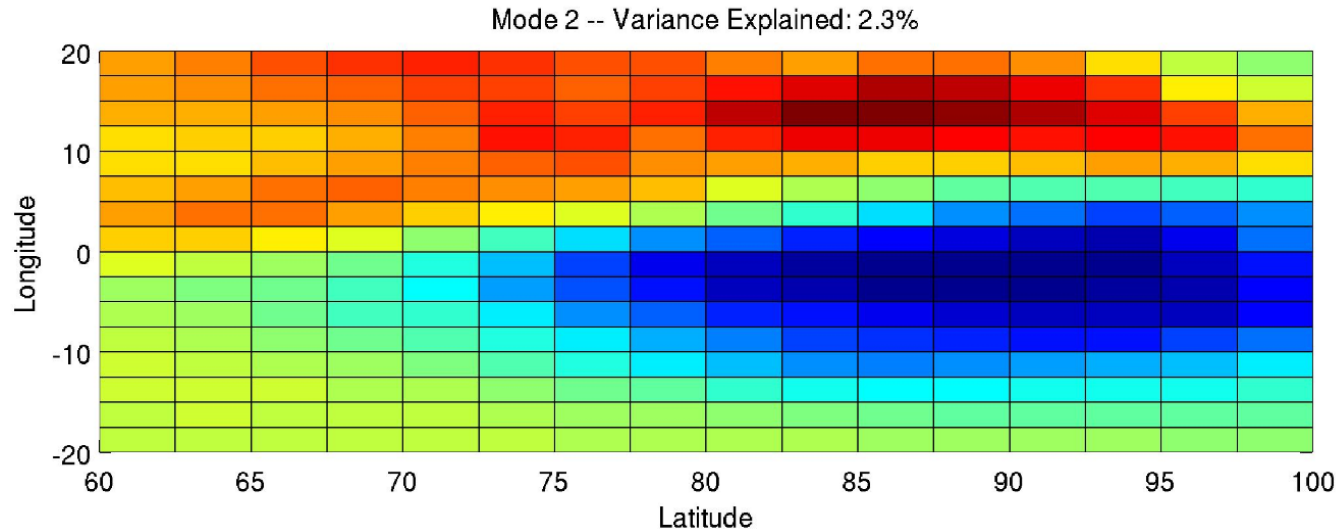
We perform an EOF analysis of summer-time (July-August) OLR over the Indian Ocean.

The first mode shows the annual onset of the summer monsoon.

↑  
(Only one oscillation per summer)



# DITCZs and the Summer Monsoon



The second EOF shows a North-South dipole of convection.

This occurs more frequently. Maybe associated with breaks in the monsoon.

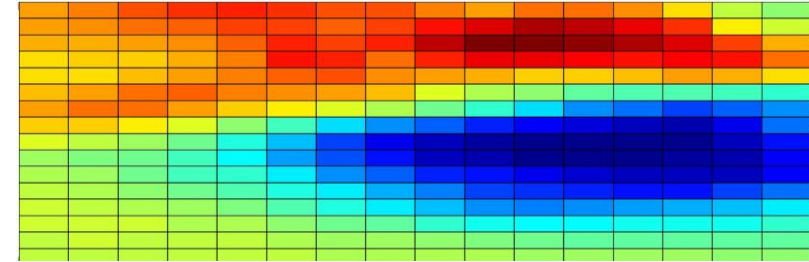


# DITCZs and the Summer Monsoon

## A new criterion for identifying breaks in monsoon conditions over the Indian subcontinent

M. R. Ramesh Kumar and Uma R. Prabhu Dessai  
Physical Oceanography Division,  
National Institute of Oceanography,  
Dona Paula ,Goa – 403004 , India.

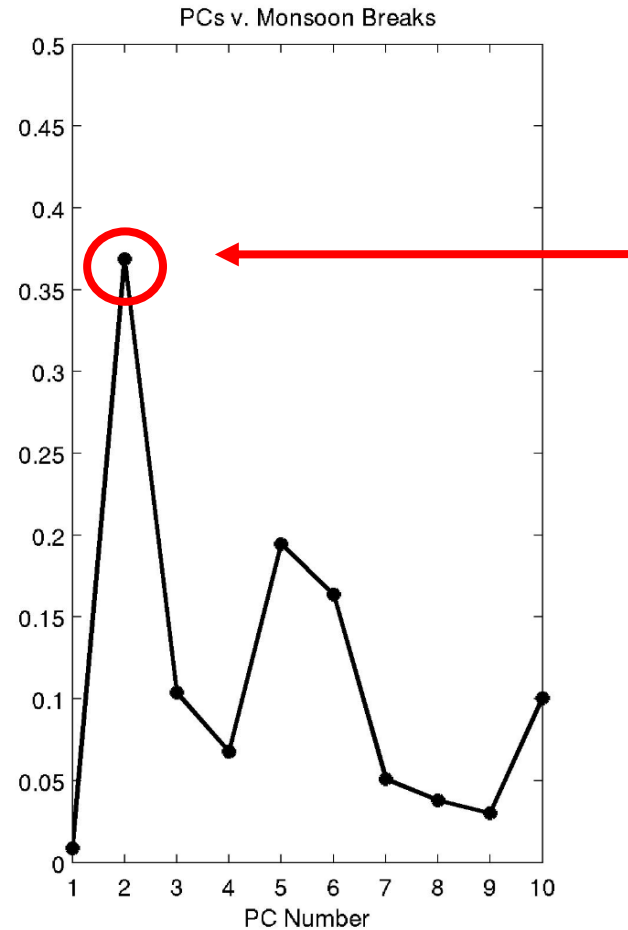
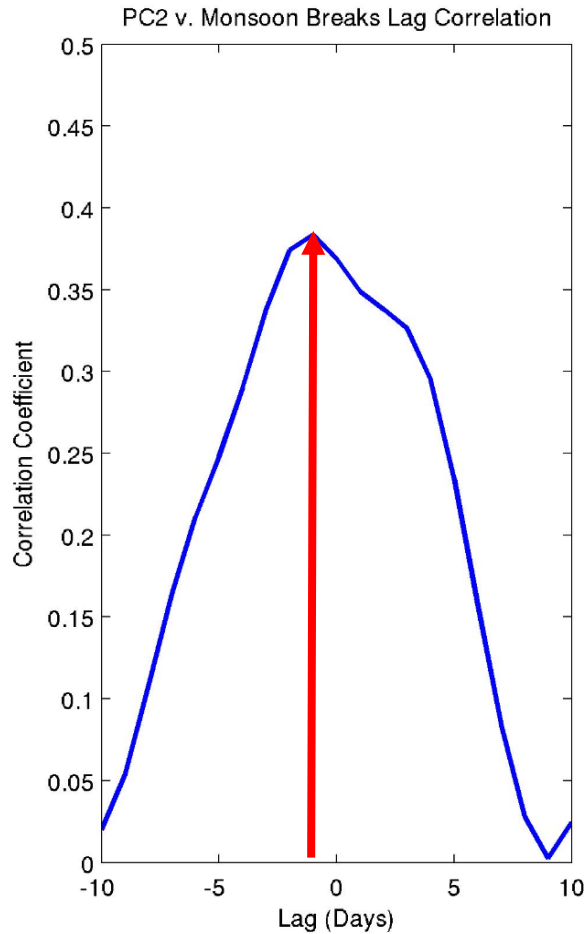
for identifying the breaks, we have catalogued them for the period 1901 to 2002. We refer to a situation as a break, if the all India rainfall is less than 9 mm/day and the condition persists for a minimum of three days and if it occurs in the mid monsoon months of July and August. The majority of the breaks in the months of July and August were of 2-4



We compare the Principal Component (time-series) associated with the 2<sup>nd</sup> EOF to a record of monsoon breaks.



# DITCZs and the Summer Monsoon



Correlation between each principal component from the EOF analysis and the monsoon breaks time-series. The second PC has the highest correlation by far.

The left plot shows lag correlations between the principal component and the monsoon breaks. Potentially useful for prediction?



# Overview

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Parallel bands of convection frequently form over the equatorial Indian Ocean, but can only be seen in multi-day or climatological means.

Double ITCZs may be related to (eastward propagating) tropospheric Kelvin waves

Dual bands of convection that occur in the Northern Hemisphere during the summer monsoon appear to be convection re-organizing over the equator during monsoon breaks

