# Utilizing Heterogeneous Satellite Products to Understand and Improve Predictability of the Indian Summer Monsoon, its Intra-Seasonal Variability, and its Relation to Large Scale Convective Regimes over the Indian Ocean

First International Operational Satellite Oceanography Symposium

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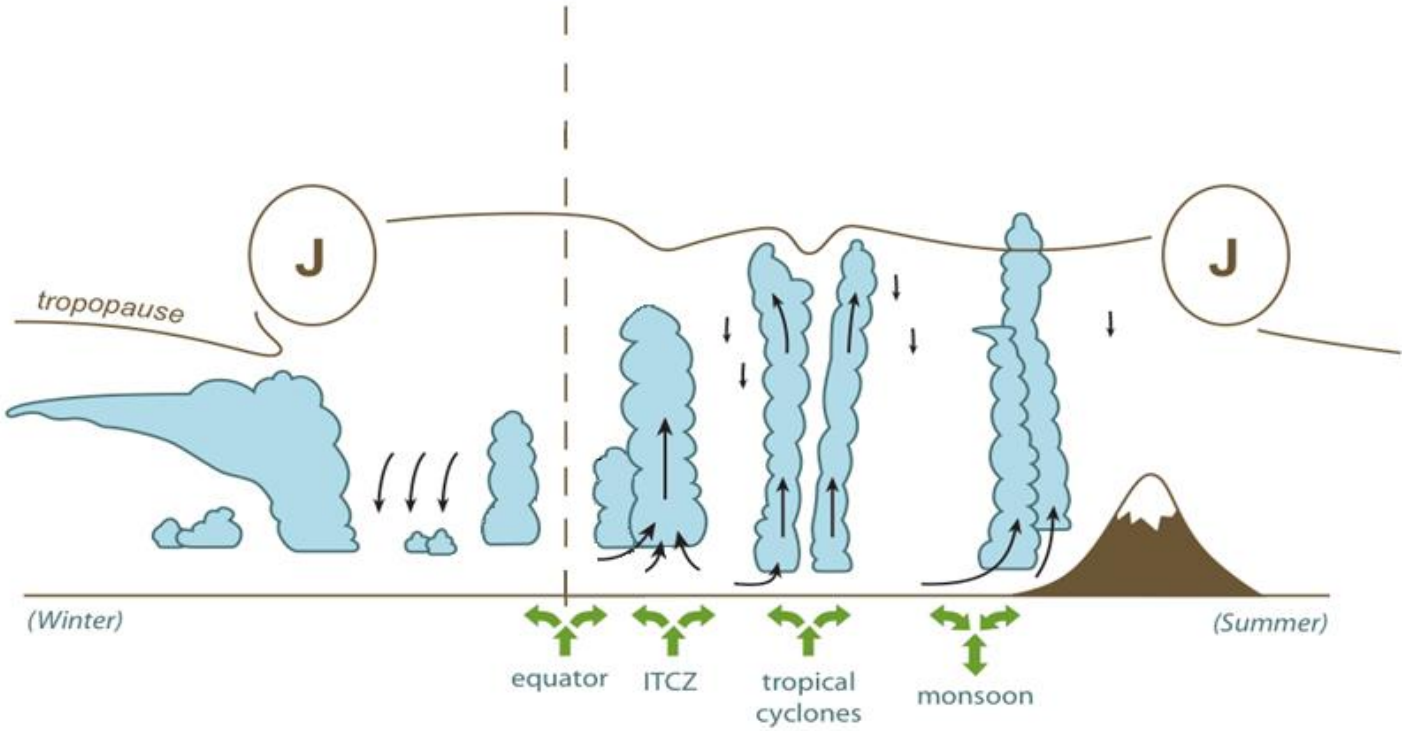
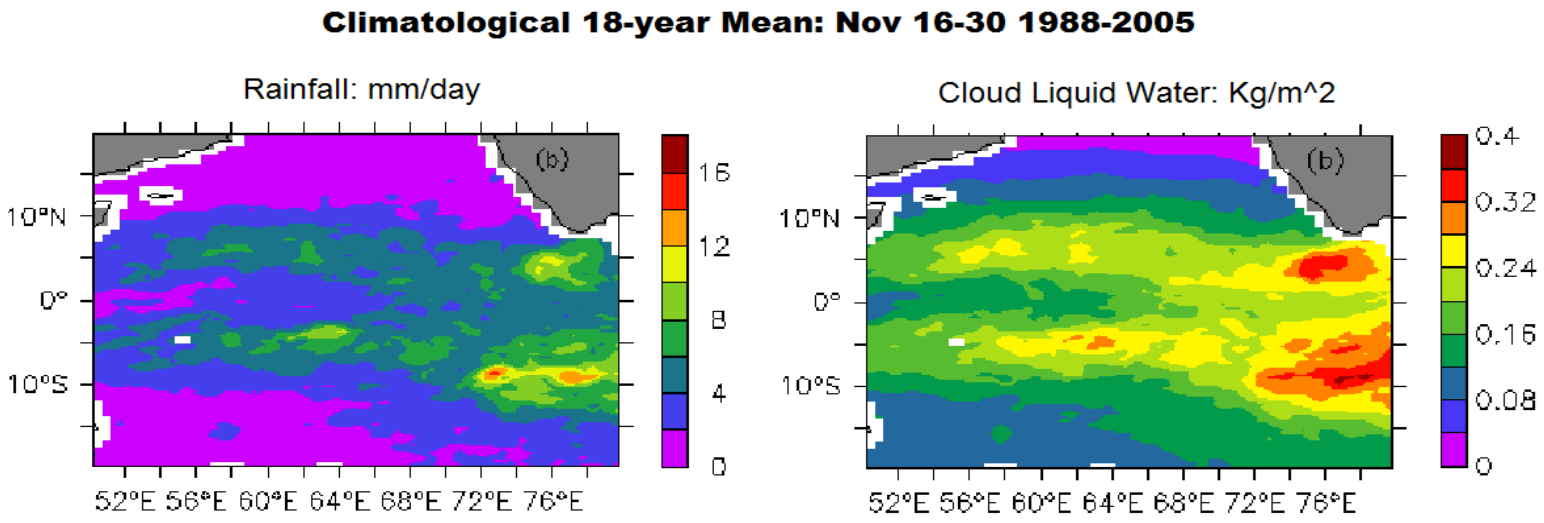
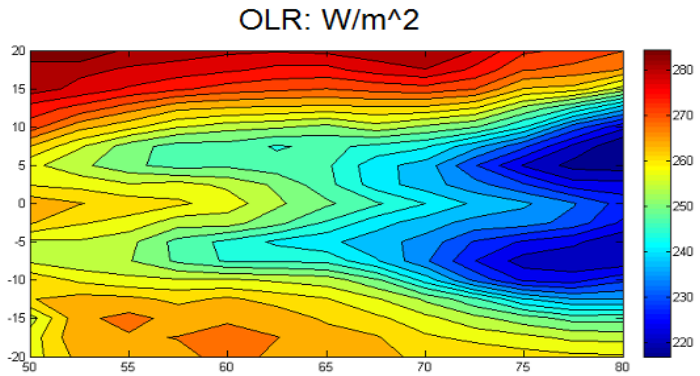
# Background: IO Convective Regimes




We use multiple satellite and in situ data products to study cases of Double Intertropical Convergence Zones, and their relation to breaks in the Indian Summer Monsoon.

# Background: DITCZs in RS data



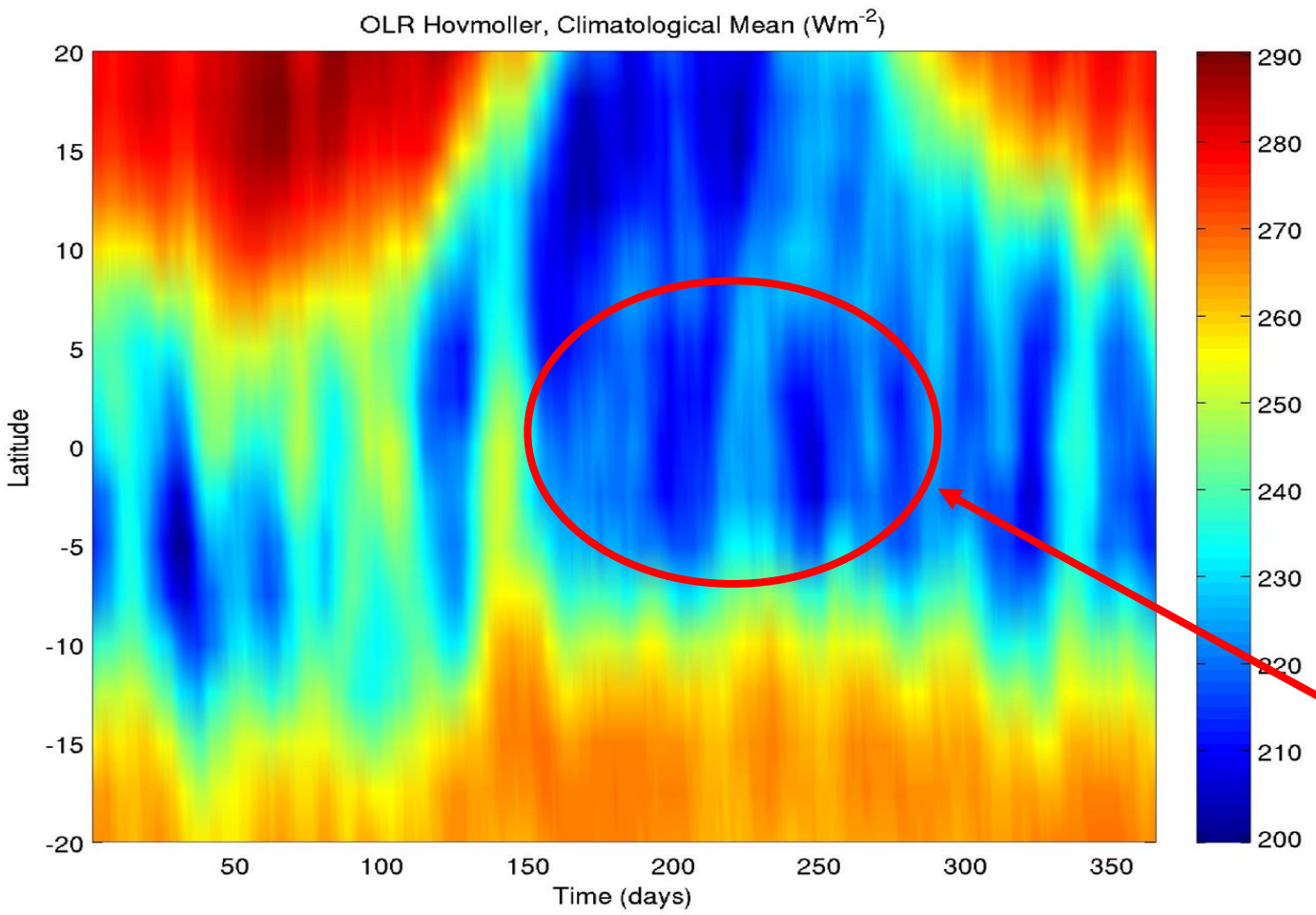




Indian Ocean DITCZs can be seen in climatological and in 5-15 day means of RS data.

On shorter time-scales convection is too disorganized

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

# Datasets: Outgoing Longwave Radiation

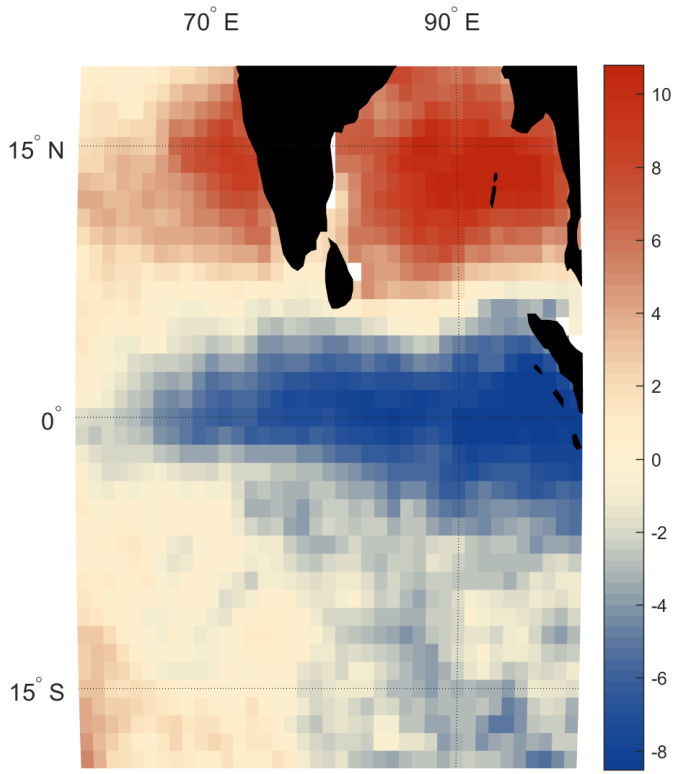



NOAA Interpolated OLR dataset, daily, 2.5 degree global resolution, from 1974 to 2018

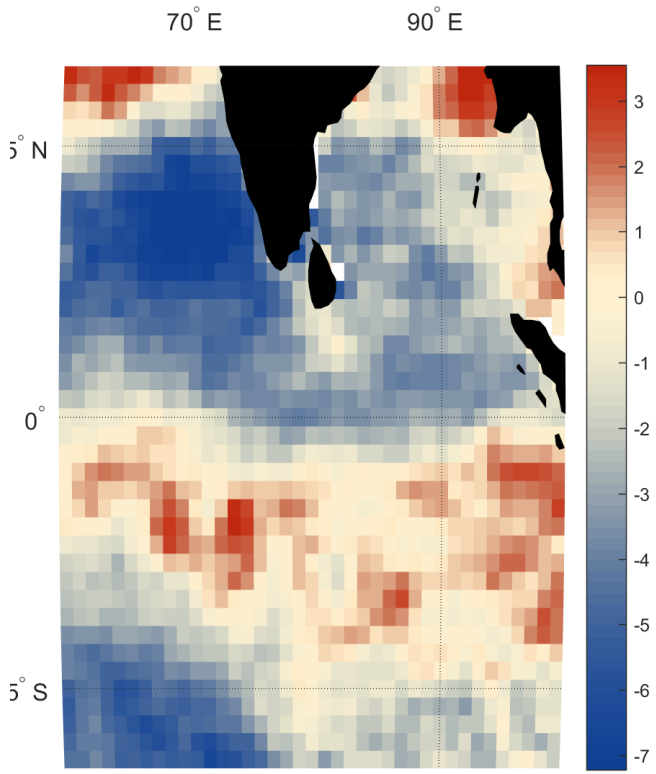
Low OLR values correspond with regions of deep convection in the tropics

Convection frequently organizes over the equator even during the summer monsoon and this is related to breaks in the monsoon

# Datasets: Winds and Surface Heat Flux




Active monsoon surface heat flux anomaly




Summer DITCZ surface heat flux anomaly

IFREMER combined radiometer/scatterometer derived surface heat fluxes and winds, 0.25 degree grid, 1992-2018.

Heat fluxes and surface wind divergence and vorticity are also related to tropical convection, and monsoon variability.

# Datasets: Rain Gauge

We compare RS data products to two rain gauge precipitation datasets, the rain gauge data is a good proxy for the strength of the monsoon:

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

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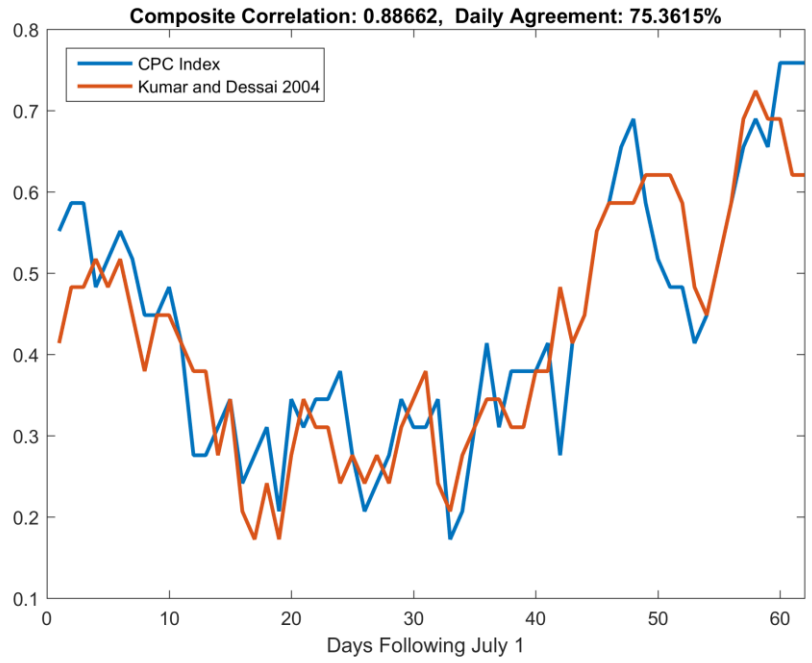
National Institute of Oceanography, India, precipitation based monsoon break record from IMD, 1950-2007

(recently we have struggled with data availability)

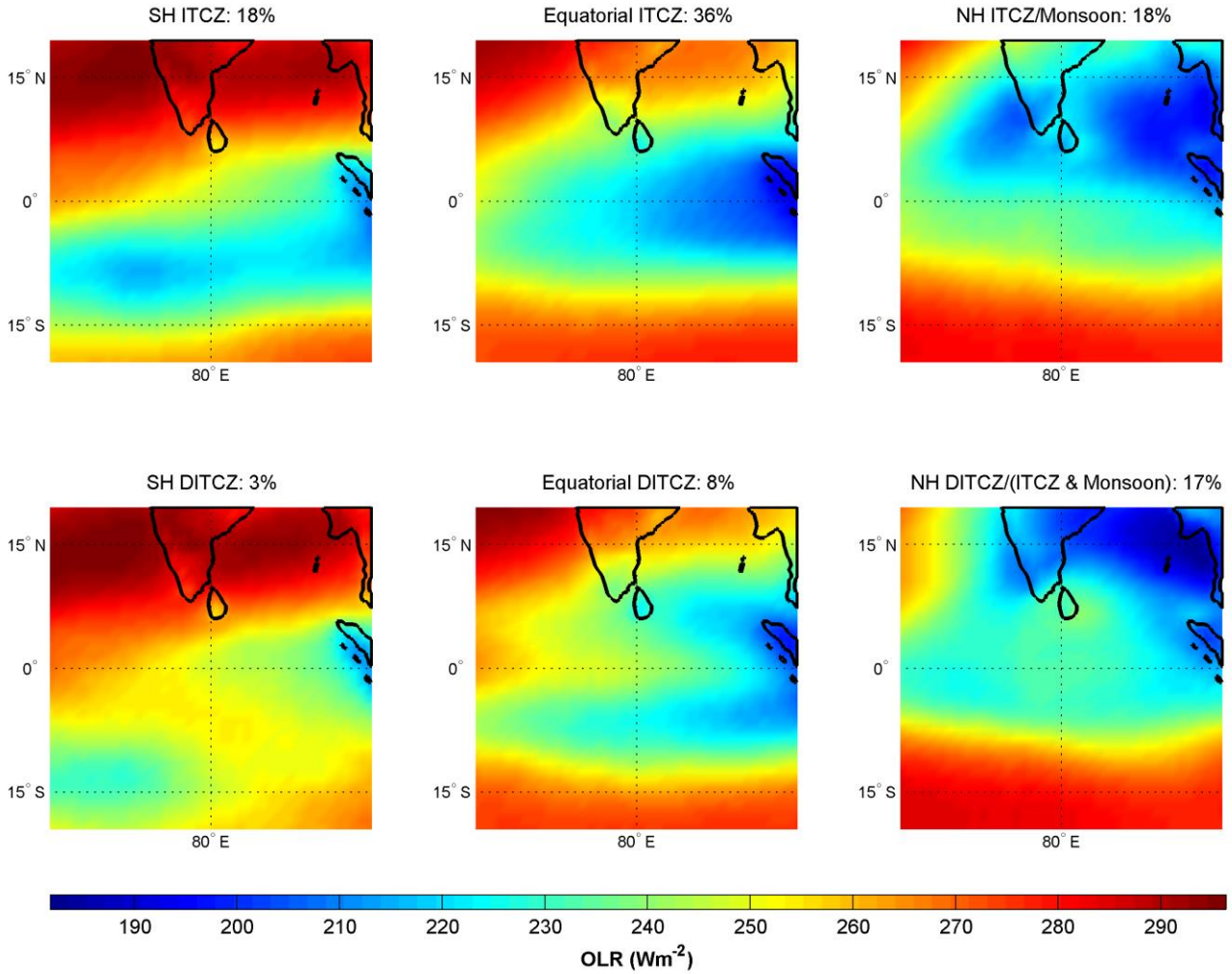



NOAA CPC – Gridded rain gauge precipitation data, averaged over the Indian continent

# DITCZ Detection

The use of automated feature extraction for diagnosing double inter-tropical convergence zones ☆

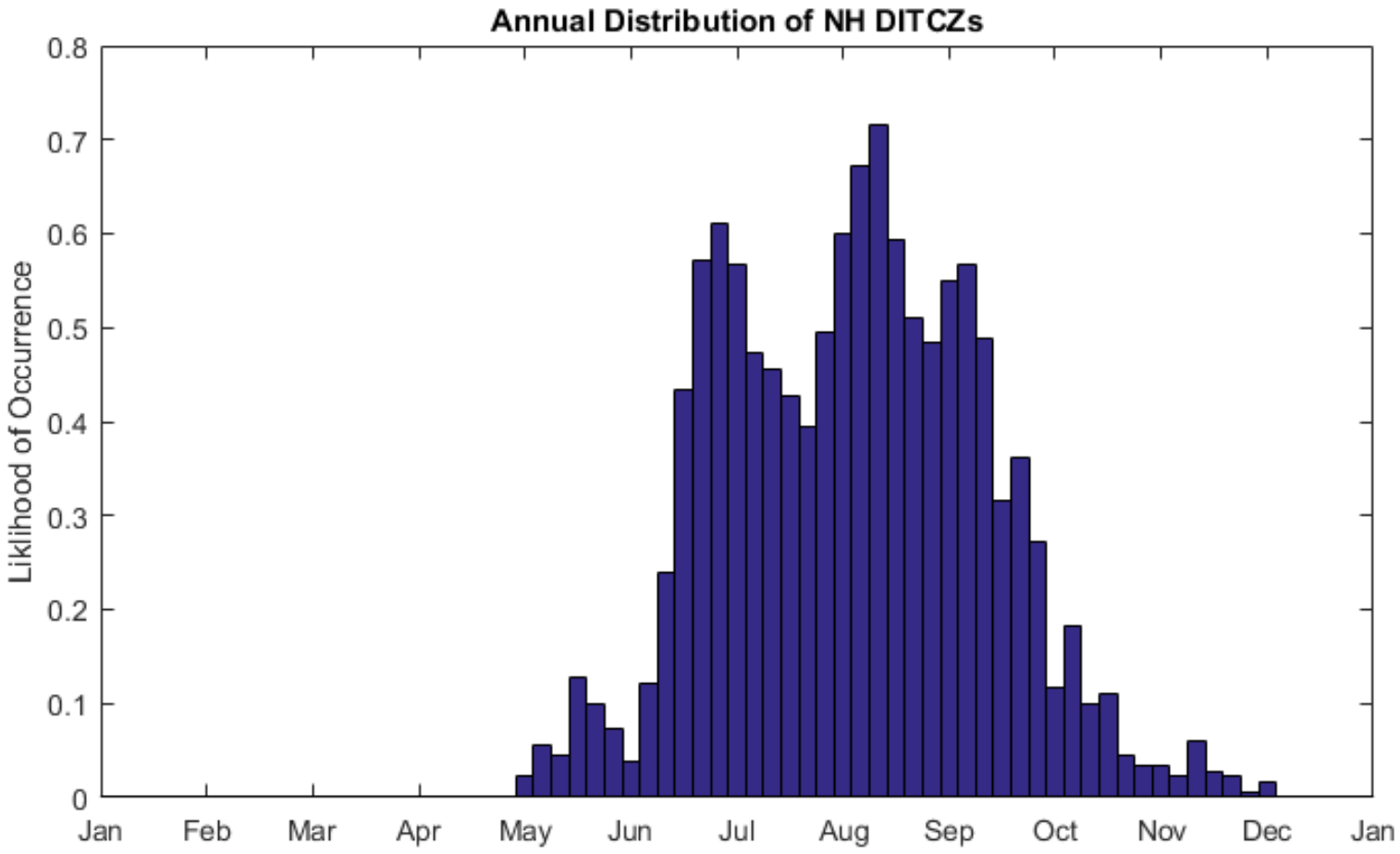
Andrew Geiss [1], Gad Levy

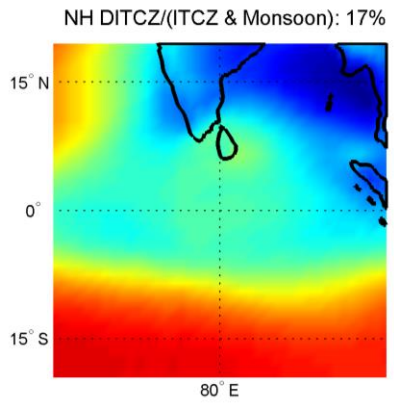



We have developed a fuzzy-metric based detection scheme to differentiate between Indian Ocean convective regimes

These are composites of OLR for each of the 6 classifications using about 30yrs of daily data, the bottom row shows cases with two parallel bands of convection.

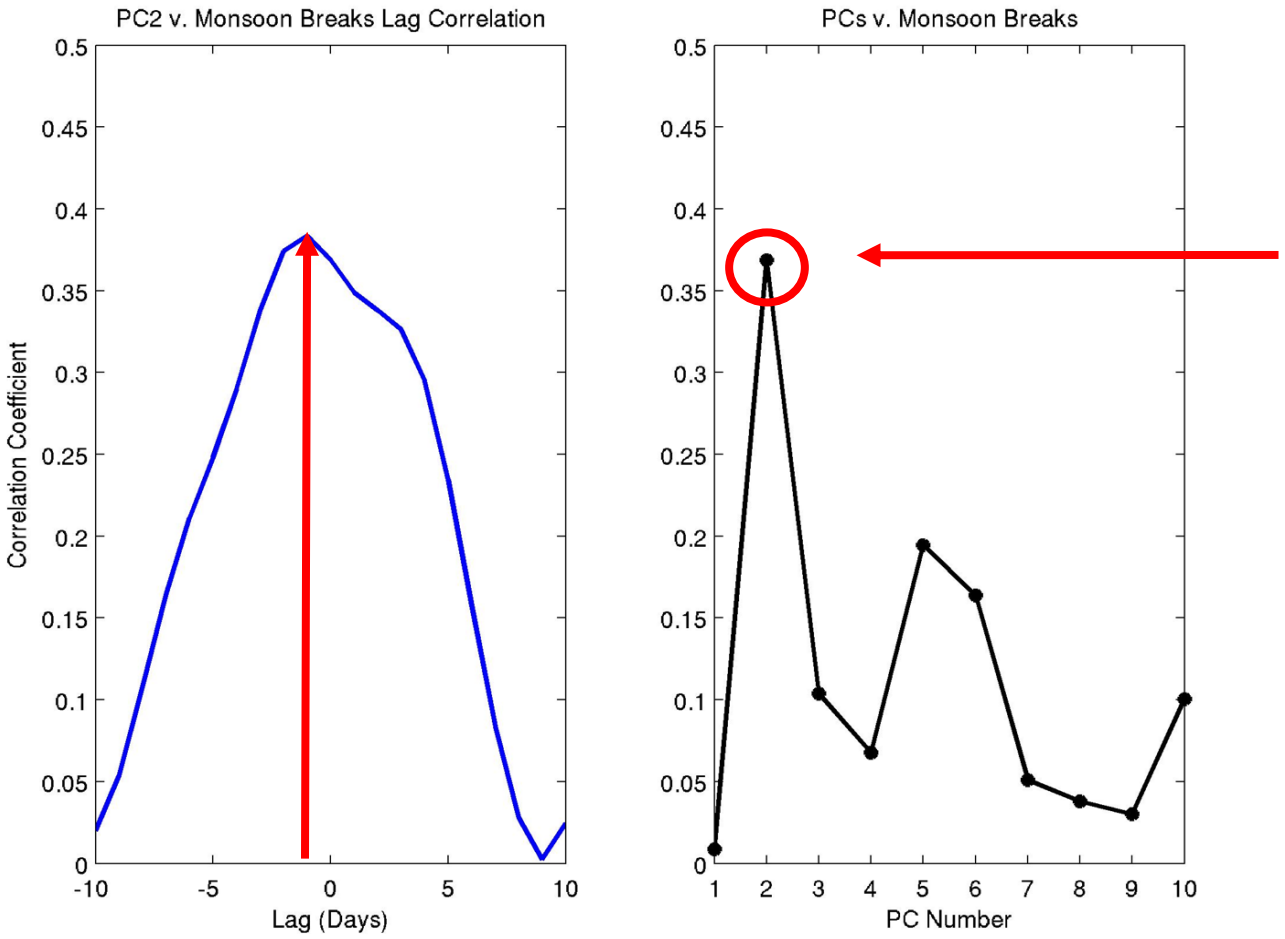
# DITCZs and the Summer Monsoon




Dual bands of convection in the northern hemisphere only occur during the summer.

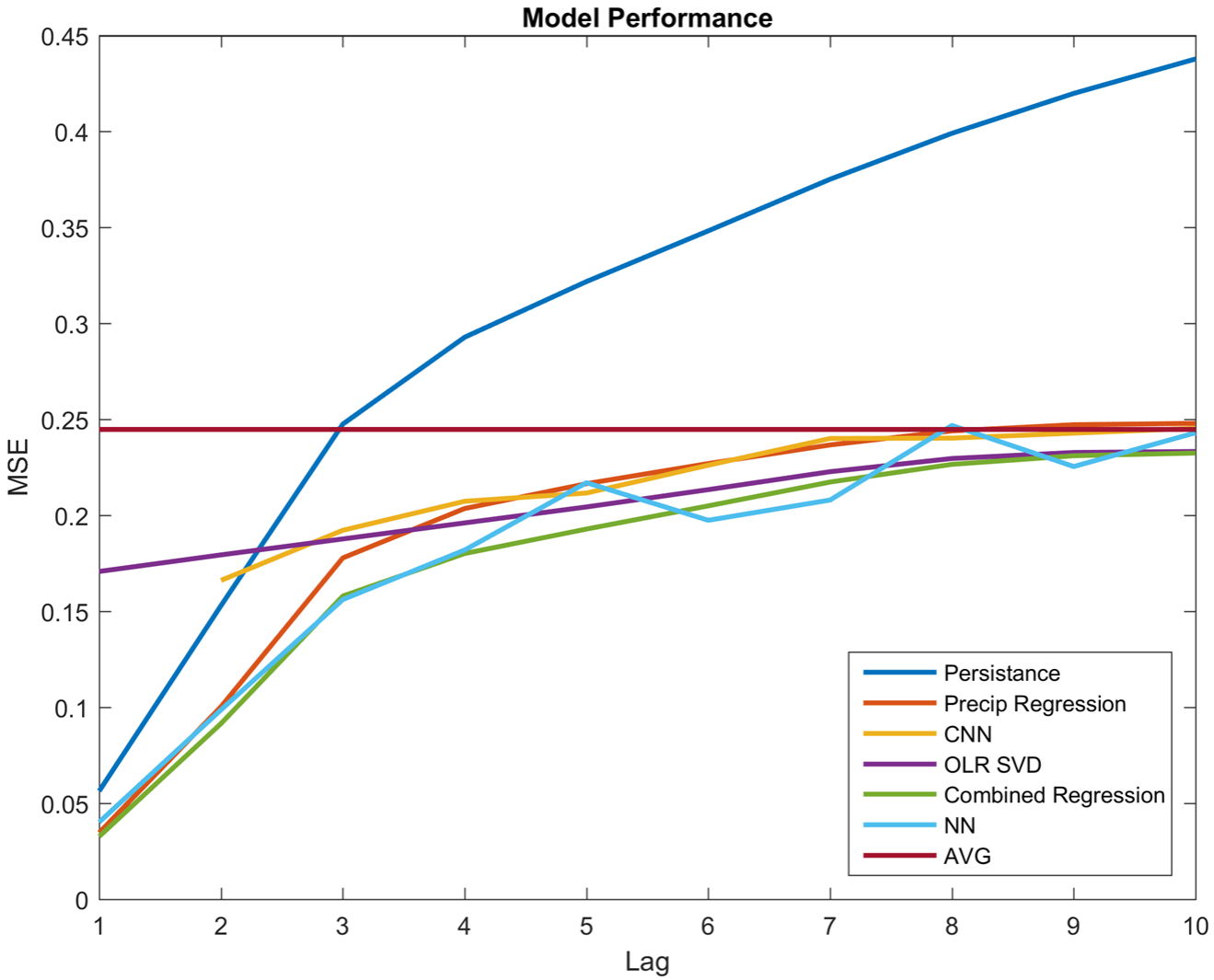
# Monsoon Breaks: EOF Analysis




Correlation between each principal component from an EOF analysis of Indian Ocean OLR 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?

# Monsoon Breaks: Prediction




Applying various statistical models, including regression, EOF analysis, and neural networks, to these datasets, and our classifications, provides better predictive skill for monsoon breaks than baseline forecasts (climatology and persistence).

# Overview

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Parallel bands of convection frequently form over the equatorial Indian Ocean and those that occur in the Northern Hemisphere during the summer monsoon appear to be convection re-organizing over the equator during monsoon breaks

Statistical models taking various satellite derived datasets as input can provide better prediction than persistence and climatological forecasts