

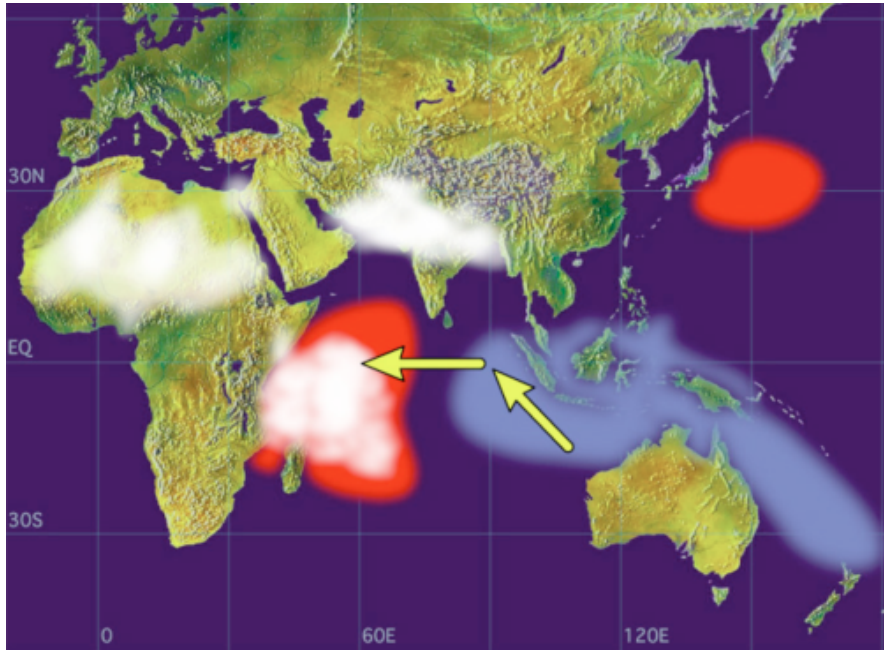
MJO Sensitivity to the Indian Ocean Dipole in the SPCAM

Jim Benedict, Bill Collins ~ Berkeley National Lab

Mike Pritchard ~ UC-Irvine

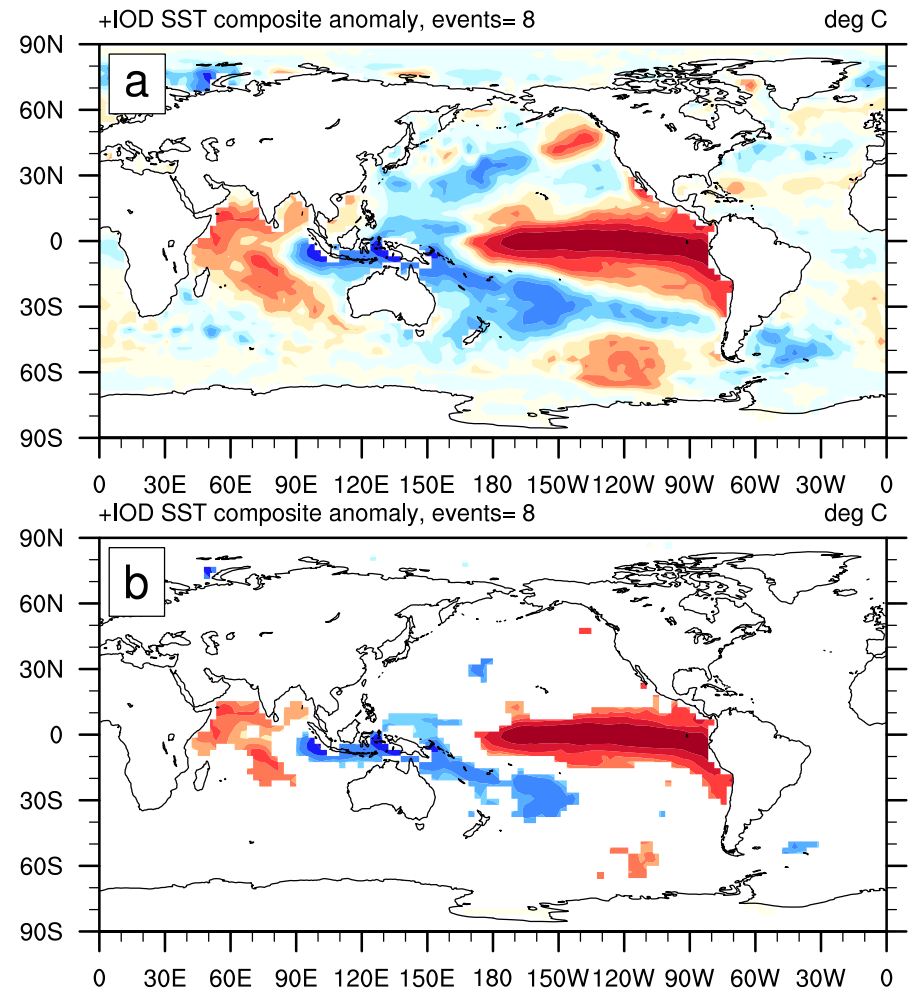
CMMAP Semiannual Meeting // Aug. 2014

Indian Ocean Dipole



JAMSTEC

SSTA: Oct Positive IOD Composite, 95% Sig

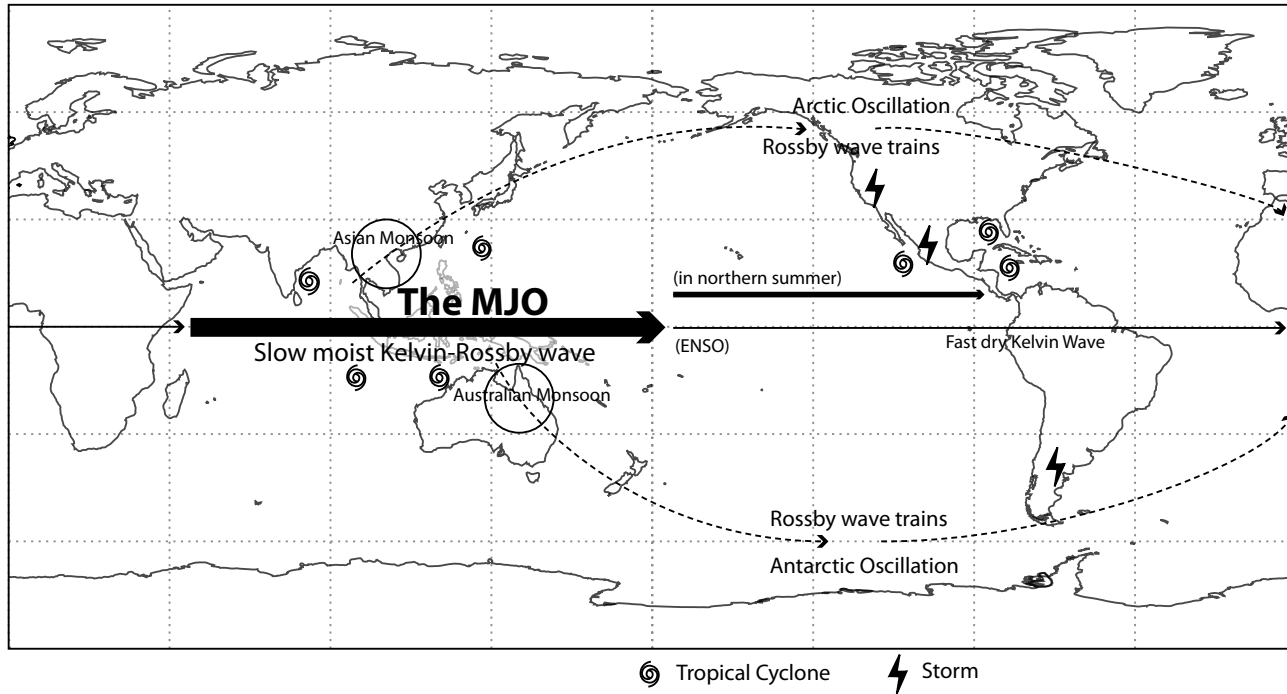


Increased frequency of extreme Indian Ocean Dipole events due to greenhouse warming

Wenju Cai^{1,2}, Agus Santoso³, Guojian Wang^{2,1}, Evan Weller¹, Lixin Wu², Karumuri Ashok⁴, Yukio Masumoto^{5,6} & Toshio Yamagata⁷

greenhouse warming is unknown. Here, using an ensemble of climate models forced by a scenario of high greenhouse gas emissions (Representative Concentration Pathway 8.5), we project that the frequency of extreme pIOD events will increase by almost a factor of three, from one event every 17.3 years over the twentieth century to one event every 6.3 years over the twenty-first century. We find that a mean state change—with weakening of both equatorial westerly winds and eastward oceanic currents in association with a faster warming in the western than the eastern equatorial Indian Ocean—facilitates more frequent occurrences of wind and oceanic current reversal. This leads to more frequent extreme pIOD events, suggesting an increasing frequency of extreme climate and weather events in regions affected by the pIOD.

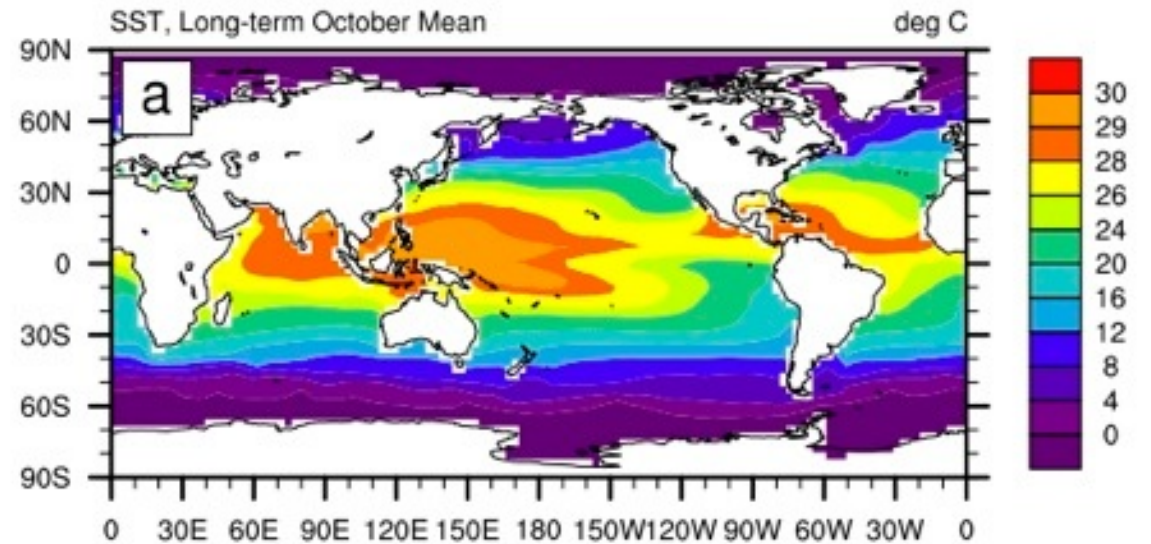
MJO Global Impact



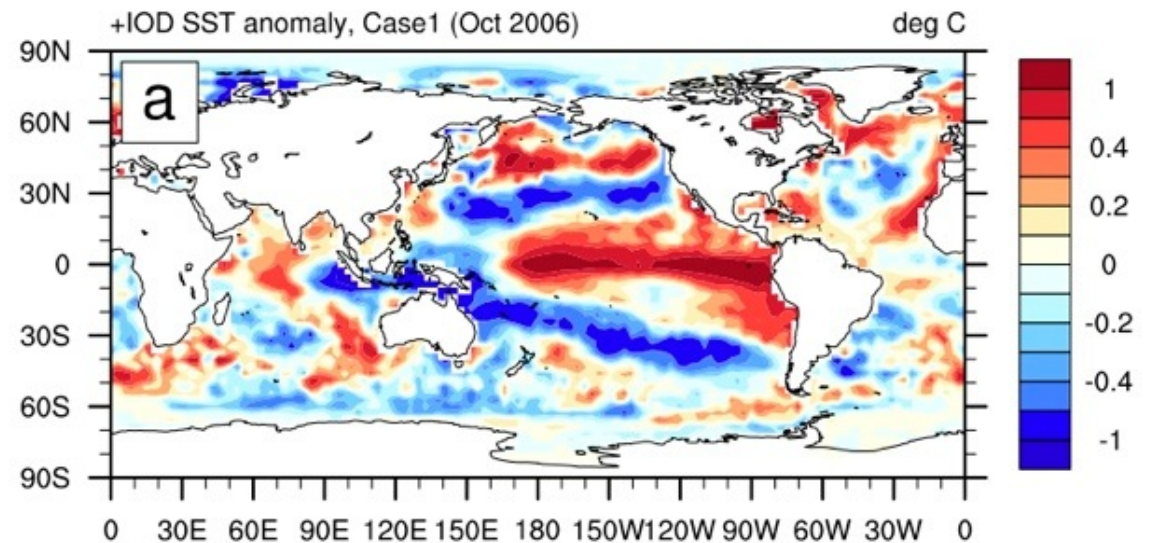
Courtesy: K. Thayer-Calder, adapted from Lin et al. 2006

(Initial) SPCAM Simulations: SST Forcing

October climatology

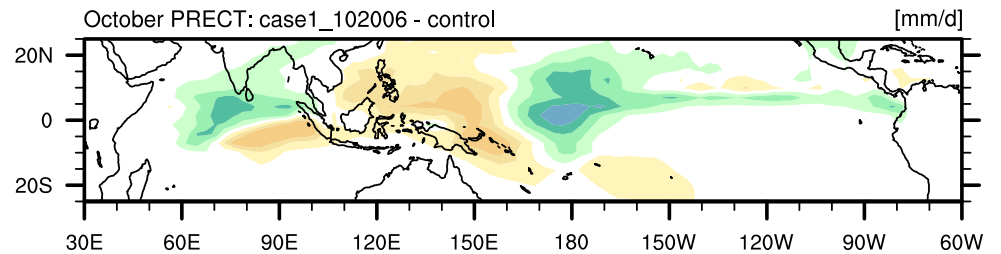
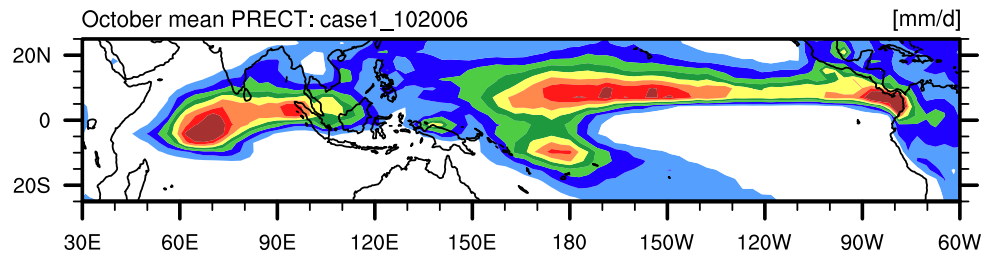
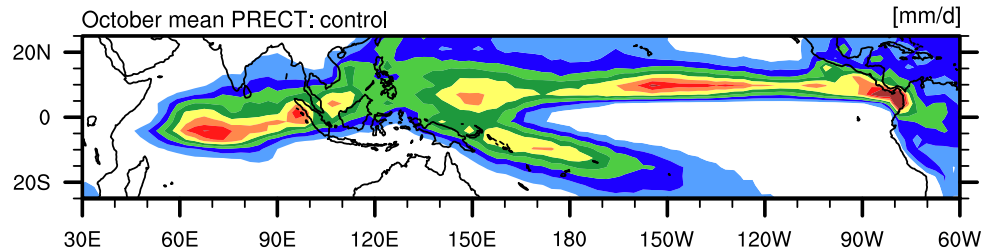


Case1: October 2006
(+IOD event)

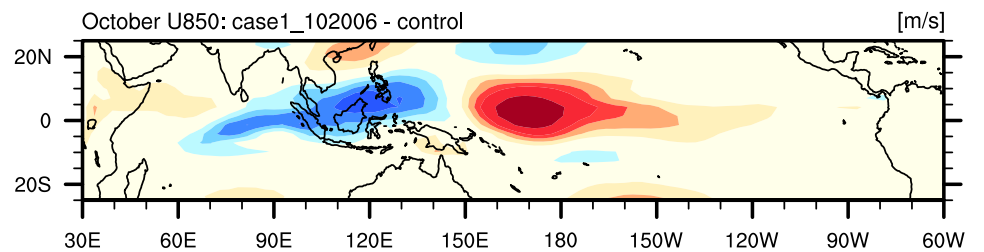
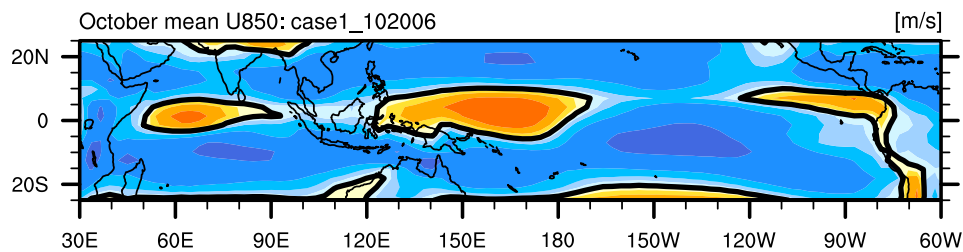
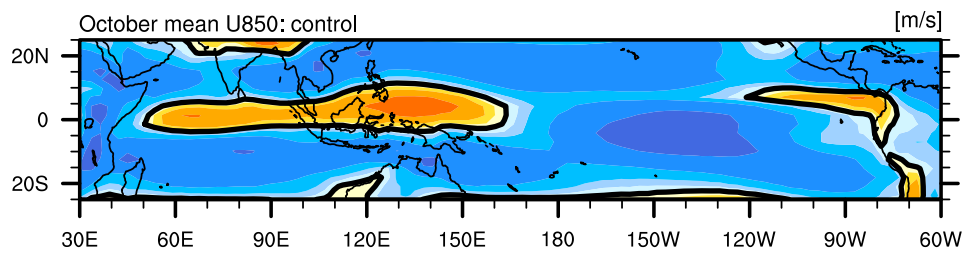


Results: Control vs. +IOD

October Mean: PRECT

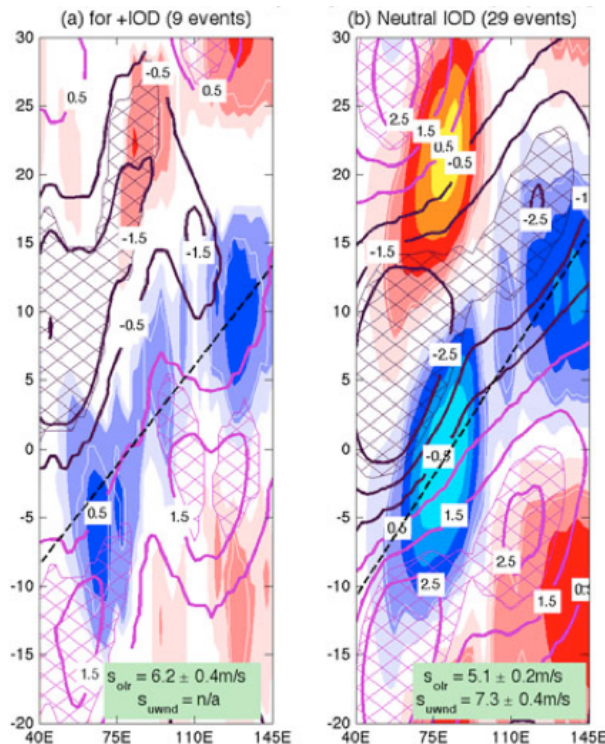
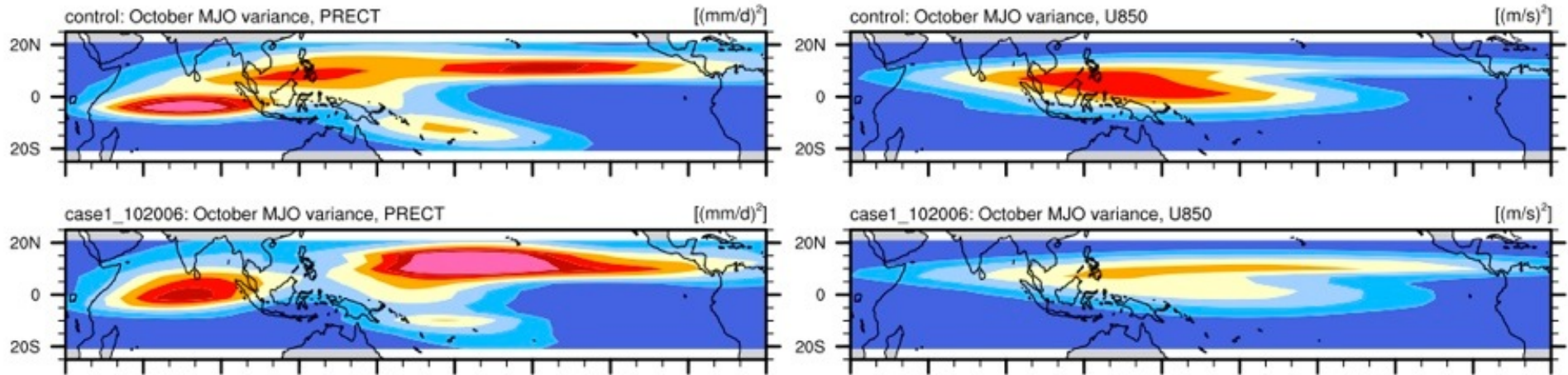


October Mean: U850



Results: Control vs. +IOD

October MJO-Filtered Variance

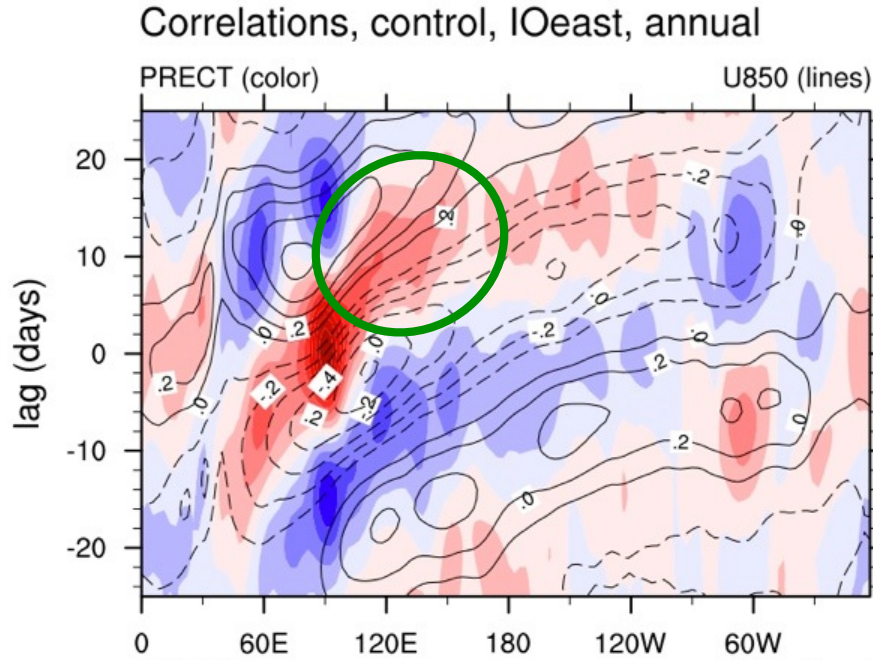


SPCAM correctly predicts reduced/disrupted of MJO signal over E. Indian Ocean and Maritime Continent during +IOD events...

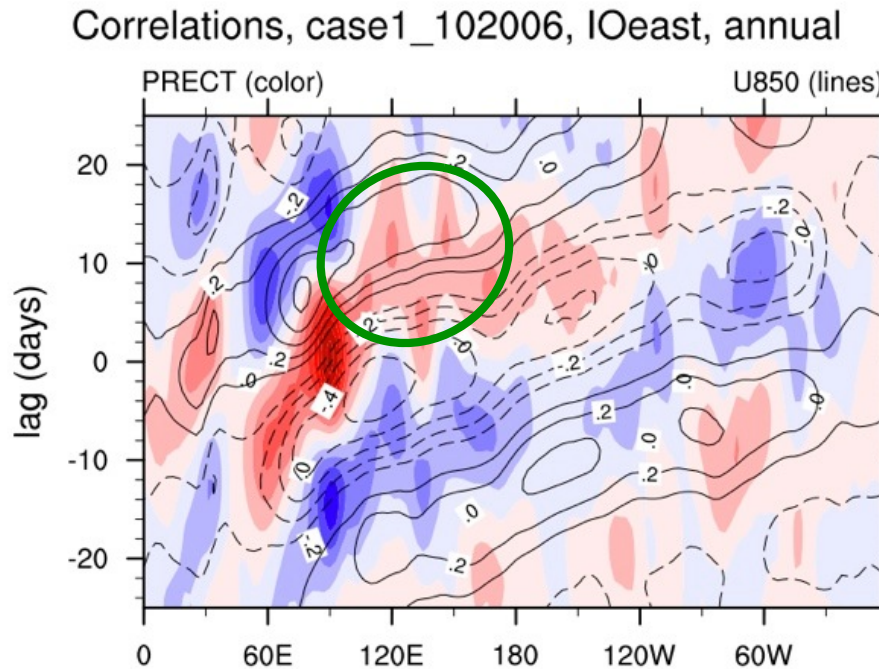
... as noted in observations.

Results: Control vs. +IOD

October control



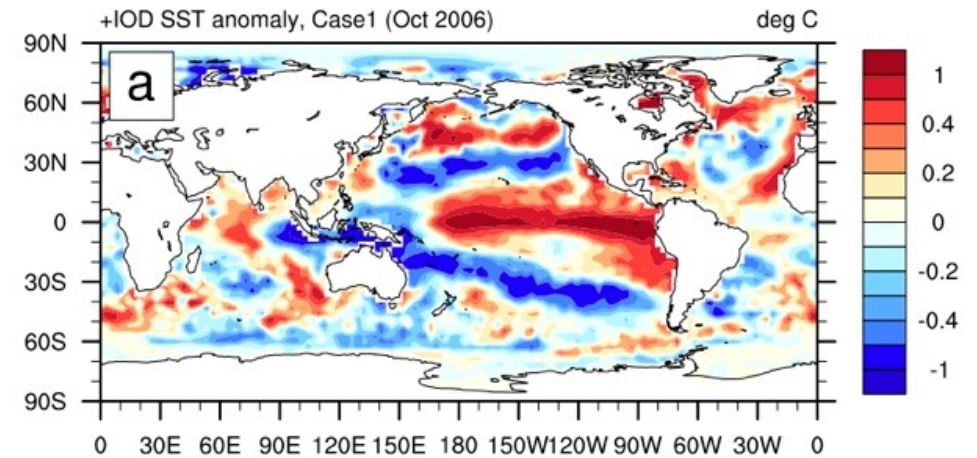
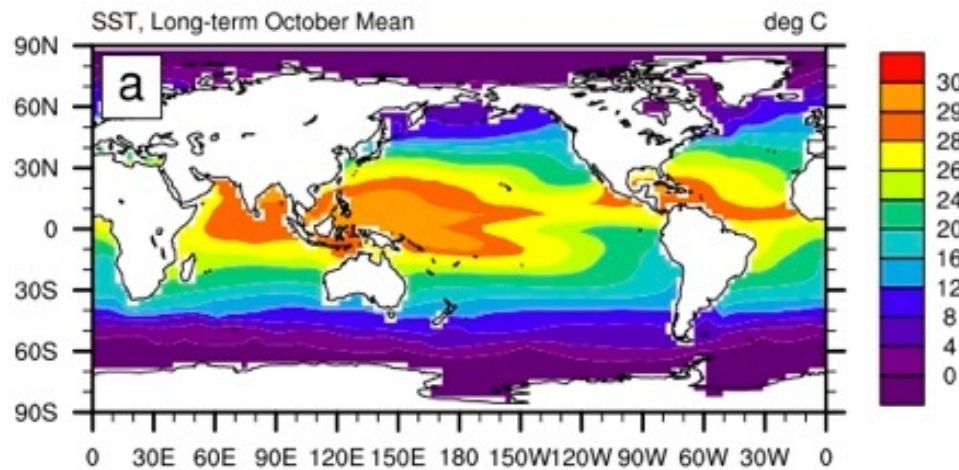
Case1: October 2006
(+IOD event)



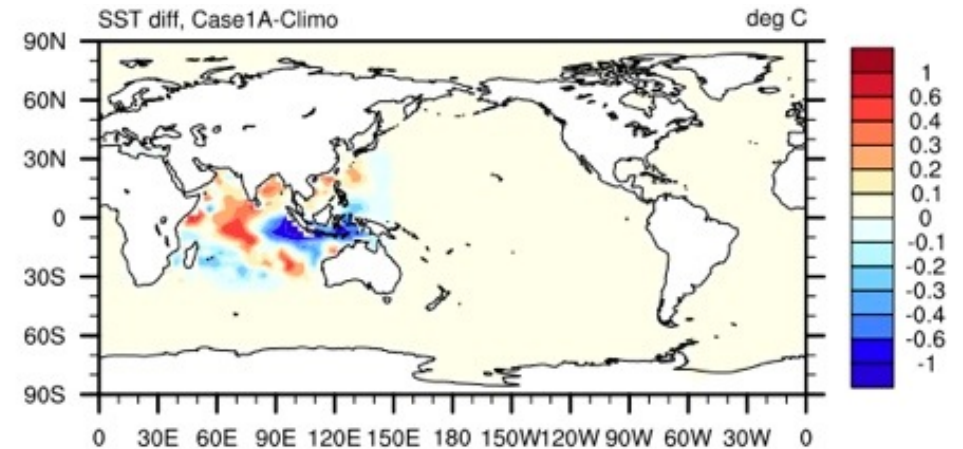
Introducing: Case I A (no Pacific SST anomalies)

Case I: October 2006

October climatology

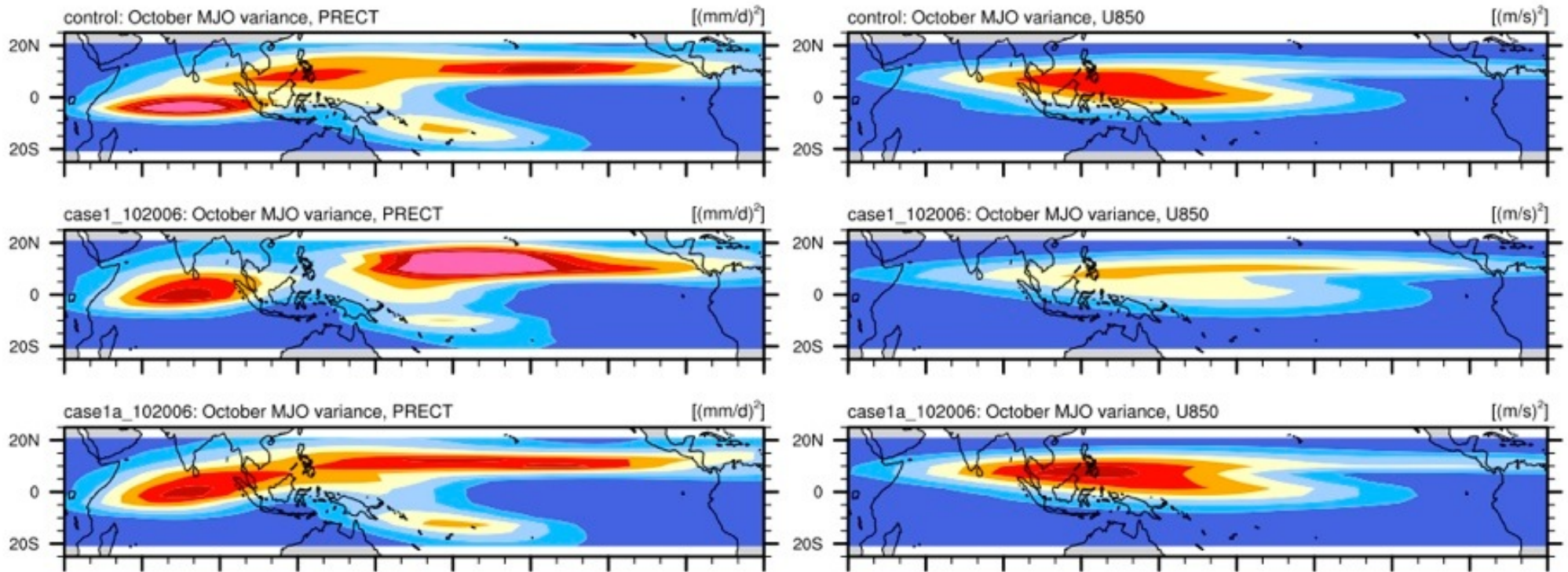


Case I A: October 2006 (no Pacific SST anomalies)



Impact of Local & Remote SSTs

October MJO-Filtered Variance

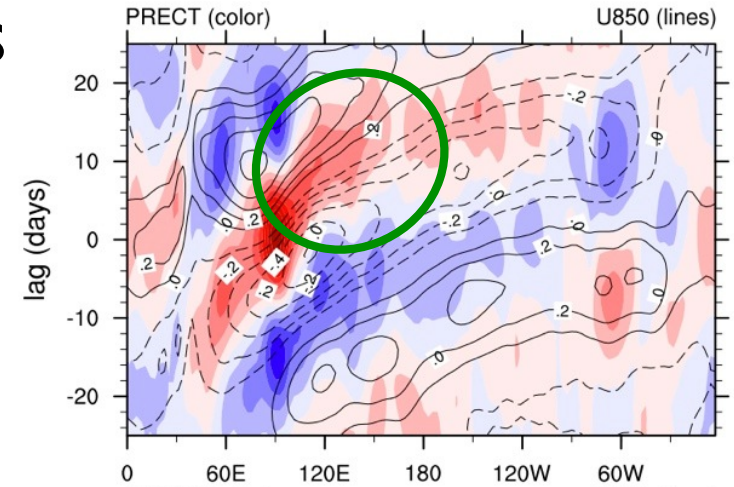


In SPCAM, removing Pacific SST anomalies during +IOD events makes the MJO resemble its control state(!)

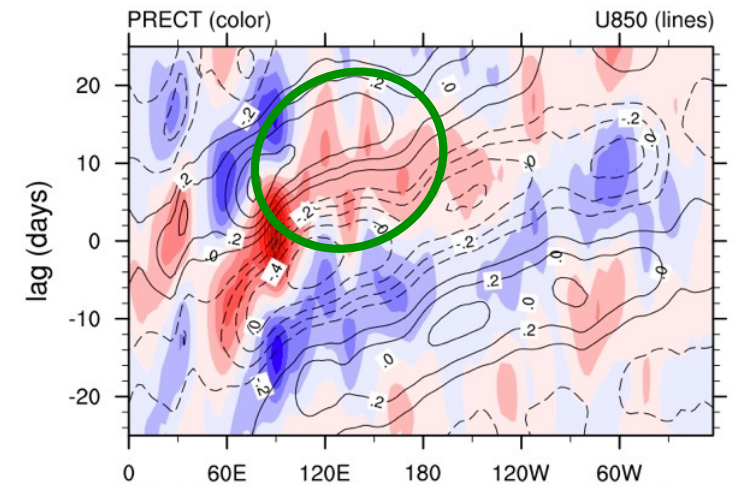
This suggests that the Pacific influences far removed from the Indian Ocean region impact MJO propagation during +IOD events in the (fixed SST) SPCAM

Results: Impact of IOD-linked SSTs

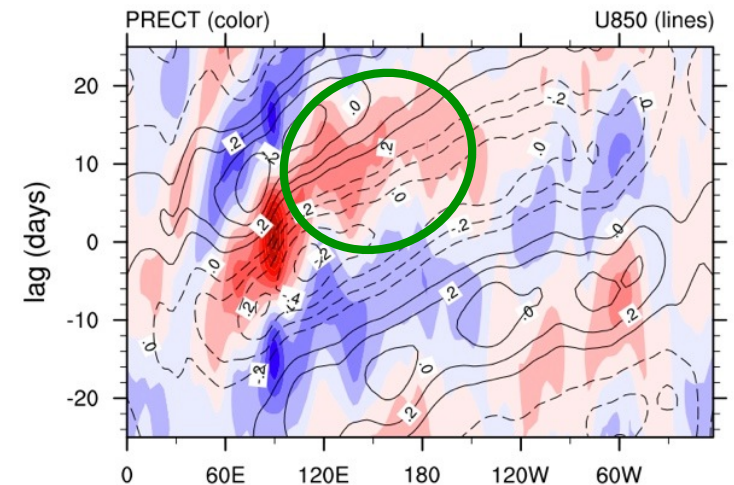
October control



Case I: October 2006
(+IOD event)

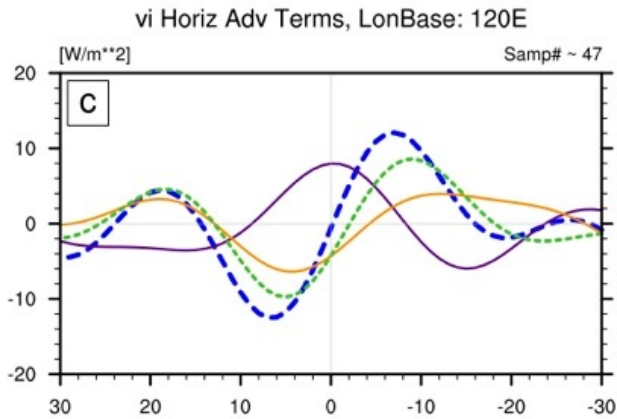


Case IA: October 2006
(+IOD event, no Pacific
SST anomalies)

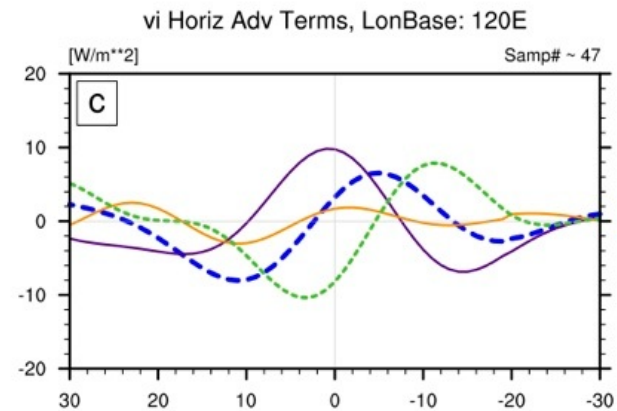


Results: Process Exploration

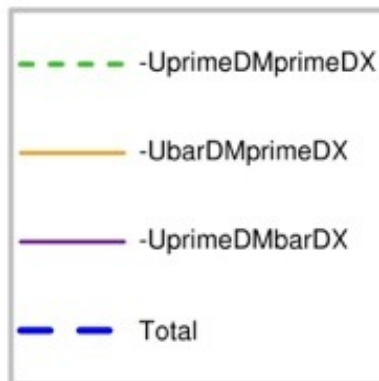
Mean-eddy moisture interactions?



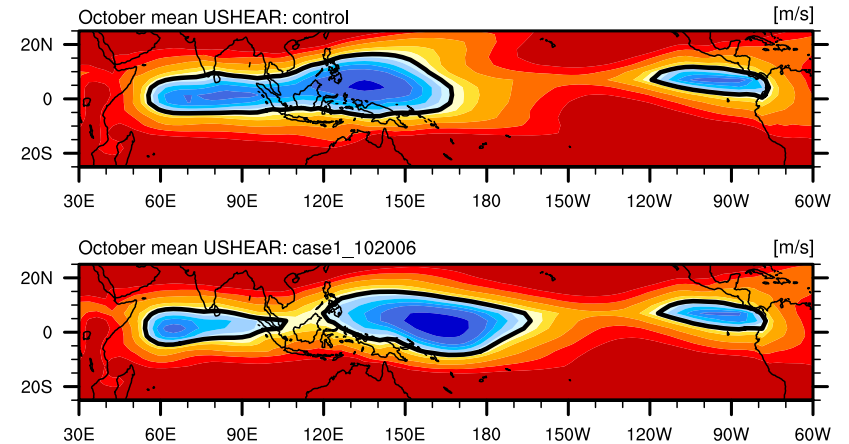
Case I: October 2006
(+IOD event)



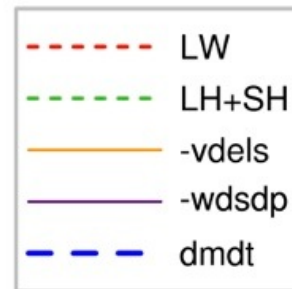
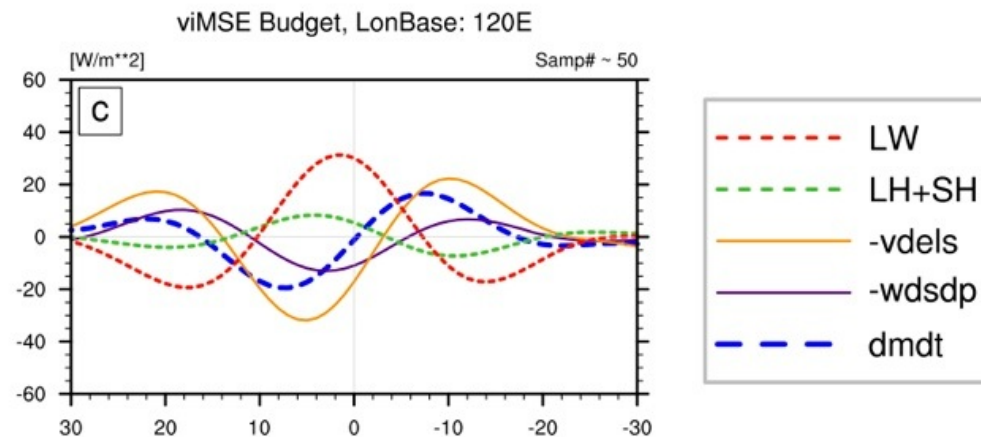
Case IA: October 2006
(+IOD event, no Pacific SST anomalies)



Wind shear?

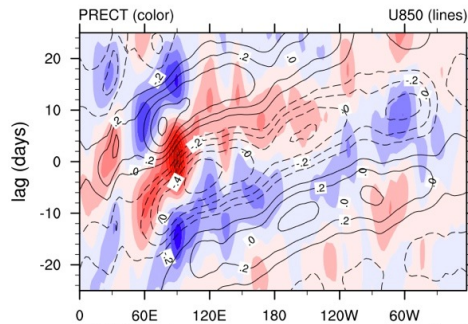
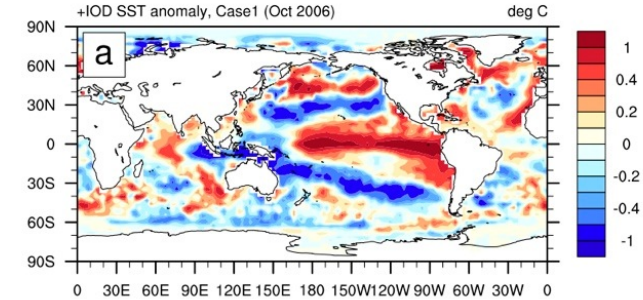


Diagnose via column MSE budget?



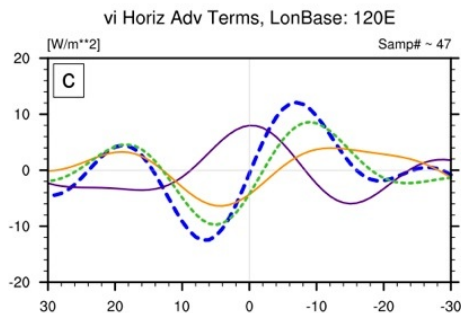
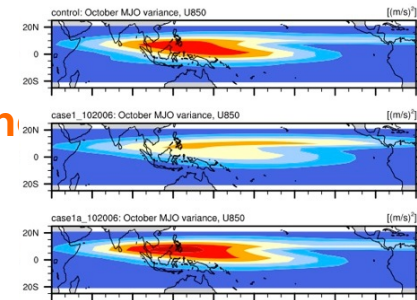
Bottom Line

MJO is strongly influenced by* sea surface temps



MJO intensity is reduced/disrupted during +IOD...
...SPCAM with fixed SST forcing captures this

When +IOD SST forcing is isolated to the Indian Ocean, the MJO restrengthens



Process exploration is ongoing...