Marine heatwaves off northern Australia and new observations to improve their predictions

Ming Feng

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Forum for Operational Oceanography

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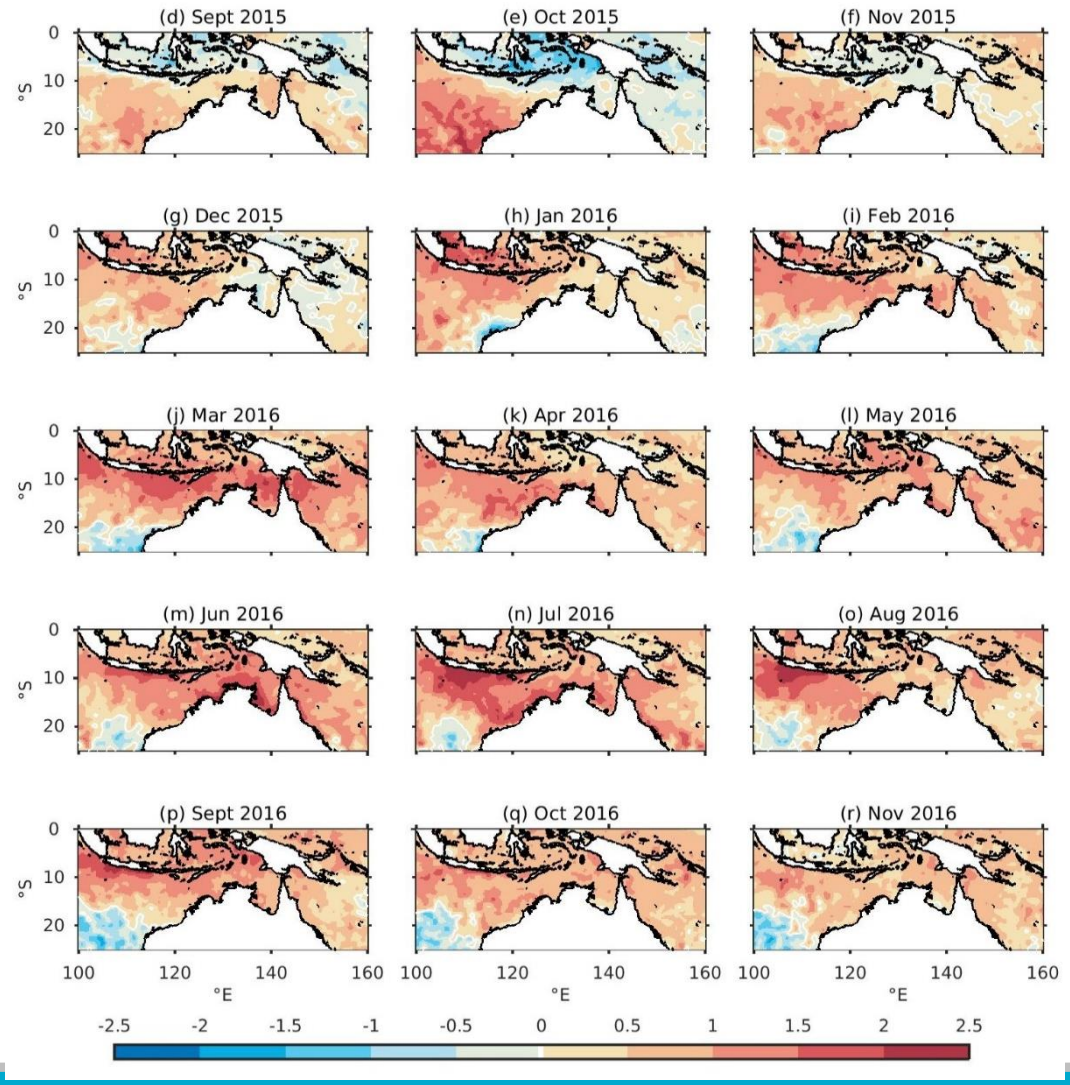
CSIRO

IMOS Integrated Marine Observing System

western australian marine science institution

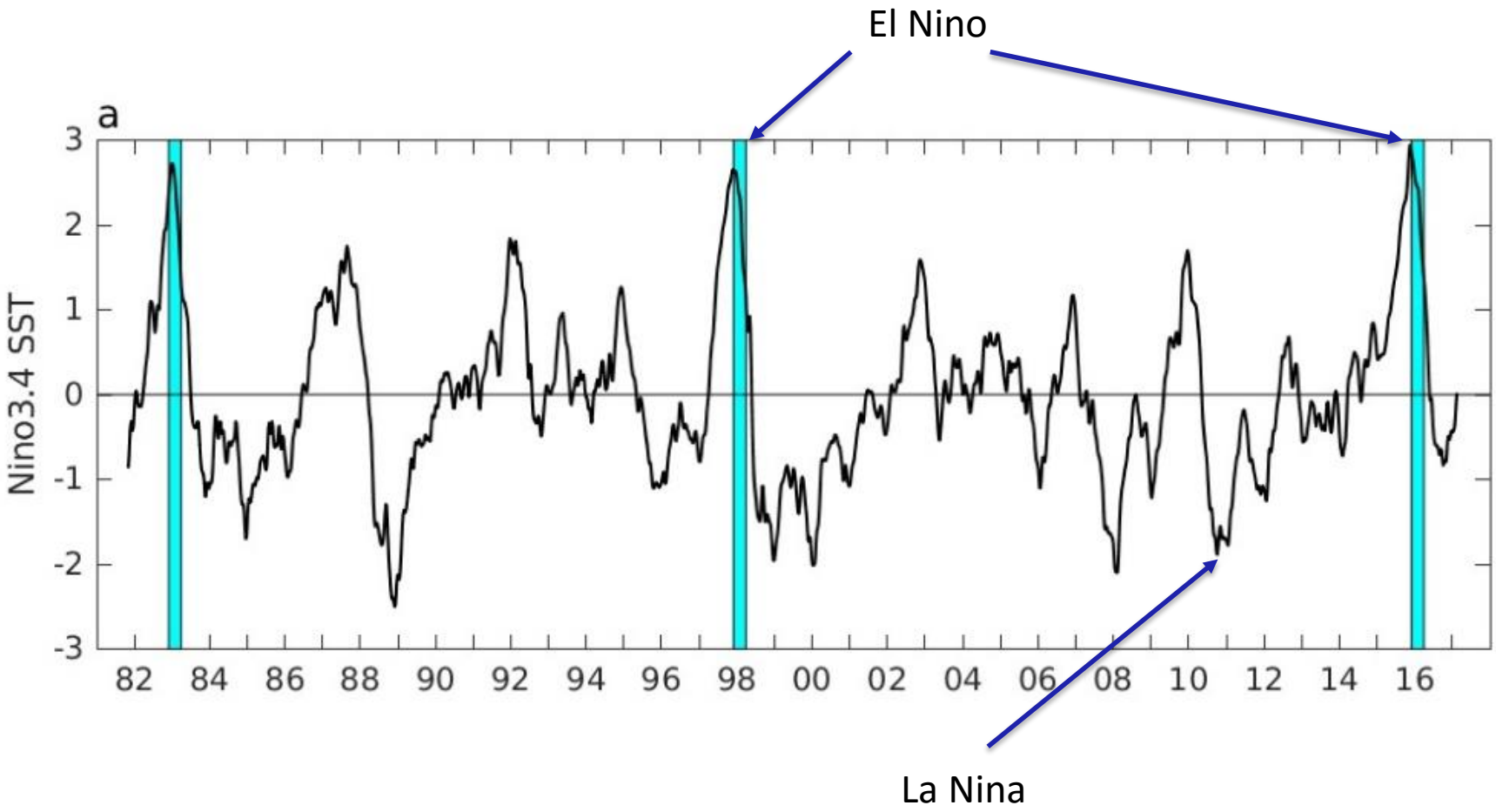
Evolution of the Marine heatwave in 2016



Coral bleaching at Scott Reef
60-90% (AIMS)

Benthuysen et al. in preparation

ENSO index


El Nino
a
Nino3.4 SST
3
2
1
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-1
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-3
82
84
86
88
90
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94
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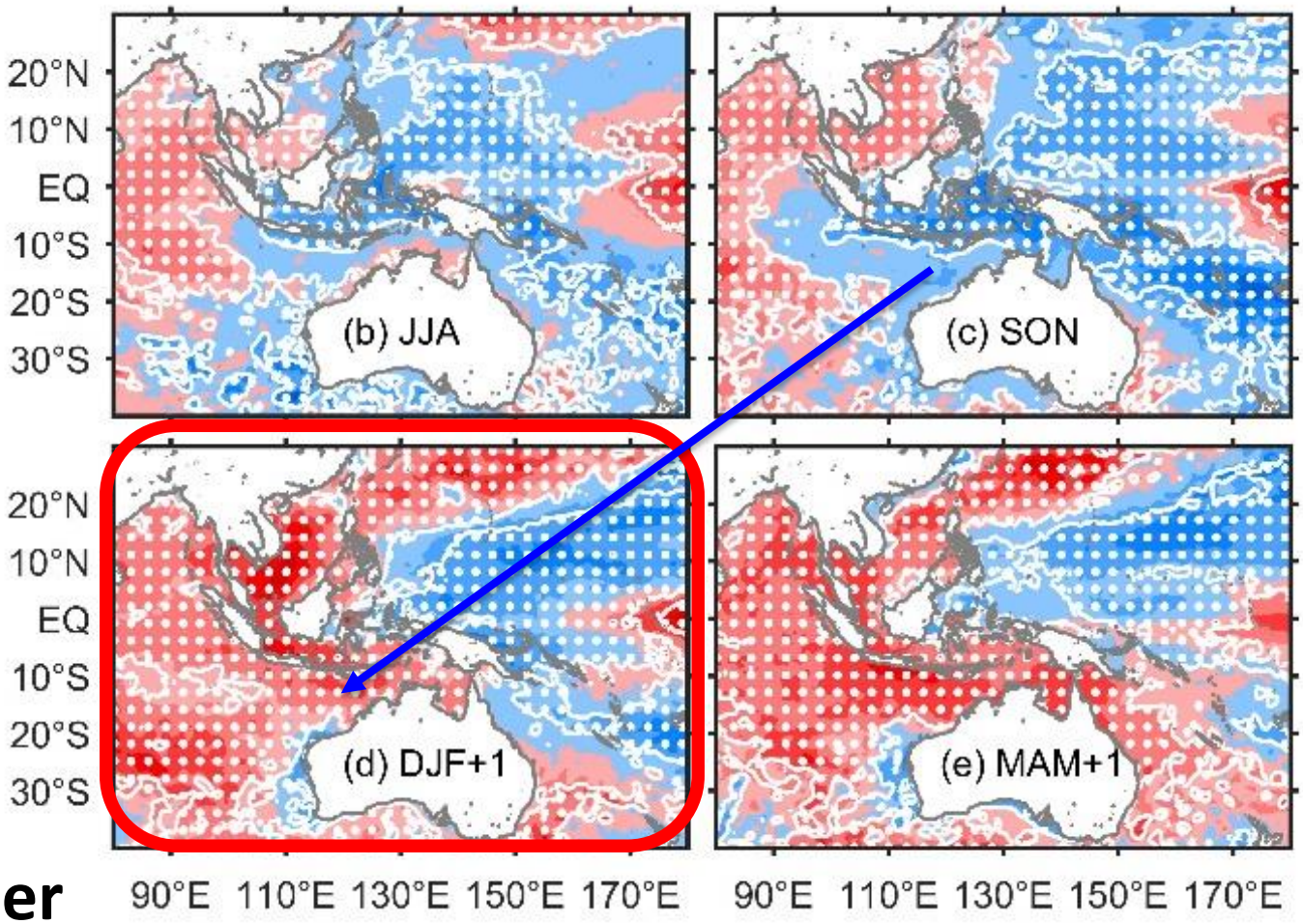
16
La Nina

Sea surface temperature composites during El Nino

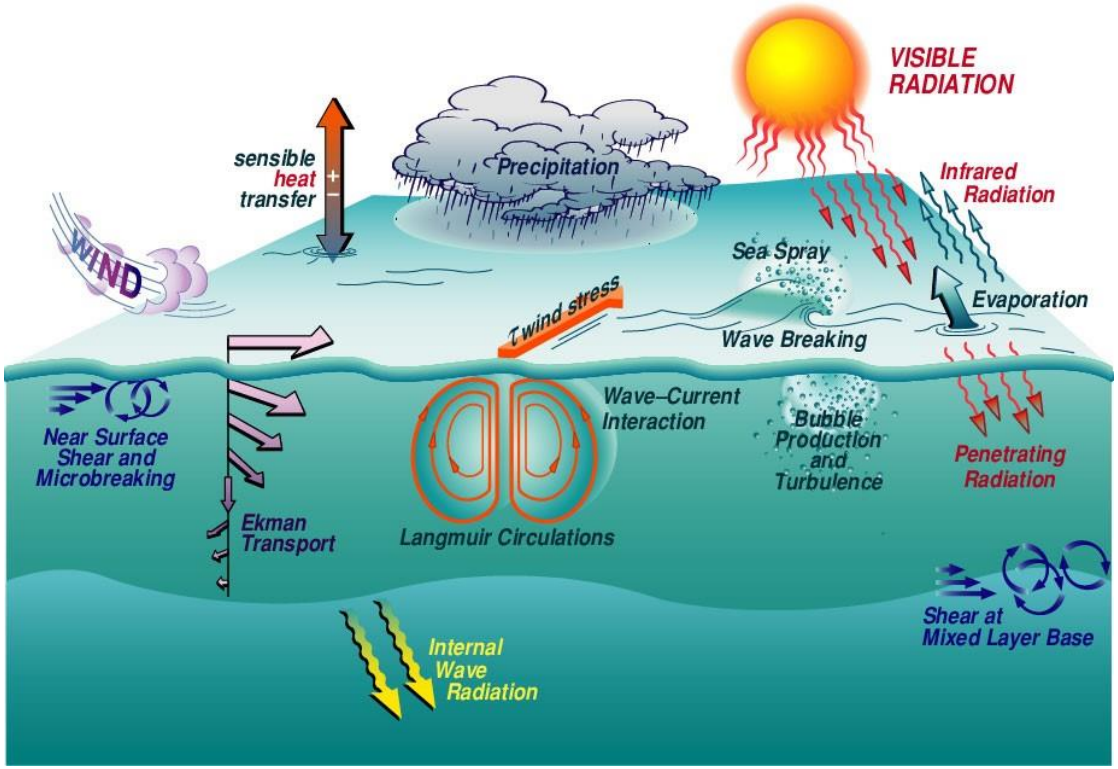


Spring

Summer

Zhang et al. 2017

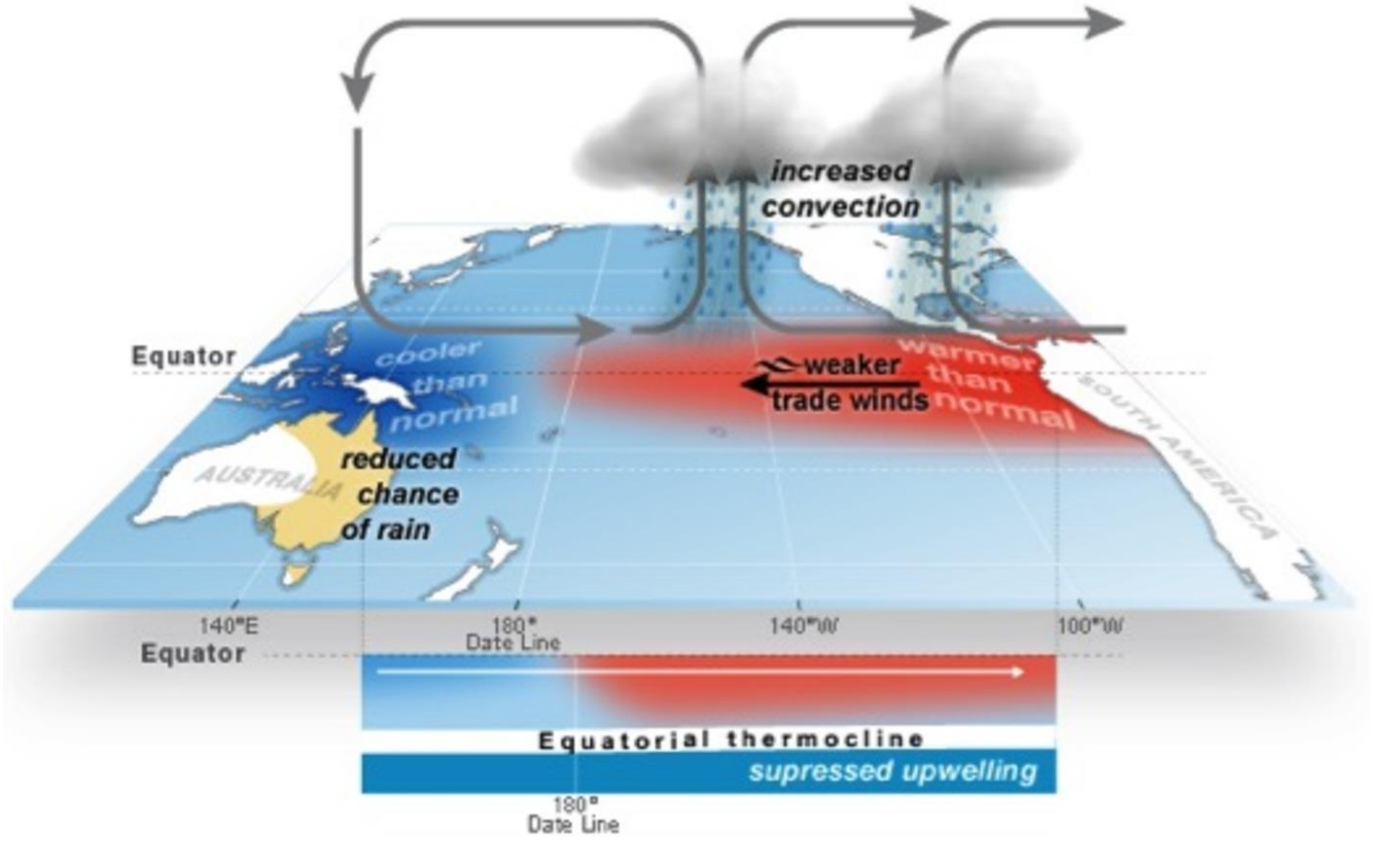
Processes affect the upper ocean heat balance and SST



Solar radiation – cloudiness

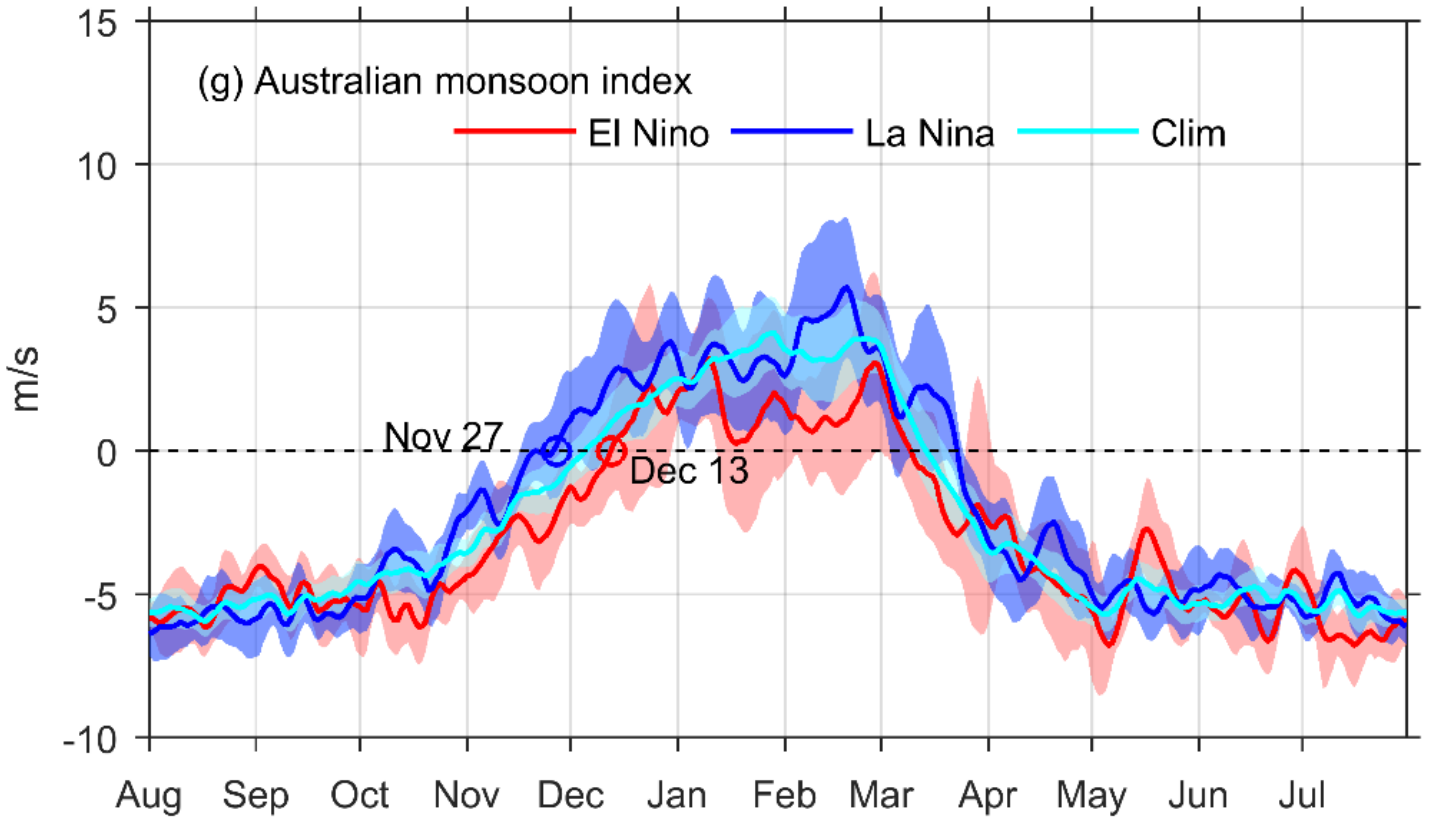
Evaporation – wind speed

El Nino condition in the tropical Pacific

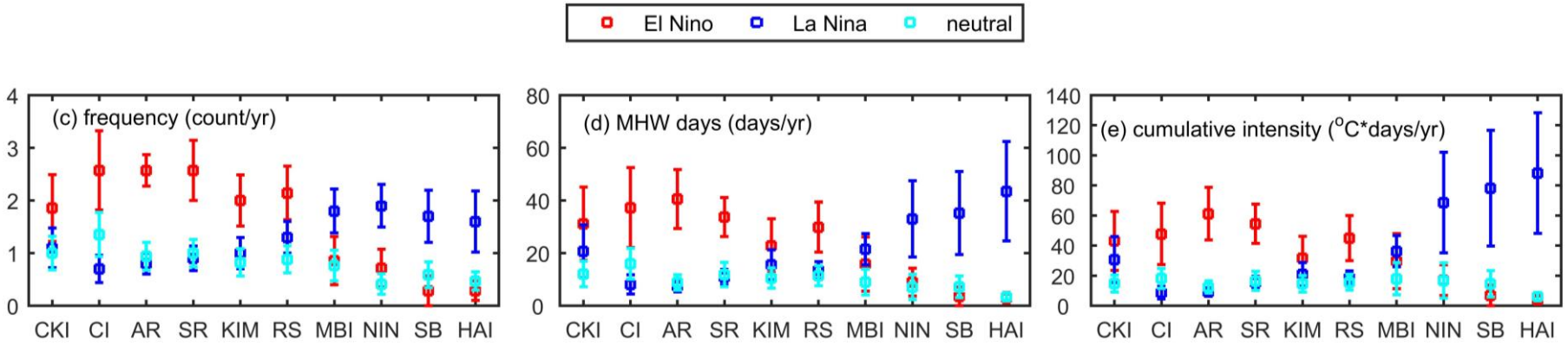


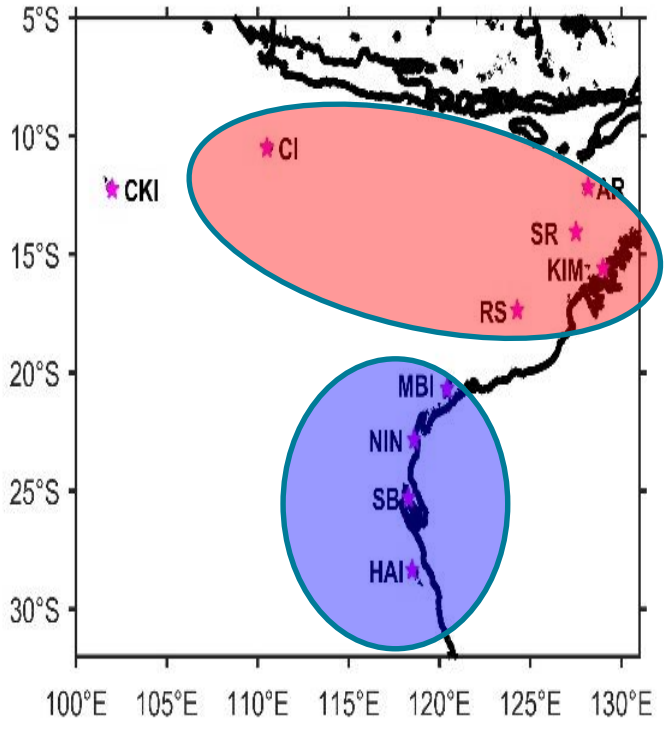
El Niño–Southern Oscillation (ENSO): **El Niño**

ENSO related monsoon variability



Composites of marine heatwave events in El Nino/ La Nina (December and April)

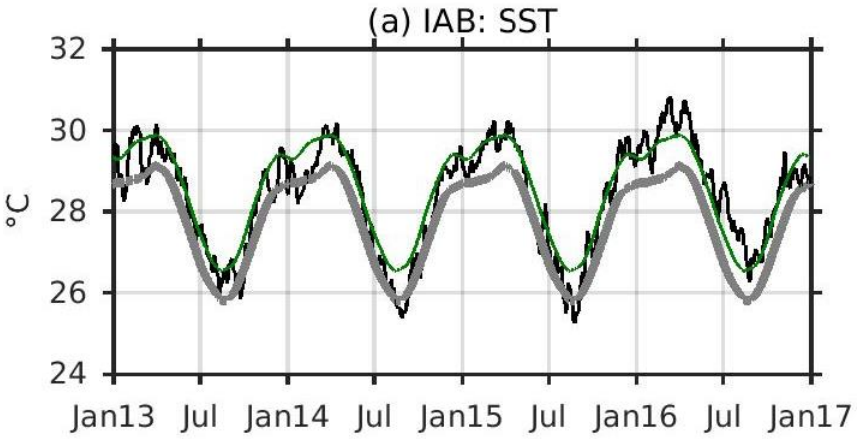


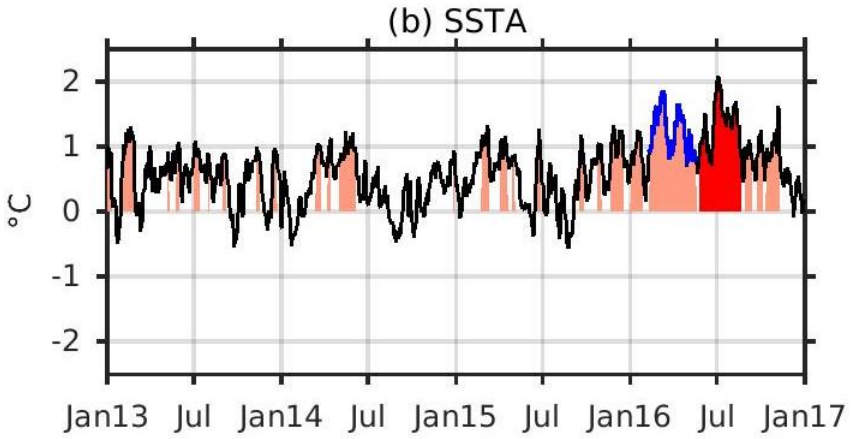


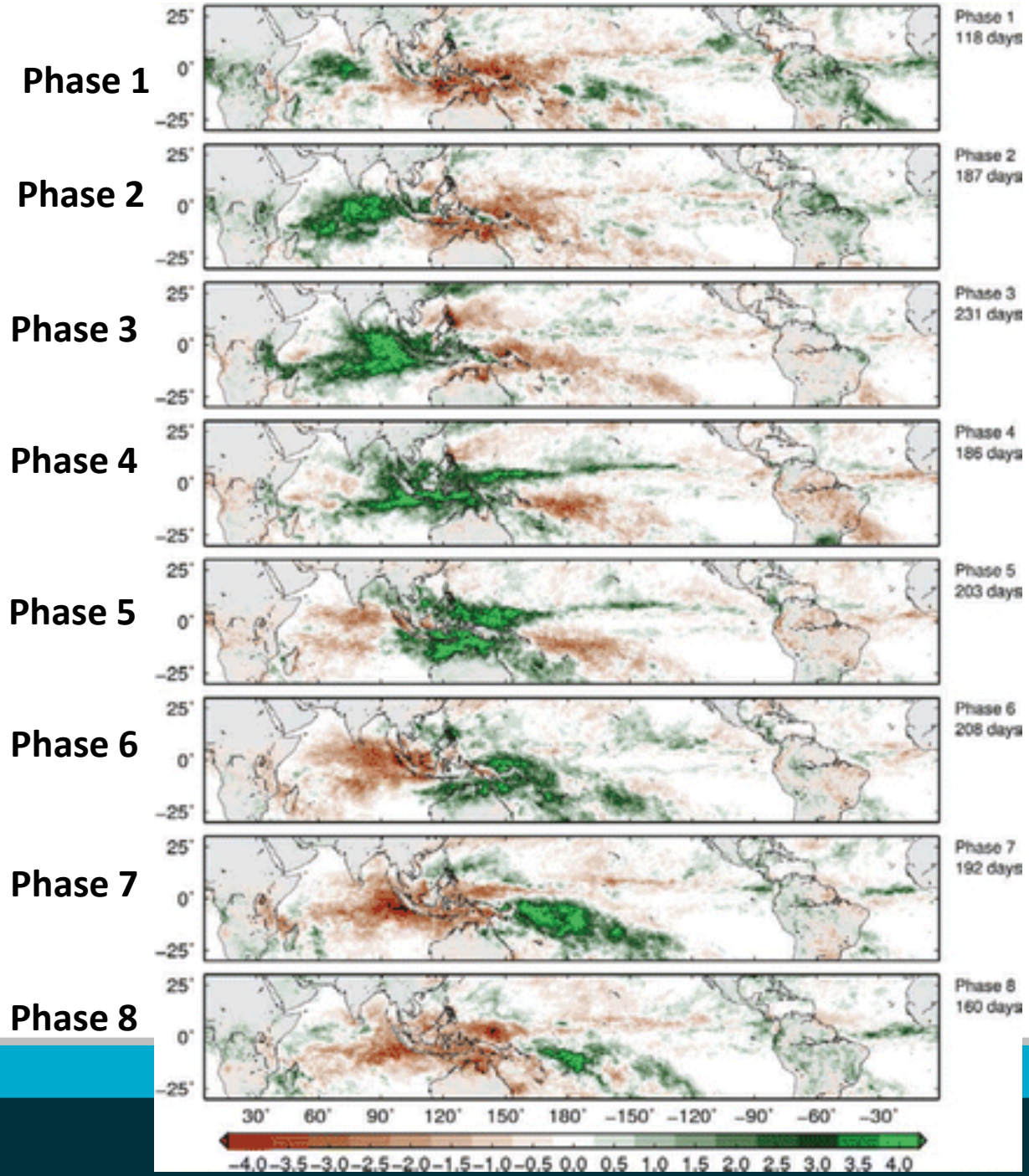
El Nino

La Nina

Intraseasonal variations of surface temperature anomalies





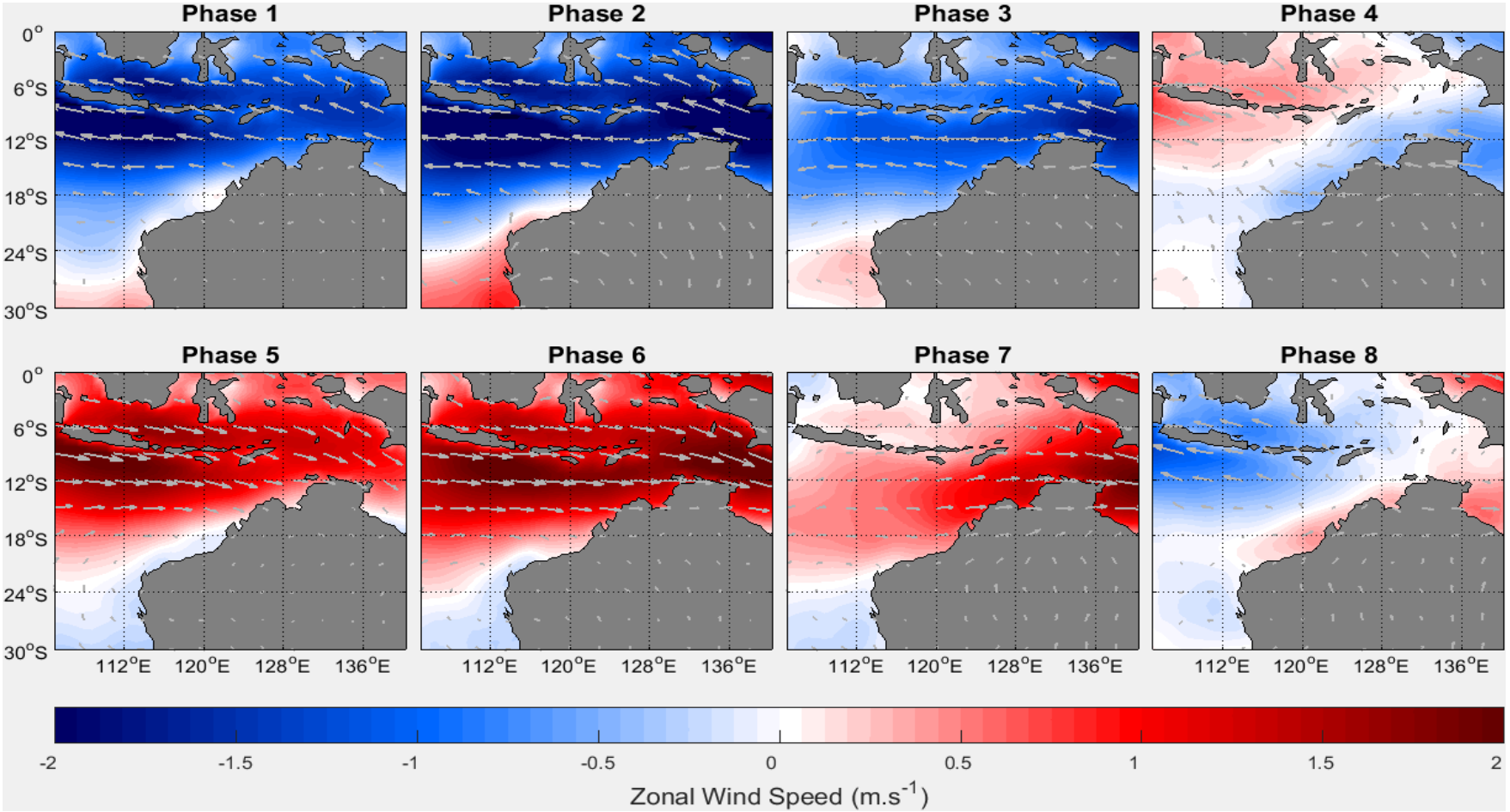


Madden-Julian Oscillation

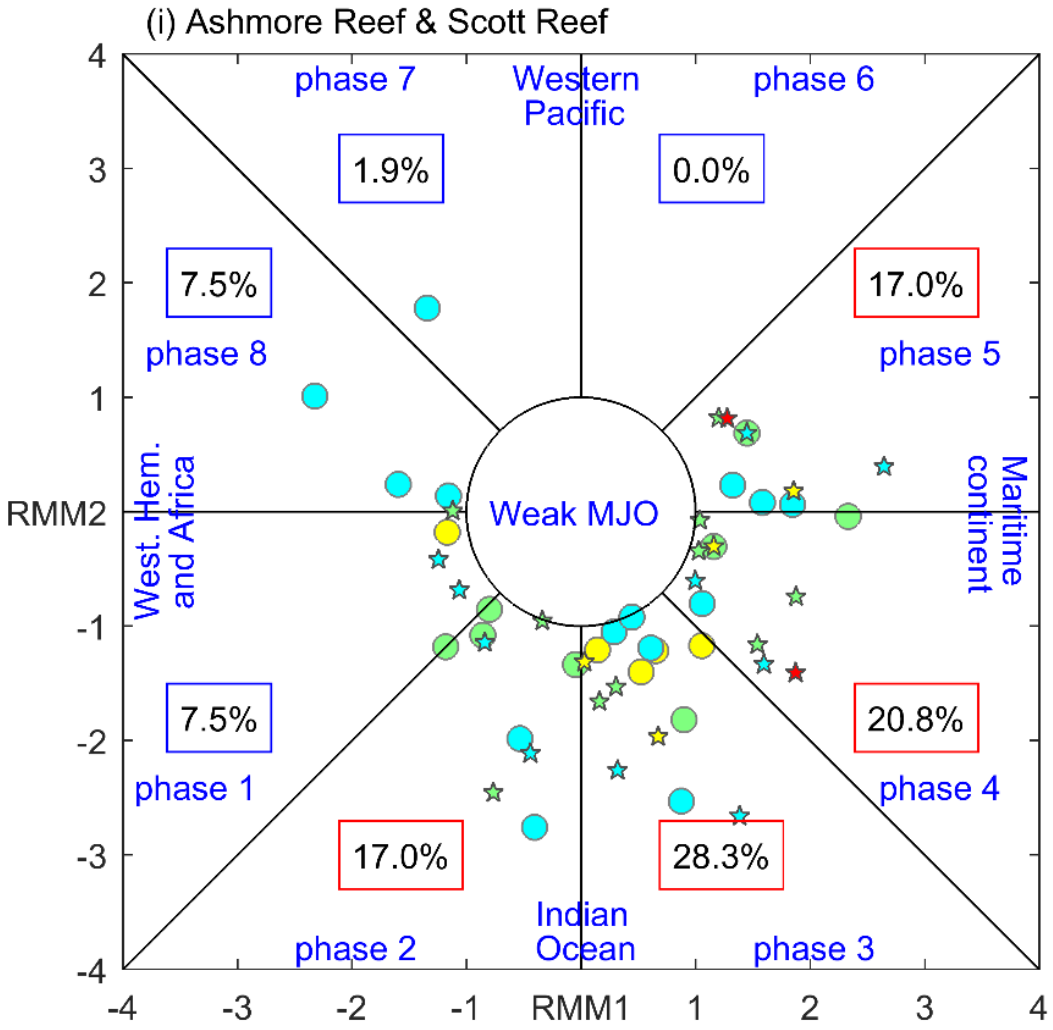
Influence on Indo-Pacific precipitation anomalies

Zhang 2013

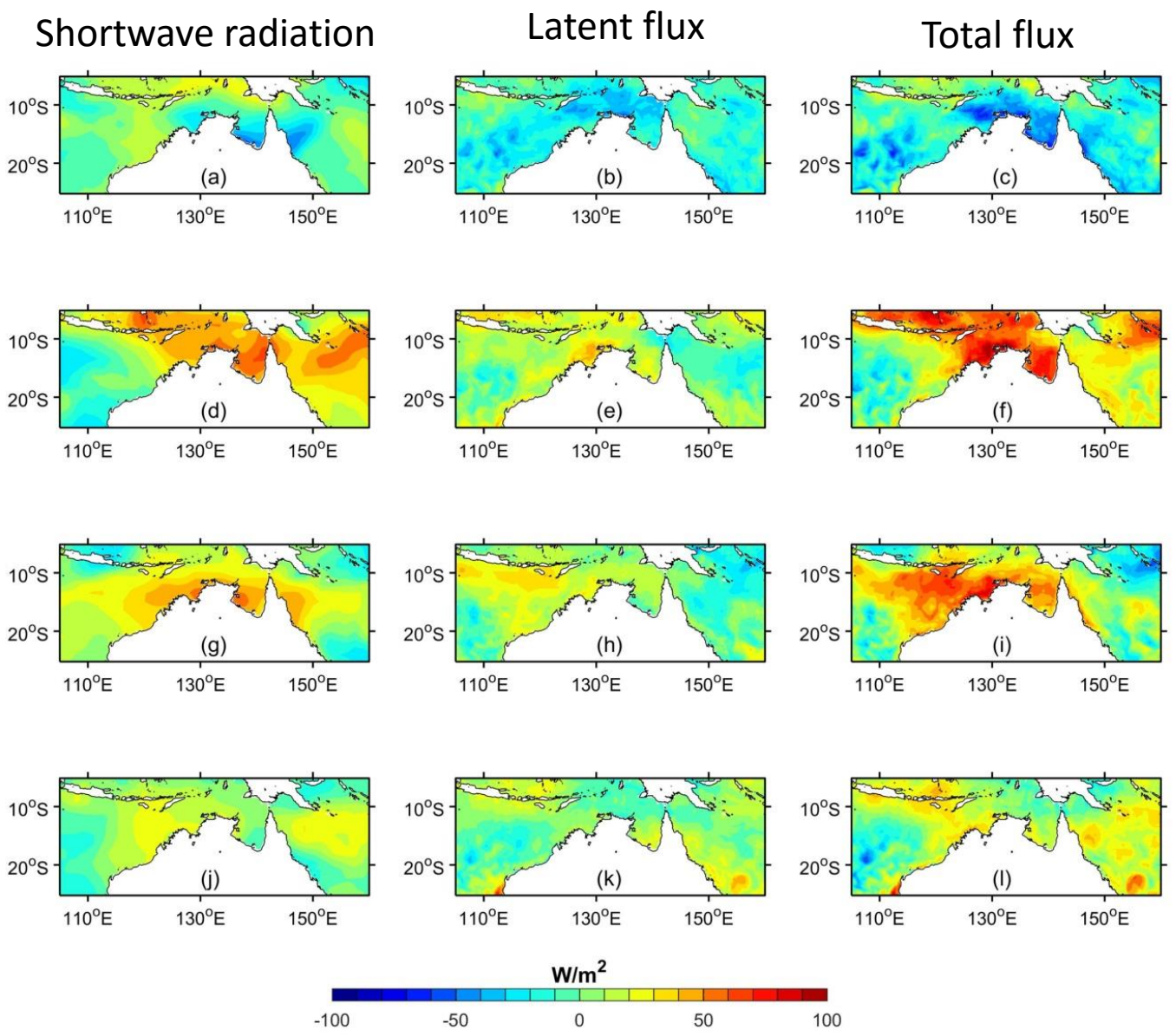
Composite of surface winds associated with MJO



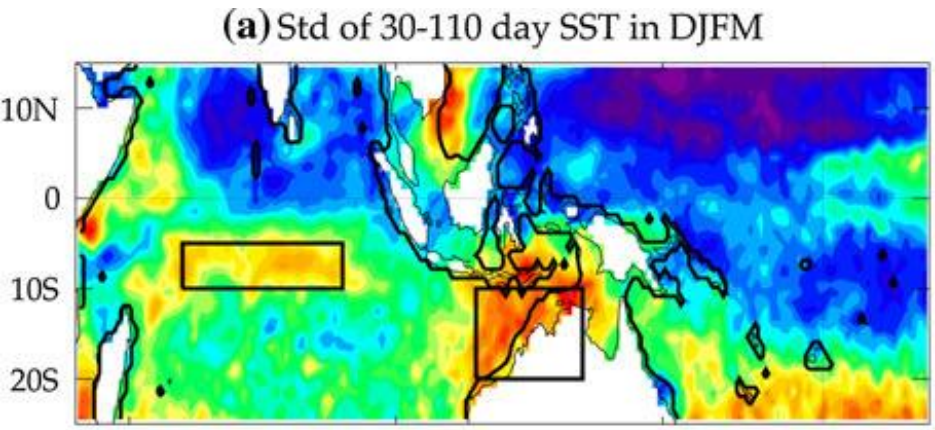
Madden-Julian Oscillation influences on marine heatwaves

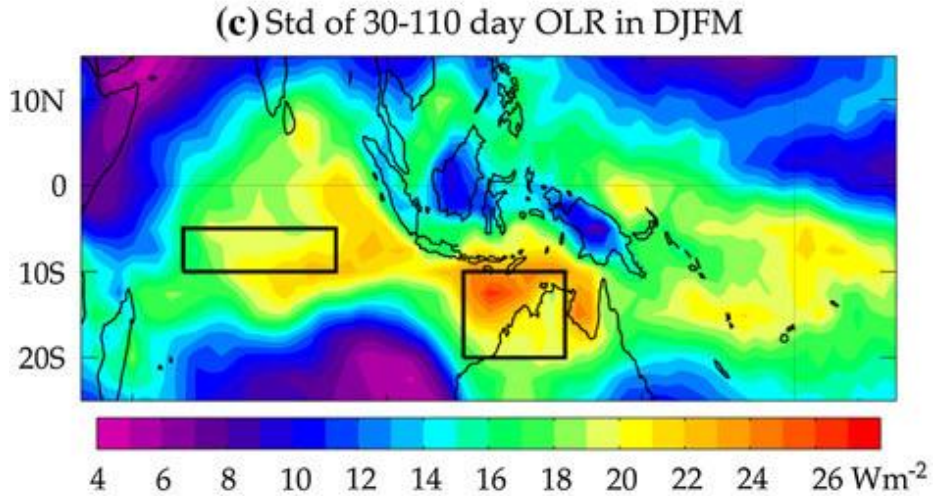


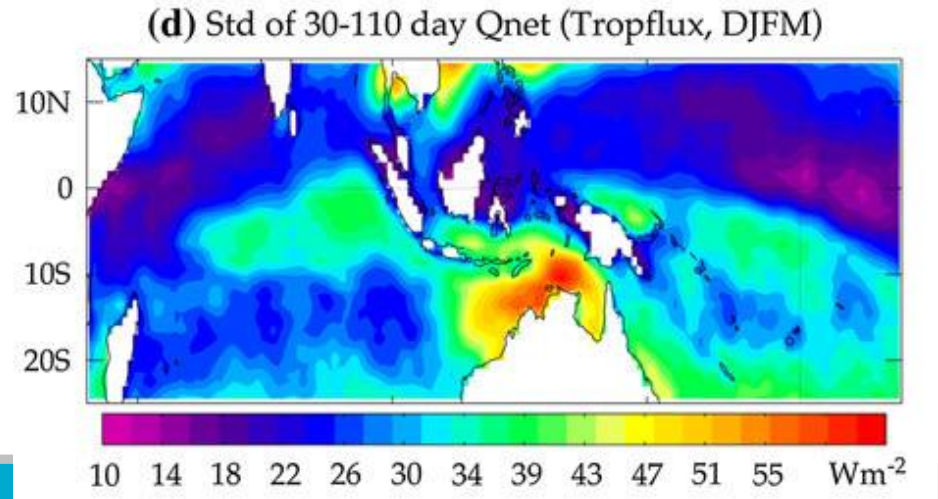
Heat flux anomalies derived from BRAN-2016



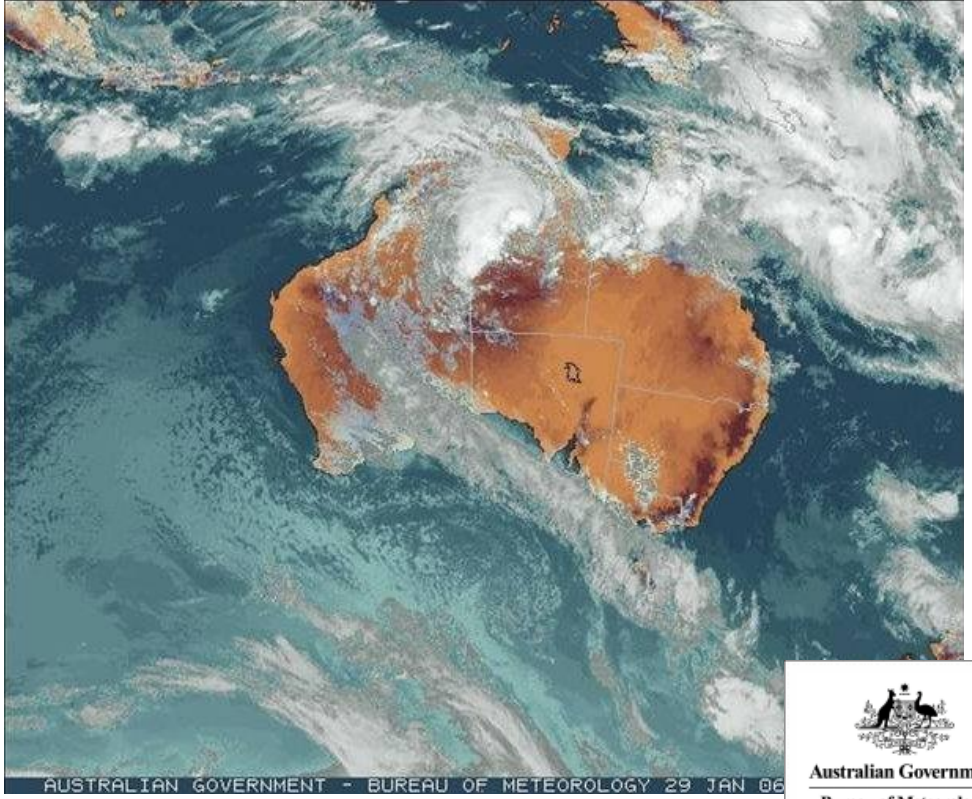
Strongest SST response to MJO off NW Australia

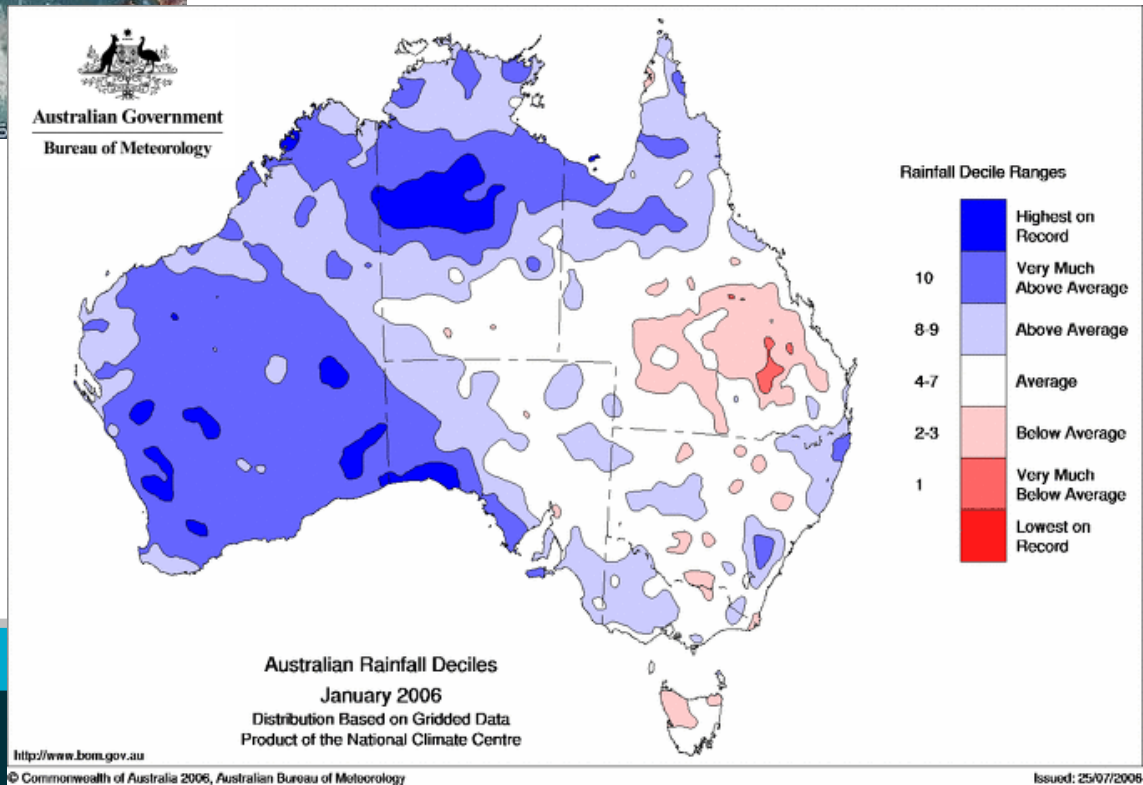






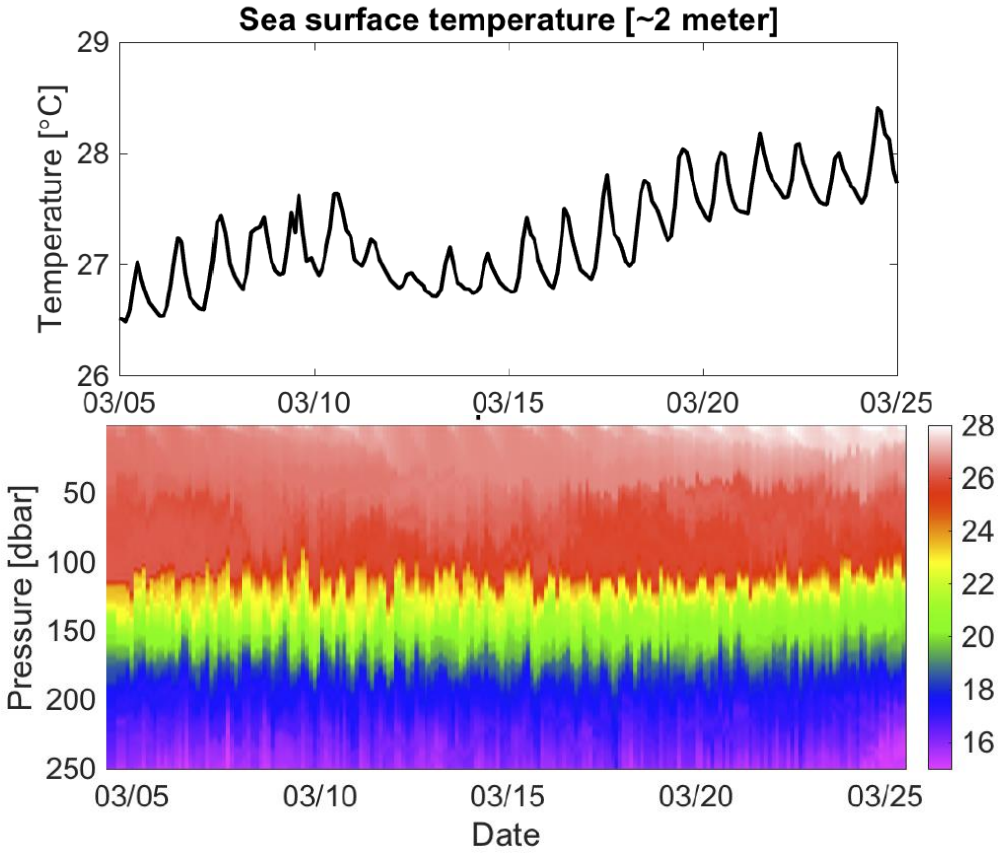
Madden-Julian Oscillation (MJO) active phase in January 2006





Bureau of Meteorology

A new observational approach: fast profiling expendable instrument



ALAMO profiling 12 times/day in the Arabian Sea – Steve Jayne, pers. Comm.

Surface meteorology measurements

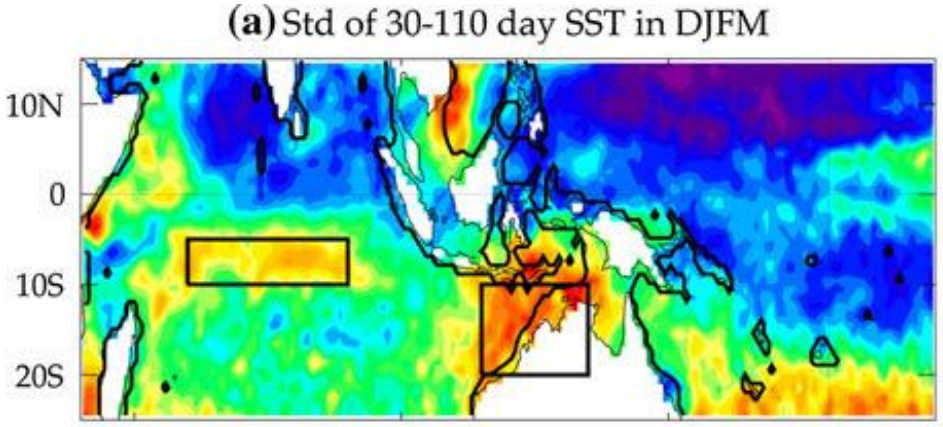
Wave glider

X Spar buoy
C. Clayson

Scheduled activities

First phase field program
2017-2018

2 X 



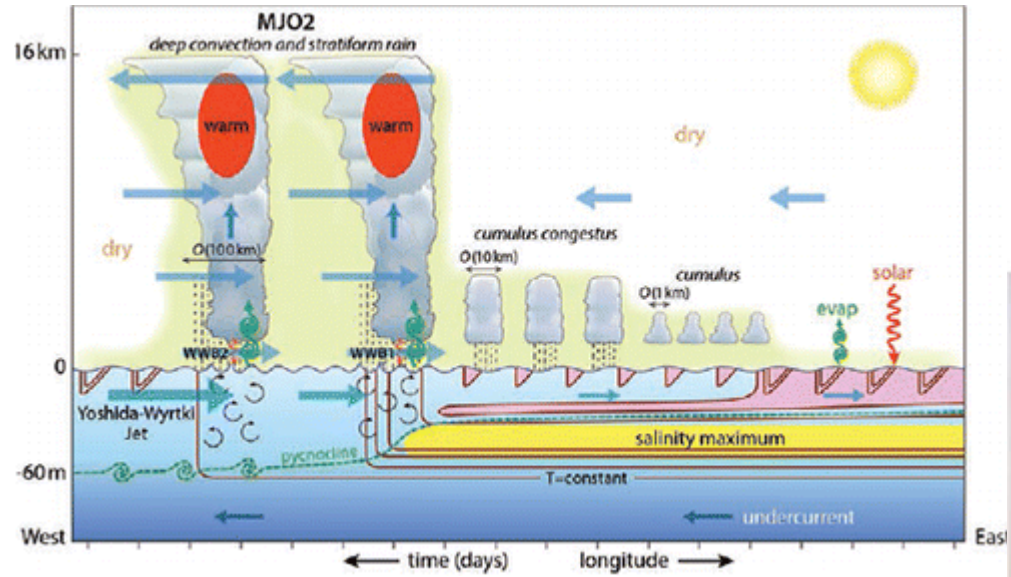
Second phase field program
2018-2019

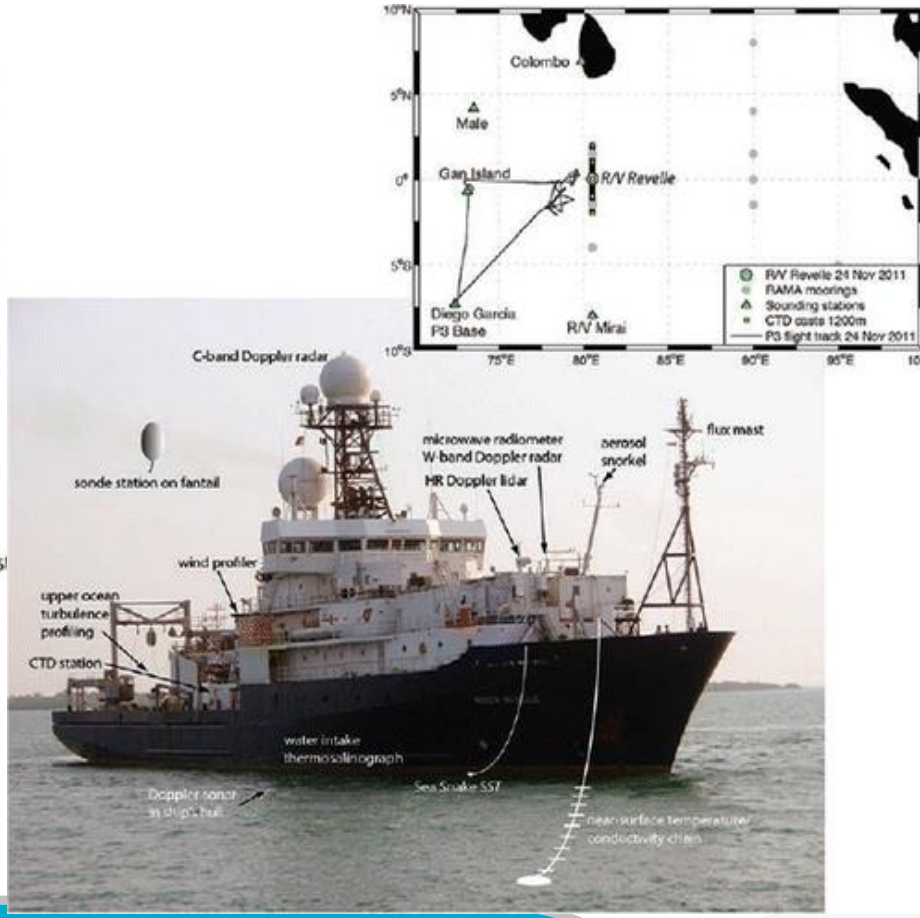
5 X 

1 X 

- Satellite remote sensing
- Rerun the BoM's new coupled forecast model for the field period

Diurnal cycling of SST interact with MJOs, monsoons, and other mode of climate variability





Moum et al. 2014, DYNAMO

Diurnal SST warming may pre-condition the strong MJO event

Summary

- Off the Kimberley coast and among the offshore atolls, marine heatwaves are prone to occur during an El Nino event
- El Nino reduces cloud cover in the region, enhance solar radiation into the surface ocean; El Nino also weakens the Australian monsoon, reducing wind speeds and evaporative cooling
- Marine heatwaves are more frequently peaks at the suppressed phase of Madden-Julian Oscillation (Australian Monsoon)
- A new field campaign is planned to better understand the air-sea coupling in the region, in the hope to better predict MJO and Australian Monsoon

Zhang, N., **M. Feng***, H. Hendon, A. Hobday, J. Zinke (2017), Opposite polarities of ENSO drive distinct patterns of coral bleaching potentials in the southeast Indian Ocean, Scientific Reports, **7,** 2443. doi: 10.1038/s41598-017-02688-y