EGU General Assembly 2021
EGU21-3535

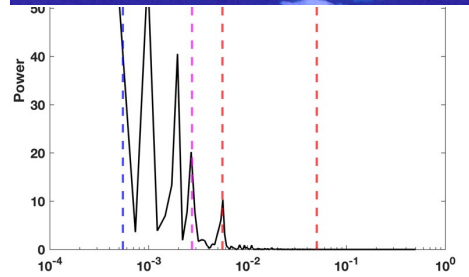
Intraseasonal variations of Ocean Heat Content in the tropical Indian and Pacific Ocean

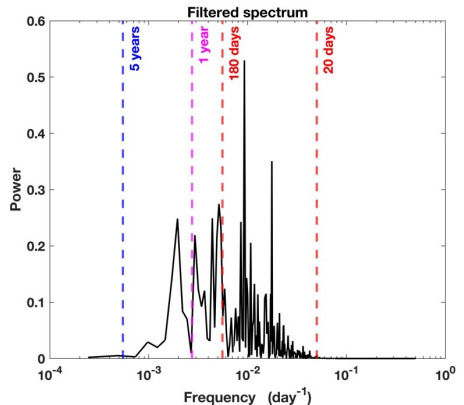
Ashneel Chandra[1*], Noel Keenlyside[1], Lea Svendsen[1] and Awnesh Singh[2]

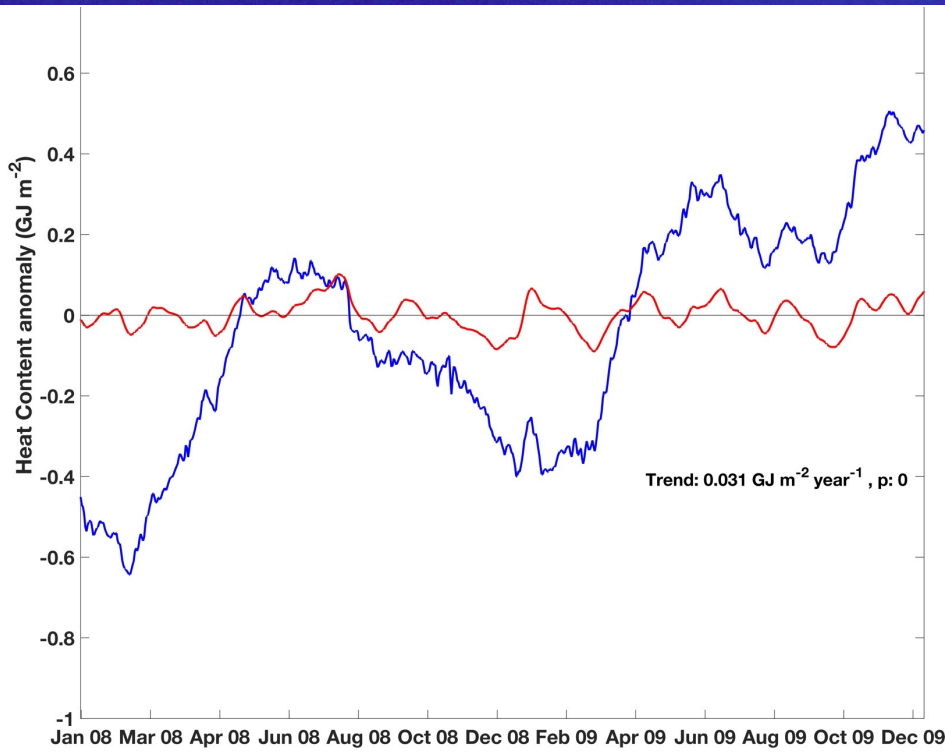
[1]Geophysical Institute, University of Bergen, and Bjerknes Centre for Climate Research, Bergen, Norway

[2]Pacific Centre for Environment and Sustainable Development, The University of the South Pacific, Suva, Fiji

[*]Ashneel.Chandra@uib.no







Motivation and research question

OHC is an important thermodynamical parameter in the Earth's climate system given the importance of the ocean in storing about **90%** of the **Earth's energy imbalance**.

Apart from this, understanding **OHC anomalies** can help us **infer** the **direction heat energy moves** within the ocean and from the ocean to the atmosphere.

On intraseasonal timescales, the **Madden-Julian Oscillation** contributes to the **atmospheric forcing** on the the equatorial Oceans, having the strongest signature in the Indian Ocean

While studies have looked at **SST** and **mixed layer temperature** **budgets**, not many studies have looked and the **OHC budget** and processes driving OHC changes.

Motivation and research question

Research question

What are the **drivers of intraseasonal variability of OHC** in the **tropical Indian and Pacific Ocean**?

A heat budget analysis can help us understand the contribution of different processes contributing to changes in OHC

$$\frac{\partial(OHC)}{\partial t} = -\bar{F} + \rho_0 c_p \int_D^0 -\nabla\overline{(\boldsymbol{u}\Theta)}\, dz + R$$

$$\boldsymbol{OHCT} \qquad \boldsymbol{Q} \qquad \boldsymbol{ADV} \qquad \boldsymbol{RES}$$

Data

Dataset	HYCOM	NOAA Interpolated OLR	NOAA OISST	AVISO SLA	NCEP/NCAR Reanalysis 1	TRMM_3B42 V7
Spatial resolution	0.08º	2.5º	0.25º	0.25º	2.5º (u,v) T62 (heat fluxes)	0.25°
Temporal resolution	3 hourly	daily	daily	daily	daily	daily

ENSO : Oceanic Niño Index (ONI) from NOAA based on ERSSTv5

MJO : Real-time Multivariate MJO indices (RMM indices) from BoM

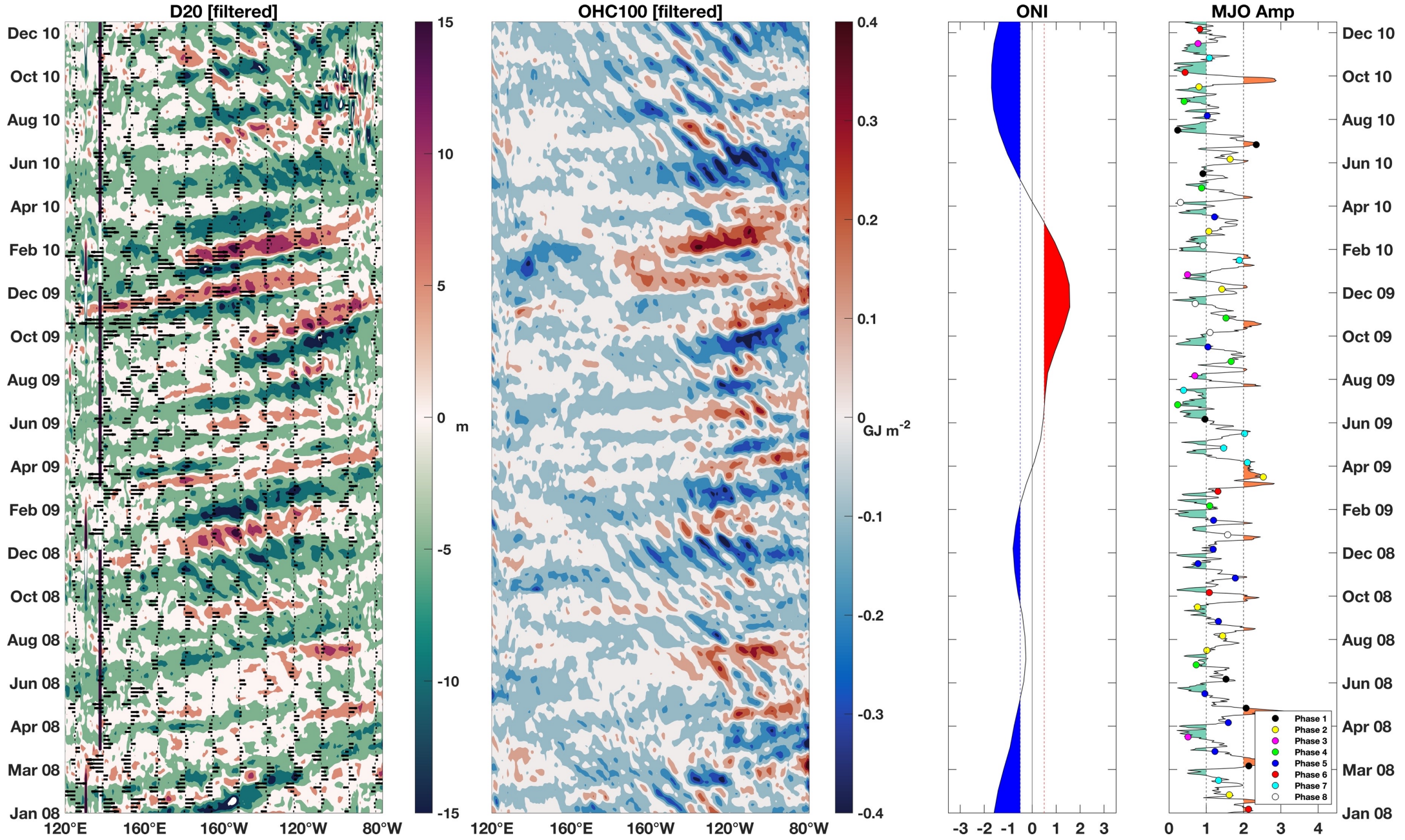
Quantities estimated:

OHC50 (Ocean heat content up to 50 m)
OHC100 (Ocean heat content up to 100 m)
D26 (Depth of 26°C isotherm)
D20 (Depth of 20°C isotherm)
BLT, MLD, ILD

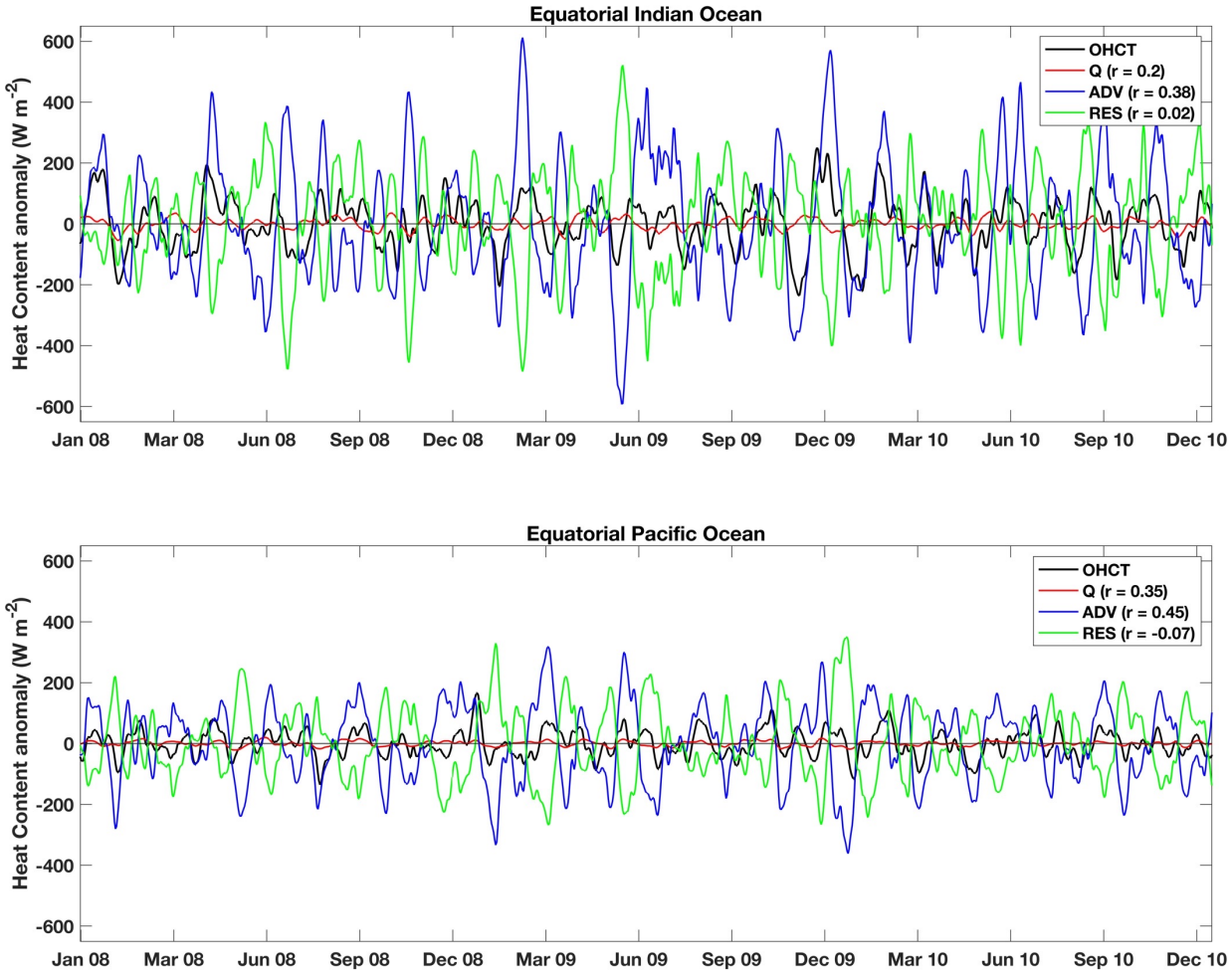
$$OHC_D = \rho c_P \int_{-D}^{0} \Theta(z)\ dz$$

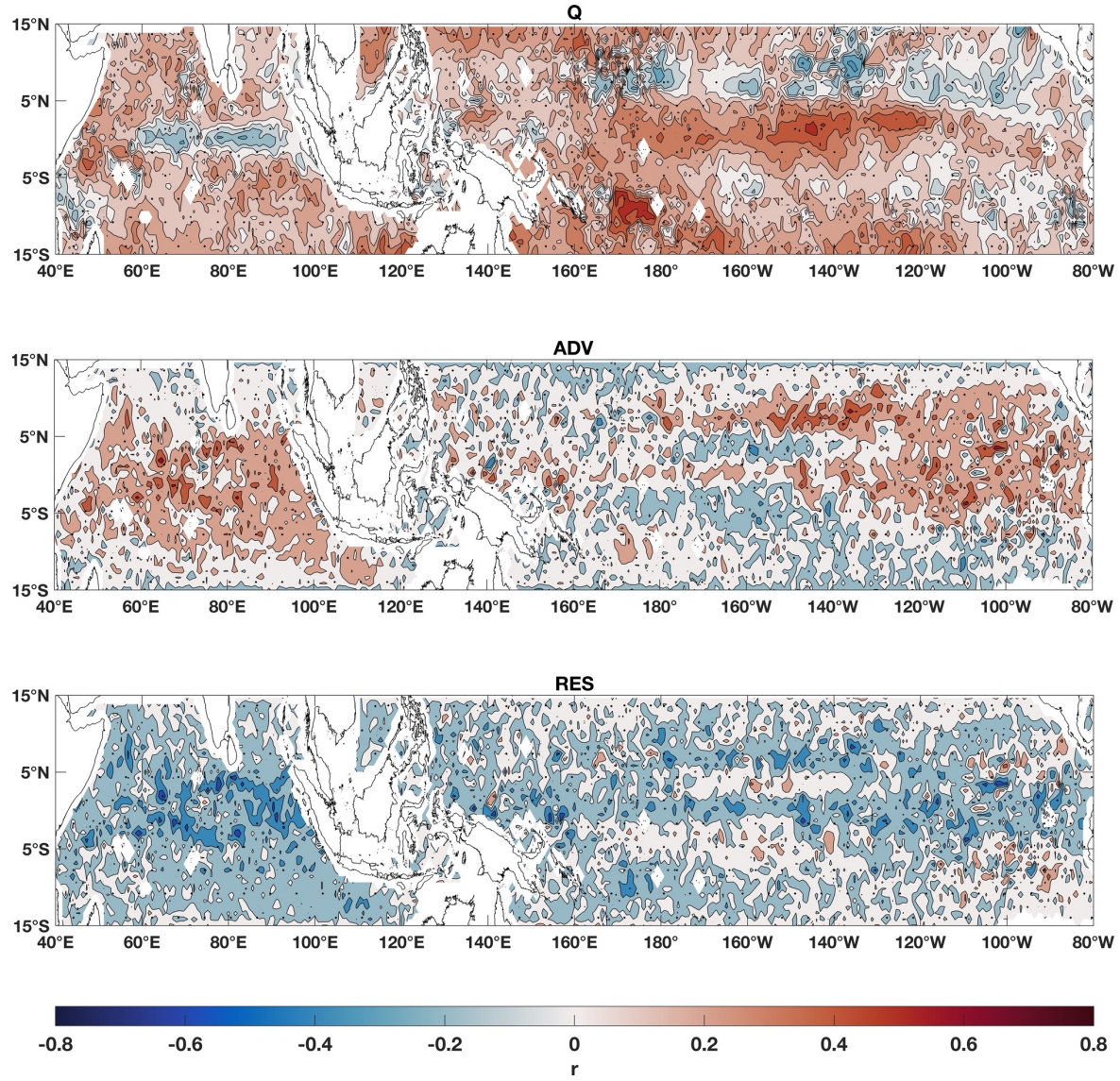
To obtain **intraseasonal anomalies**, the **long term mean**, **trend** and **climatological seasonal cycle** were **removed** after which the signal was passed through a **20 – 180 day bandpass filter**

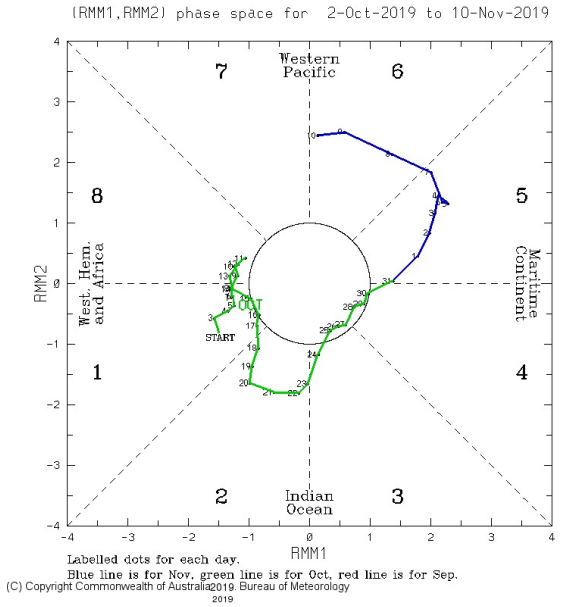
Pacific Ocean (2°S – 2°N)

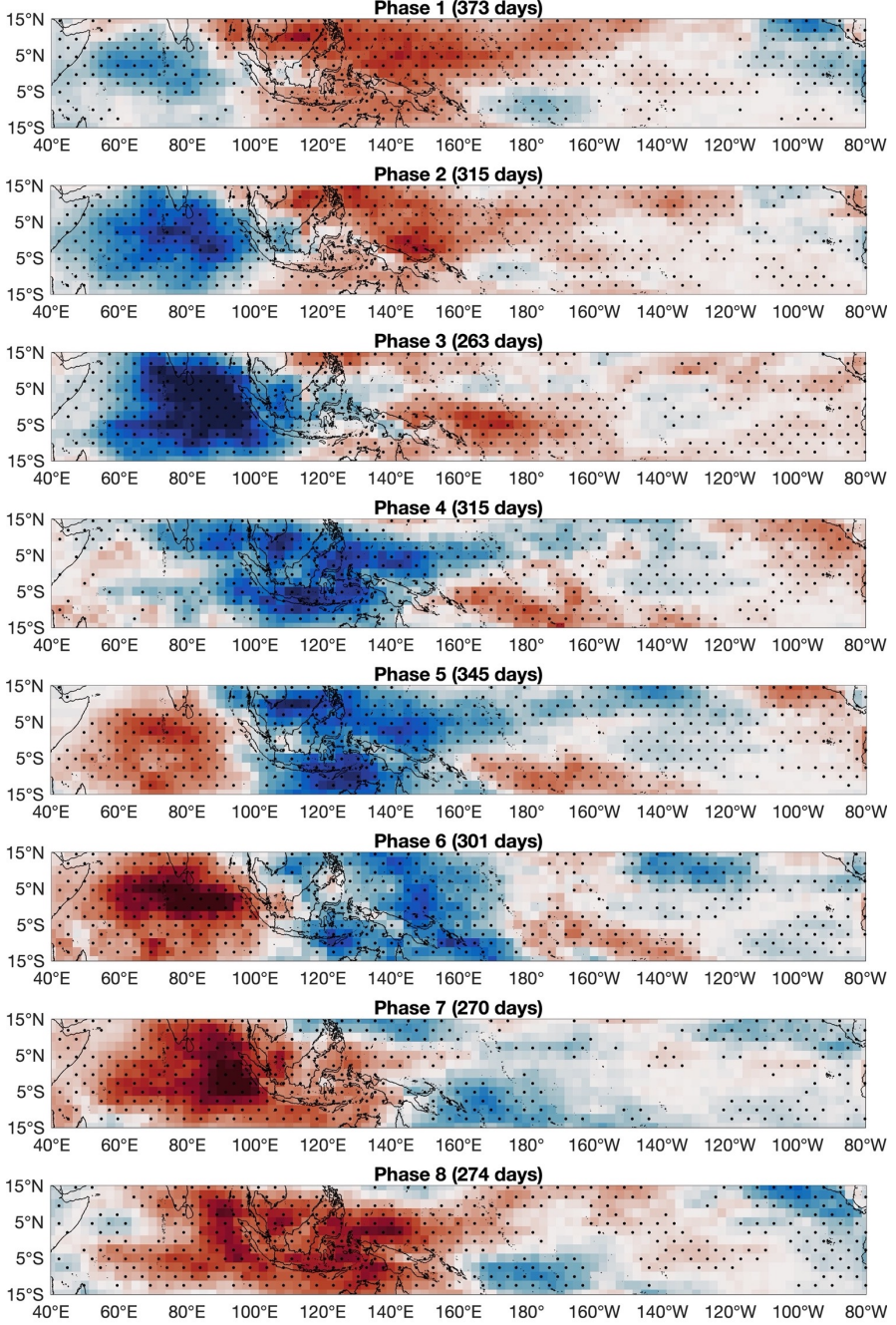


$$OHCT = Q + ADV + RES$$

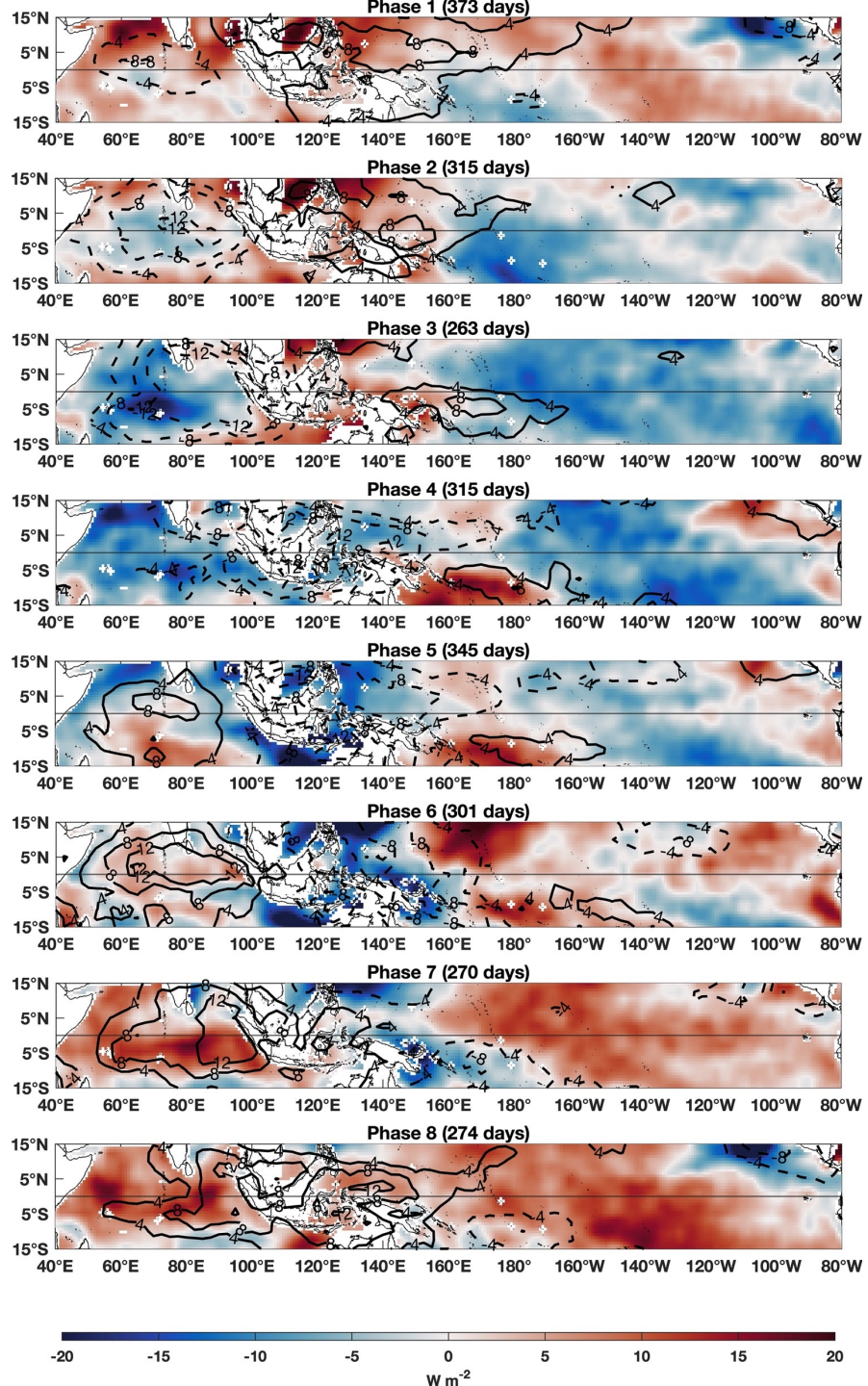





(RMM1,RMM2) phase space for 2-Oct-2019 to 10-Nov-2019
Western Pacific
7
6
8
5
West. Hem. and Africa
Maritime Continent
1
4
2
Indian Ocean
3
START
OCT
RMM1
RMM2
Labelled dots for each day.
Blue line is for Nov, green line is for Oct, red line is for Sep.
(C) Copyright Commonwealth of Australia2019, Bureau of Meteorology
2019


Phase 1 (373 days)
Phase 2 (315 days)
Phase 3 (263 days)
Phase 4 (315 days)
Phase 5 (345 days)
Phase 6 (301 days)
Phase 7 (270 days)
Phase 8 (274 days)
15°N
5°N
5°S
15°S
40°E 60°E 80°E 100°E 120°E 140°E 160°E 180° 160°W 140°W 120°W 100°W 80°W
-15 -10 -5 0 5 10 15
W m-2

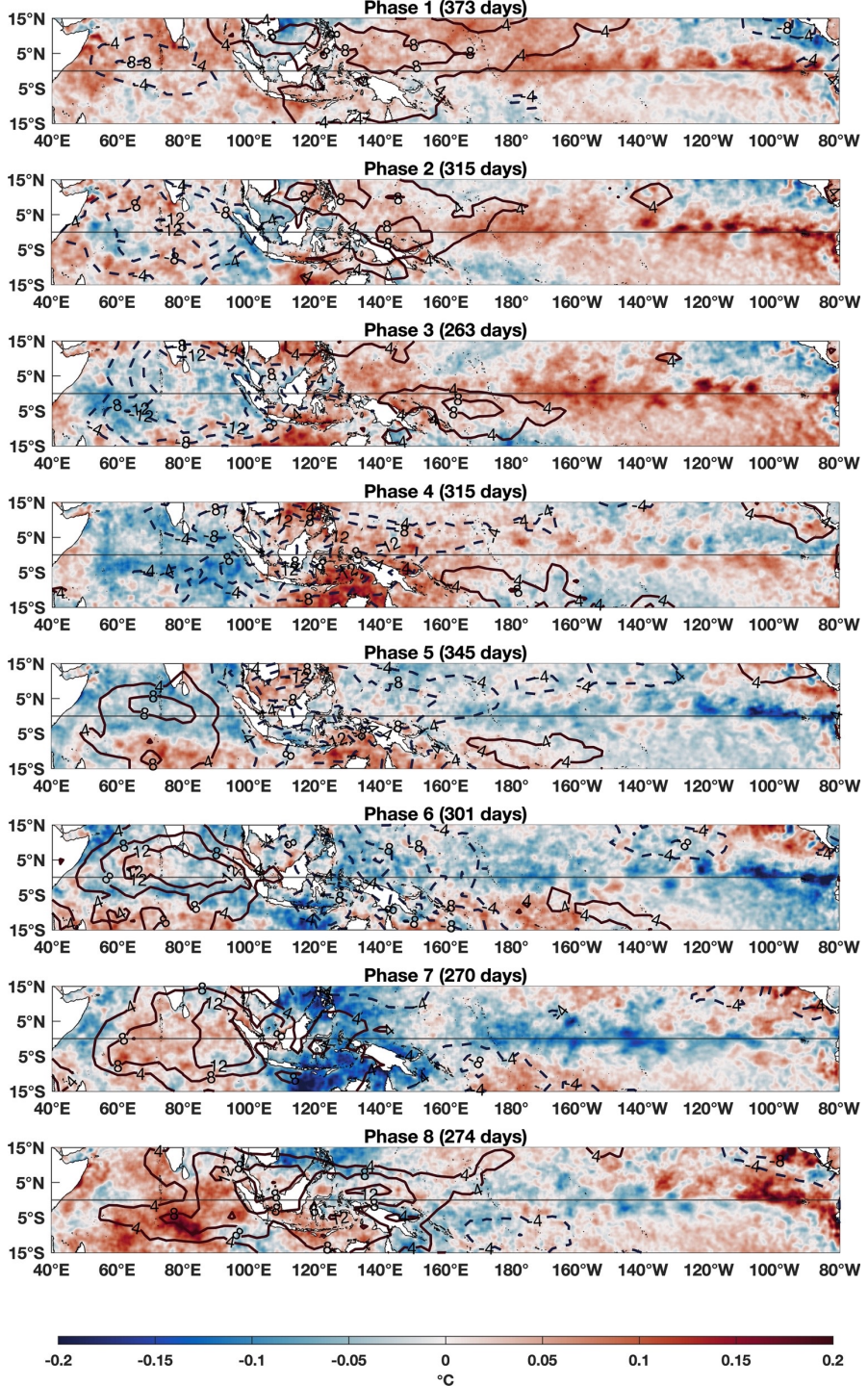
OLR



OLR (contours) negative [dashed]
positive [solid]

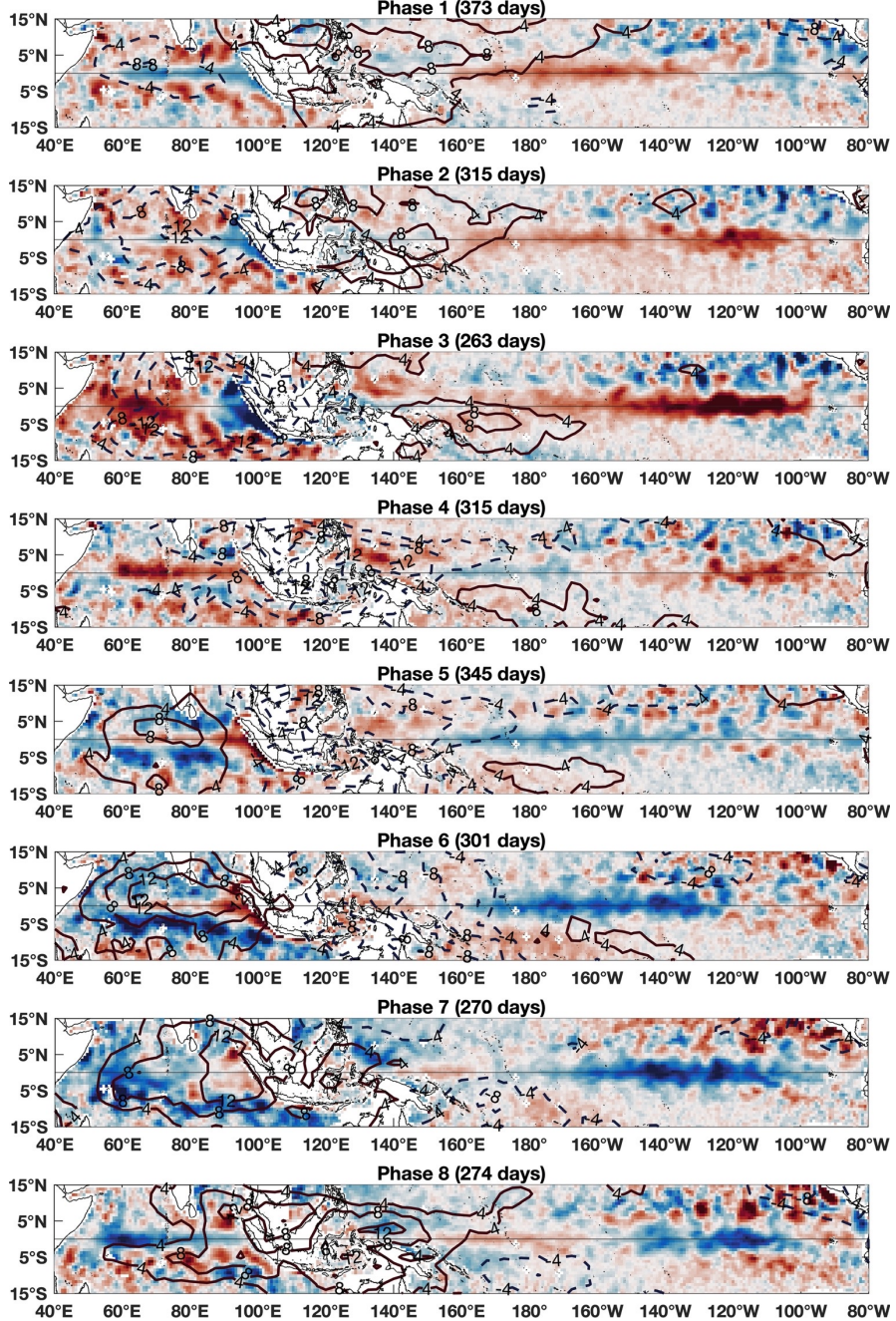
Surface heat fluxes (shading)

Positive surface fluxes are downward



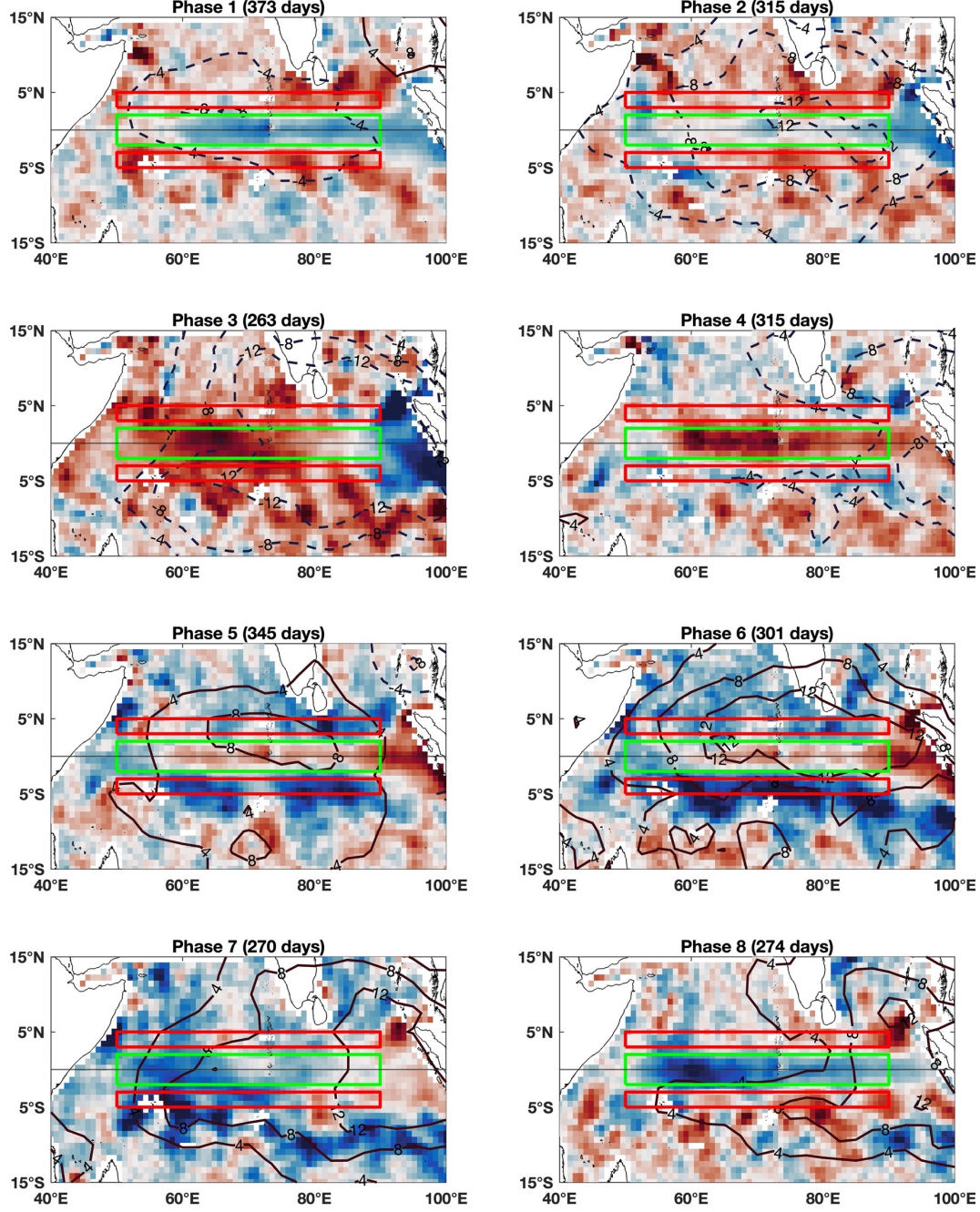
OLR (contours) **negative [dashed]**
positive [solid]

SST OISST (shading)



OLR (contours) **negative [dashed]**
positive [solid]

OHC100 (shading)



OLR (contours) **negative [dashed]**
positive [solid]

OHC100 (shading)

Summary

- **Equatorial Kelvin waves** are seen to be **associated with the eastward propagation of OHC anomalies** in both the Indian and Pacific Ocean

- **Advection and adiabatic redistribution** is seen to be the **strongest driver of intraseasonal OHC variability** in both the basins

- In the Indian Ocean, **intraseasonal equatorial OHC** is seen to be mainly **in phase** with the MJO while **intraseasonal off-equatorial OHC** is seen to be mostly **out of phase** with the MJO

THANK YOU