

Ocean-Atmosphere Interactions in the Indian Ocean



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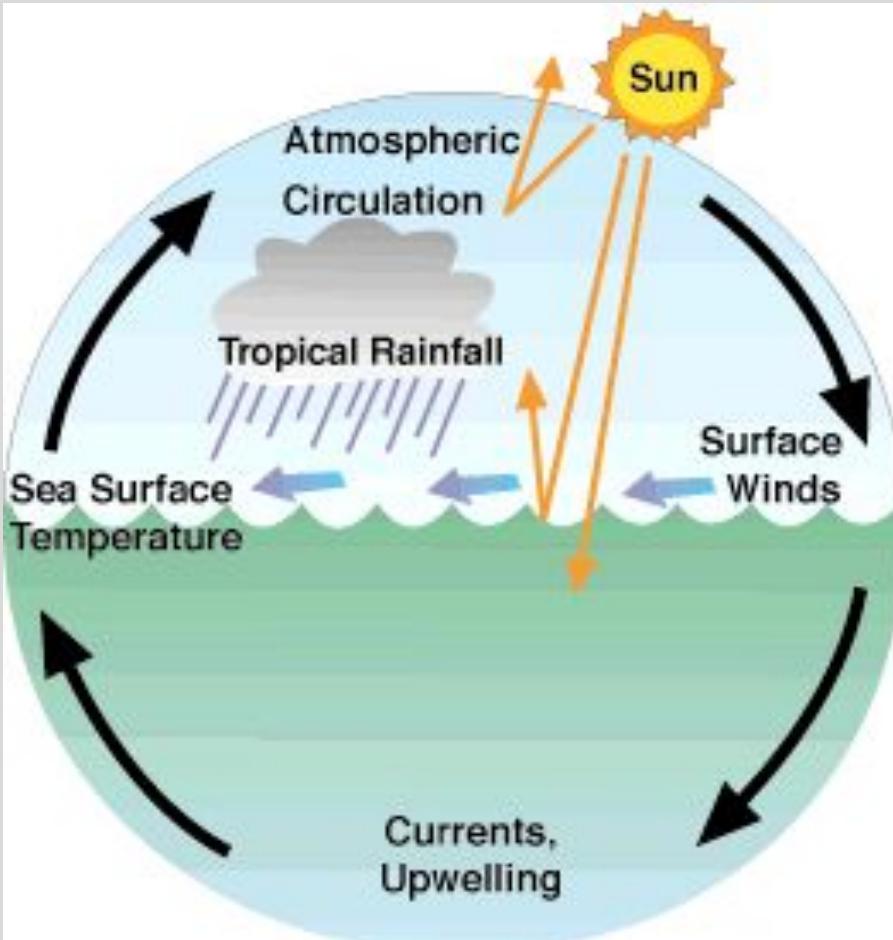


Why study the Indian Ocean and monsoon?

- One third of world depends on monsoon rainfall
- Economic and food security
- Indian Ocean Dipole and monsoon have interactions that affect other climate variabilities (MJO, ENSO...)



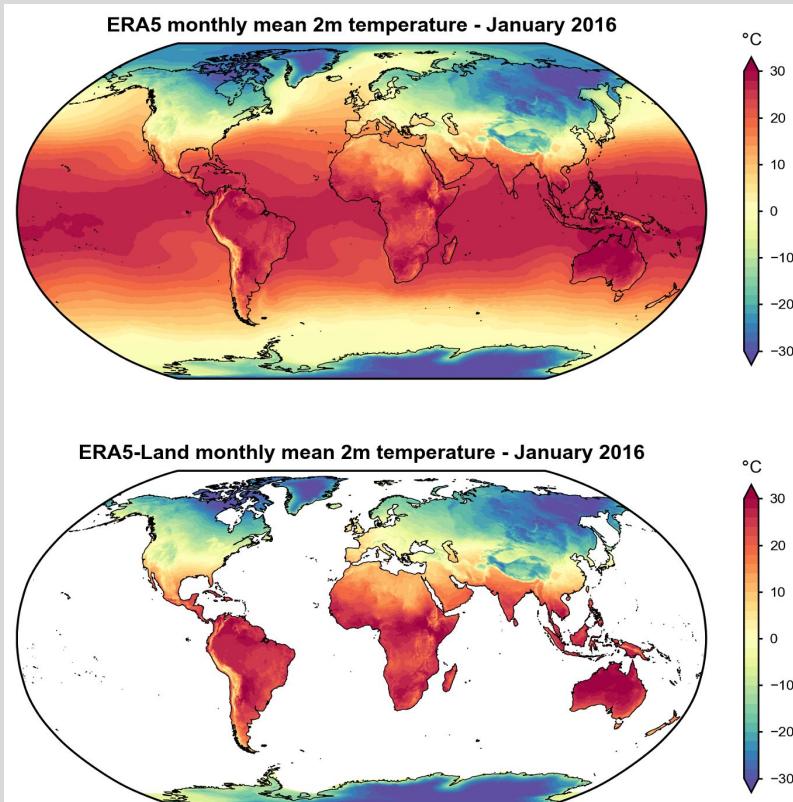
How do the ocean and atmosphere interact?





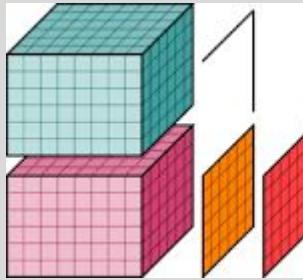
What is ERA5 data?

- Reanalysis product from European ECMWF model
- Assimilates observations into model to improve accuracy of simulation and fill in gaps in observations.
- 30 km grid
- Data used from 1979-2019 for surface level
 - Sea Surface Temperature (SST)
 - Wind Components (Zonal and Meridional)
 - Total Precipitation



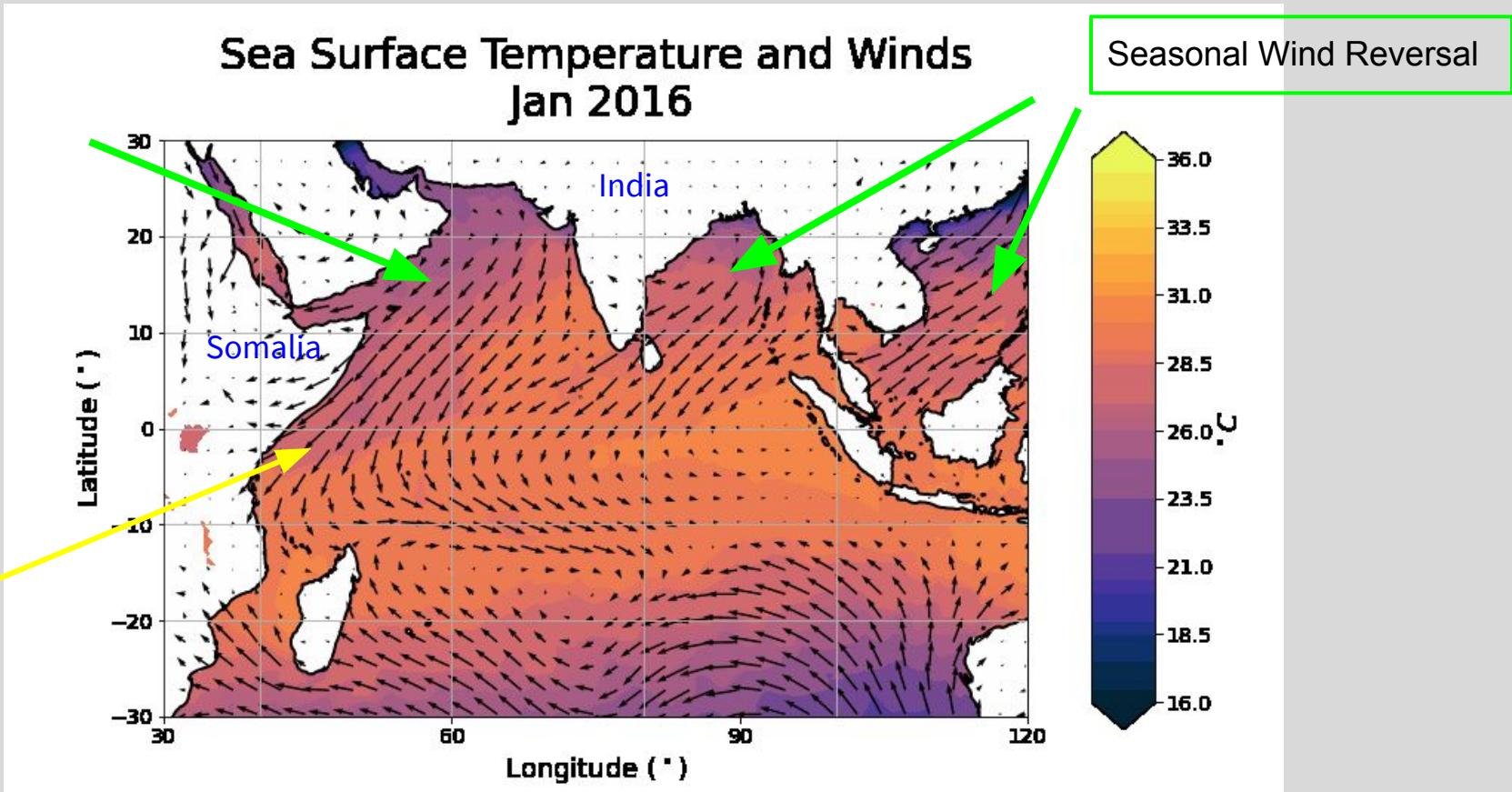
Computation Methods

- Xarray library in Python
- Get Climatology for 1979-2019 by grouping data monthly, seasonally, or annually and taking the time means.
- Then subtract the climatology from 2016-2019 data to get anomalies

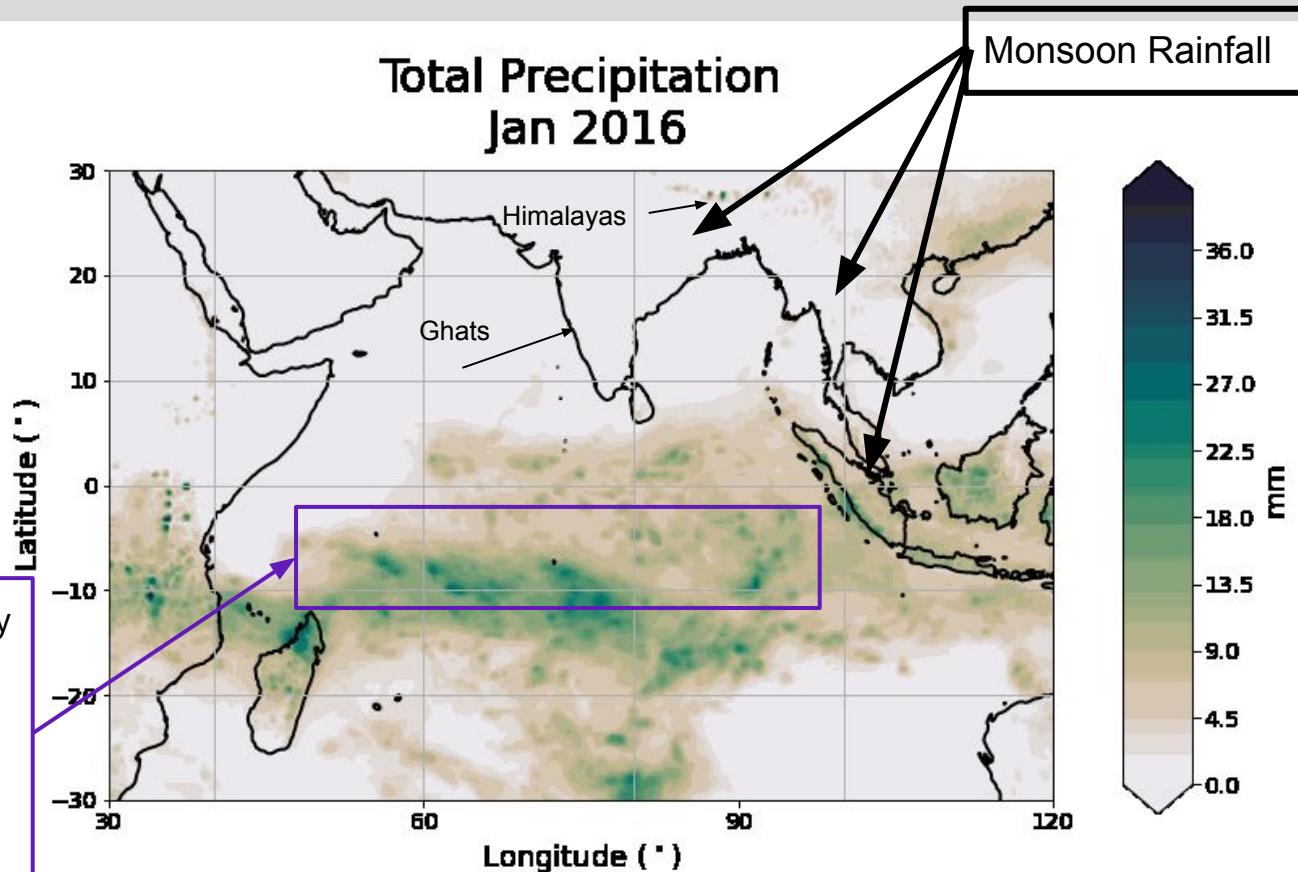


matplotlib

What is monsoon?



What is monsoon?

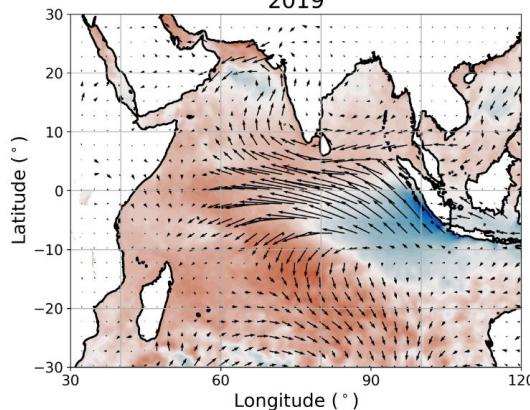
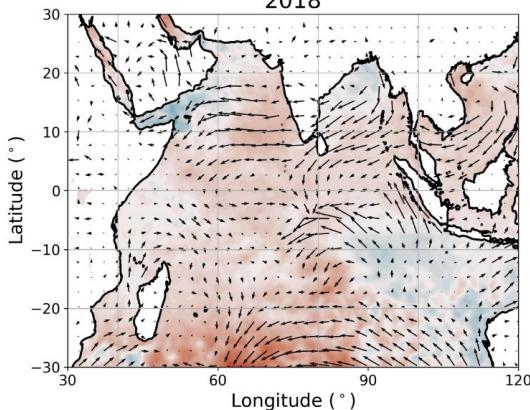
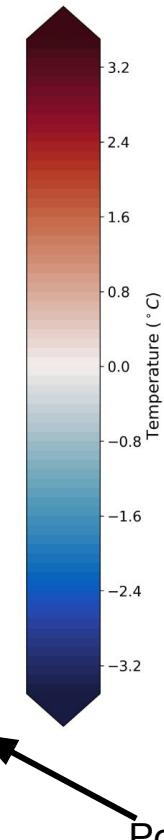
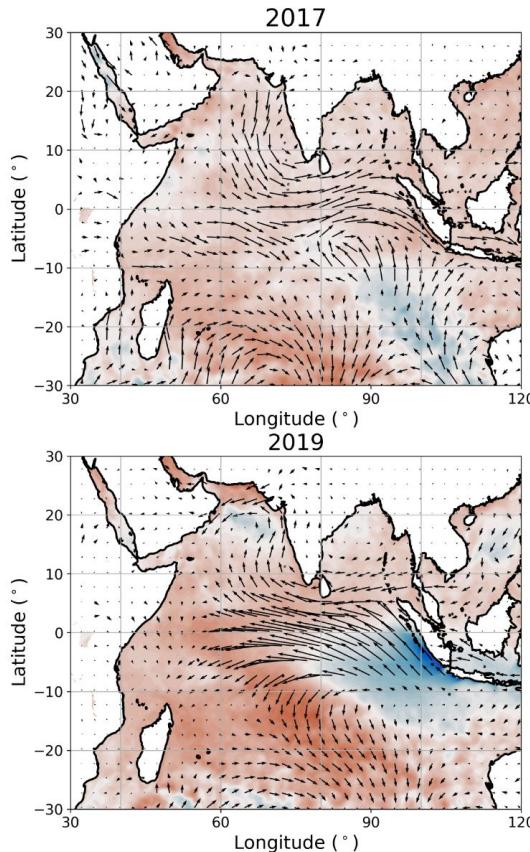
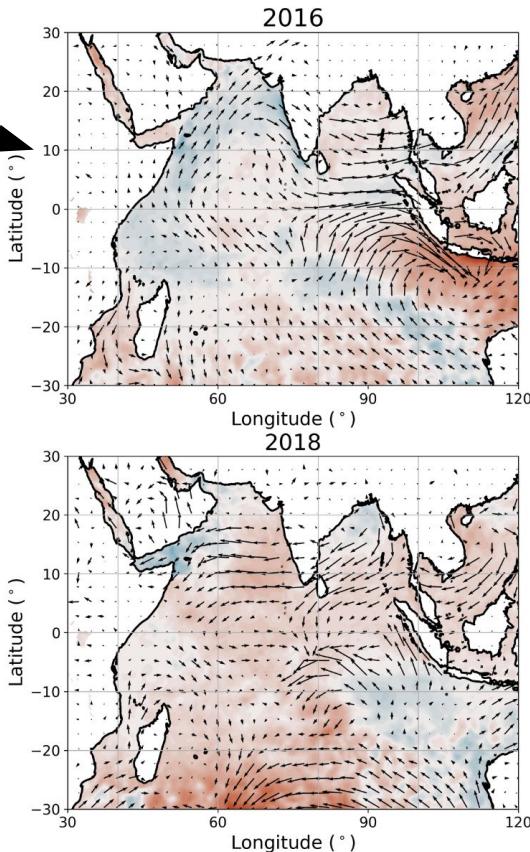


Indian Ocean Dipole (IOD)



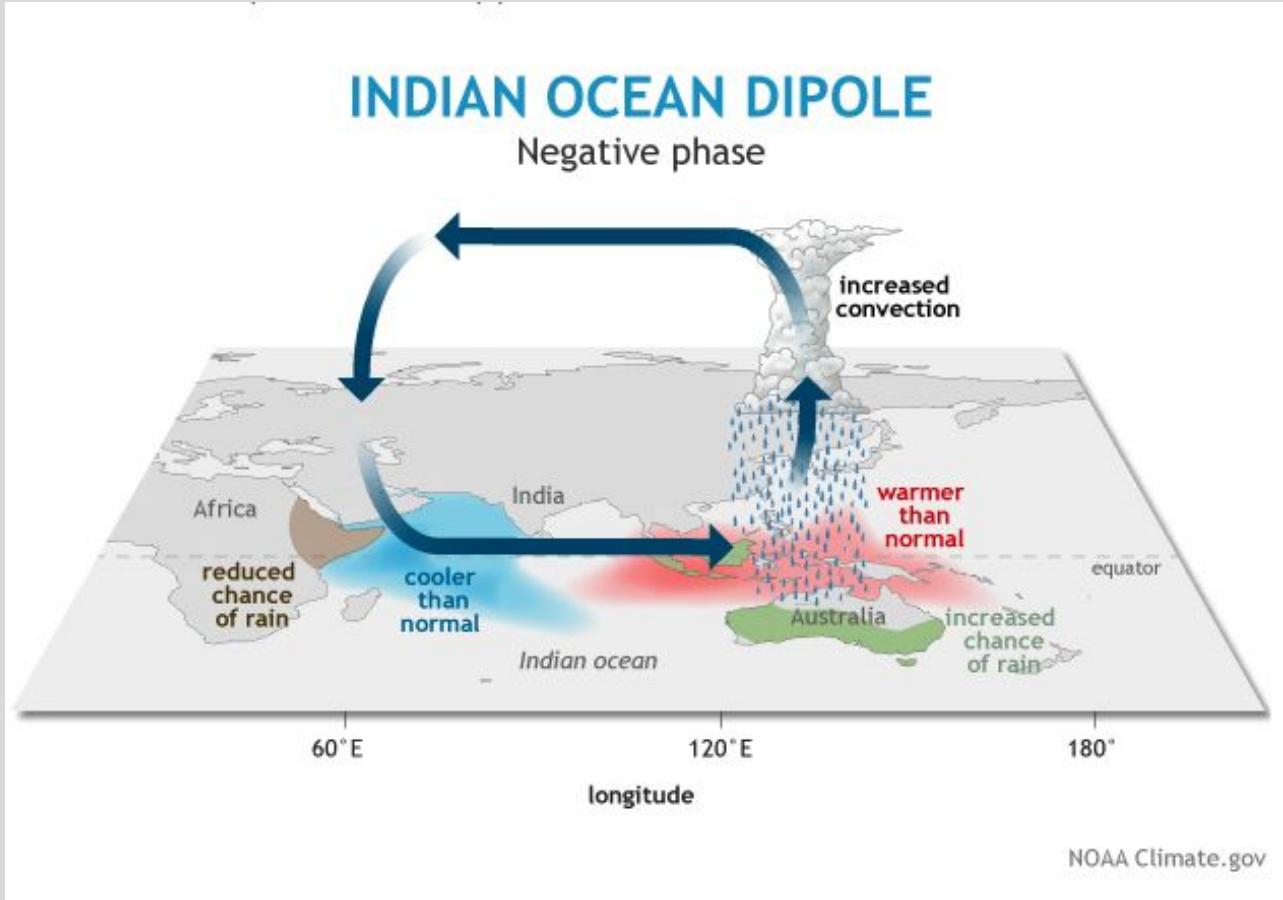
Seasonal (SON) SST and Wind Anomaly 2016-2019

Negative IOD

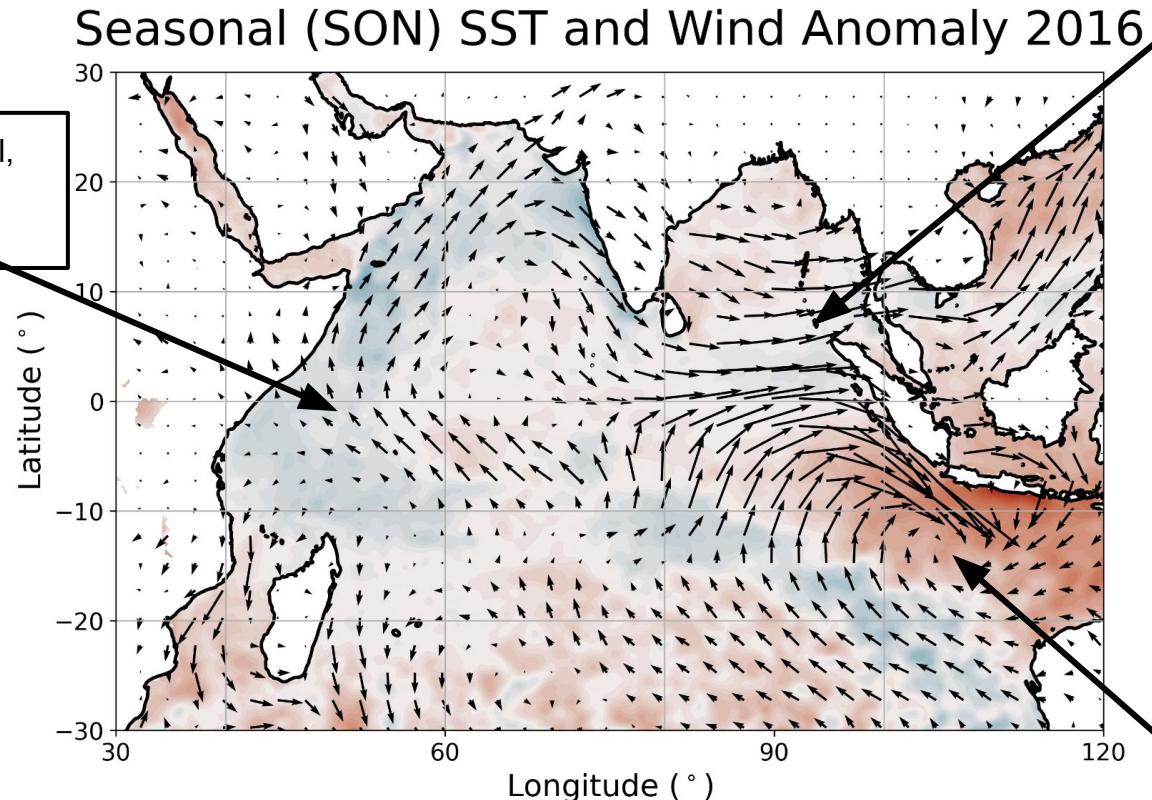


Positive IOD

Negative IOD



Negative IOD

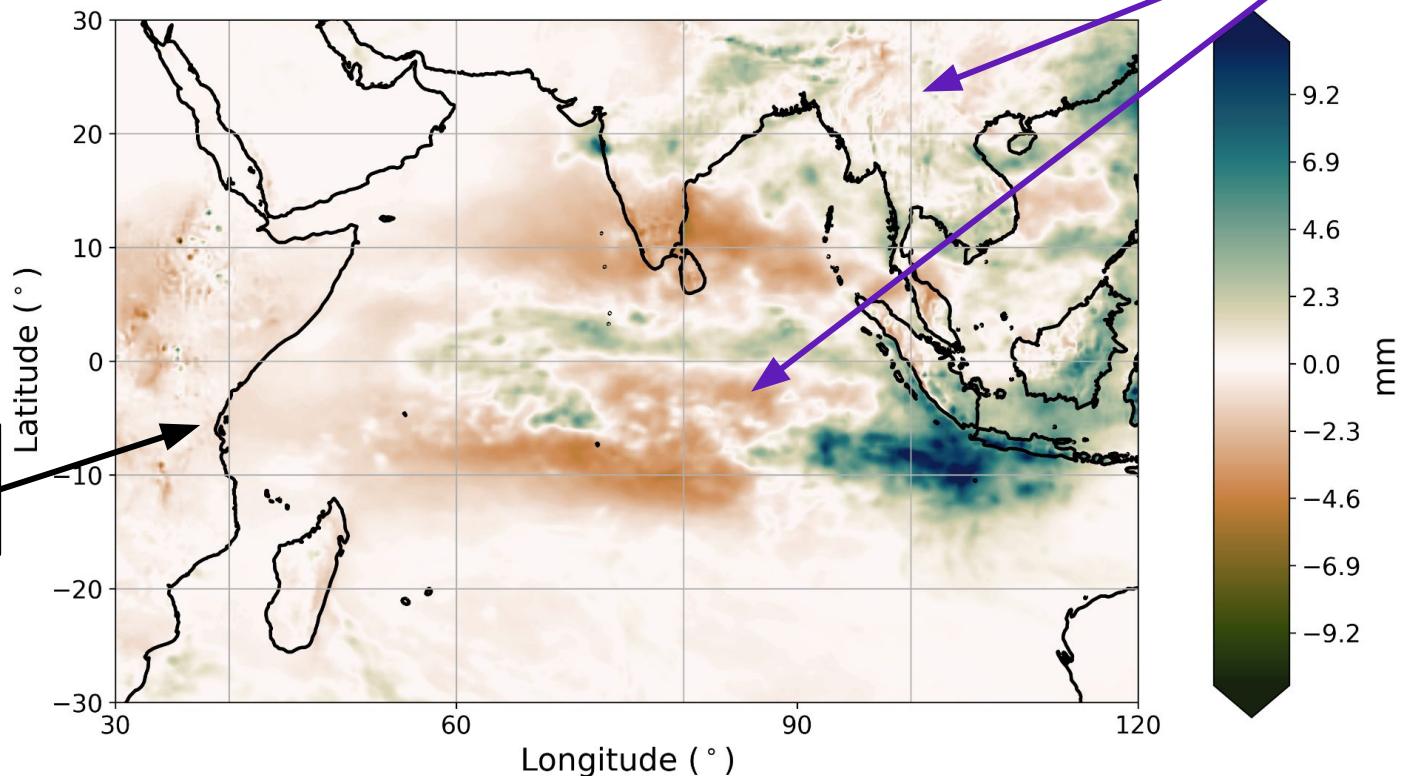


Negative IOD

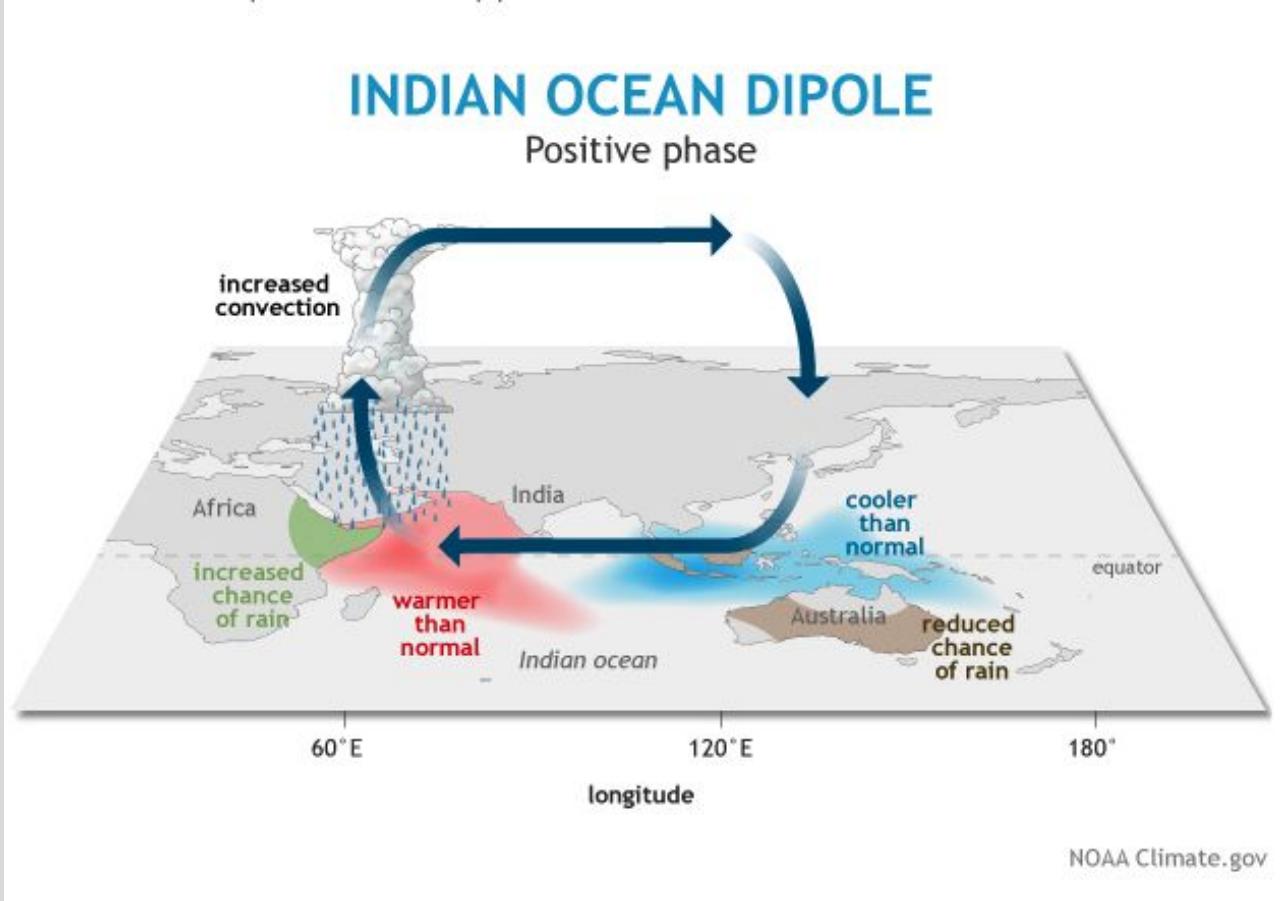
Enhanced Rainfall over SE Asia, Maritime Continent



Total Precipitation Seasonal (SON) Anomaly 2016

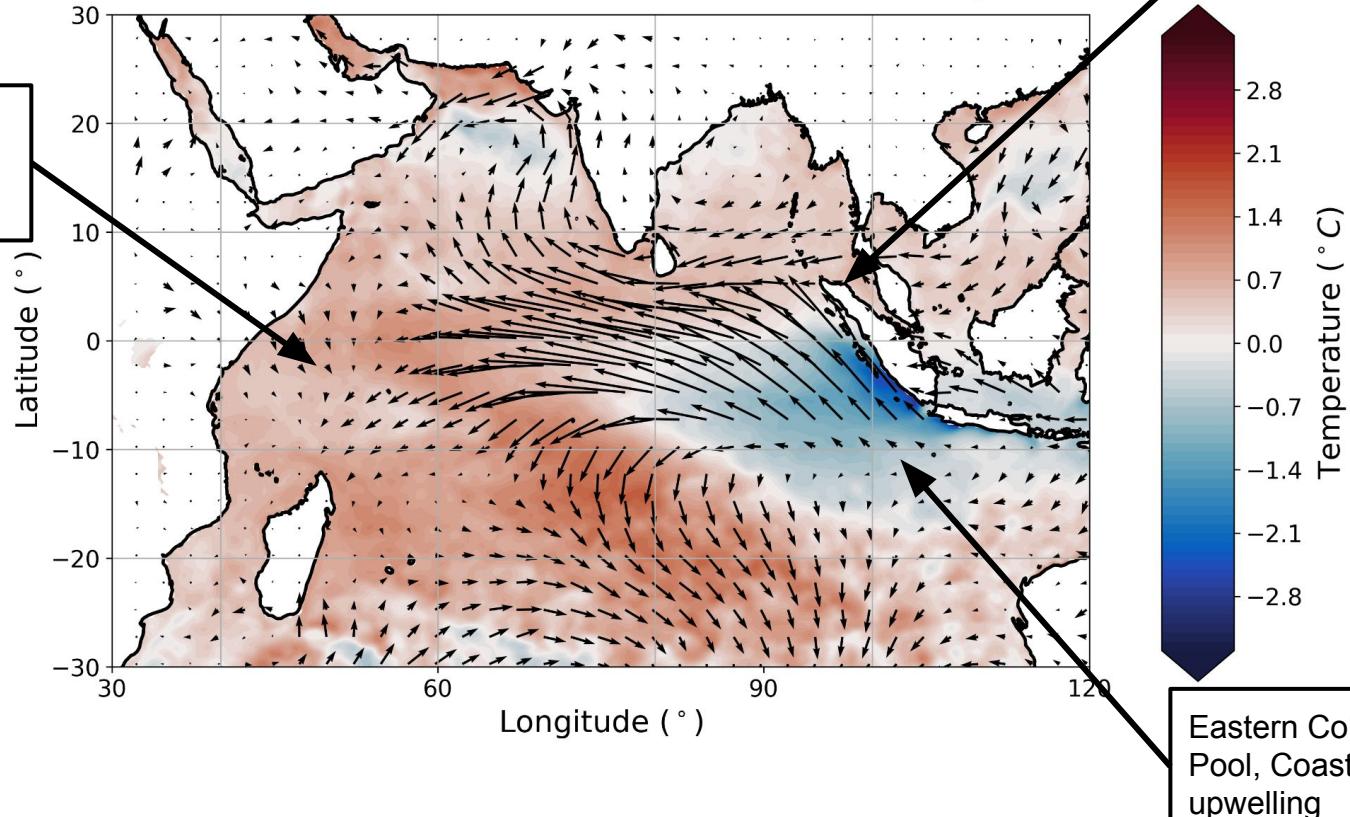


Positive IOD



Positive IOD

Seasonal (SON) SST and Wind Anomaly 2019

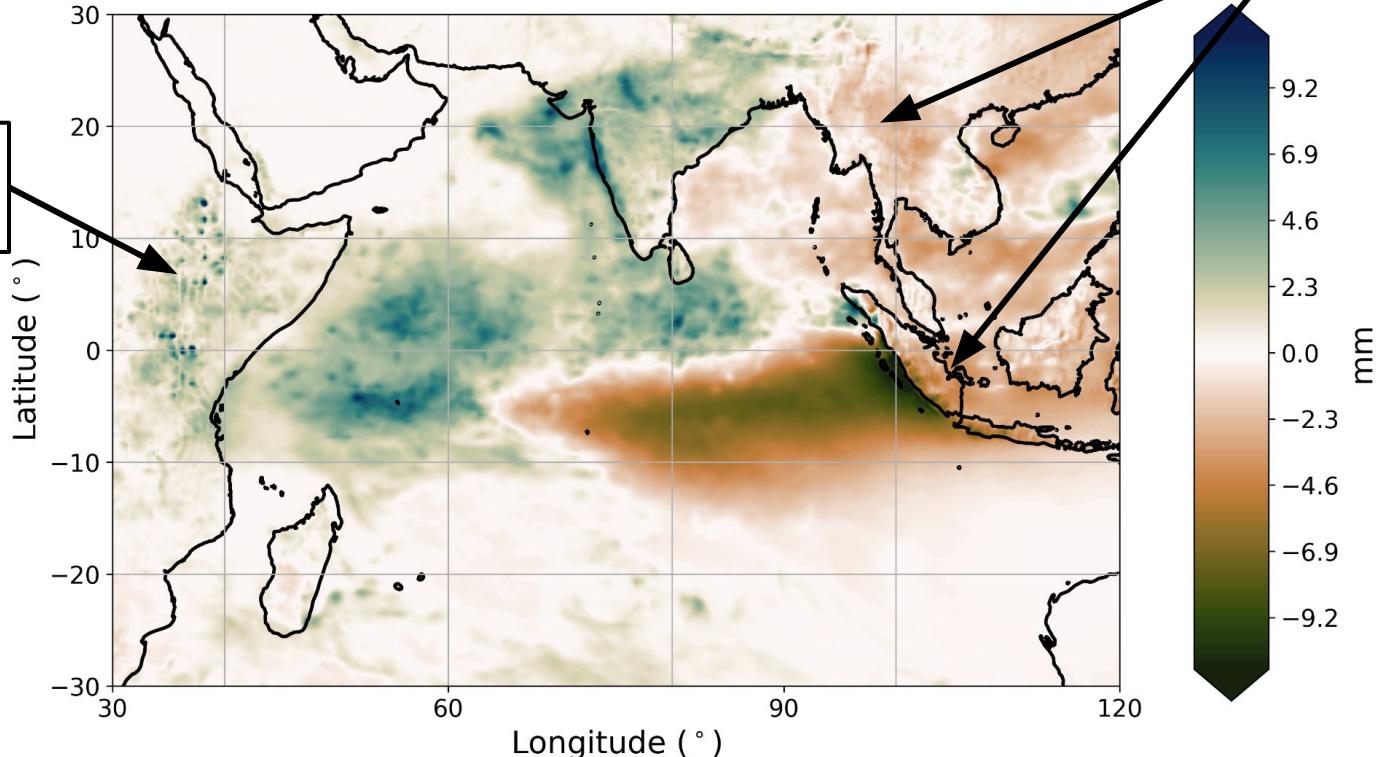


Positive IOD



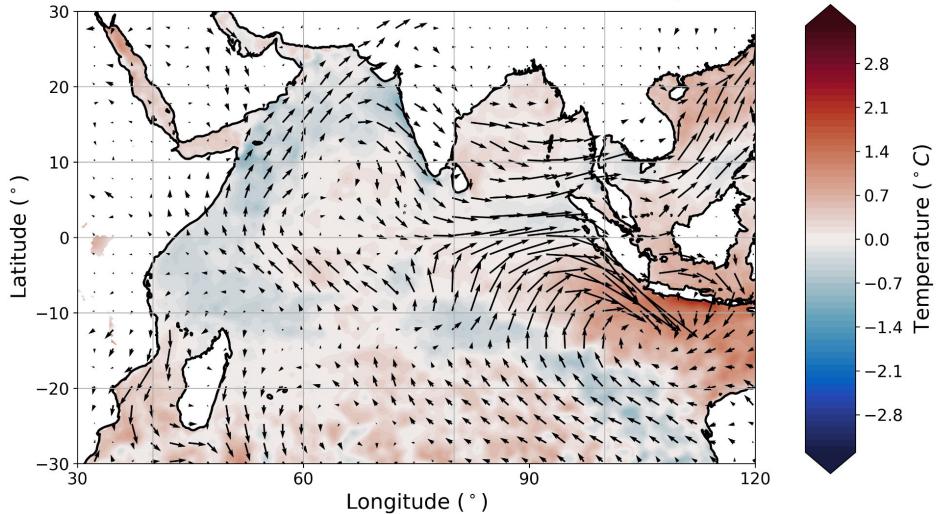
Drier in SE Asia,
Maritime Continent

Total Precipitation Seasonal (SON) Anomaly 2019



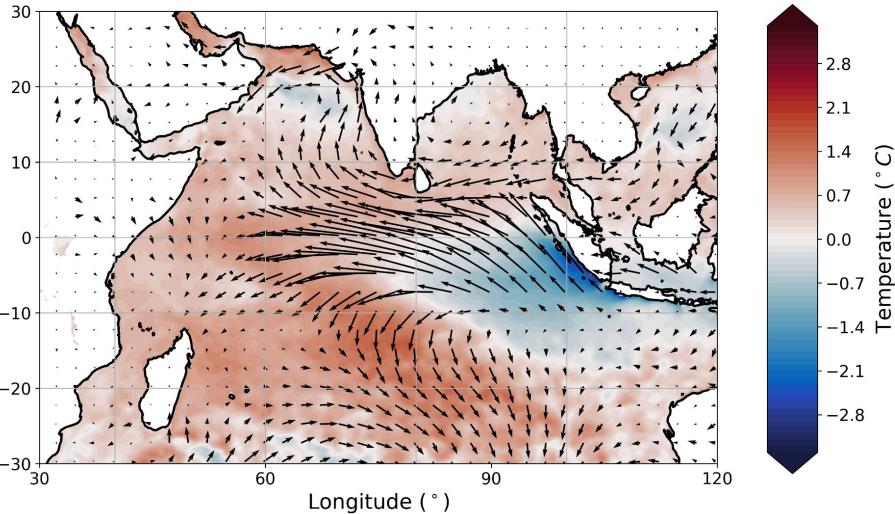
Opposite IOD phases

Seasonal (SON) SST and Wind Anomaly 2016



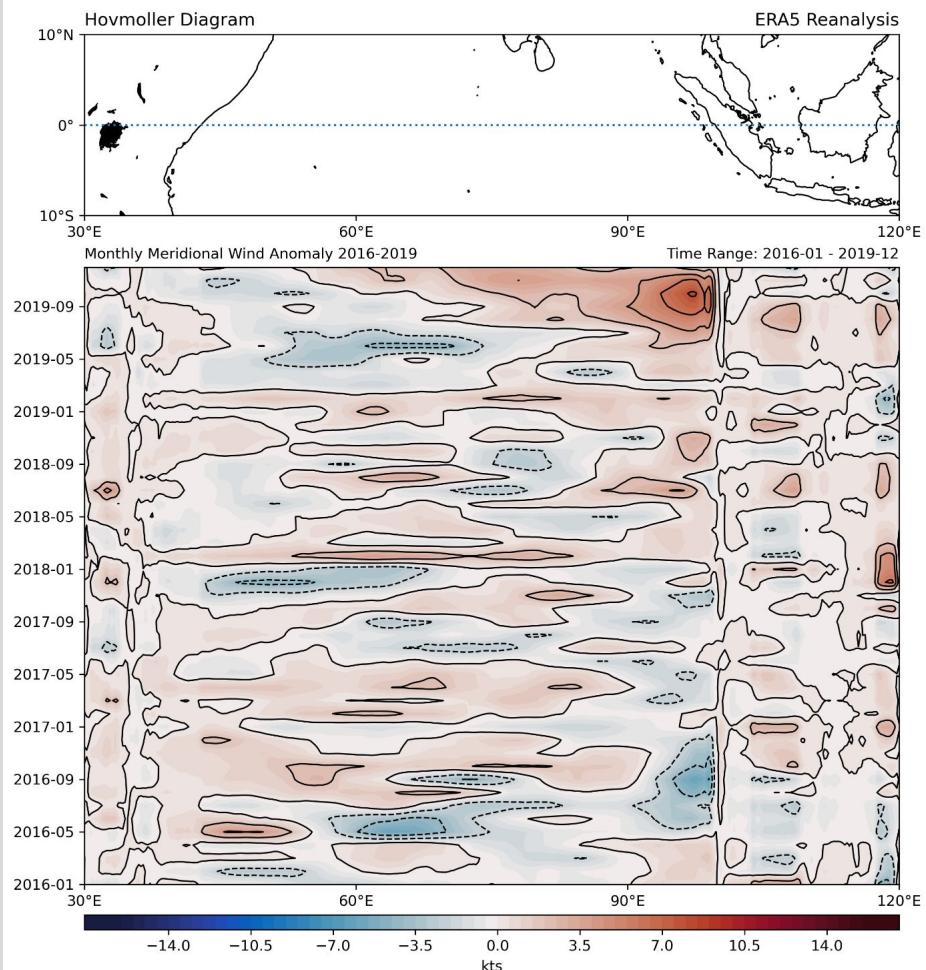
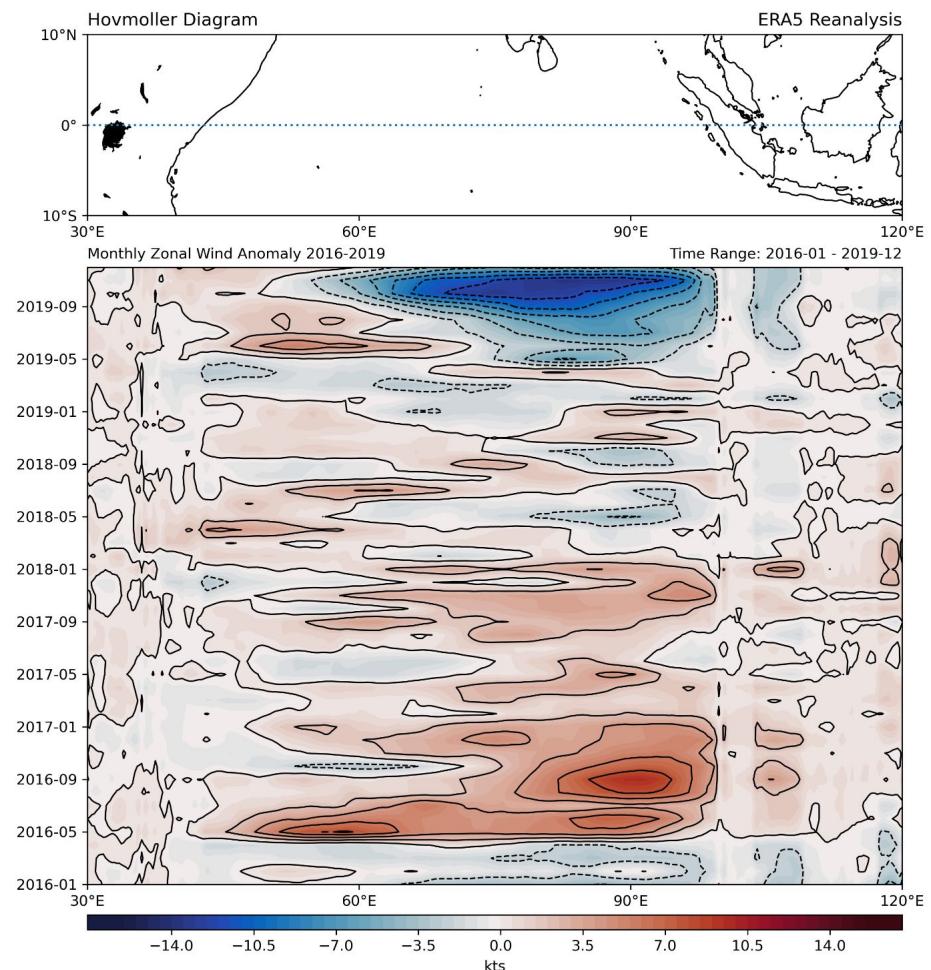
Strong Negative IOD (2016)

Seasonal (SON) SST and Wind Anomaly 2019

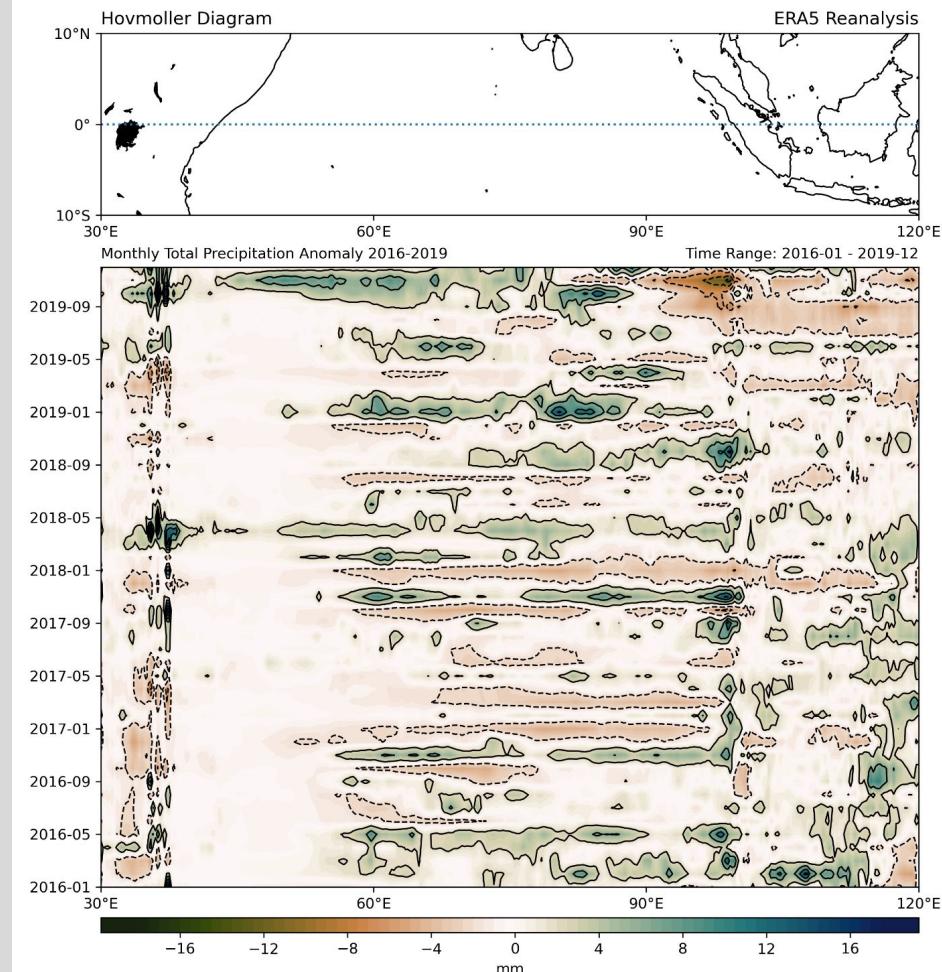
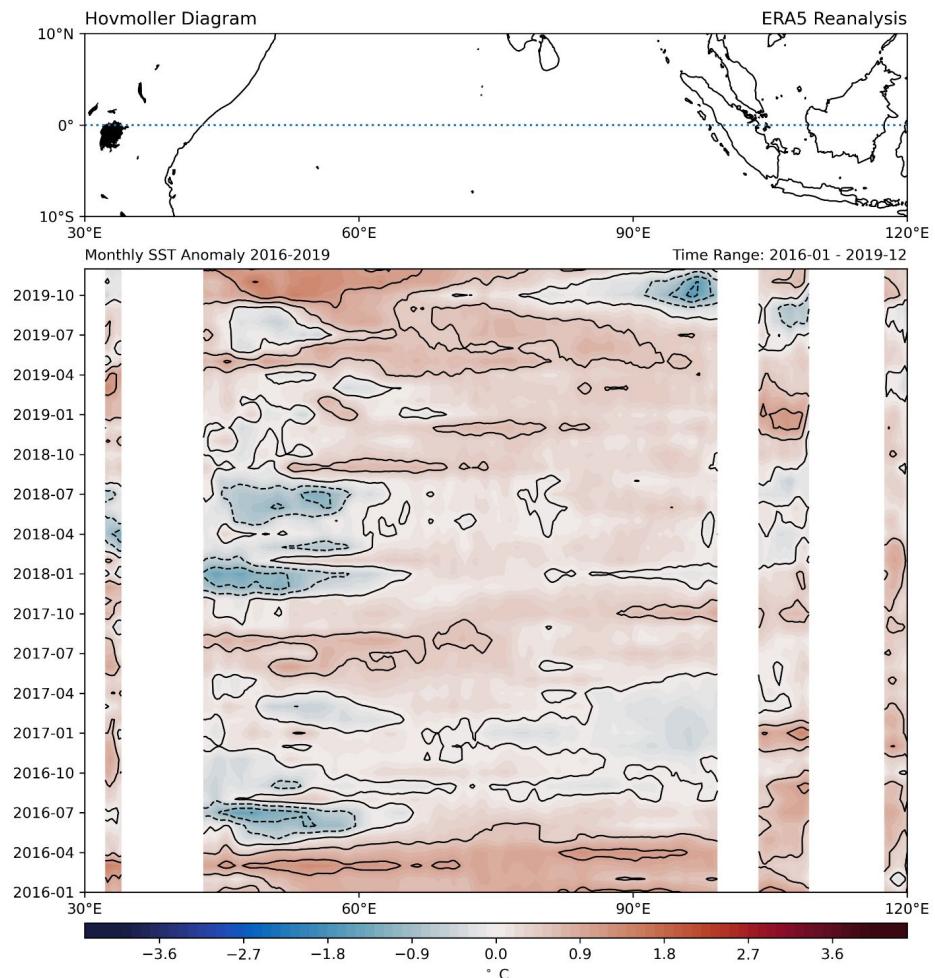


Strong Positive IOD (2019)

Temporal Evolution of Zonal and Meridional Wind components along the Equator



Temporal evolution of SST and Precipitation





Summary and Conclusion

- Seasonal monsoon and IOD have significant role in influencing global weather and climate.
- Large number of variabilities over small spatial scale require increased availability of observations to better characterize.
- Current efforts include satellites and the Research Moored Array for African–Asian–Australian Monsoon Analysis and Prediction (RAMA)



Acknowledgements

- Dr. Mike McPhaden: For mentoring me!
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