Surface winds, air-sea flux and SST variability associated with atmospheric rivers in the Arabian Sea

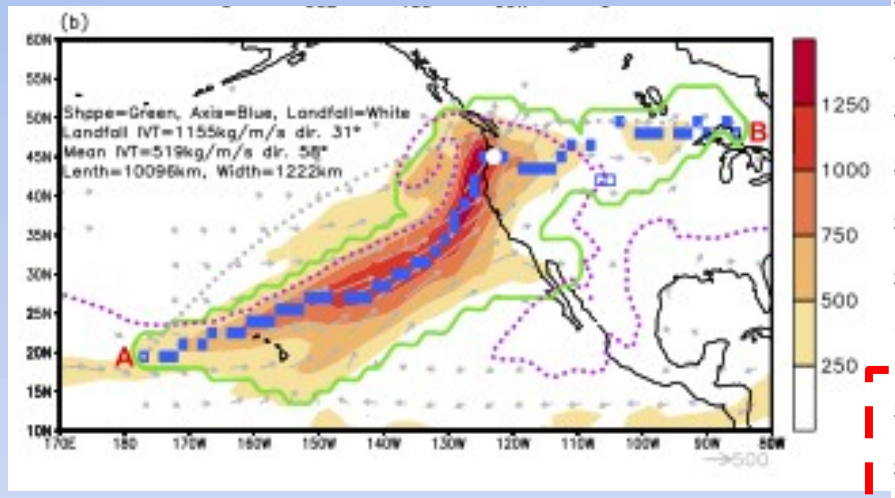
Toshi Shinoda[1], Suyang Pei, Weiqing Han[2]

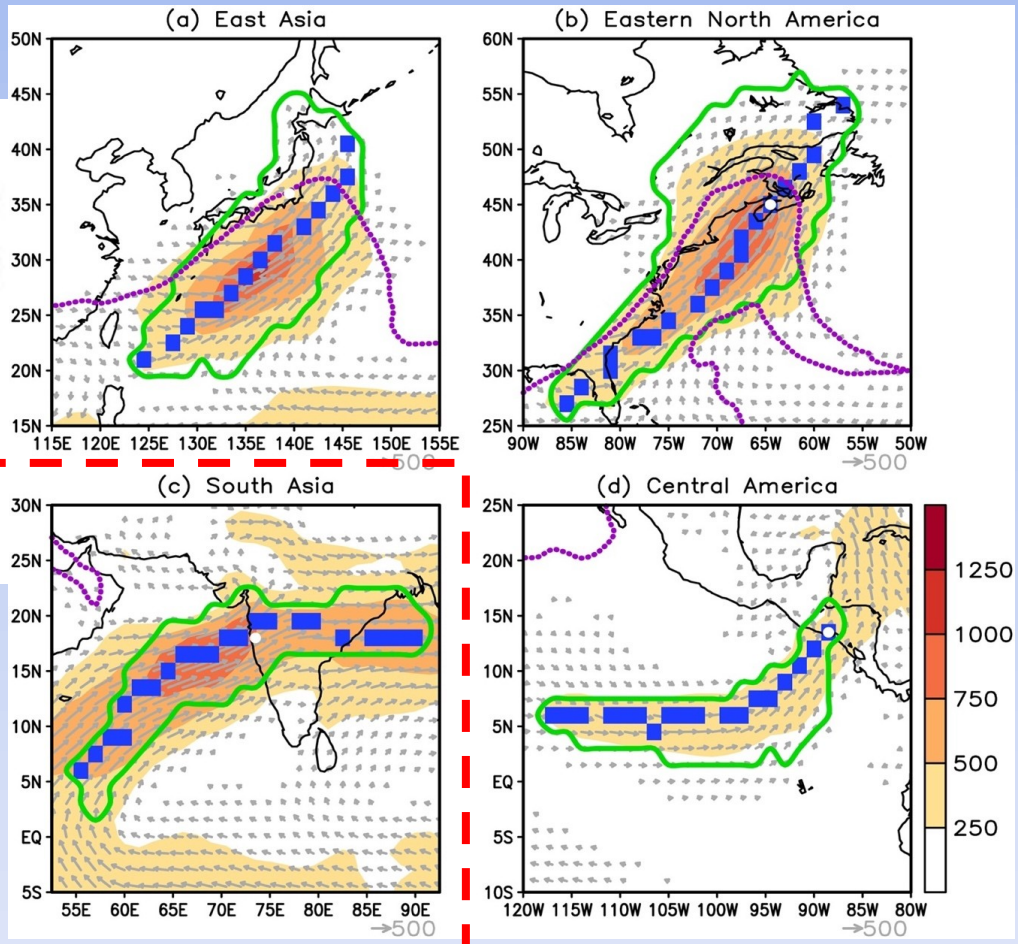
[1]Texas A&M University - Corpus Christi
[2]University of Colorado

Atmospheric rivers (ARs) in the Arabian Sea

Global AR datasets (Guan and Waliser 2015, Guan et al. 2018)

- ***AR detection: IVT (Integrated water vapor transport) > 85th percentile of monthly climatology***

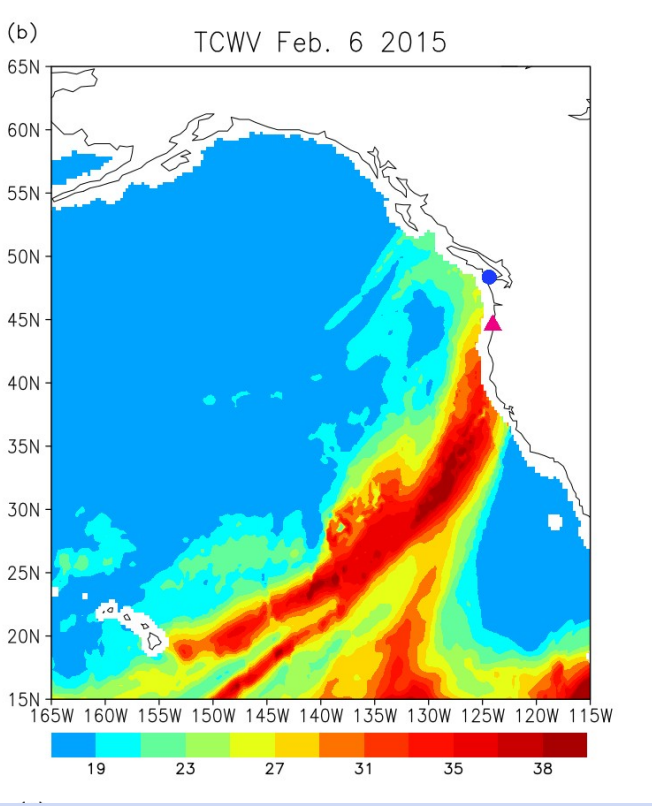


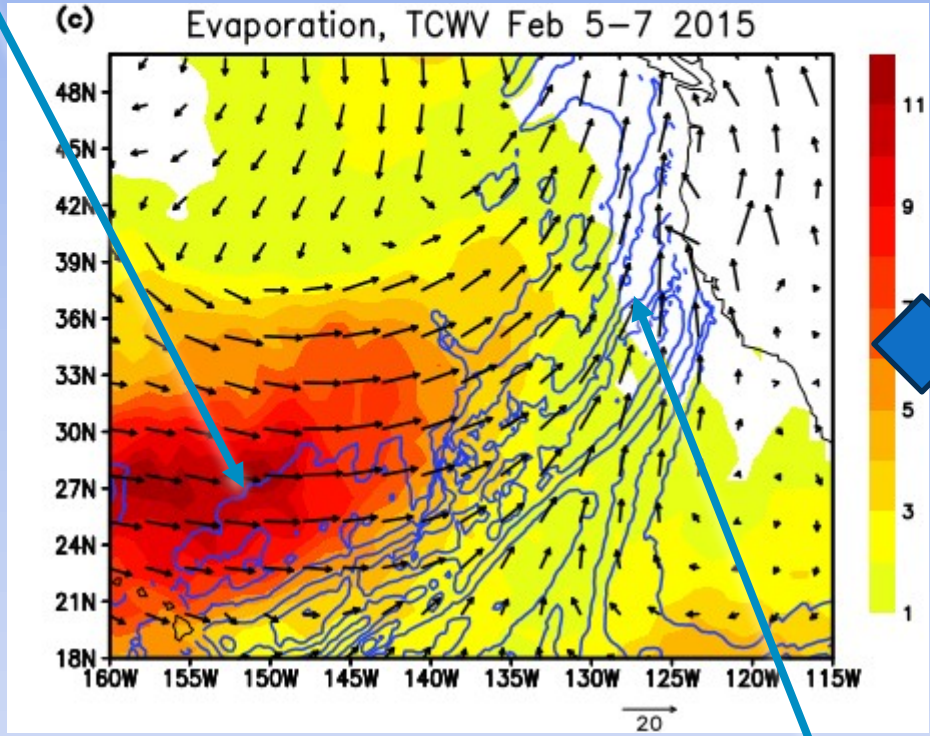


Guan and Waliser (2015)

Air-sea fluxes produced by ARs in the northeast Pacific

Substantial latent heat flux (evaporation) only on the northwestern side of AR upstream area





Shinoda et al. (2019)

Latent heat flux observed during CalWater 2015 field campaign (37ºN,127ºW) was nearly zero.

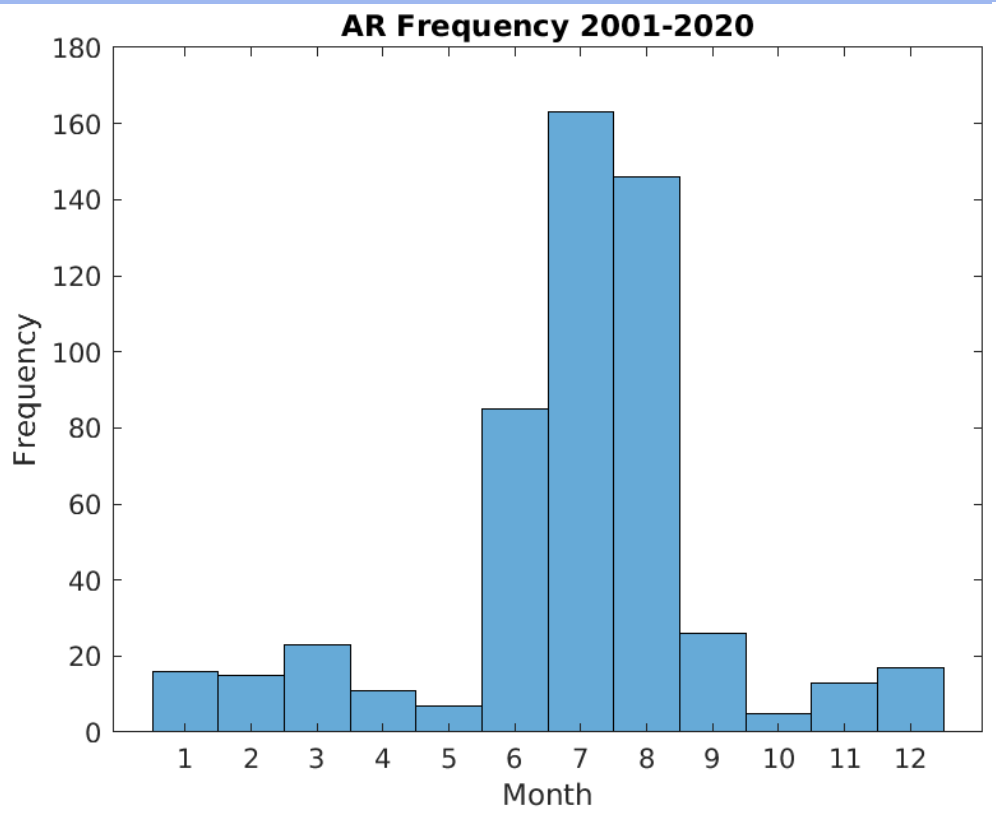
Focus of this study

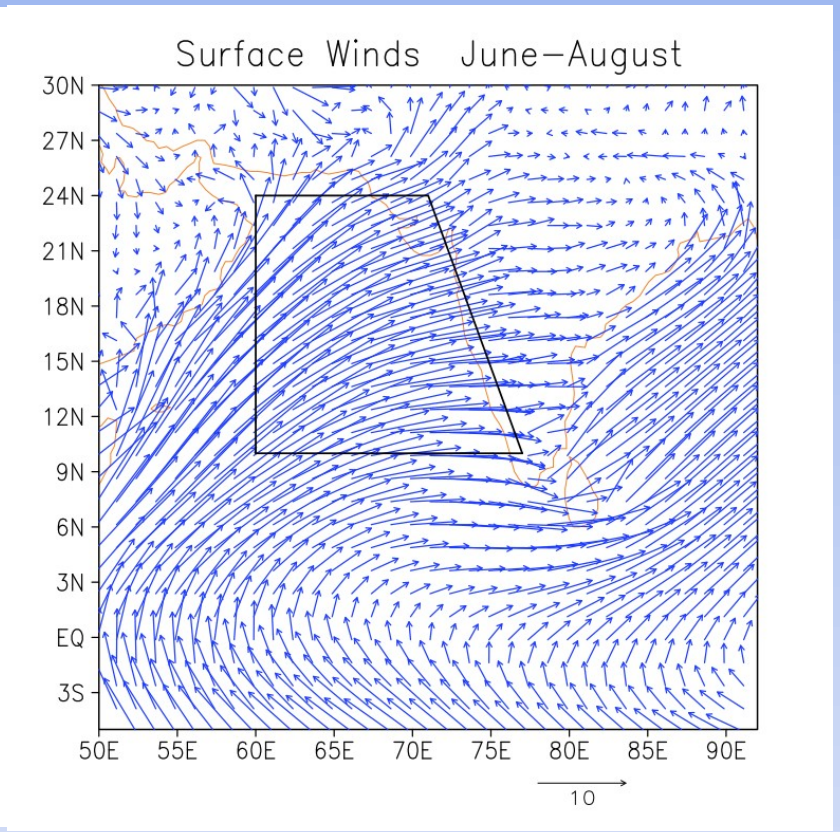
- Characteristics of ARs over the Arabian Sea
- Surface winds, air-sea fluxes, and SST associated with ARs
- Comparison of AR-related processes between the Arabian Sea and the Northeast Pacific

Data

- CCMP surface winds (v3.1)
- OAFlux (Yu et al. 2008)
  - Latent heat flux (Surface evaporation)
  - Sensible heat flux
- Shortwave and longwave radiation (CERES)
- IMERG precipitation
- TCWV (Total Column Integrated Water Vapor) from ERA5
- MW OI SST

Seasonal changes in AR frequency

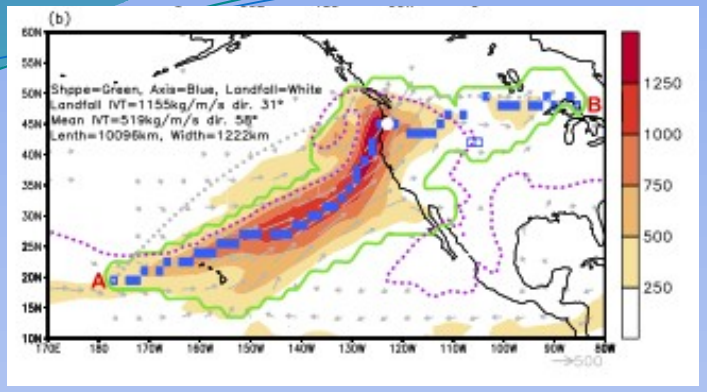




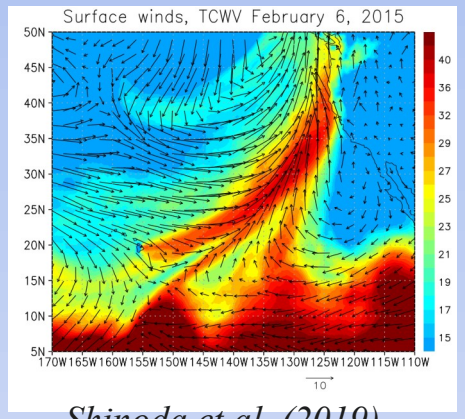
Strong southwesterlies in almost the entire Arabian Sea during the Indian summer monsoon season

Comparison of ARs between the Arabian Sea and the Northeast Pacific

Northeast Pacific

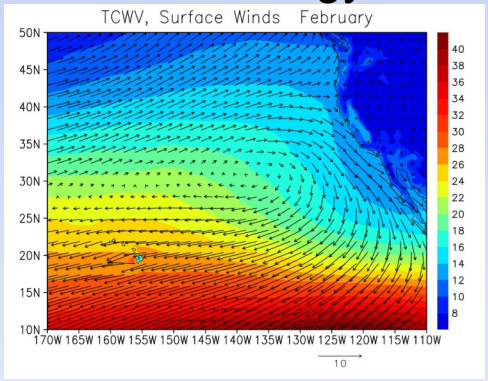


Guan and Waliser (2015)

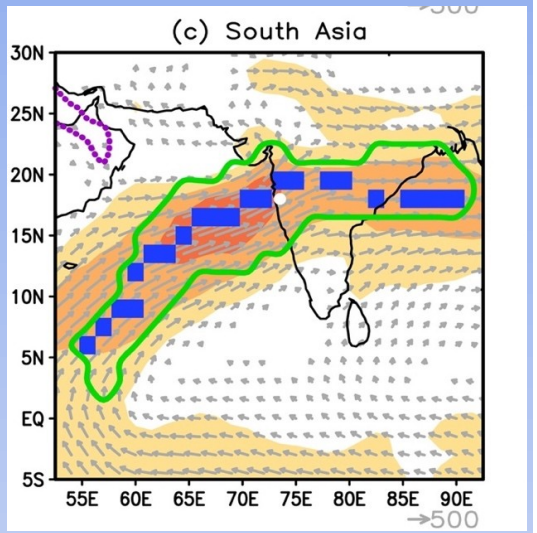


Shinoda et al. (2019)

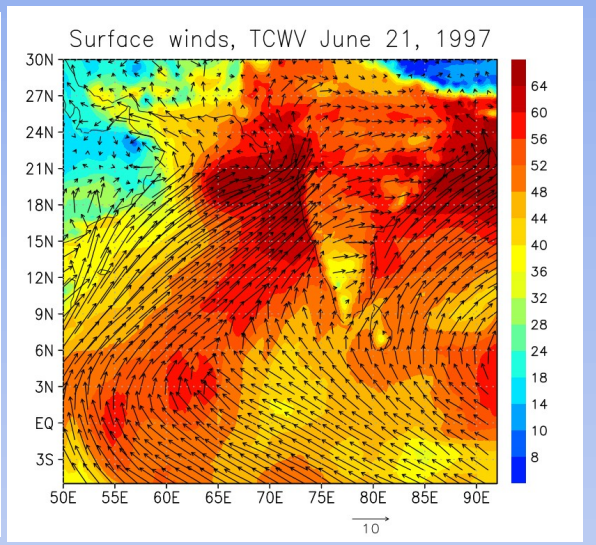
Climatology



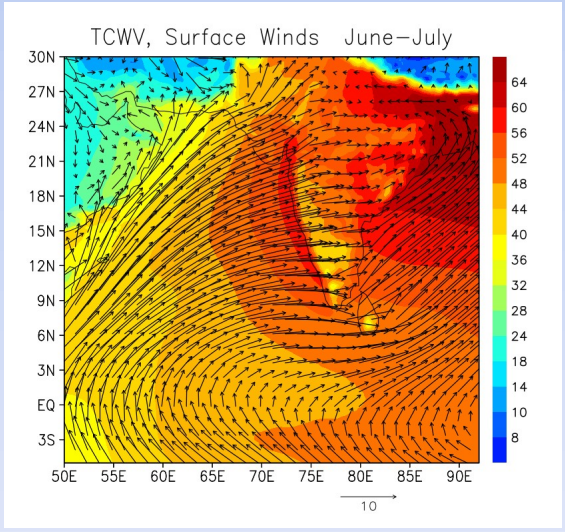
Arabian Sea



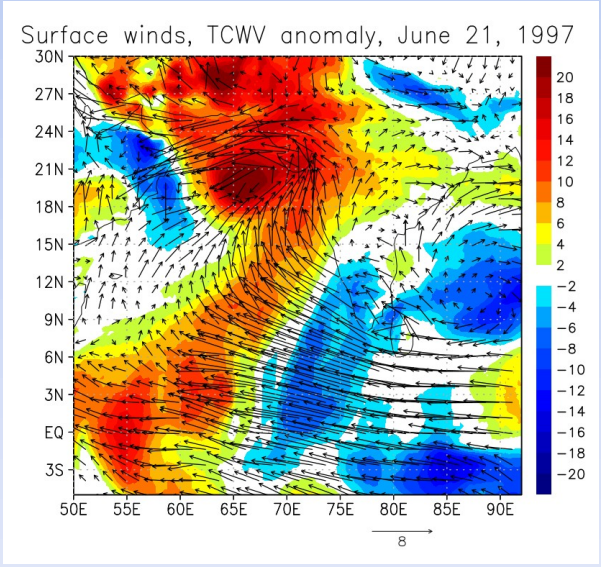
Guan and Waliser (2015)



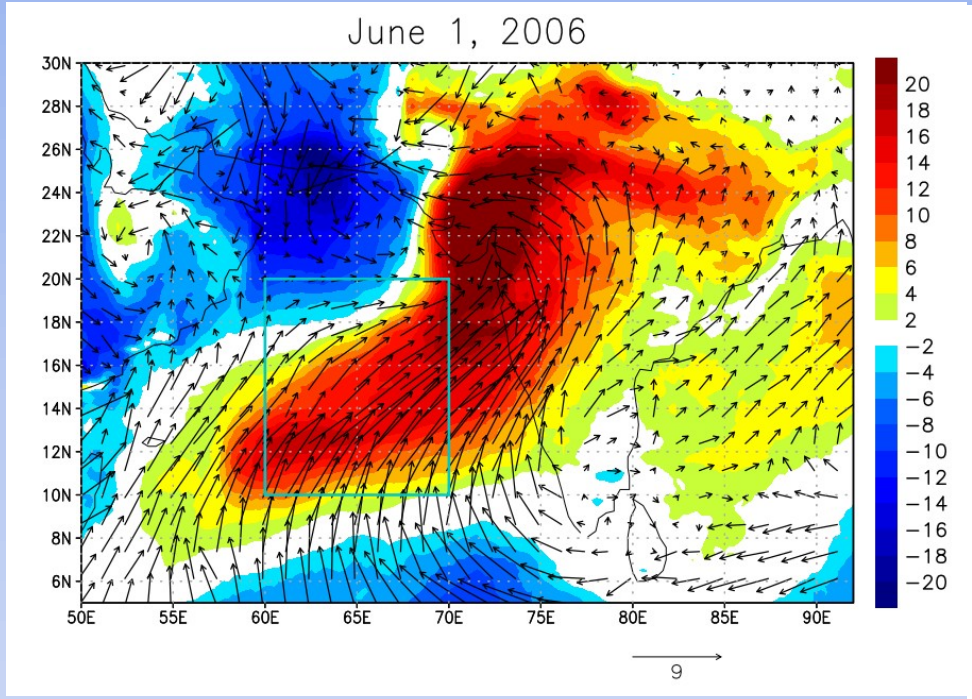
Climatology

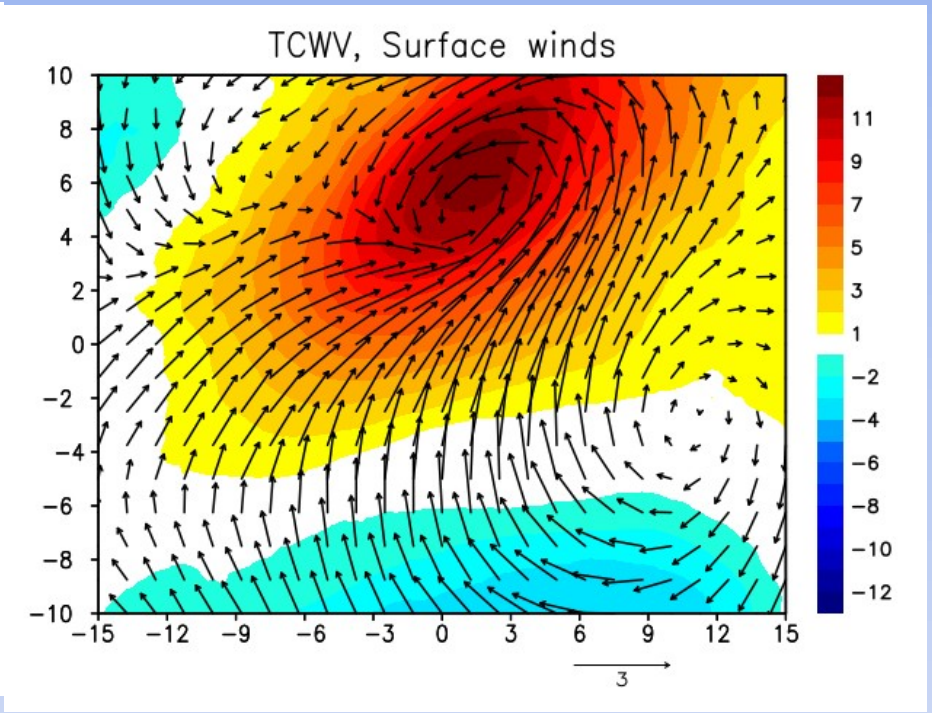


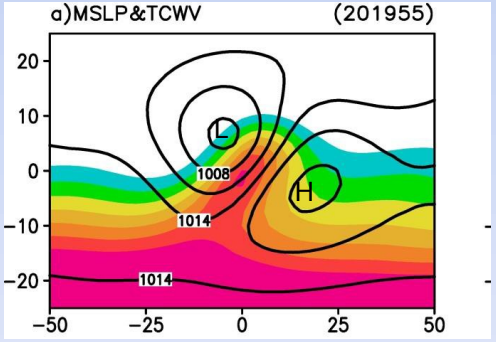
Anomaly



AR composite based on the global AR data set





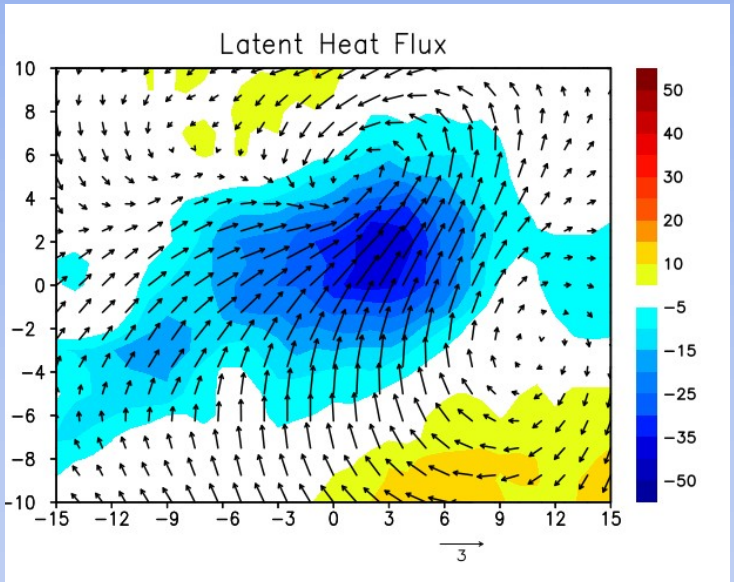


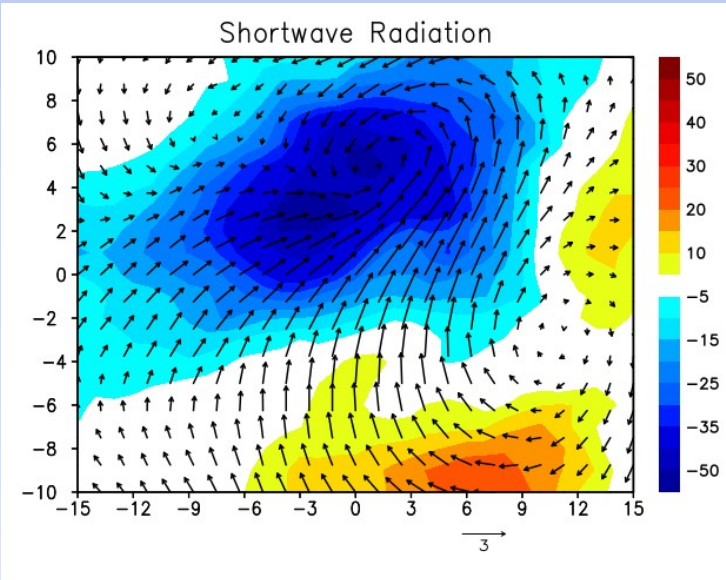
(0, 0): AR centroid detected by IVT criteria

Guo, Shinoda et al. (2020)

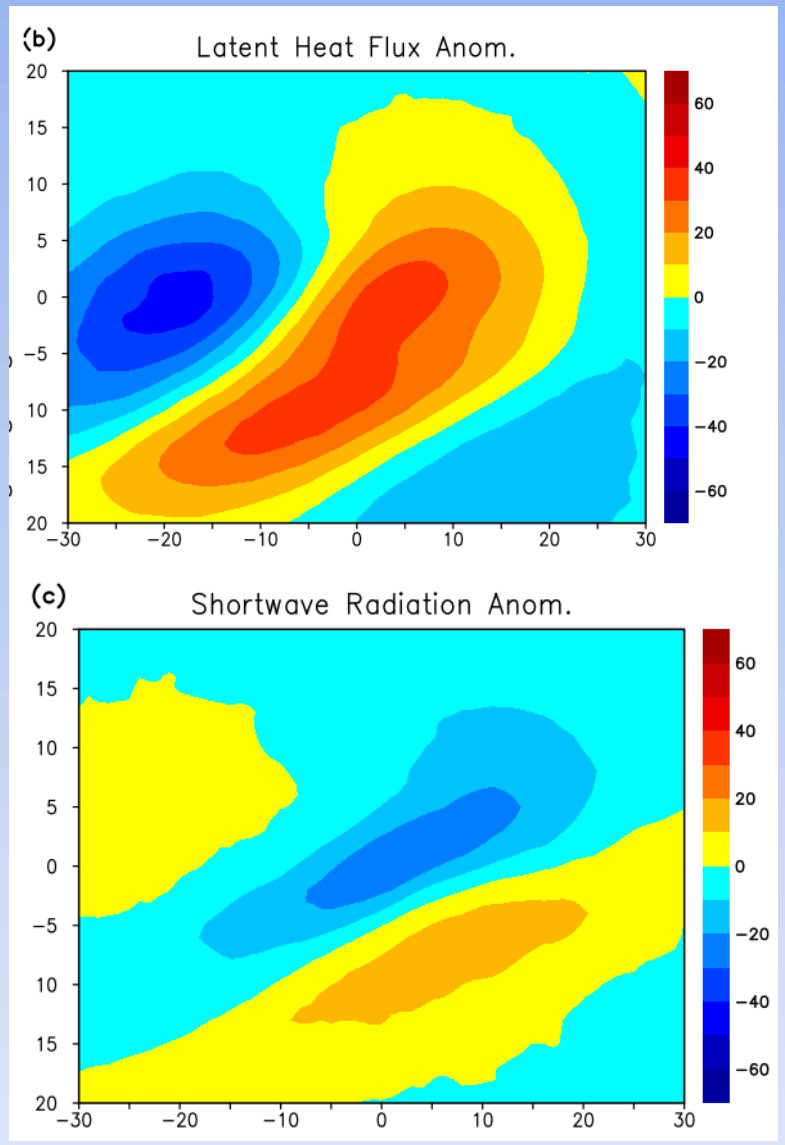
Air-sea fluxes associated with ARs

Arabian Sea





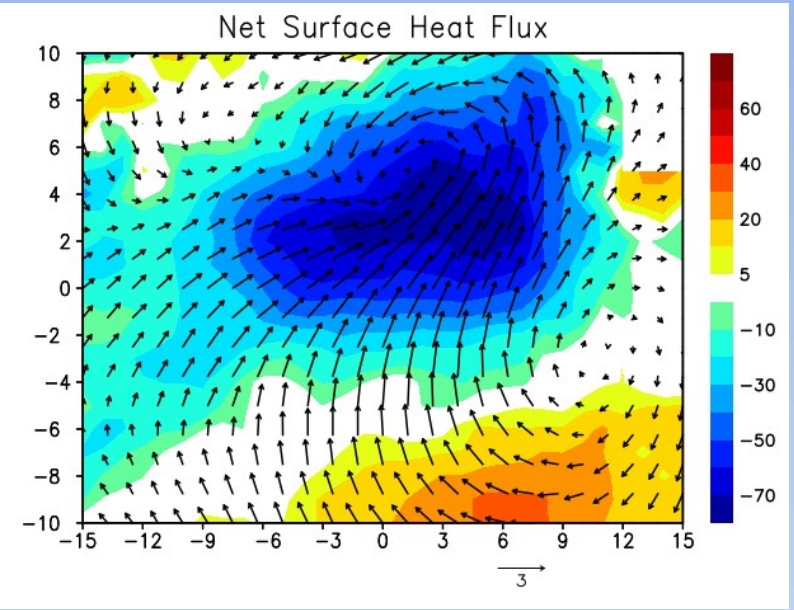
Northeast Pacific

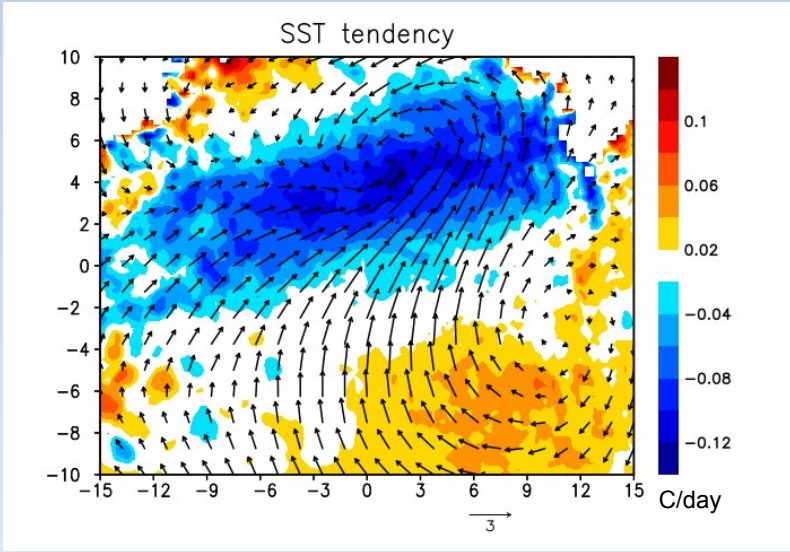


Shinoda et al. (2019)

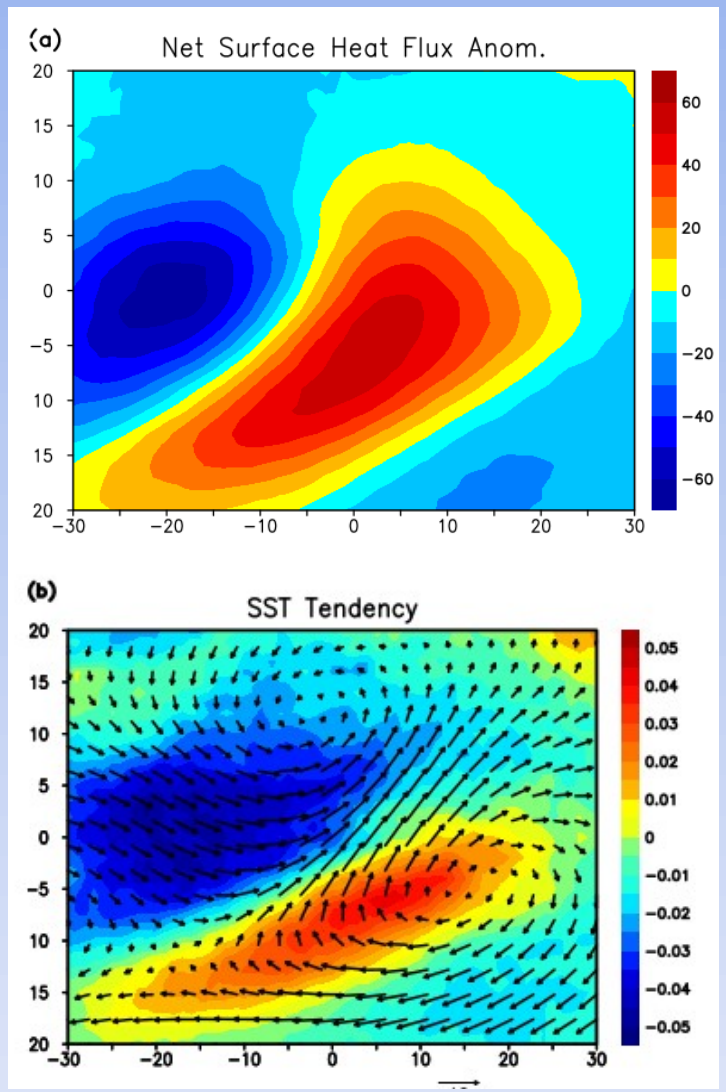
Net surface heat flux and SST tendency

Arabian Sea





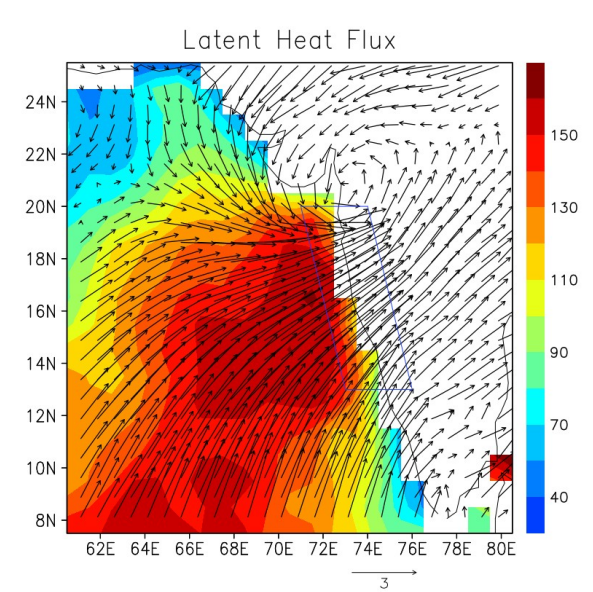
Northeast Pacific

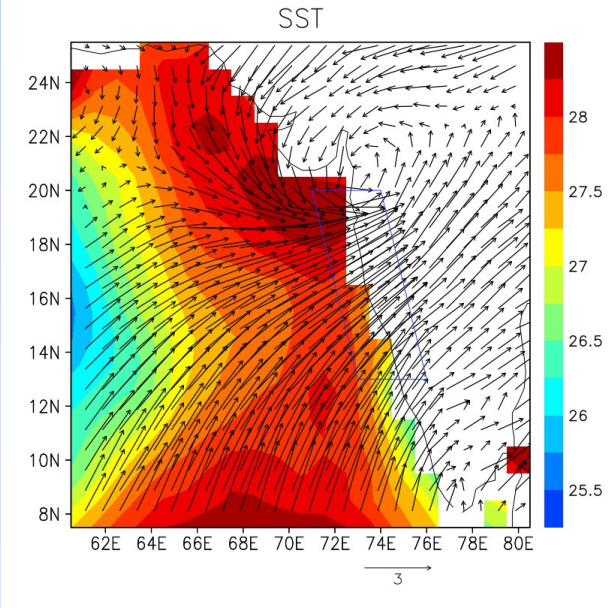


Shinoda et al. (2019)

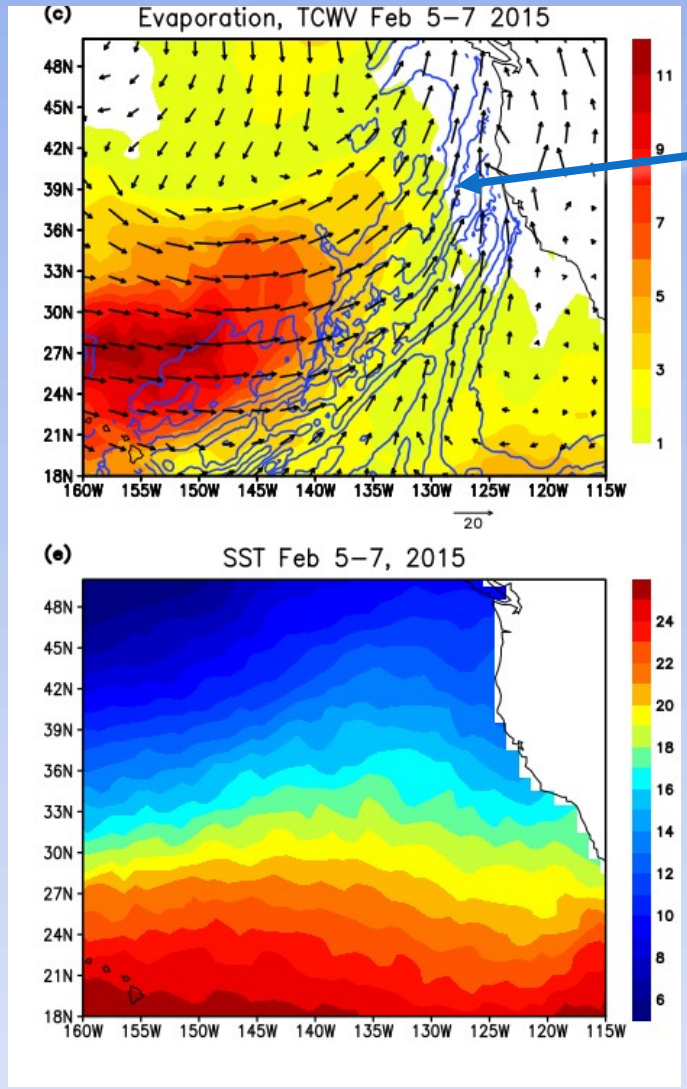
Landfalling ARs

Arabian Sea





Northeast Pacific

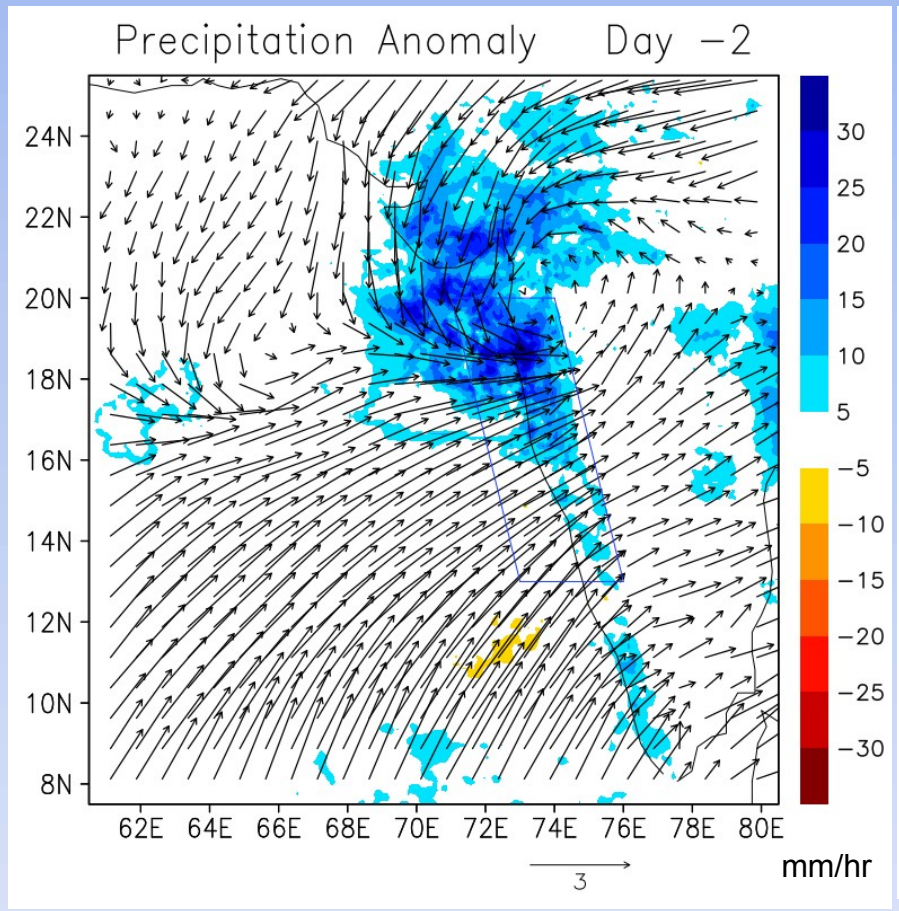


Very small evaporation along the coast due to cold SST and moist air

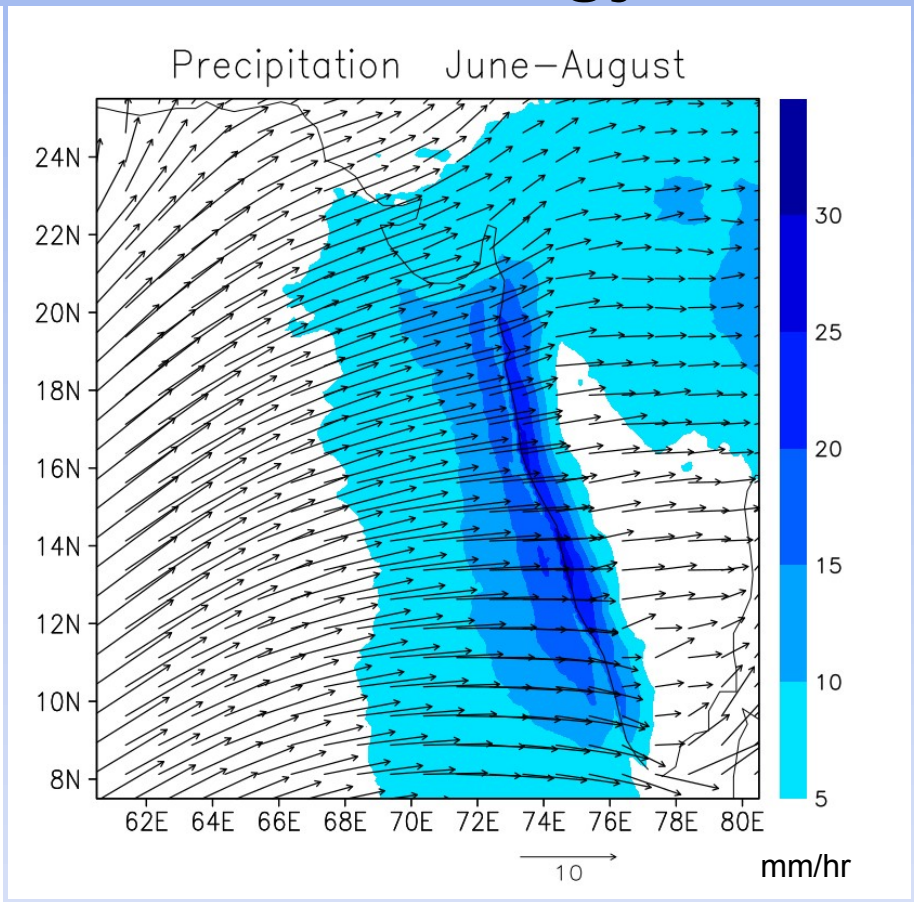
Shinoda et al. (2019)

Precipitation associated with ARs

AR composite



Climatology



Summary

- Most AR events over the Arabian sea are observed during the Indian summer monsoon season.

- Based on the composite analysis of ARs, a large latent heat flux is observed near the AR centroid on the northern side, in contrast to the northeast Pacific where the large latent heat flux is located on the western poleward side of the AR centroid.

- The surface shortwave radiation associated with ARs is comparable in magnitude to the latent heat flux, and significant SST cooling is observed on the northern side near the AR centroid.

- Precipitation associated with landfalling ARs along the west coast of India makes a significant contribution to Indian summer monsoon rainfall.

- Large latent heat flux associated with ARs is found along the west coast of India, where warm SSTs are present.

Ongoing study

- Impact of marine heatwaves on the AR-induced moisture transport and precipitation along the west coast of India.

- Ocean responses such as changes in coastal sea level and sea surface salinity.