Sea Surface Temperature Variability in the Arabian Sea:

Exploring Seasonal Patterns and Atmospheric Interactions

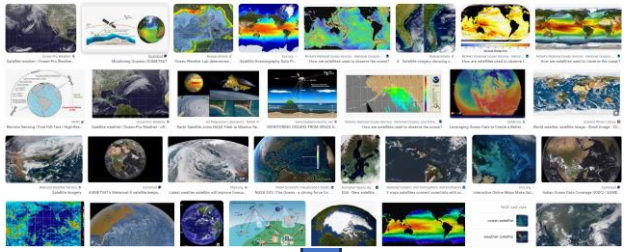
Main Points:

- Sea Surface Temperature SST , Importance and Impacts
- SST Measurements
- A quick Journey throughout the SST seasons of Arabian Sea
- Historic Review on SST of Arabian Sea

Ibrahim Al Abdulsalam / Meteorologist
Center of Excellence for Satellite Applications

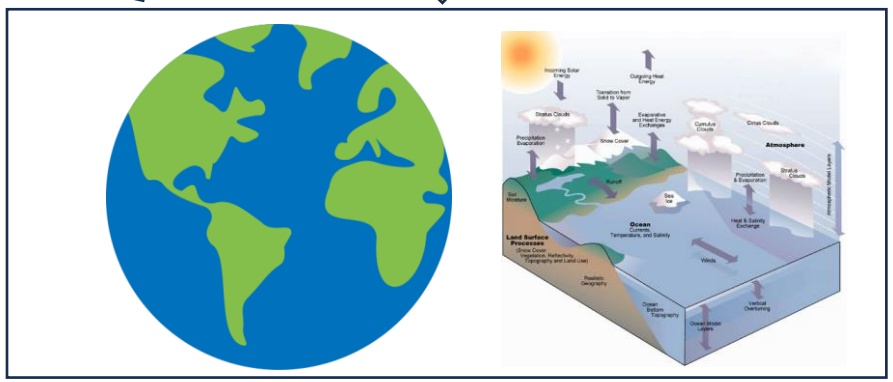
Why SST and how it’s measured ?

Data



Earth's Energy Budget

Input = Output



Better understanding

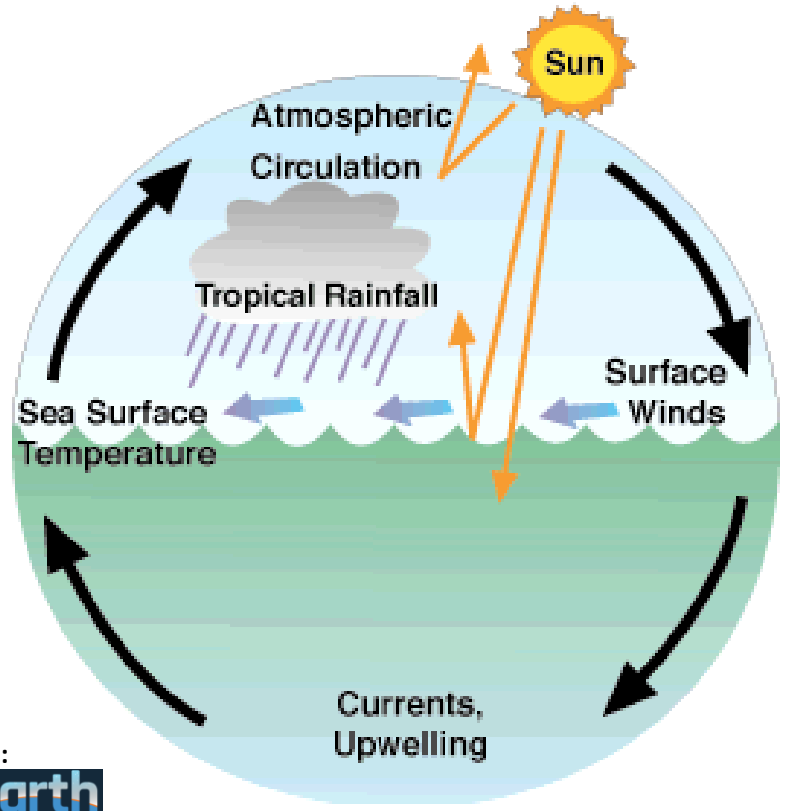
Earth is not over heated

SST !

Why SST and how it’s measured ?

Atmosphere-ocean coupling

Refers to the interaction and exchange of **energy**, **momentum**, and **mass** between the Earth's atmosphere and its oceans.



Credit:

Exchange of energy like :

- Solar SW insolation and
  land , atm and ocean LW radiation
- Heat fluxes like conduction and convection

Momentum exchange like:

-winds , sea waves ,pressure and ocean currents ……

Mass exchange like :

- water by evaporation and precipitation , aerosols, and other substances.

Like in Tropical Cyclone!

SST!

***That is fully nonlinear.**

>> Very complex !

>> Numerical Models

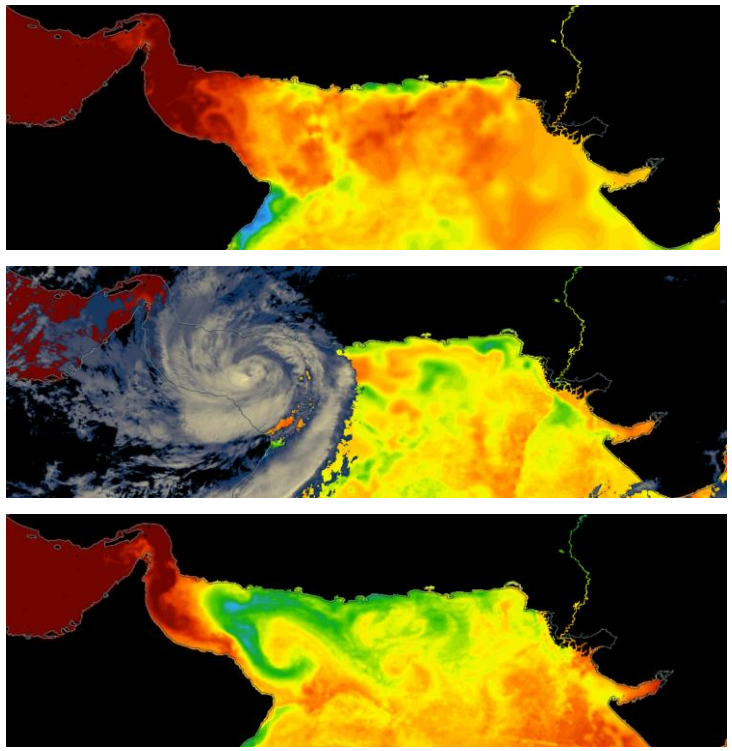
Why SST and how it’s measured ?

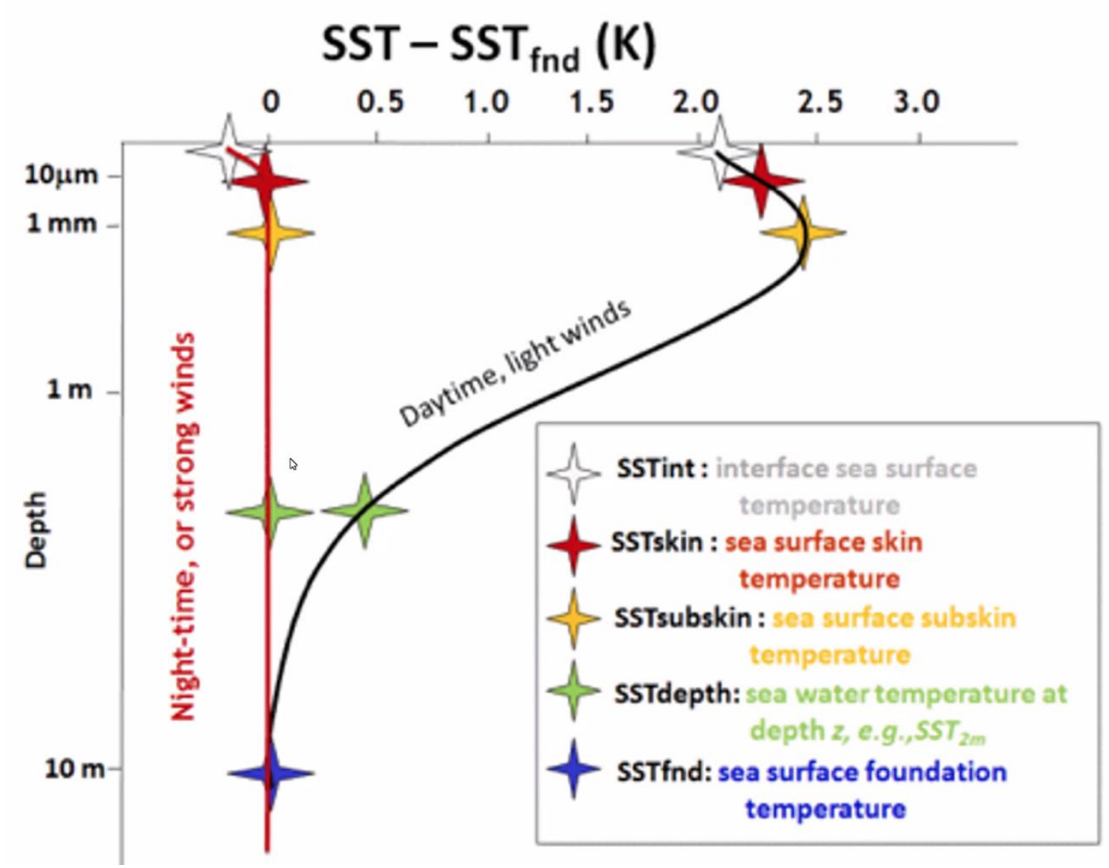
In Meteorology :

The sea surface temperature is defined as the temperature of the ocean at depths of 0-10 meters.

Before

After





*Foundation Temperature is nearly free of any diurnal temperature variability

Why SST and how it’s measured ?

SST can be measured by various methods, including:

- **In situ measurements such as:**

buoys, ships, and others floats equipped with sensors to directly measure the temperature of the ocean surface beside other air and water parameters . Later will sea Saildrone!

Accurate and detailed data  **but very limited in spatial coverage** 

- **Satellite-based measurements:**

Mosely infrared and microwave radiometers can measure the thermal radiation emitted by the ocean surface then it could corrected or calibrated to SST In situ measurements .

provide wide spatial coverage  **lower accuracy and less temporal details** 

Satellite Carrying instruments with SST Capability:

NOAA-20
MetOp series
Sentinel-3
Aqua and Terra
.
.
.

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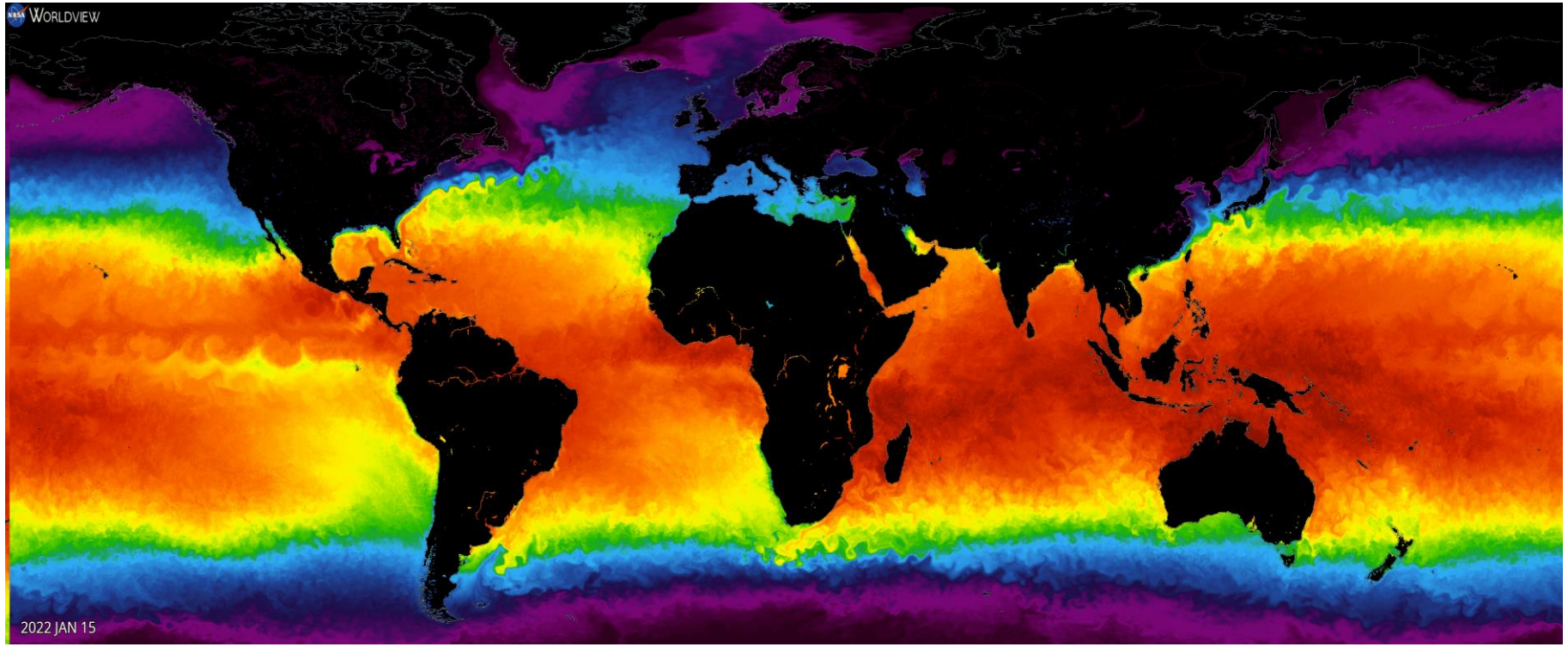
provide wide spatial coverage **lower accuracy and less temporal details**

Integrated into one System for optimal accuracy Like :

The **Group for High Resolution Sea Surface Temperature (GHRSST)**
>> skin sea surface temperature at approximately 10-20 µm

using instruments like :
AVHRR , VIIRS , MODIS and SLSTR + in-situ instruments



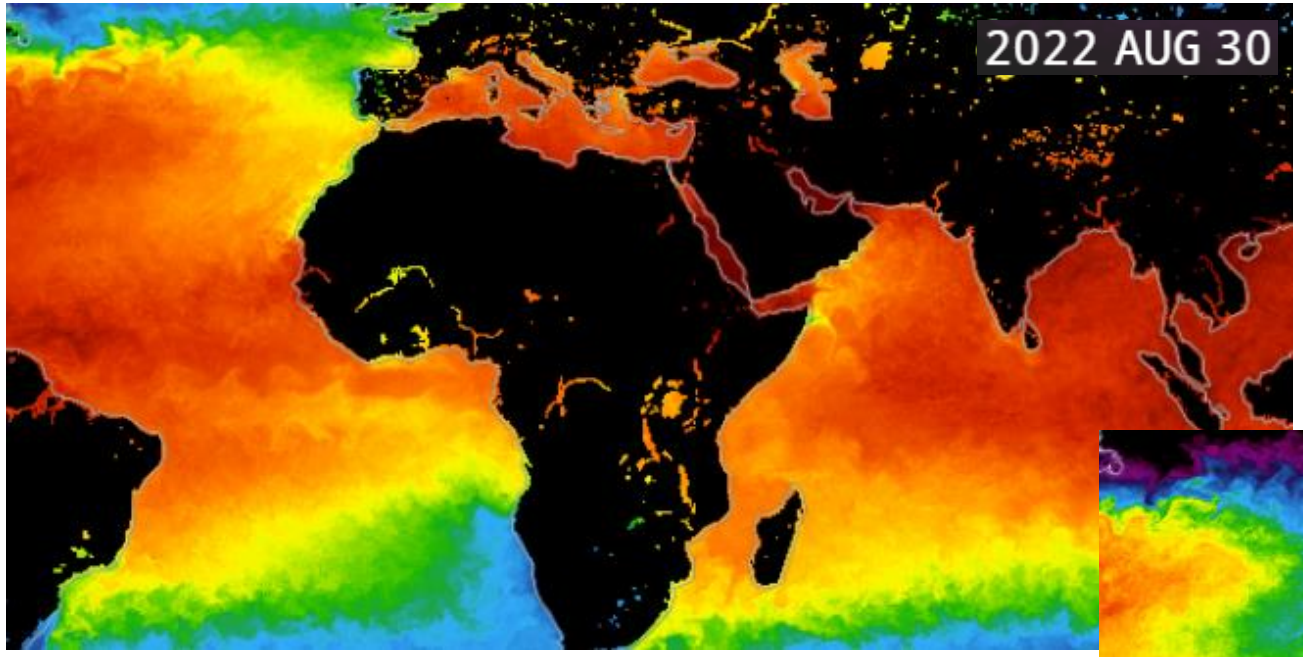
GHRSST
GROUP FOR HIGH RESOLUTION SEA SURFACE TEMPERATURE

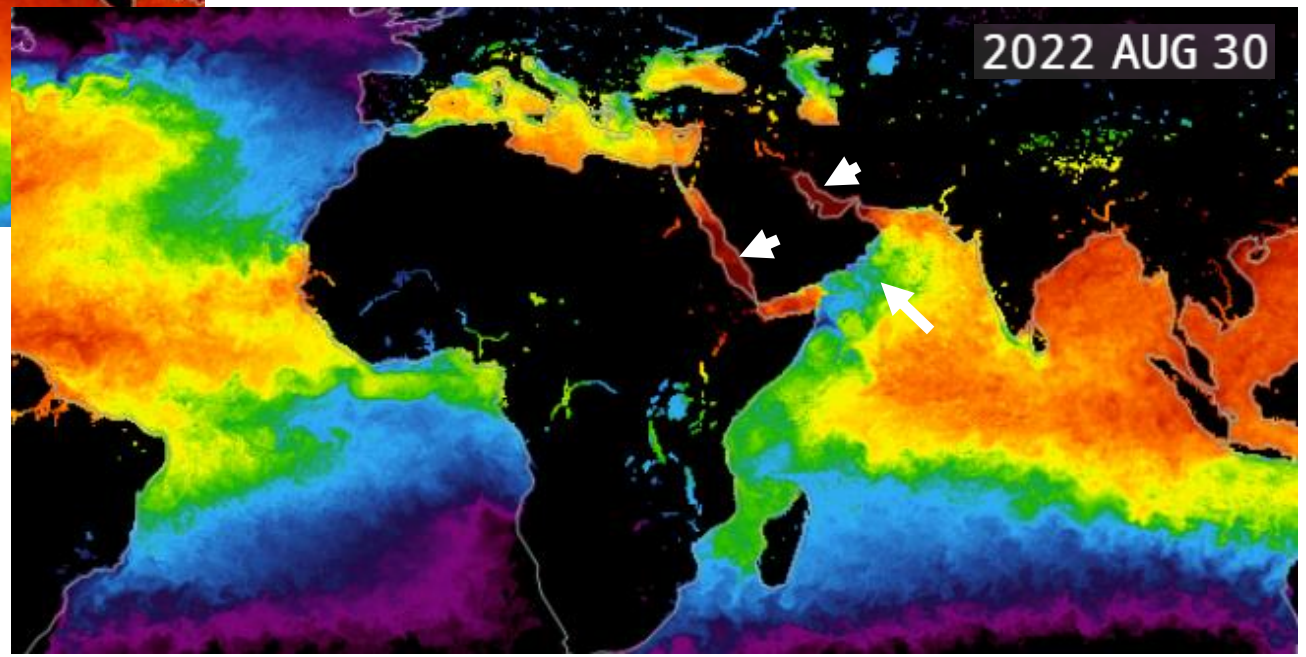
https://www.ghrsst.org/

NASA WORLDVIEW

https://worldview.earthdata.nasa.gov/

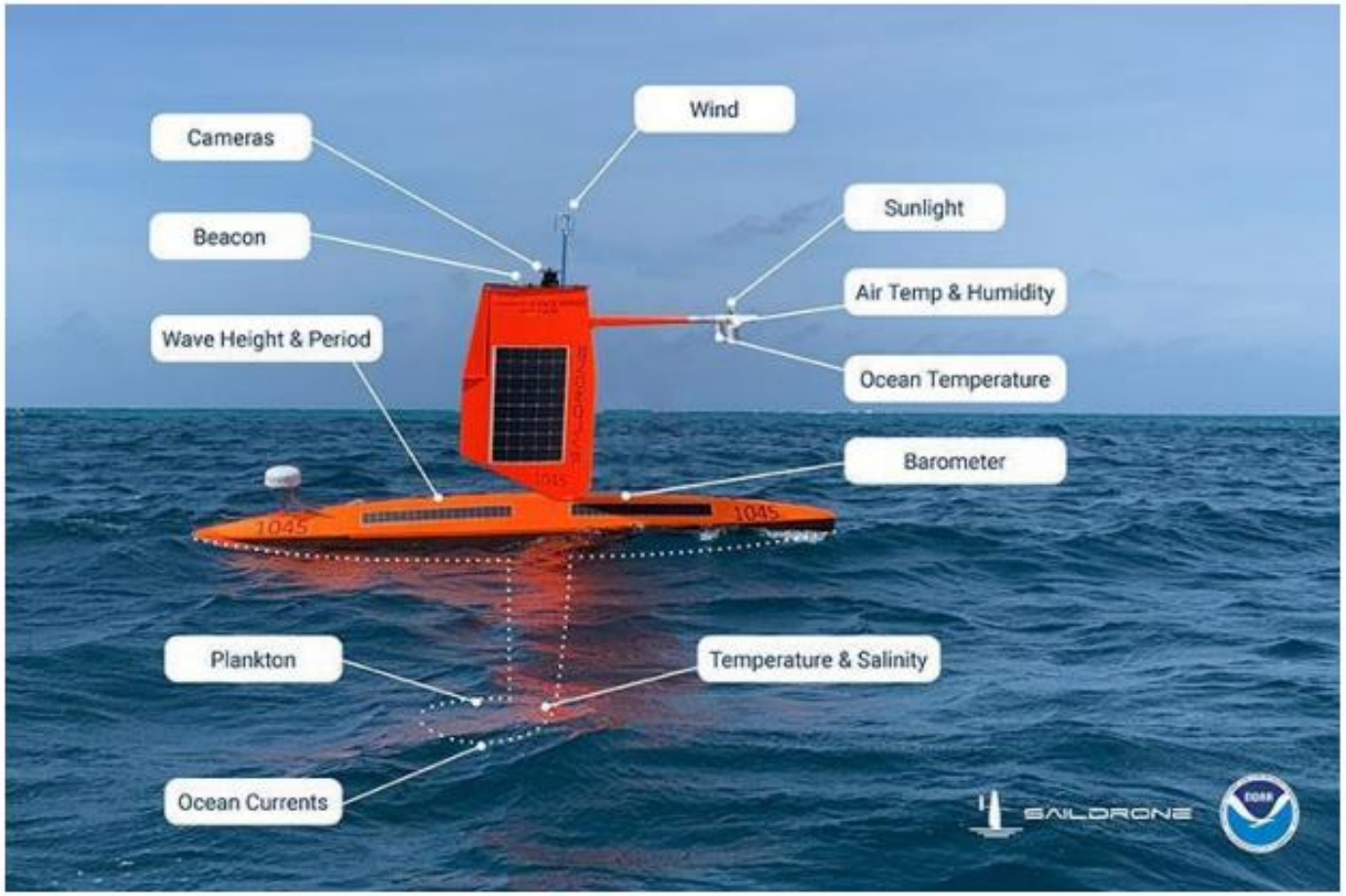
Why SST and how it’s measured ?



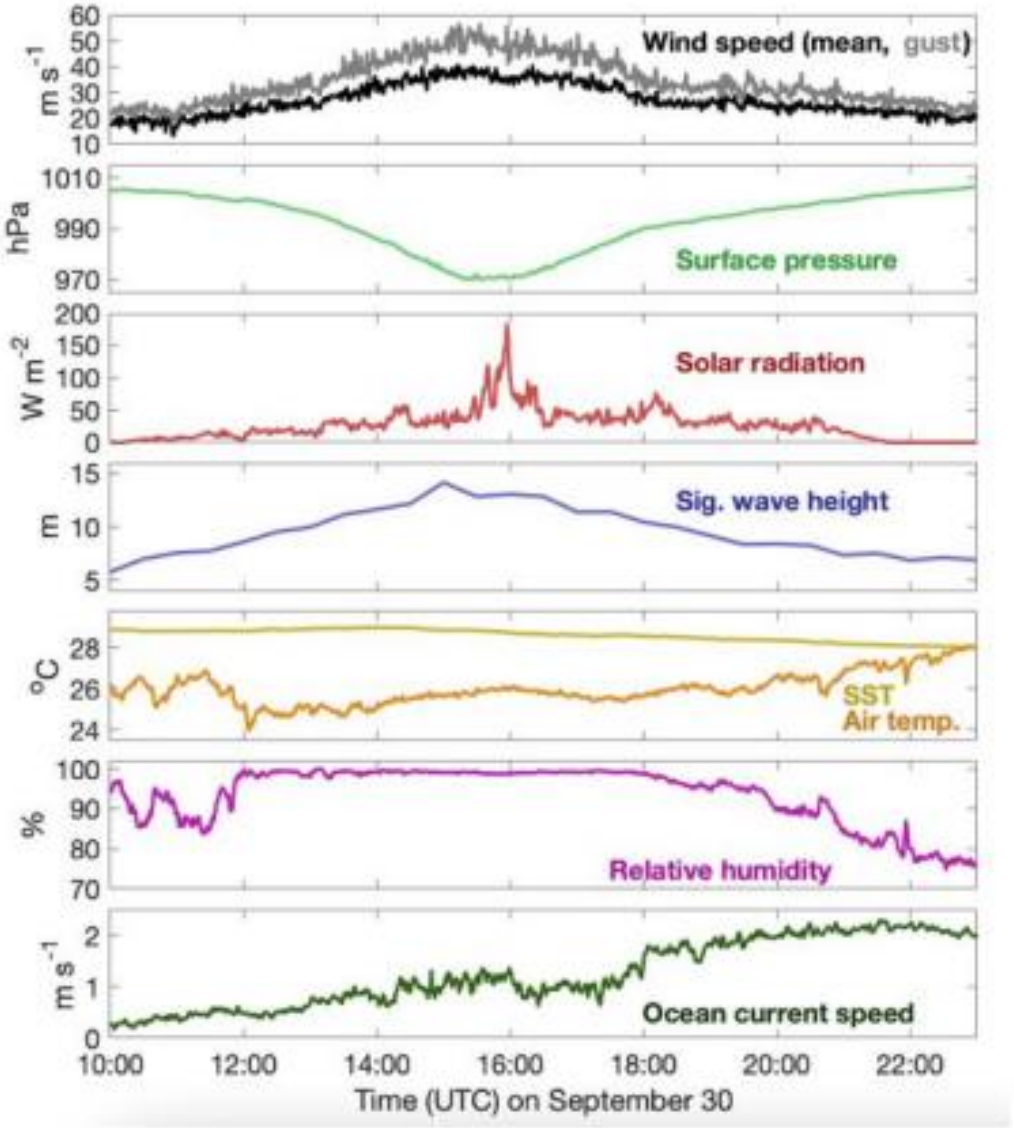


Why SST and how it's measured ?

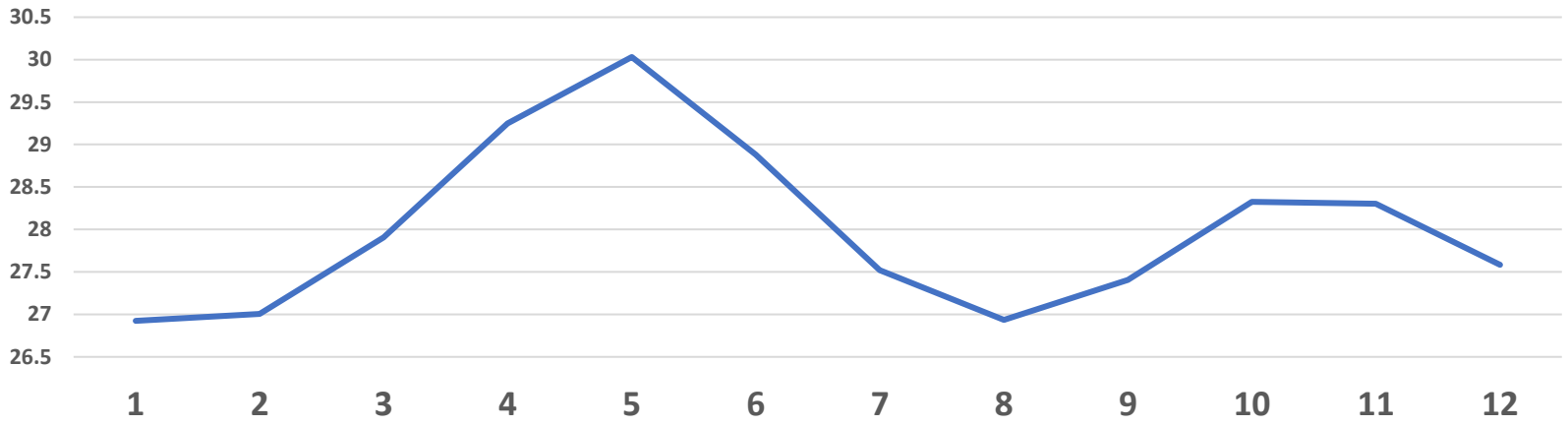
Saildrone



https://www.youtube.com/watch?v=H-jL427Bx7I



Arabian Sea SST Seasonal Variation



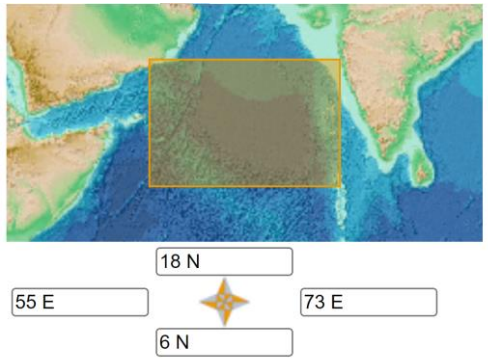
Monthly Average Arabian Sea SS 1982-2021

SOURCE: NOAA OI

DATASET: Hydrosphere
VARIABLE: Monthly Mean Sea Surface Temperature (degrees Celsius)
TIME : 01-DEC-1981 00:00
NOTES:

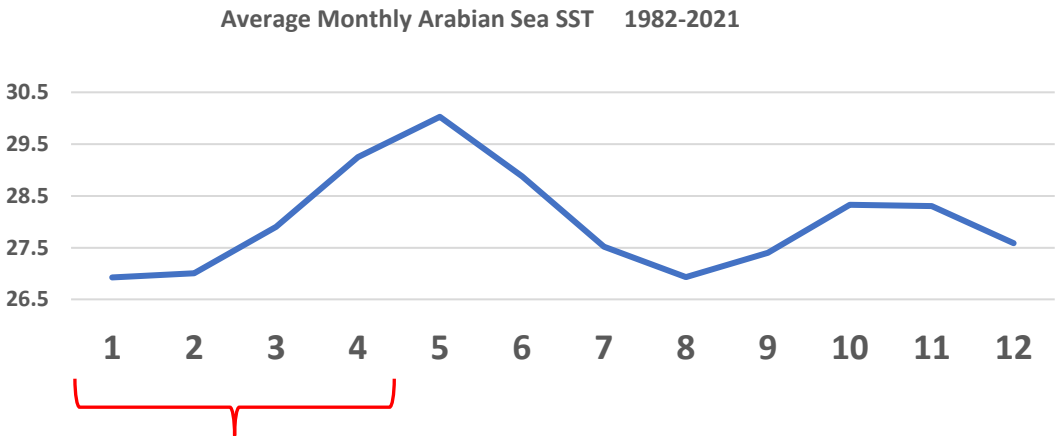
- SOURCE: NOAA OI
- DESCRIPTION: The sea surface temperature is defined as the temperature of the ocean at depths of 0-10 meters. These data have a grid spacing of 1 degree longitude and 1 degree latitude. Tip: If you want to add contours and labels to your map plot, click the Chart Options button on the right-hand side of the screen (look directly above the mini-map). In the menu that pops up, locate the Contour style drop-down menu. Select the Color filled and lines option in the menu. If you then update your chart, you should see contour lines and labels showing the sea surface temperature on the plot.
- UNITS: The sea surface temperature is given in units of degrees Celsius.

LAS 8./PyFerret 7.63 NOAA/PMEL



https://mynasadata.larc.nasa.gov/

Arabian Sea SST Seasonal Variation



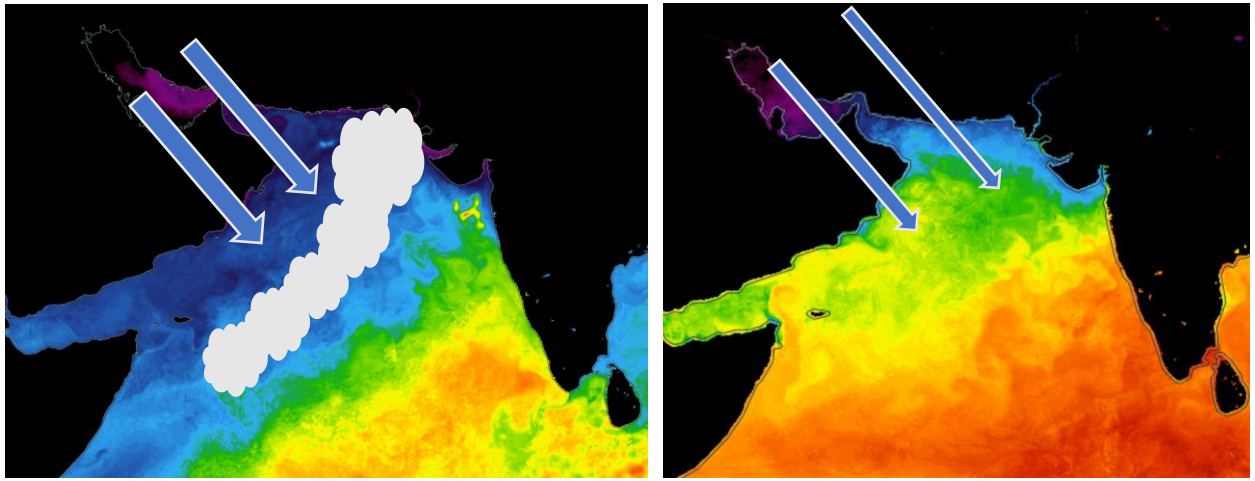
Westerlies ,fronts and shamal winds
Winter IIndian monsoon!

Winter

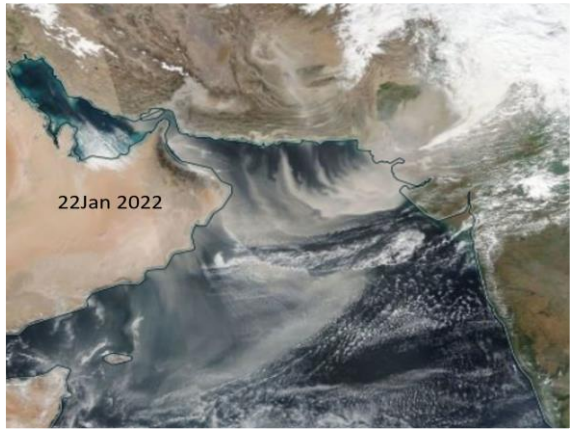
Jan - Feb

Transition

Mar - Apr

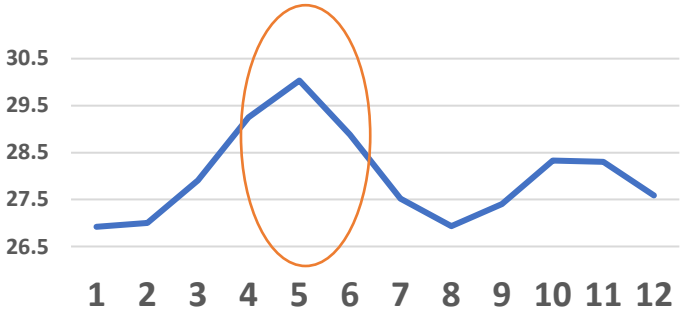


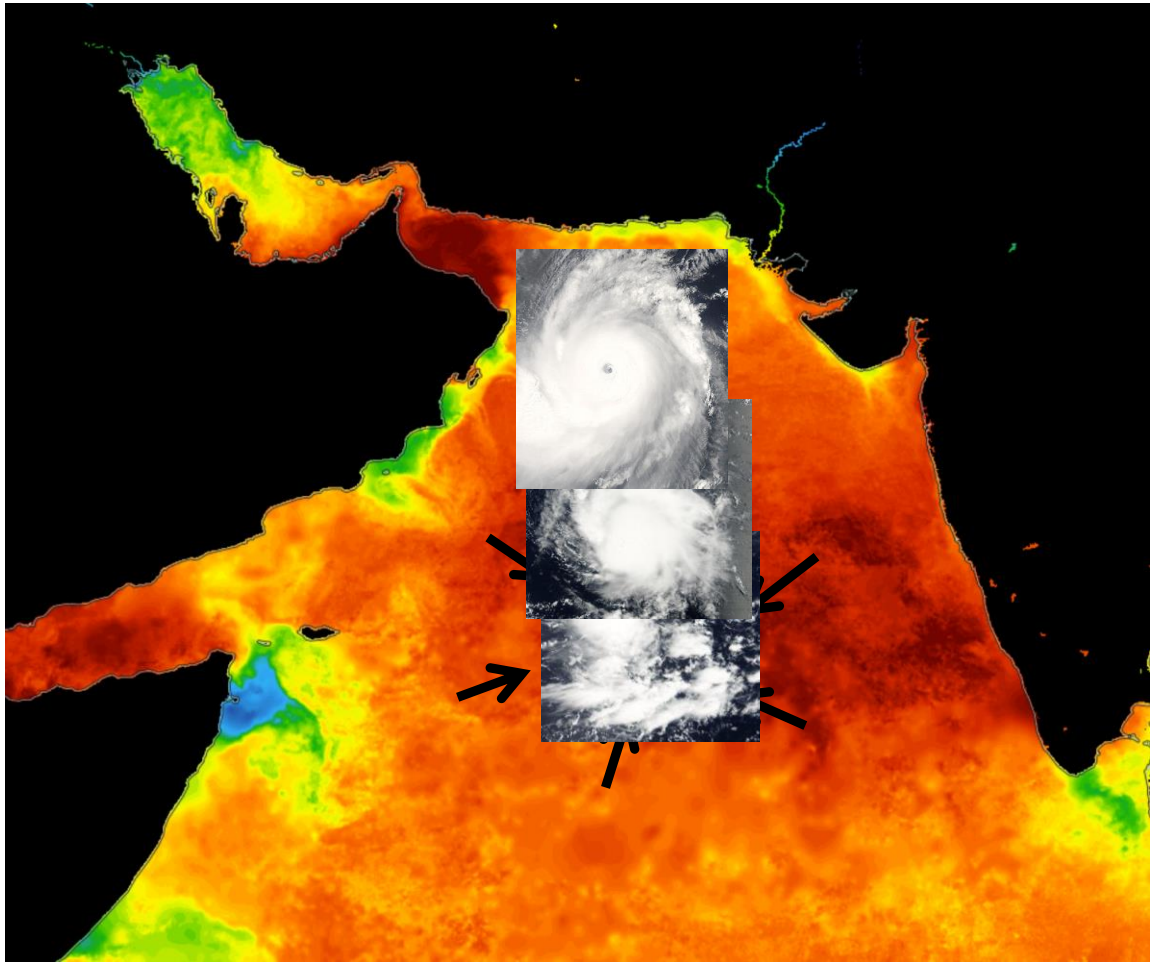
20 **26** **>32C**



Arabian Sea SST Seasonal Variation

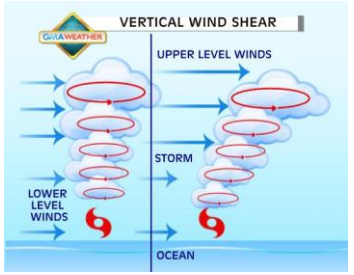
Pre monsoon Season
20 May to 20 July



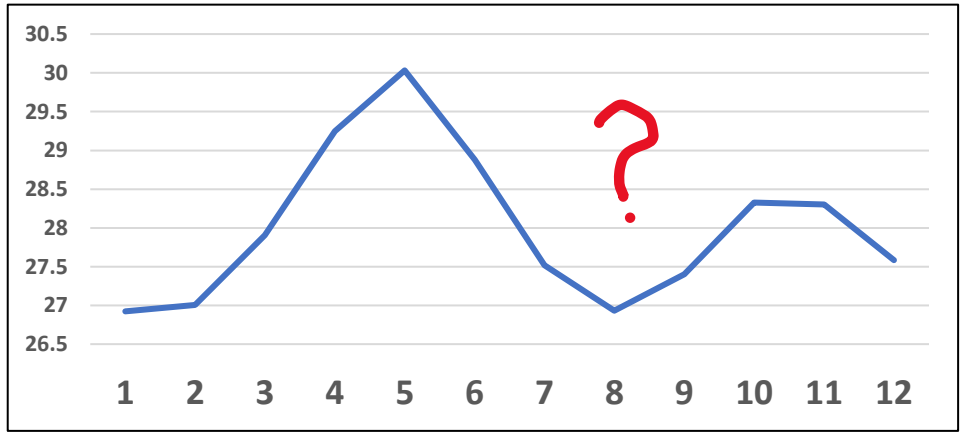


Cyclogenesis Ingredients :

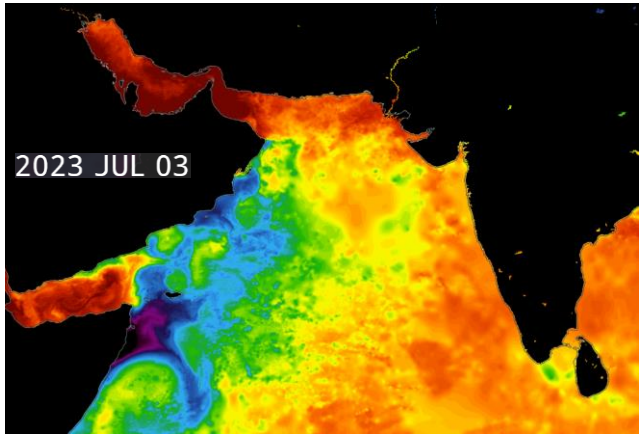
- **SST > 26.5 Deep down to 50 m**
- **Instability**
- **Sufficient moisture in low and mid troposphere**
- **A pre-existing atm disturbance, such as a tropical wave or a low-pressure system**
- **Low vertical wind shear**

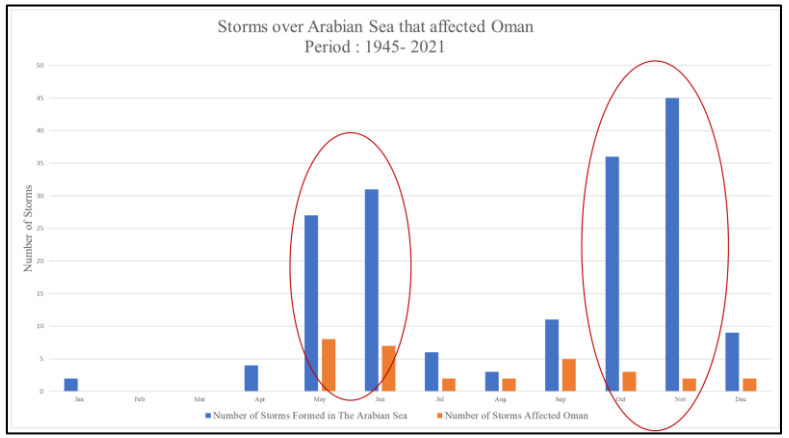


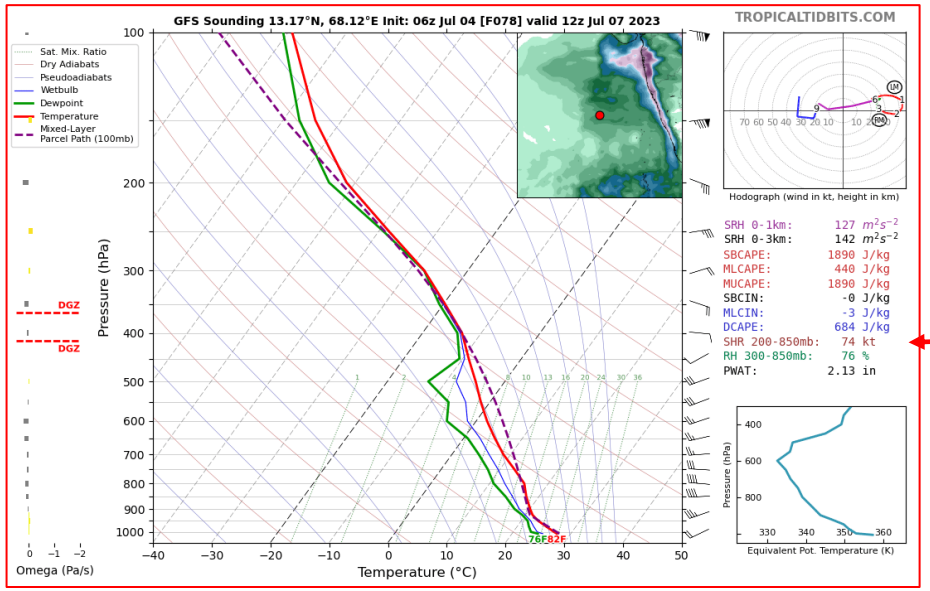
Arabian Sea SST Seasonal Variation

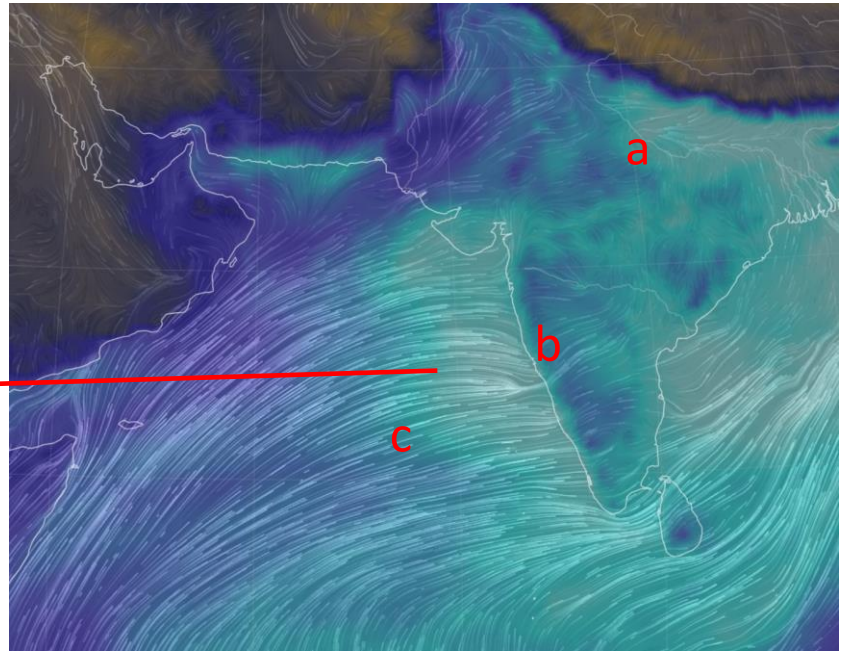


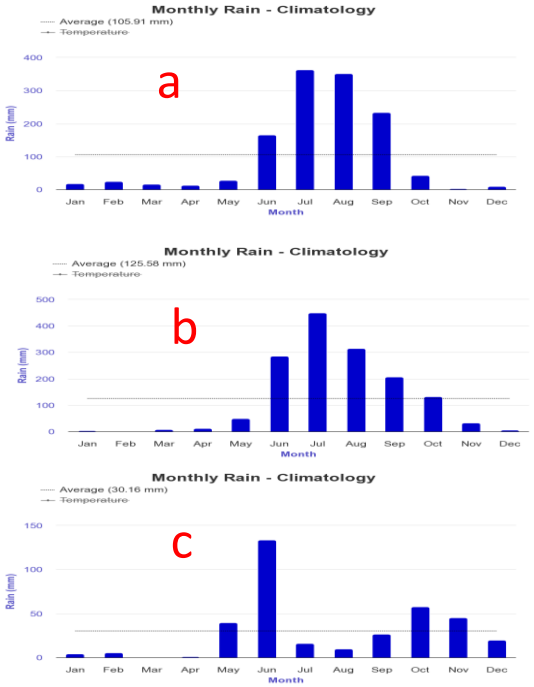
Average Monthly Arabian Sea SST 1982-2021





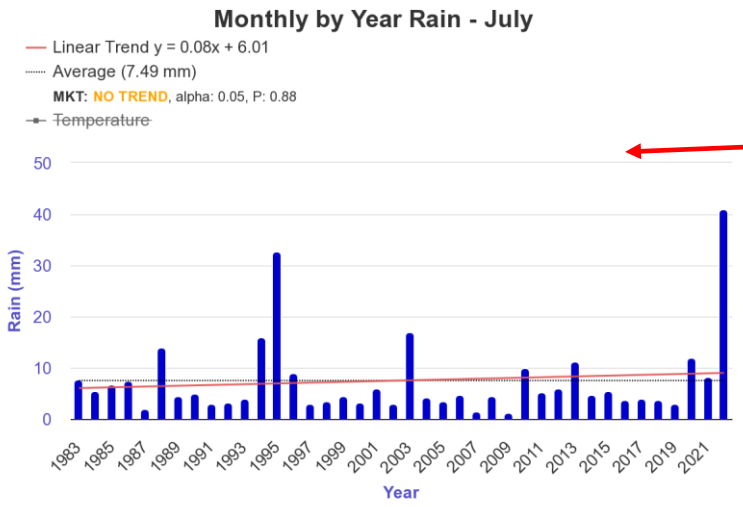


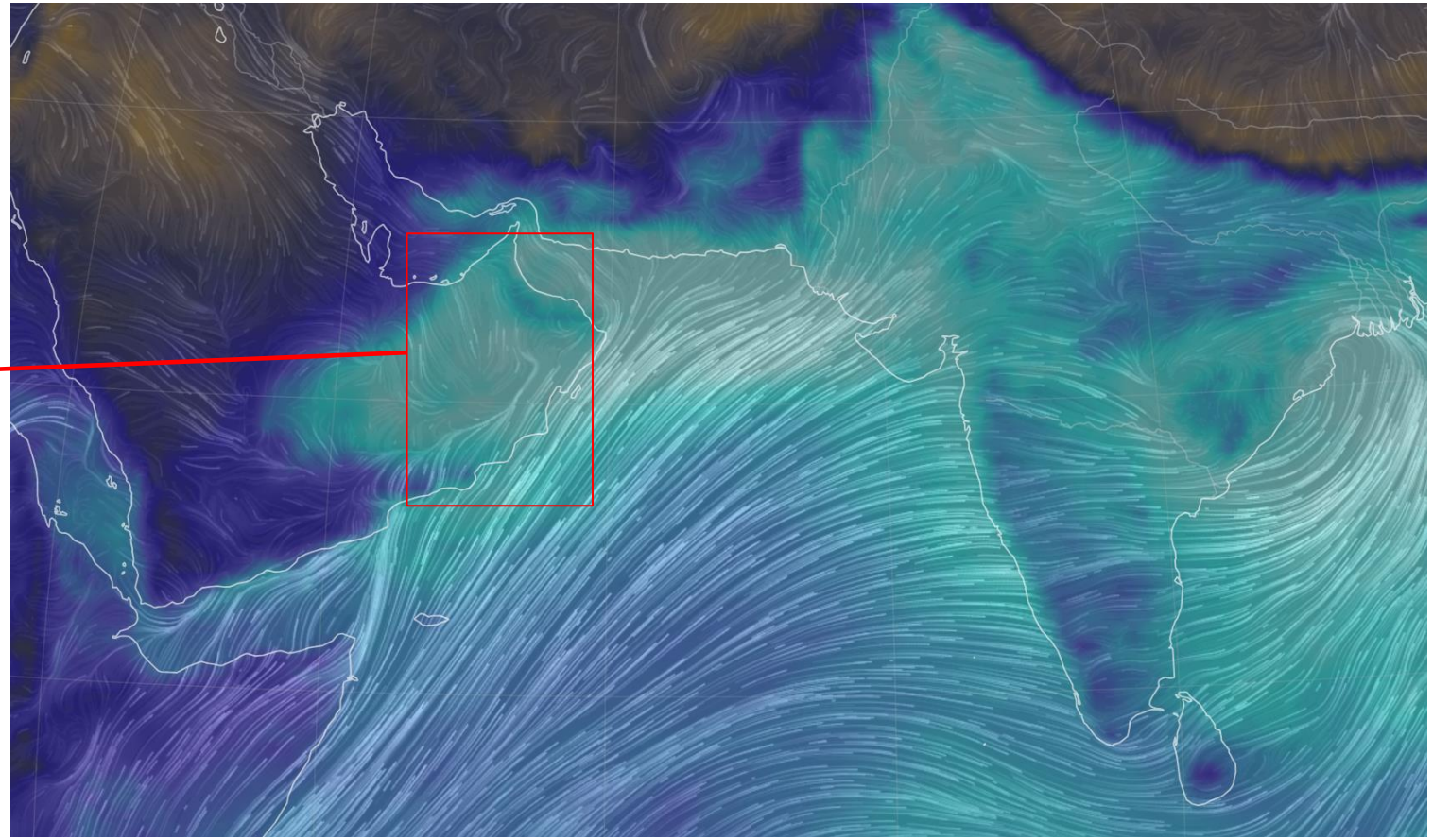




Indian Summer Monsoon

Arabian Sea SST Seasonal Variation





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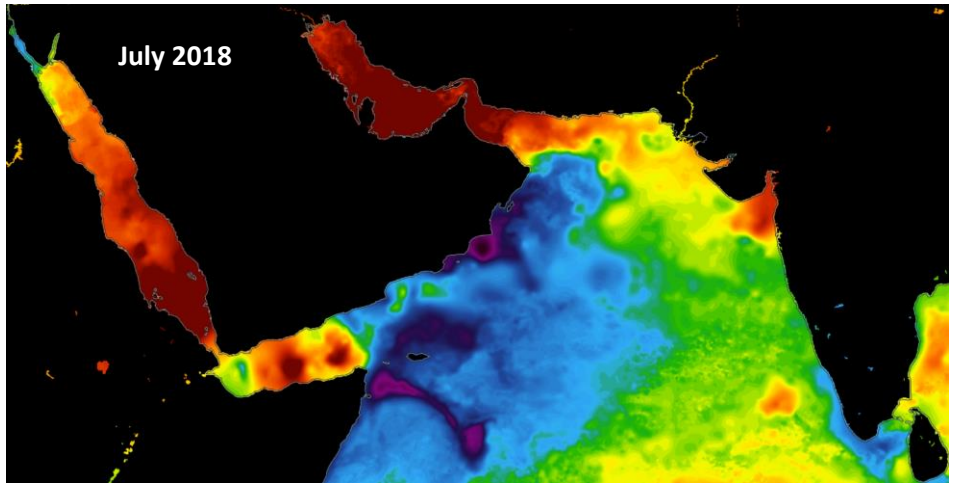
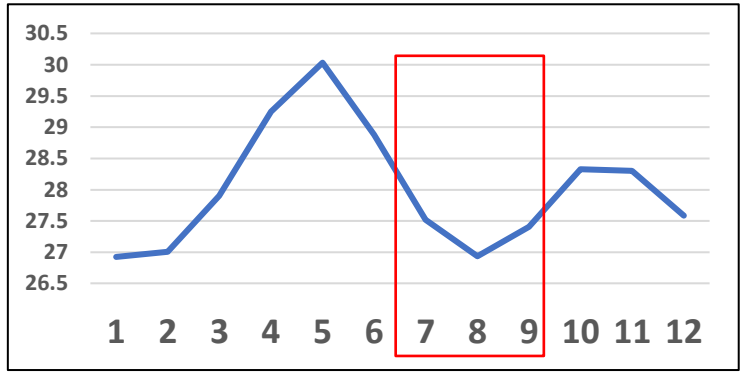
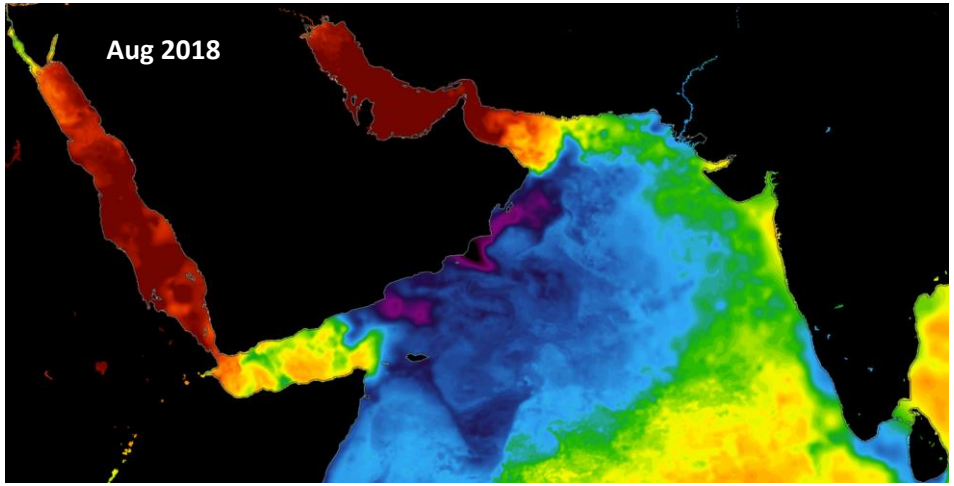
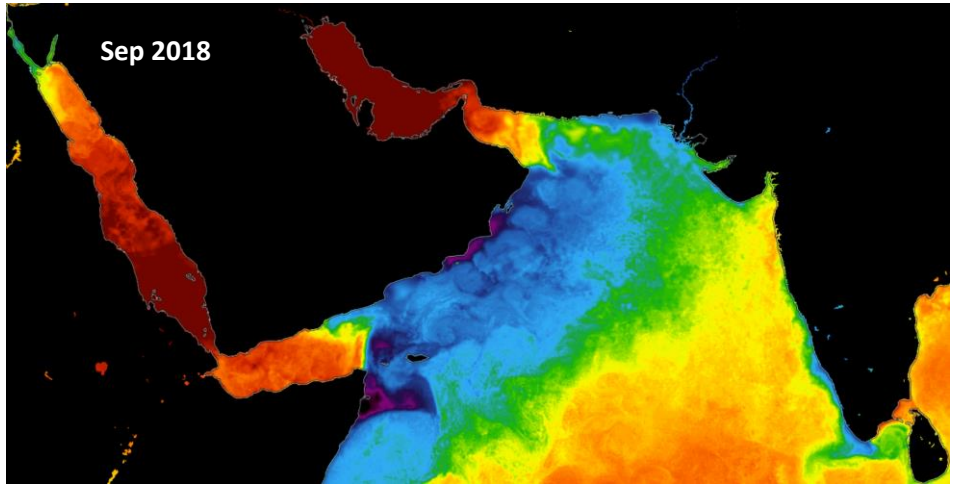




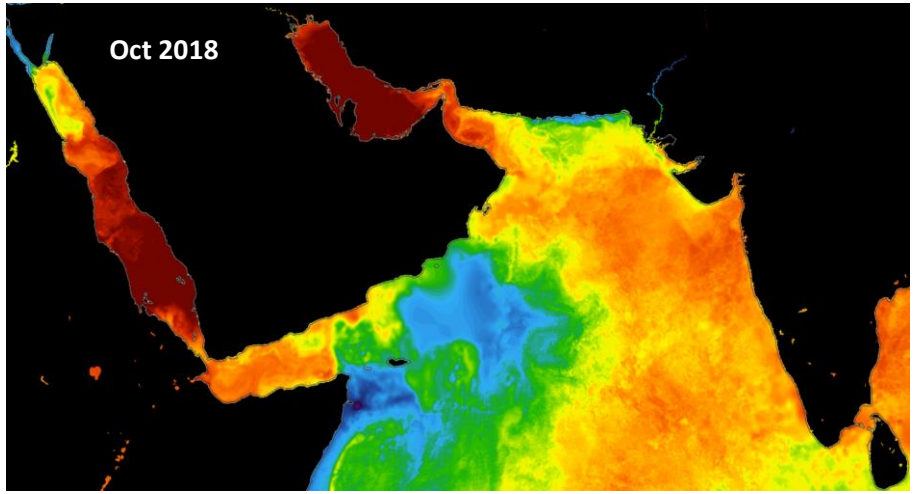


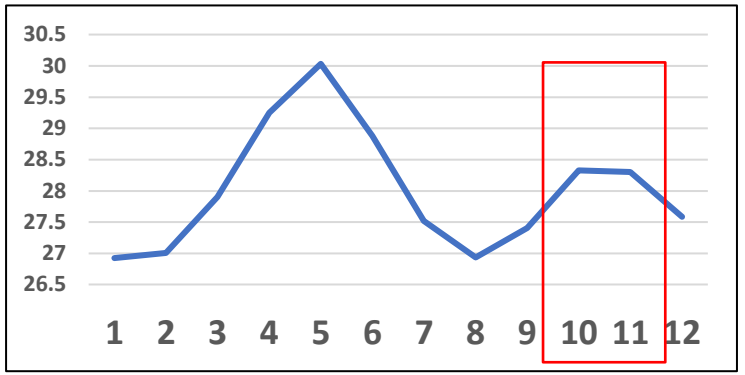


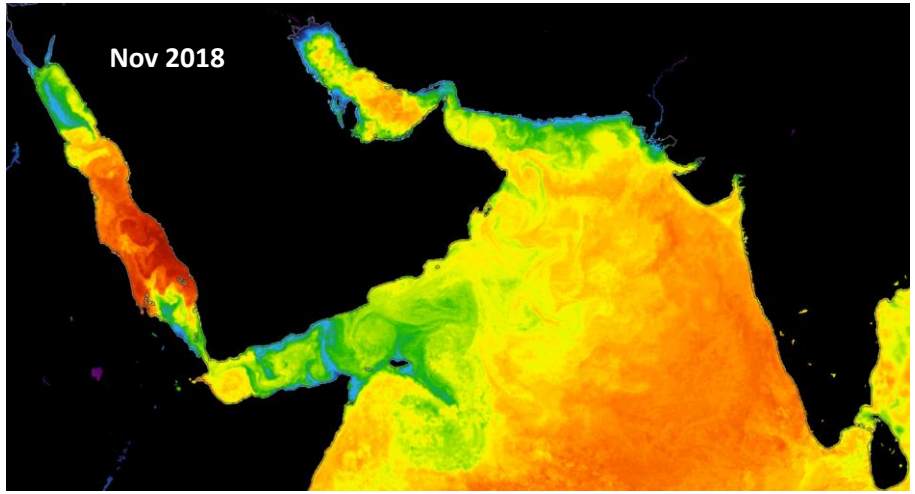
20 26 >32C

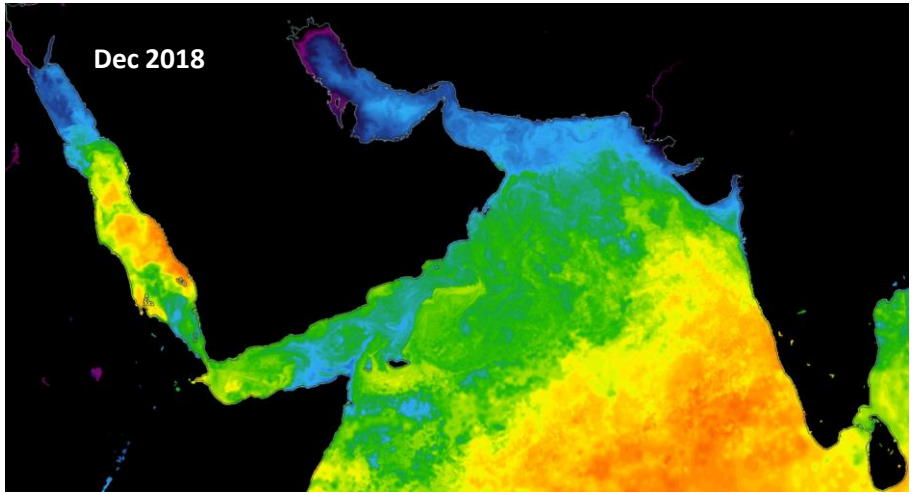
Arabian Sea SST Seasonal Variation

AS Post Monsoon TC season





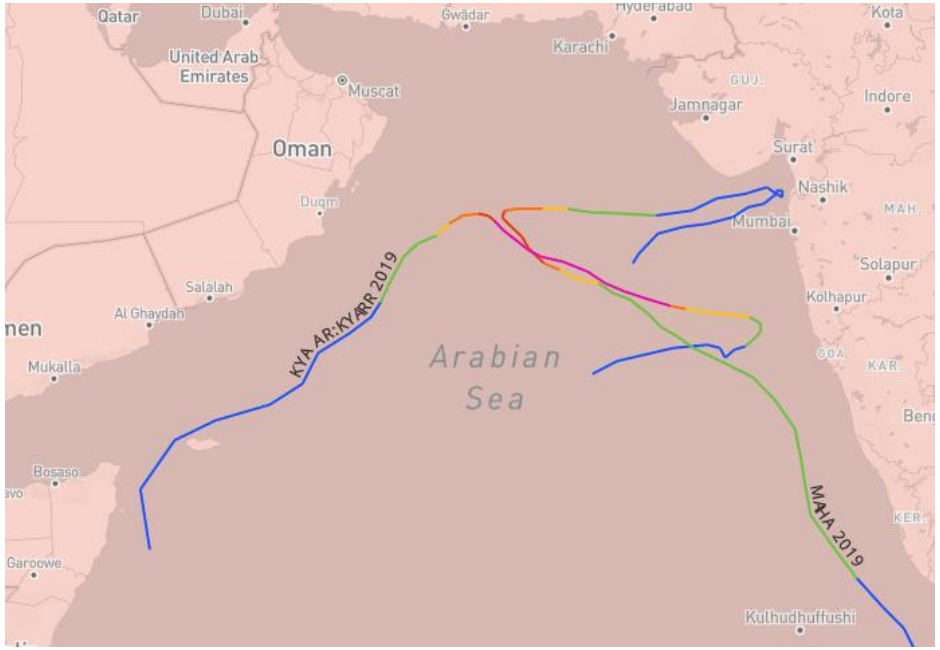




20 26 >32C

Arabian Sea SST Seasonal Variation

Kyaar and Maha Impact



STORM NAME	DATE RANGE	MAX WIND SPEED	MIN PRESSURE	MAX CATEGORY
MAHA 2019	Oct 28, 2019 to Nov 11, 2019	105	959	H3
KYAAR:KYARR 2019	Oct 22, 2019 to Nov 03, 2019	135	924	H4

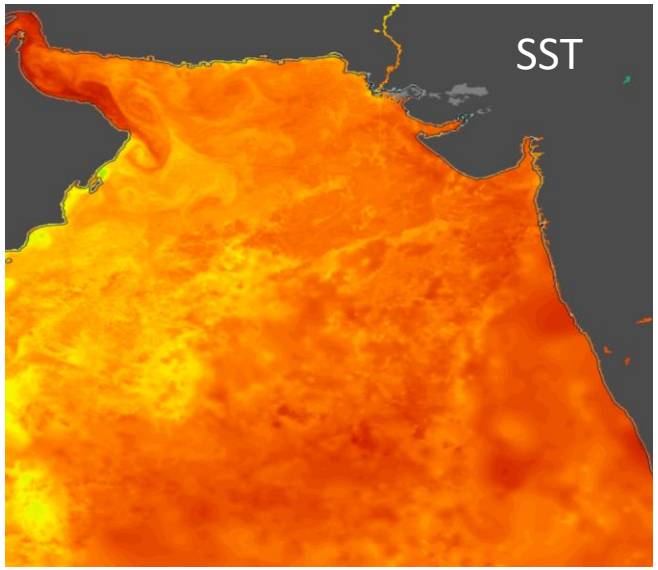
Credit: HISTORICAL HURRICANE TRACKS

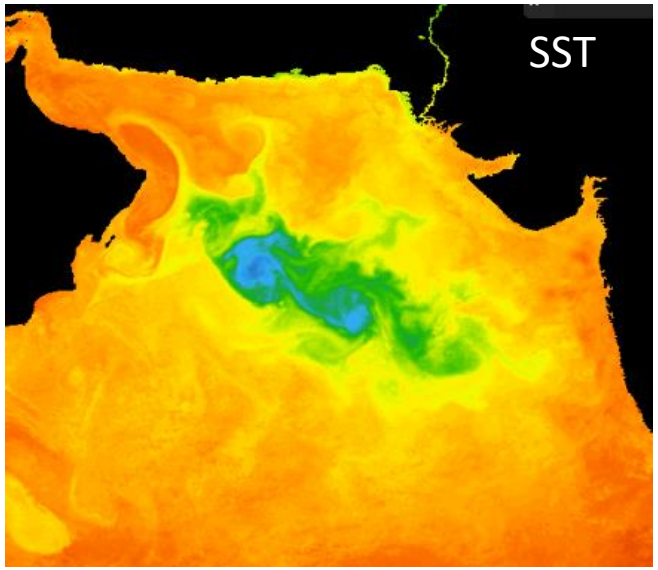
https://coast.noaa.gov/hurricanes/#map=4/32/-80

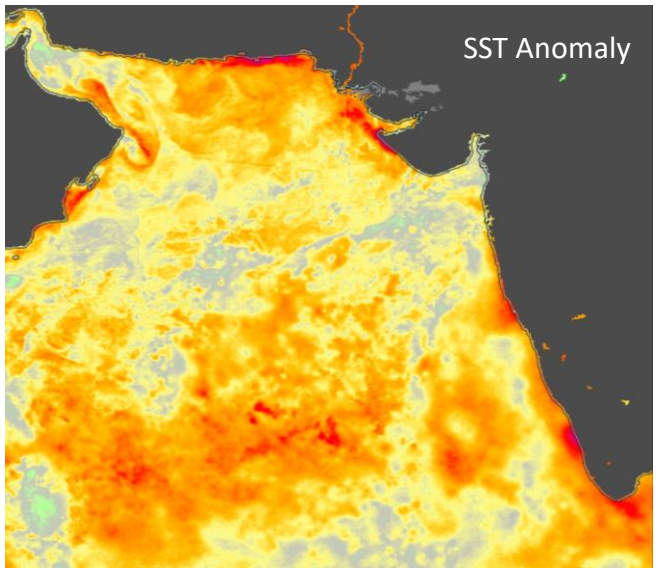
Before

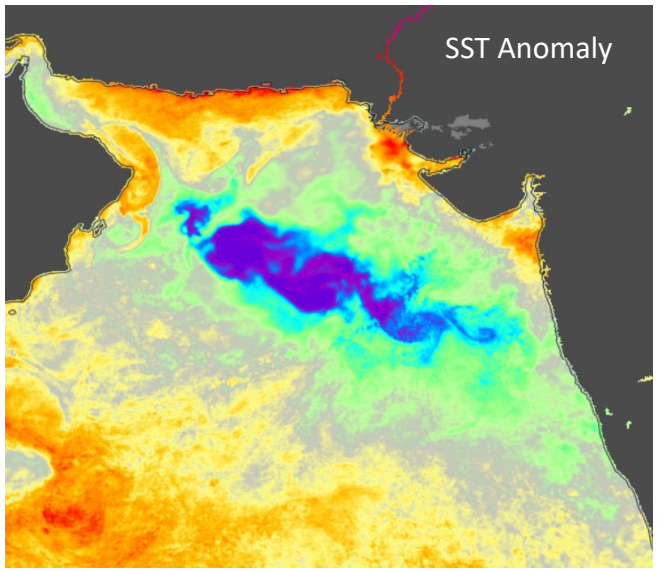
After

GHRSST GROUP FOR HIGH RESOLUTION SEA SURFACE TEMPERATURE









Historic Review on SST of Arabian Sea

Check for updates

Changing status of tropical cyclones over the north Indian Ocean

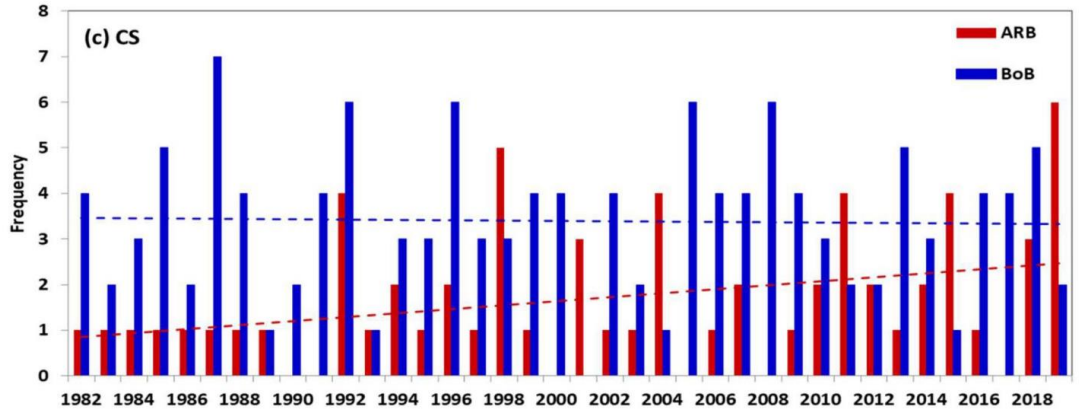
Medha Deshpande[1] · Vineet Kumar Singh[1,2] · Mano Kranthi Ganadhi[1,3] · M. K. Roxy[1] · R. Emmanuel[1,3] · Umesh Kumar[1,4]

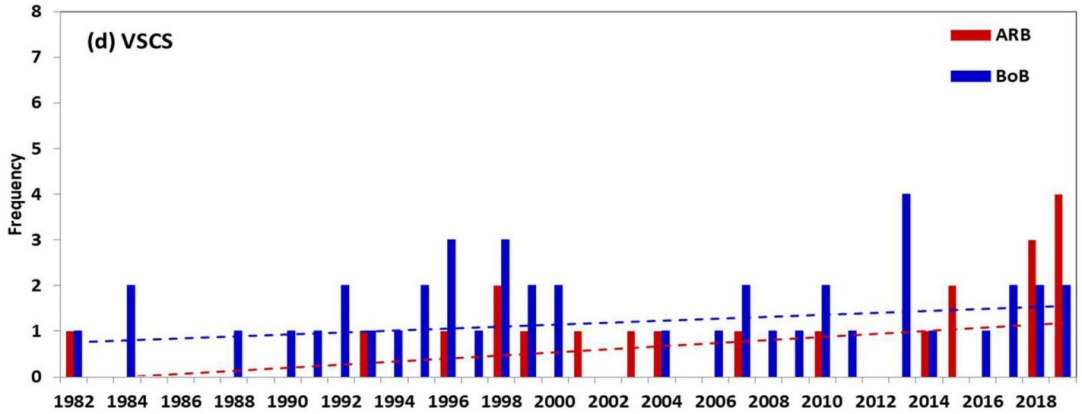
Received: 1 October 2020 / Accepted: 4 July 2021

Abstract
Climatologically, the frequency of tropical cyclones (TCs) in the Bay of Bengal (BoB) is higher relative to that over the Arabian Sea (ARB). However, recent years exhibit a greater number of TCs forming in the ARB than in the BoB. During the study period (1982–2019), a significant increasing trend in the intensity, frequency, and duration of cyclonic storms (CS) and very severe CS (VSCS) is observed over the ARB. There is a 52% increase in the frequency of CS during the recent epoch (2001–2019) in the ARB, while there is a decrease of 8% in the BoB. Over the ARB, increment in CS duration is 80% and VSCS is almost threefold in the recent epoch as compared to the past epoch (1982–2000). Also, lifetime maximum intensity and accumulated cyclone energy have increased over the ARB implying an increase in the strength of TCs. The increase in TC duration over the ARB is prominent during May, June, and October and a decrease over the BoB is noted during November. The increase in the duration of TCs in the ARB is associated with an increase in mid-level relative humidity and column averaged (950-150 hPa) moist static energy, which is significantly correlated to an increase in sea surface temperatures and tropical cyclone heat potential in the basin. In the recent epoch, TC genesis is observed at lower latitudes (< 8° N), which is another factor contributing to longer durations of TCs. This increases the probability of TC intensification with the support from other favourable environmental parameters. Significant changes in TC tracks are also noted in May, June, and October due to changes in steering currents.

Keywords Tropical cyclones · Climate change · North Indian Ocean · Bay of Bengal · Arabian Sea

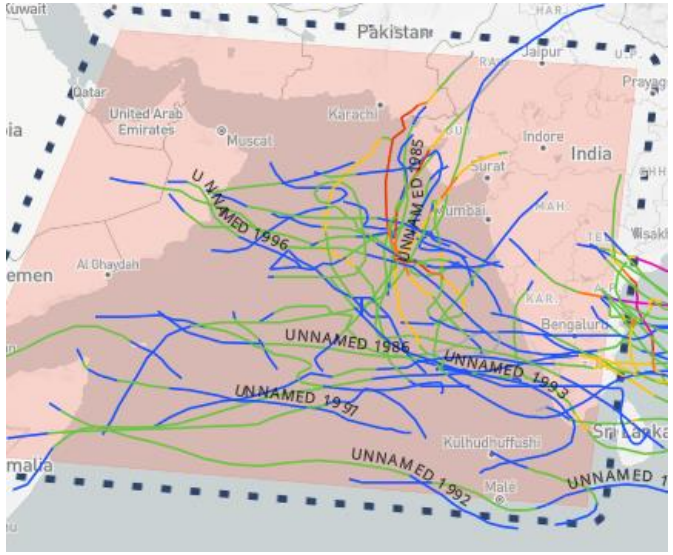
http://www.rocksea.org/bin/research/deshpande_cyclones_climate_dynamics_2021.pdf



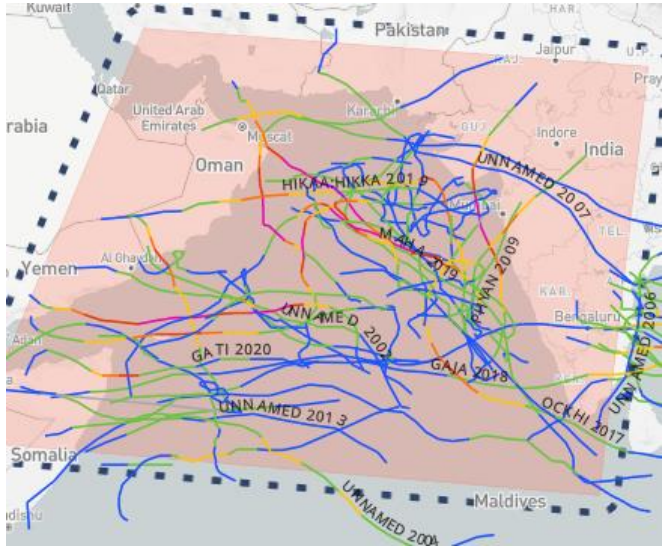


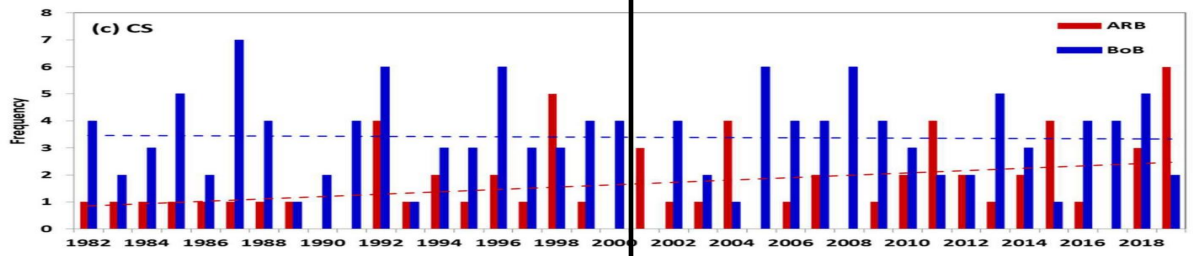
Historic Review on SST of Arabian Sea

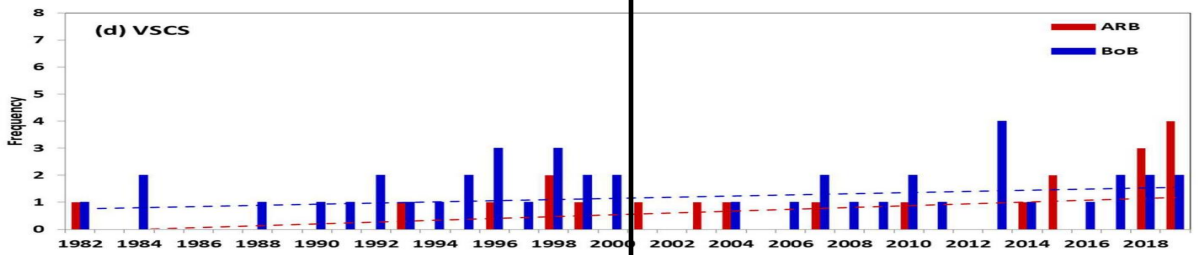
1982-2000



2001-2019





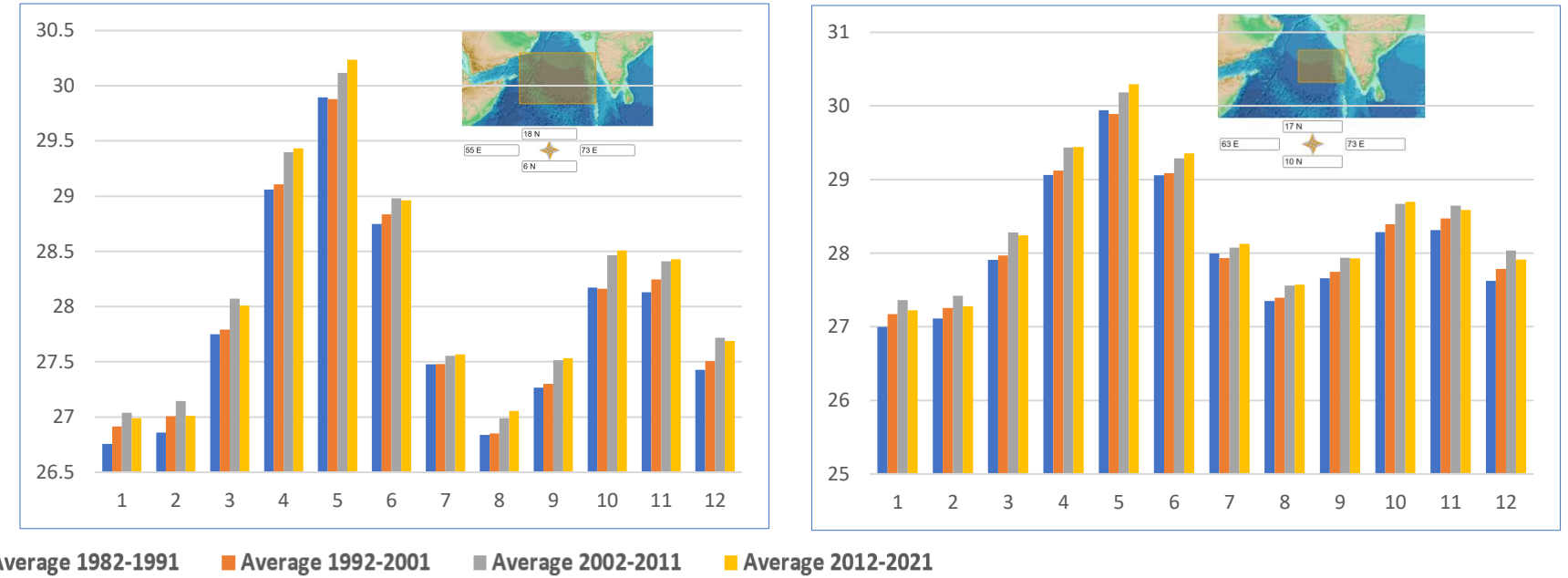


Credit: HISTORICAL HURRICANE TRACKS

https://coast.noaa.gov/hurricanes/#map=4/32/-80

Historic Review on SST of Arabian Sea

Arabian Sea SST



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LAS 8./PyFerret 7.63 NOAA/PMEL

https://mynasadata.larc.nasa.gov/

Спасибо
Ke a leboga
Thank you
Grazia
شكرا لكم
Mersi
Maraming salamat
gratias
Takk
Ihe edn
Žĕkujom
Hioy'oy
Aguyje
Рахмет
Mitela
Asante sana
Zikomo
Suksema
Daank
Mange tak
Meur rasta
Ura
Yin aca leec
Eio
Dankeg
Tsikomo
Mercès
Eskerrik
Paldies
Tapadh leat
Moltes gràcies
Pilámaya
Gracias
Dankscheen
Mercés
Ευχαριστώ
Tack så
Мулцумеск
Tanggio
Tlazohcamati
Ngiyabonga
Terima
Solpayki
Dzięki
ki'e, ki'esai, ki'ecai
Много вам хвала
Aitäh Suur aitäh
Grazzii assai
Ви благодарам
Merci
Recht
Terima kasih banyak
Hatur nuhun
hennaid
Maltiox
Nia:we
Nais
Fakaaue
Gratias tibi ago
Grantangi
Muchas gracias
Háw'aa
Misaotra
спасибо
Sepk'eec'a
Grassie
Hantanye
Dalu
Maulíate
Grazias
Gracies
Liels paldies
Tákk
FaleminDaghang
Kia ora
Дзякуй
Tänan Tänan
Obrigadu
Çox sağ ol
Kiitos
Eso po yu
Wela'lin
Ngiyathokoza
Mahadsanid
Tusen Takk
Makasih ya
Баярлалаа
Thank ye, ta
धन्यवाद
תודה רבה
感謝