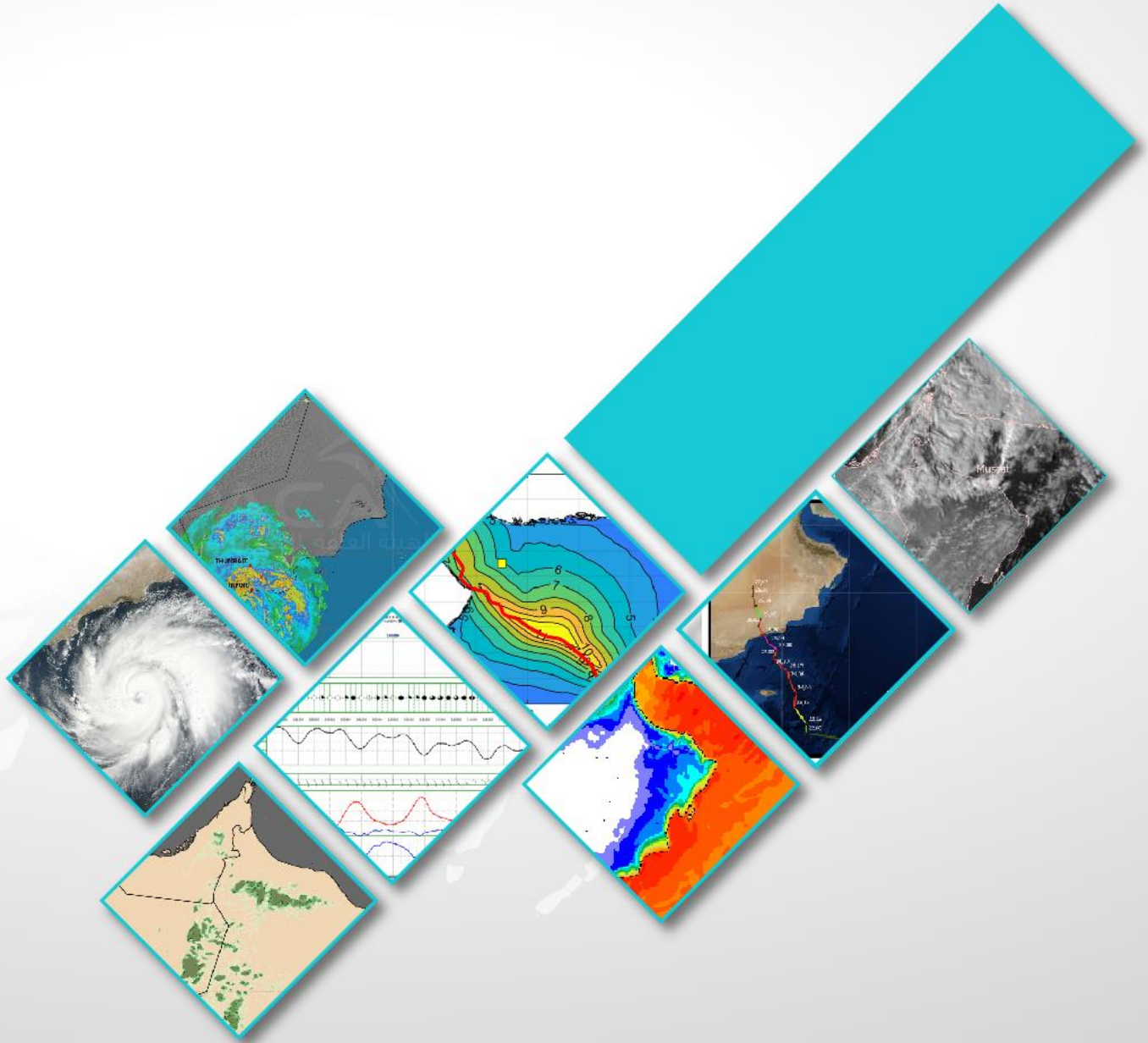
Tropical Cyclones

From formation to dissipation



Content creator: Kahlan Al Toubi

Lecturer: Kahlan Al Toubi

Content

- Definition and names
- Tropical Cyclones zones
- Regional centres and naming protocol
- Structures and features
- Classifications
- Ingredients and favourable conditions
- Formation, maturity and dissipation
- Climatology and history
- Impacts and devastations
- Reading list and useful links

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Definition and names

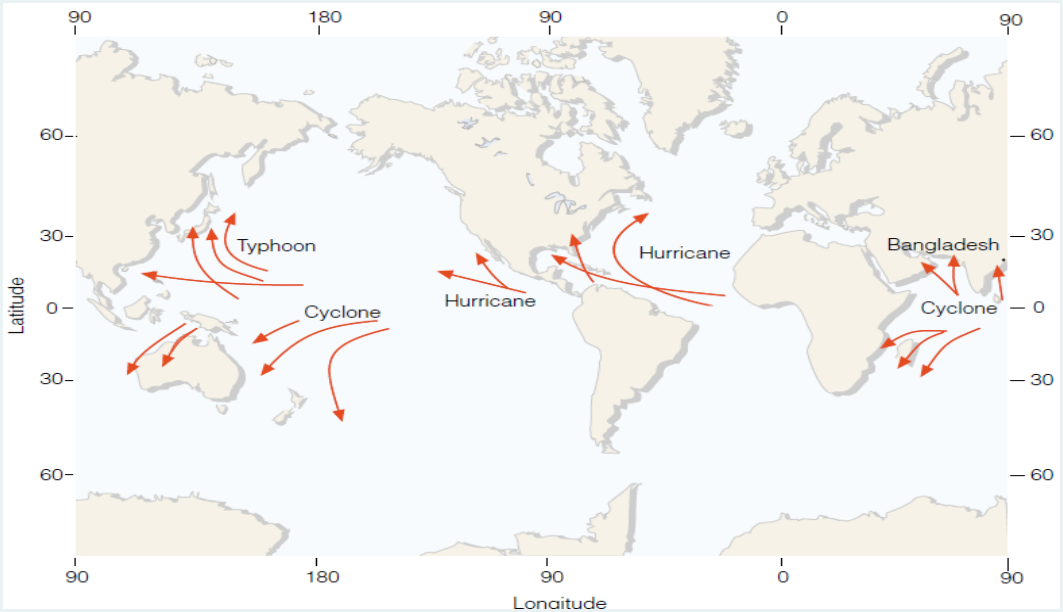
Tropical Cyclones are intense rotating storms form originally in warm tropical water away from the equator with sustained wind around the centre exceeding 64 kts.

There are different names for the system which are:

1-Hurricanes: N. Atlantic and east north Pacific (from Taino language of central America means god of evil

2-Typhoon: western N. Pacific comes from Chinese means big winds

3-Cyclones in Indian ocean and Australia



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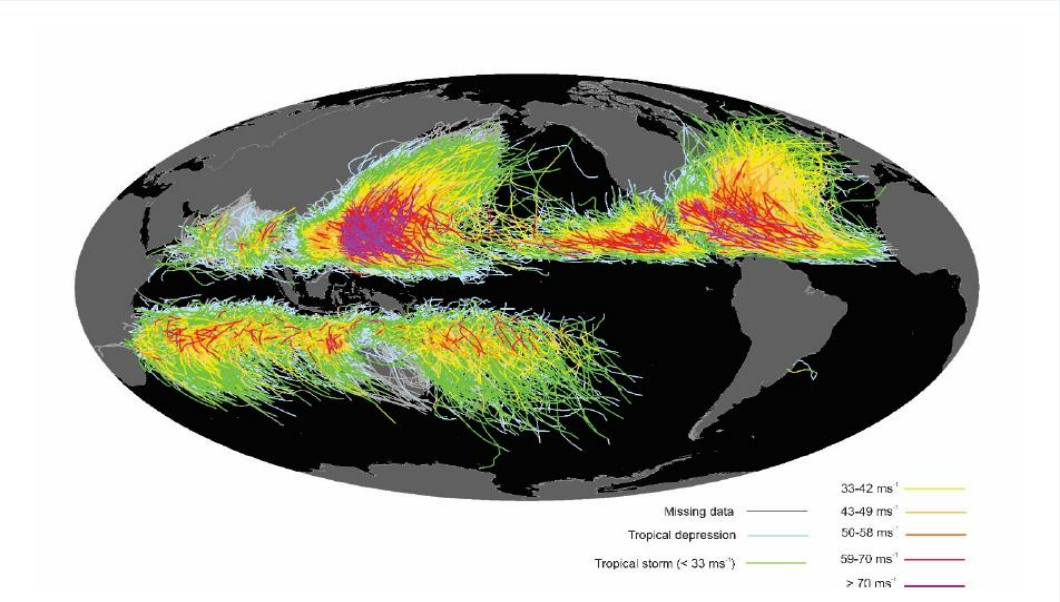
Tropical Cyclones zones

The tropical cyclones develop away from the equator towards the north west or south west. The tropical cyclones form between 5- and 20-degrees altitude. The systems will not develop in the equator as the Coriolis force is zero which means that there is no rotation within the equator.



Tropical Cyclones zones

Ocean Basin	Season	Season Peak	Name
N Atlantic Ocean (includes Caribbean and Gulf of Mexico)	June to November	September	Hurricane
NE Pacific (east of dateline)	Mid May to mid November	Late August to early September	Hurricane
NW Pacific Ocean (west of dateline, includes S China Sea)	All year	Late August to early September	Typhoon
N Indian Ocean (includes Bay of Bengal, Arabian Sea)	April to June and October to December	May and November	Severe Cyclonic Storm
SW Indian Ocean	October to May	mid January to early March	Tropical Cyclone
SE Indian Ocean (north of Australia)	October to May	mid January to early March	Severe Tropical Cyclone
SW Pacific Ocean	November to April	February to early March	Severe Tropical Cyclone

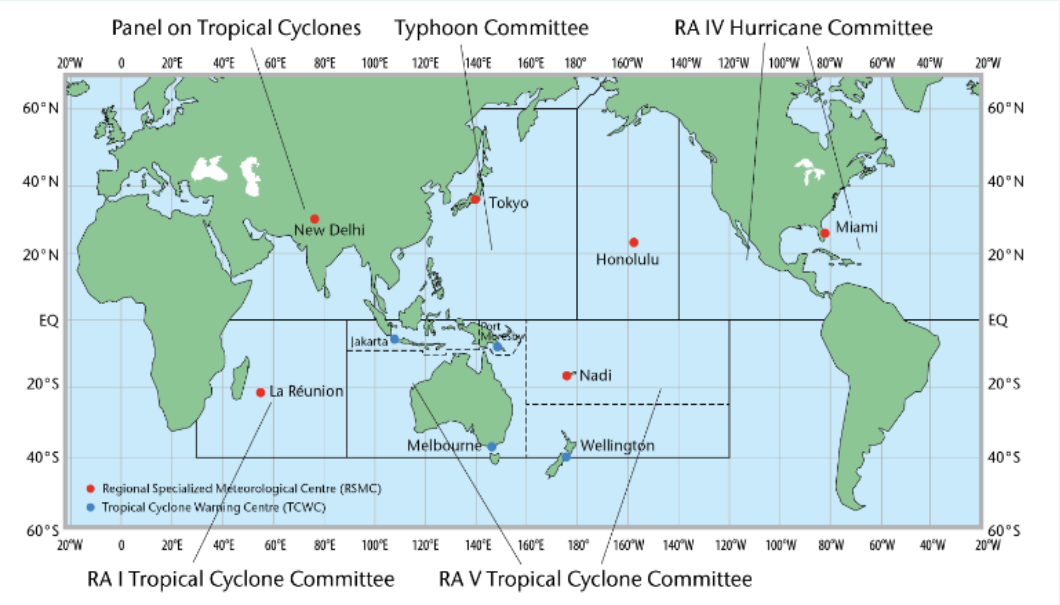
Regional centres and naming protocol

Members of each regional centre agree in a list of names.

The names are ordered using alphabetical order of the countries

Use the link to check the next name of the any upcoming tropical system.

The system gains its name once it developed to tropical storm



Regional centres and naming protocol

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See all regions: https://wmo.int/content/tropical-cyclone-naming

The names to be used will be taken from the list below, starting with Nisarga, then Gati, Nivar, etc.

WMO/ESCAP Panel Member countries	Column 1		Column 2		Column 3		Column 4	
	Name	Pron'	Name	Pron'	Name	Pron'	Name	Pron'
Bangladesh	Nisarga	Nisarga	Biparjoy	Biporjoy	Arnab	Ornab	Upakul	Upokul
India	Gati	Gati	Tej	Tej	Murasu	Murasu	Aag	Aag
Iran	Nivar	Nivar	Hamoon	Hamoon	Akvan	Akvan	Sepand	Sepand
Maldives	Burevi	Burevi	Midhili	Midhili	Kaani	Kaani	Odi	Odi
Myanmar	Tauktae	Tau'Te	Michaung	Migjaum	Ngamann	Ngaman	Kyarthit	Kjathi
Oman	Yaas	Yass	Remal	Re-Mal	Sail	Sail	Naseem	Naseem
Pakistan	Gulab	Gul-Aab	Asna	As-Na	Sahab	Sa-Hab	Afshan	Af-Shan
Qatar	Shaheen	Shaheen	Dana	Dana	Lulu	Lulu	Mouj	Mouj
Saudi Arabia	Jawad	Jowad	Fengal	Feinjal	Ghazeer	Razeer	Asif	Aasif
Sri Lanka	Asani	Asani	Shakhti	Shakhti	Gigum	Gigum	Gagana	Gagana
Thailand	Sitrang	Si-Trang	Montha	Mon-Tha	Thianyot	Thian-Yot	Bulan	Bu-Lan
United Arab Emirates	Mandous	Man-Dous	Senyar	Sen-Yaar	Afoor	Aa-Foor	Nahhaam	Nah-Haam
Yemen	Mocha	Mokha	Ditwah	Ditwah	Diksam	Diksam	Sira	Sira

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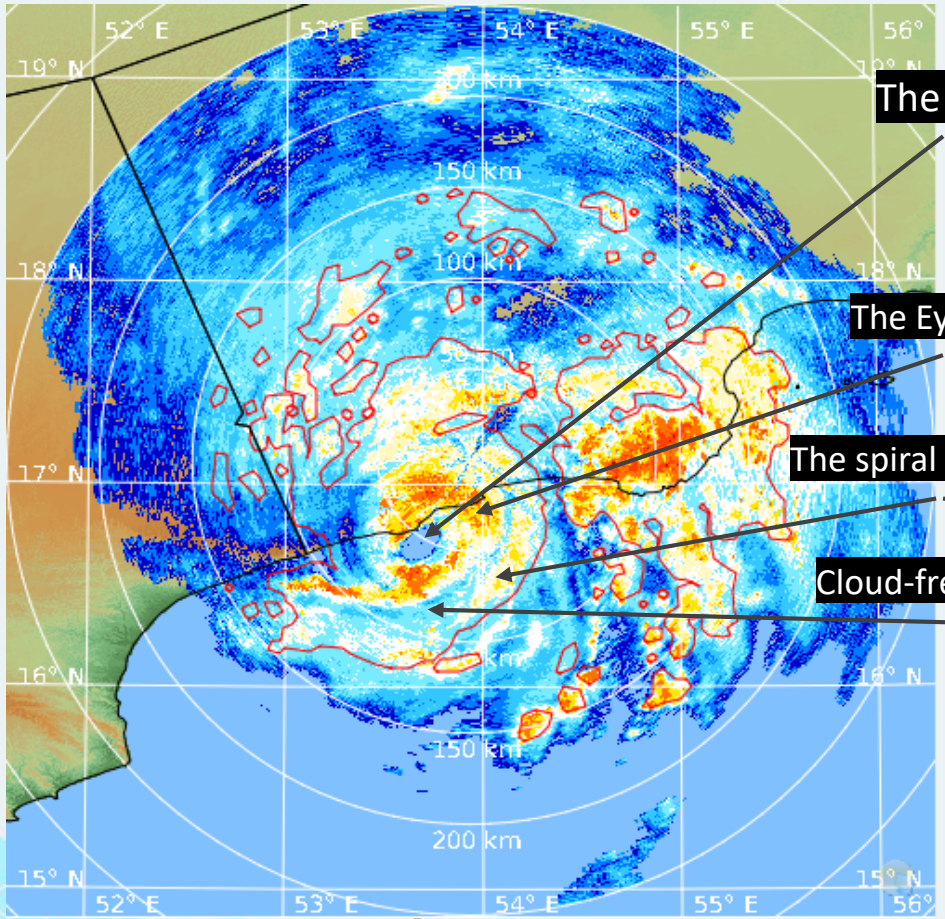
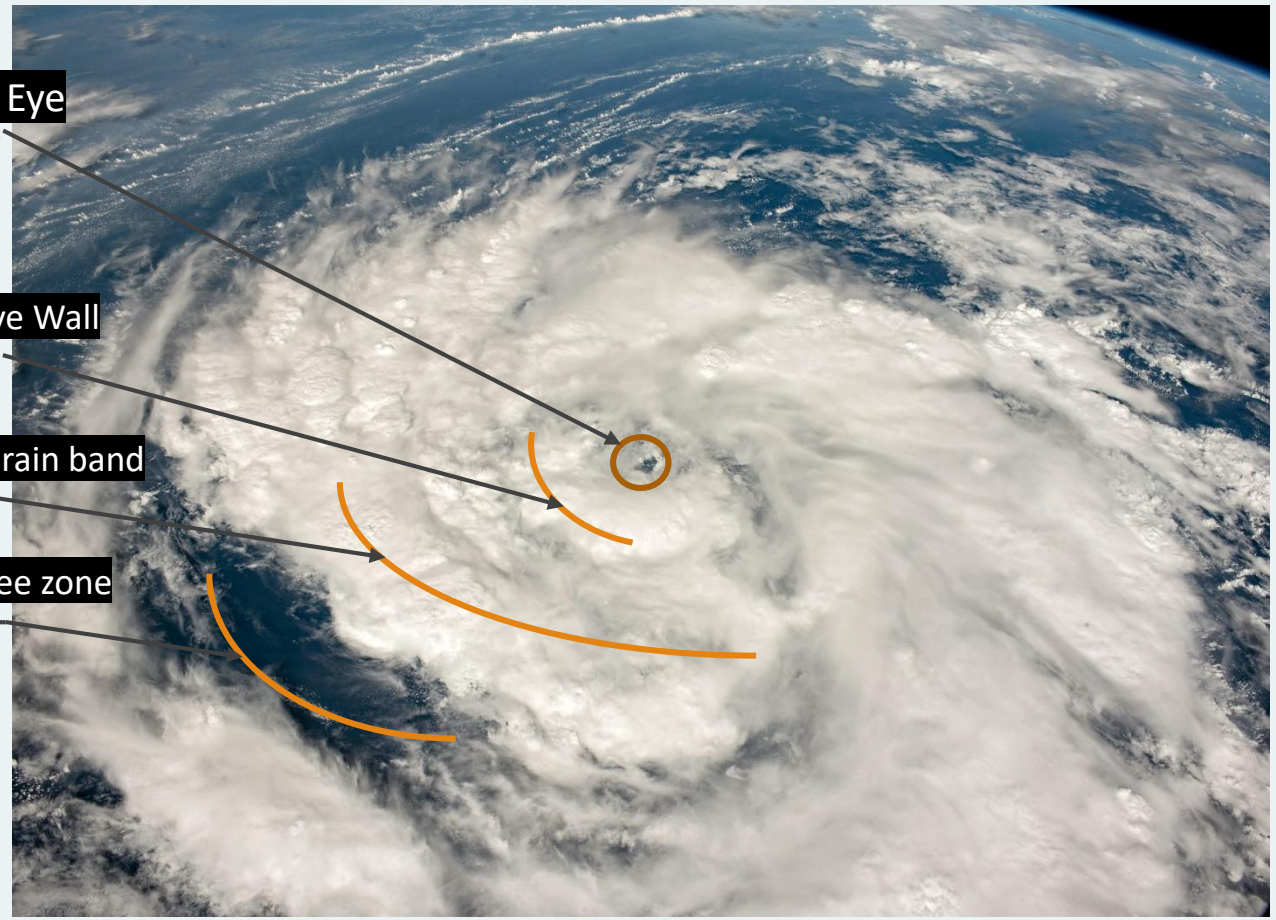
Structure and features



Mekunu 2018



Tej 2023

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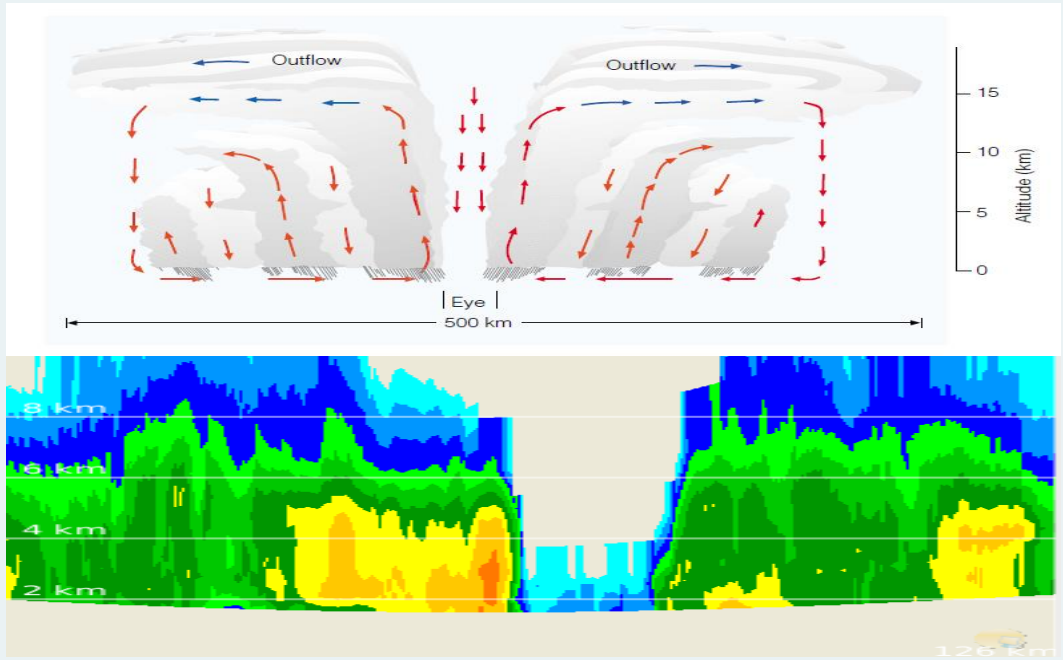
Structure and features

Moist air rises and condenses as it is moving towards the centre.

The air loses the moisture as it gets lifted which form divergence zone aloft

The latent heat adds heat to warm air to form high pressure aloft.

The sink of air within the eye keeps the eye a cloud-free area.



Mekunu 2018

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Classifications

The classification differs from region to region. It is just like the names of the cyclones i.e typhoon, hurricanes.

The Indian meteorological department have slightly different classification scheme comparing to the other regional centres.

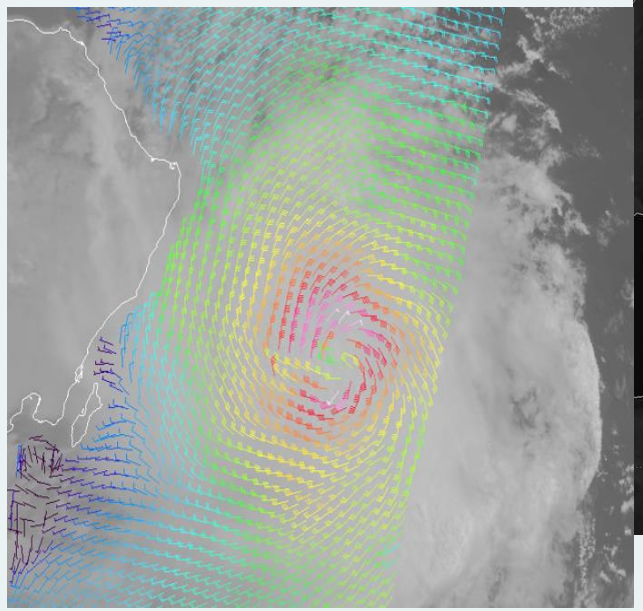
Oman classification scale

The wind speed is estimated by ASCAT instrument

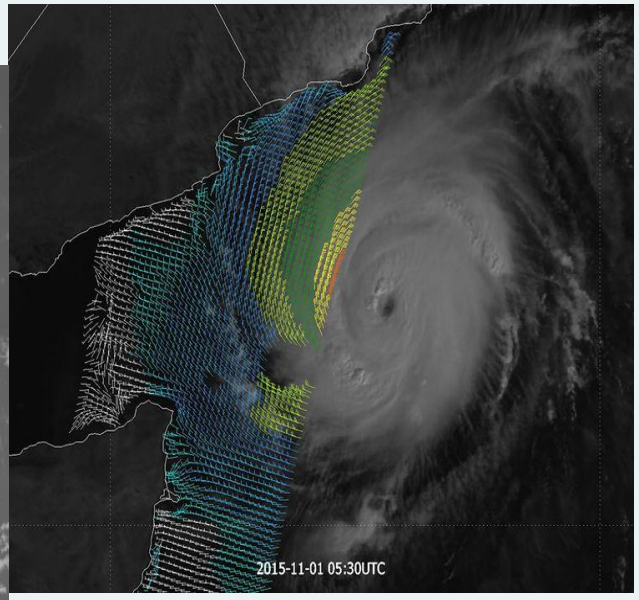
Oman- DGMET 10-minute sustained winds		JTWC 1-minute sustained winds		RSMC "New Delhi" 3-minute sustained winds	
≤ 17	Low Pressure	-	-	≤ 17	Area of Low Pressure
17 to 33	Deep Depression	≤ 33	Tropical Depression	17 to 27	Depression
34 to 63	Tropical Storm	34 to 63	Tropical Storm	28 to 33	Deep Depression
64 to 82	CAT 1	64 to 82	CAT 1	34 to 47	Cyclonic storm
83 to 95	CAT 2	83 to 95	CAT 2	48 to 63	Severe cyclonic storm
96 to 112	CAT 3	96 to 112	CAT 3	64 to 89	Very severe cyclonic storm
113 to 136	CAT 4	113 to 136	CAT 4	90 to 119	Extremely severe cyclonic storm
≥ 137	CAT 5	≥ 137	CAT 5	>120	Super cyclonic storm

Classifications

“The Advanced Scatterometer (ASCAT) uses radar to measure the electromagnetic backscatter from the wind-roughened ocean surface, from which data on wind speed and direction can be derived. The measuring principle relies on the fact that winds over the sea cause small-scale disturbances of the sea surface, which modify its radar backscattering characteristics in a particular way. These backscattering properties are well known and are dependent on both the wind speed over the sea and the direction of the wind with respect to the point from which the sea surface is observed. Once MetOp is in its polar orbit 800 kilometres above the surface of the Earth”



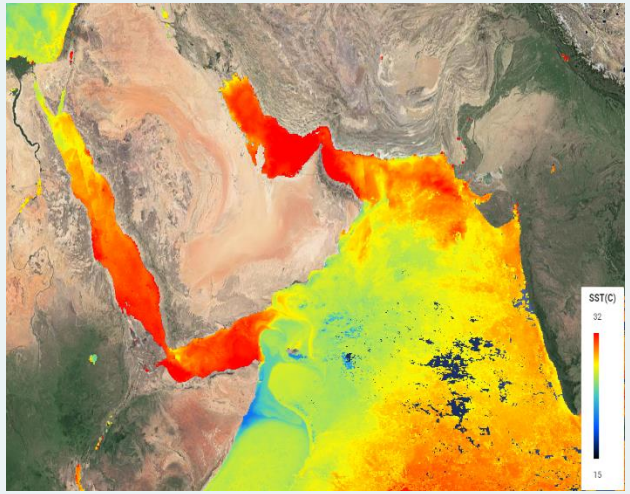
Ashoba,2015



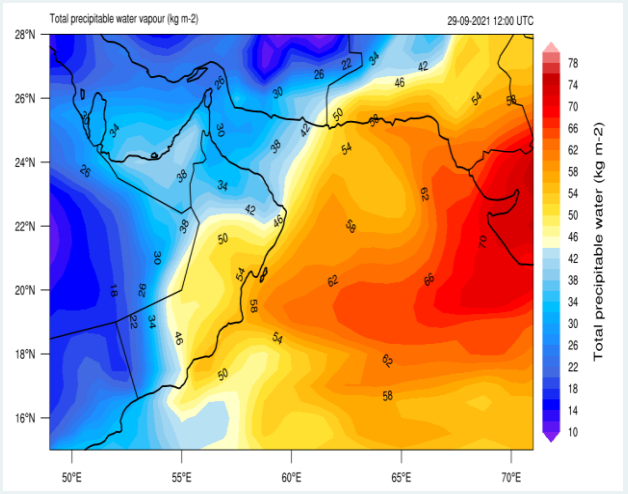
Luban, 2018

Ingredients and favourable conditions

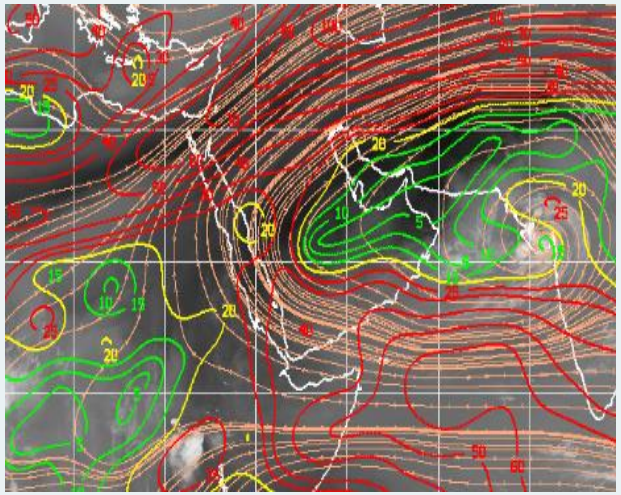
Shaheen,2021



Warm Ocean



Warm, moist air



Weak to no vertical wind shear

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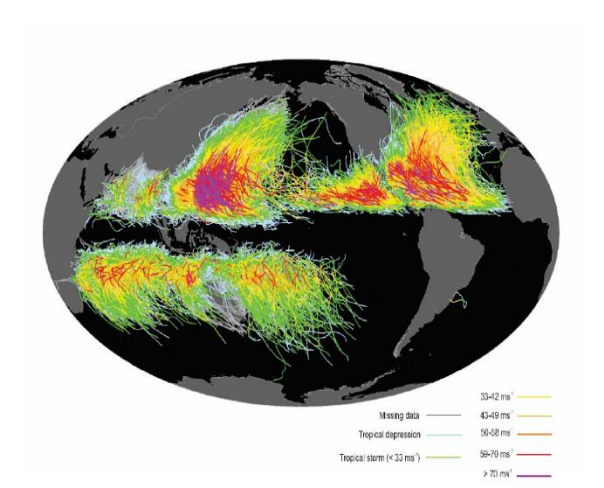
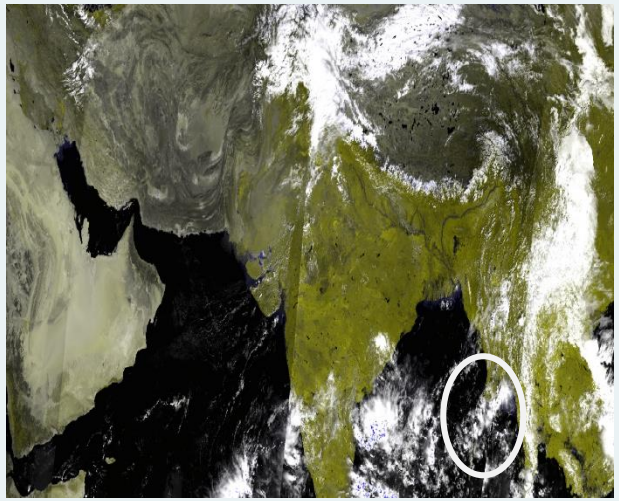
Ingredients and favourable conditions

Shaheen,2021



5 degrees from equator



Pre-existing disturbance or low

Formation, maturity and dissipation

1- formation:

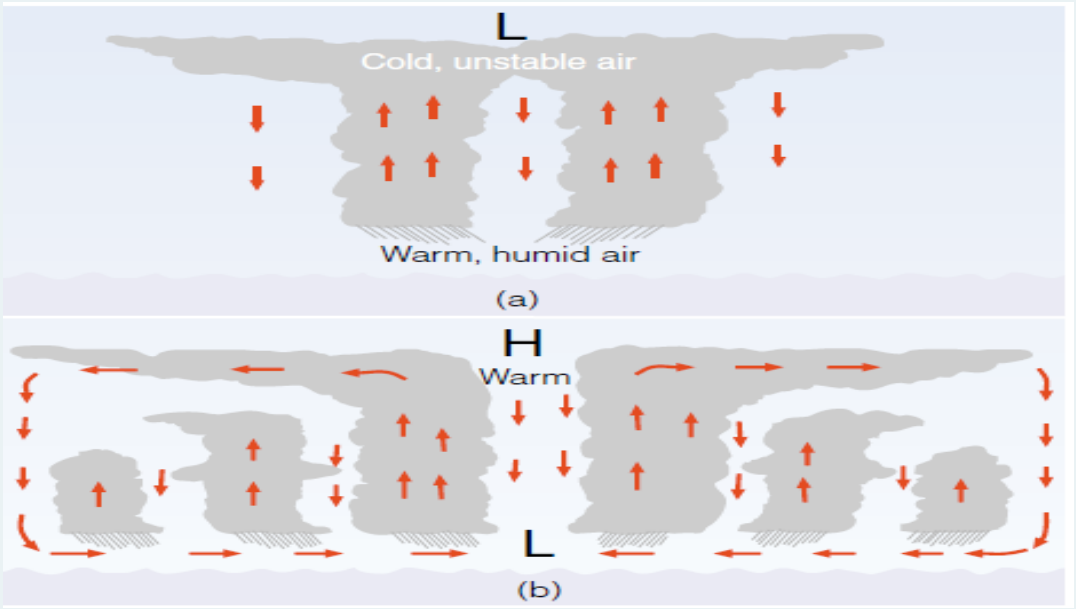
a pre-existing area of low pressure to initiate the vorticity and rotation. The initiation needs a sustained moisture feeding into the system as well as the instability

2- Maturity

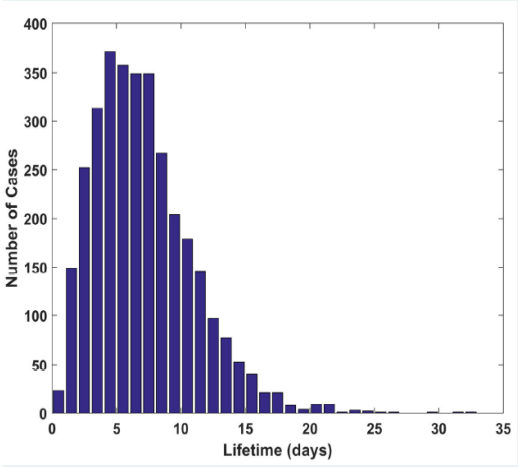
The feeding continuous till the system reaches a stage where the thunderstorms consume all the energy and the air has not have enough heat to warm up, and the low level inflow exceeds the upper air outflow.

3- dissipation

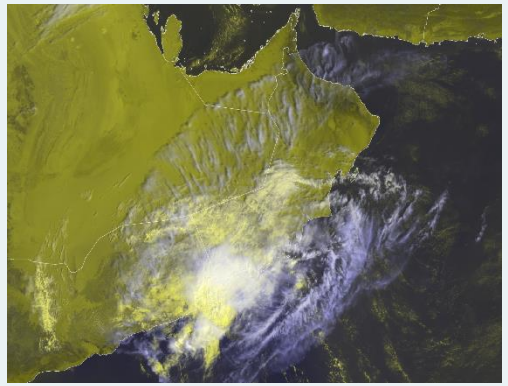
The system start to dissipate when the energy source is cut off either because it moves over colder water or makes landfall.



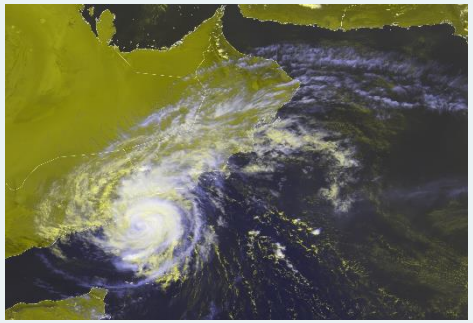
Formation, maturity and dissipation

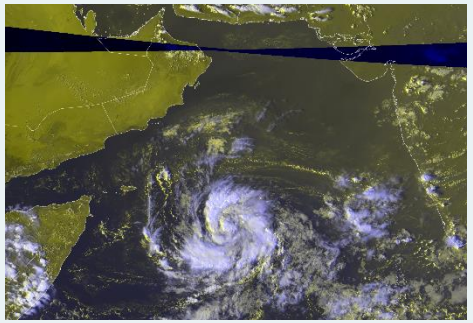


Dissipation



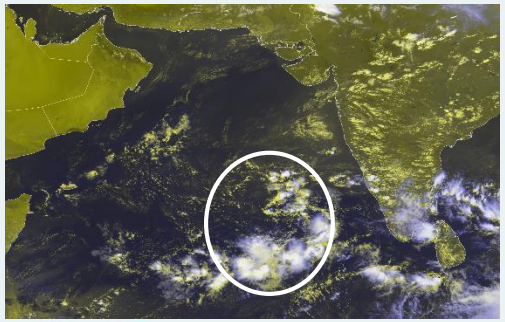
Tropical cyclone



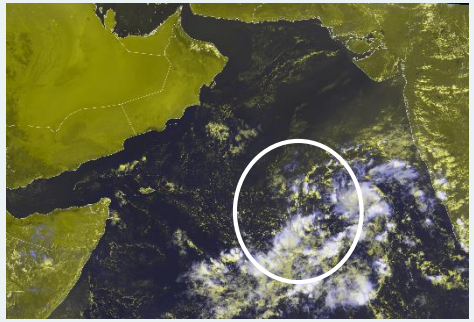


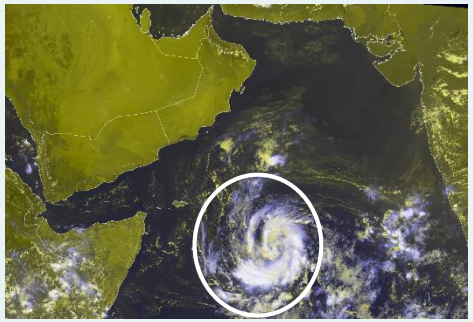
Tropical storm

Disturbance



Area of low pressure

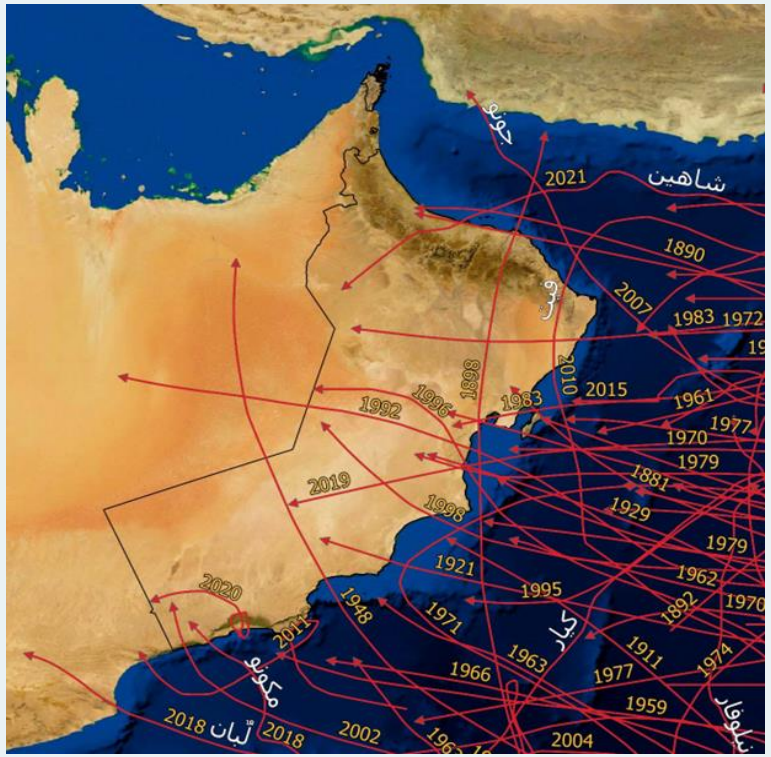




Deep depression

Climatology and history

- Oman is affected by the tropical cyclones with different intensity.
- The affect can be direct or indirect
- Most of the cyclones moves towards the coastal areas along with Arabian sea comparing to the Sea of Oman
- There is no exact frequency of tropical systems formation and development
- The Tropical cyclones over Oman can be divided into three seasons



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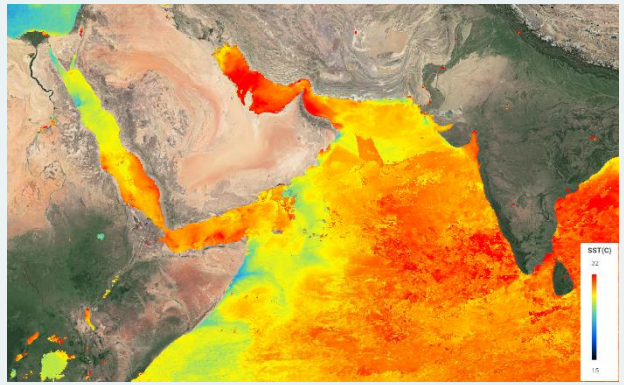
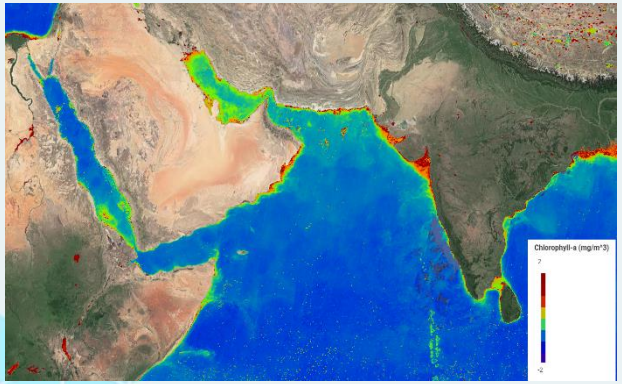
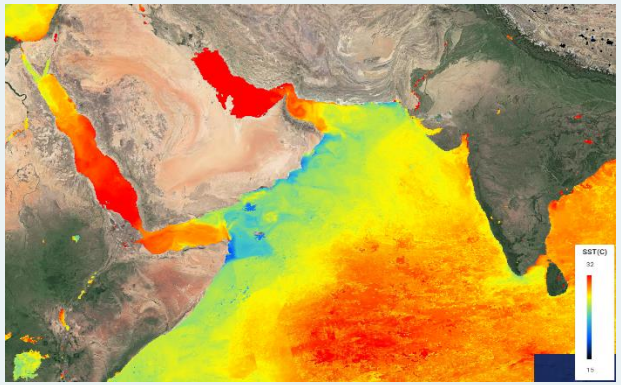
Climatology and history

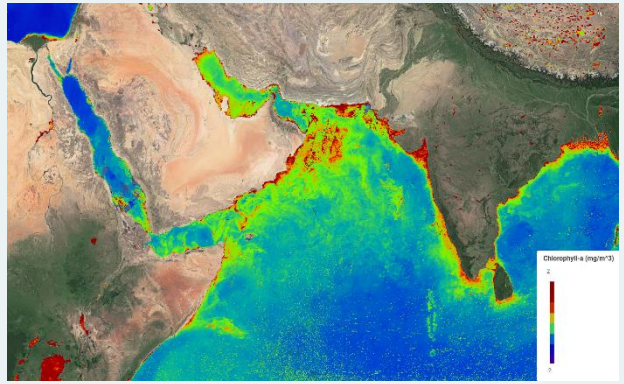
Pre-Monsoon



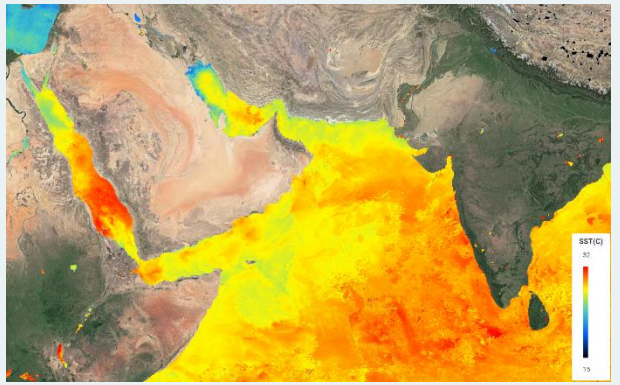


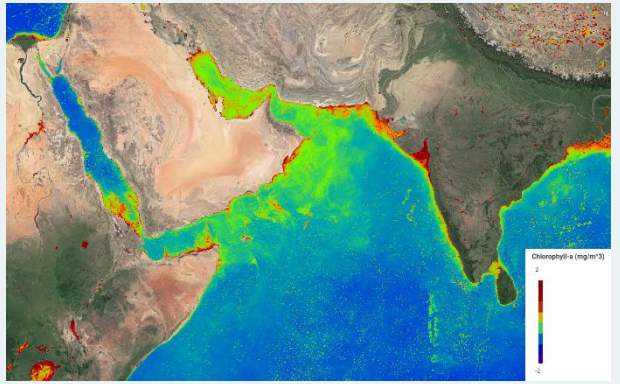
Monsoon





Post-Monsoon





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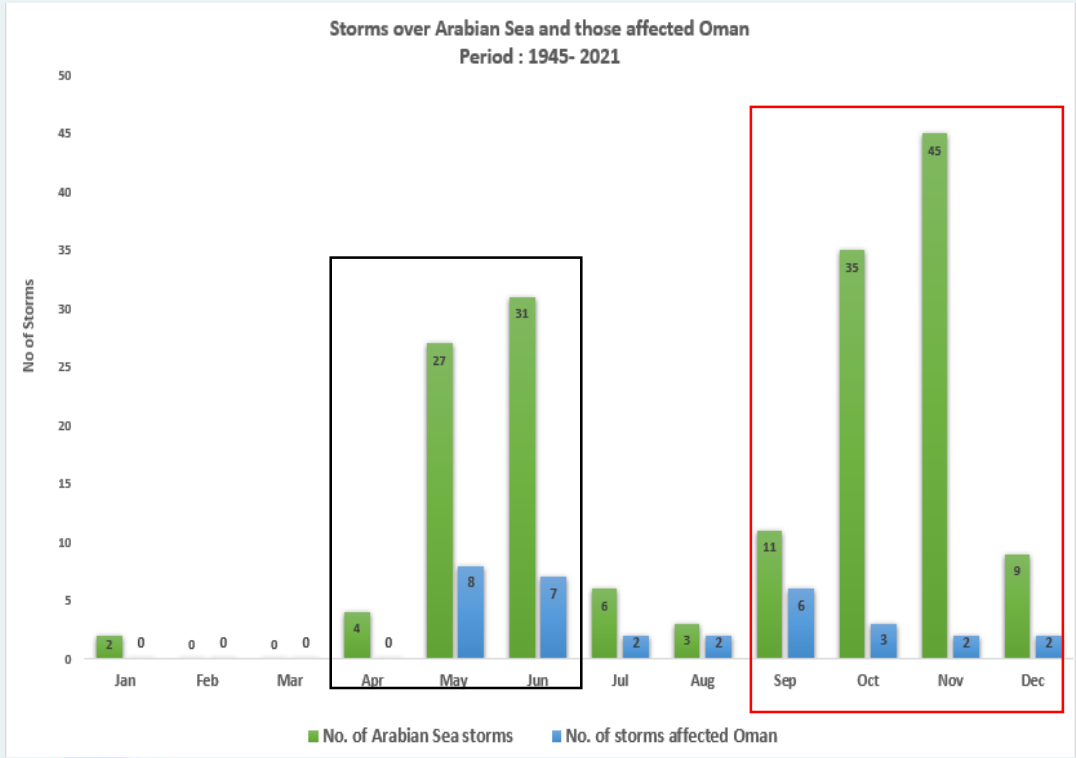
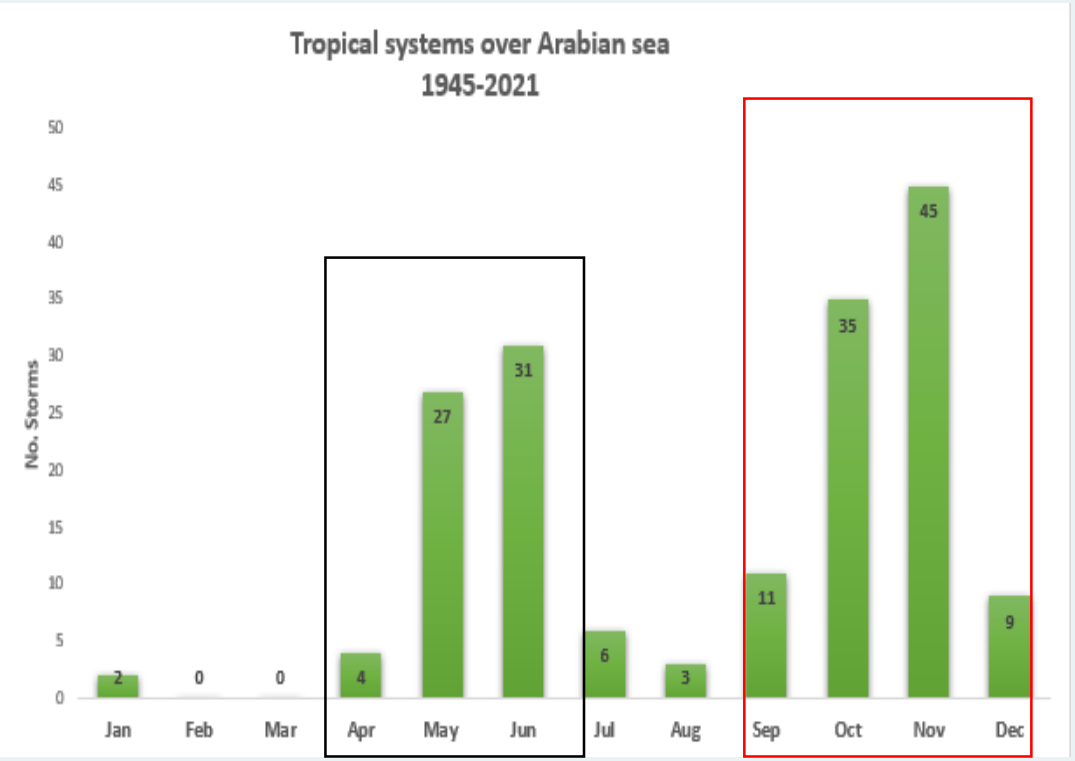
Climatology and history

Pre-Monsoon



Post-Monsoon



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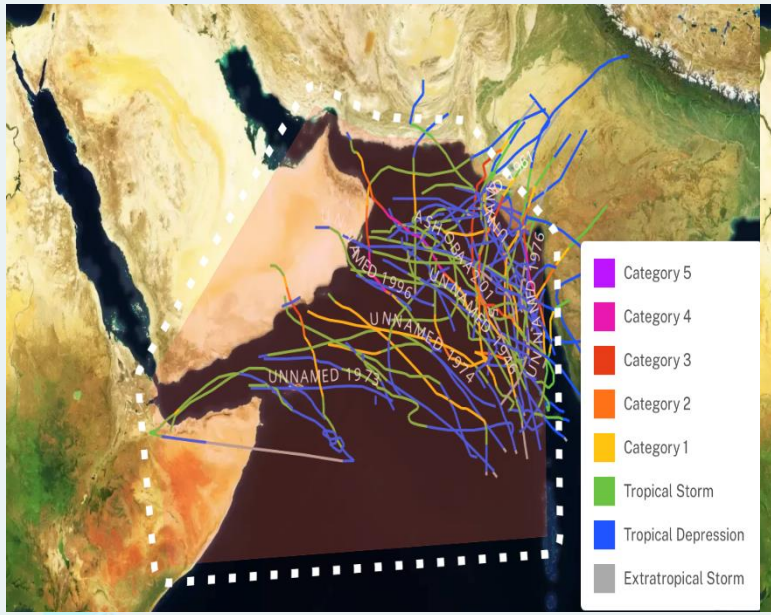
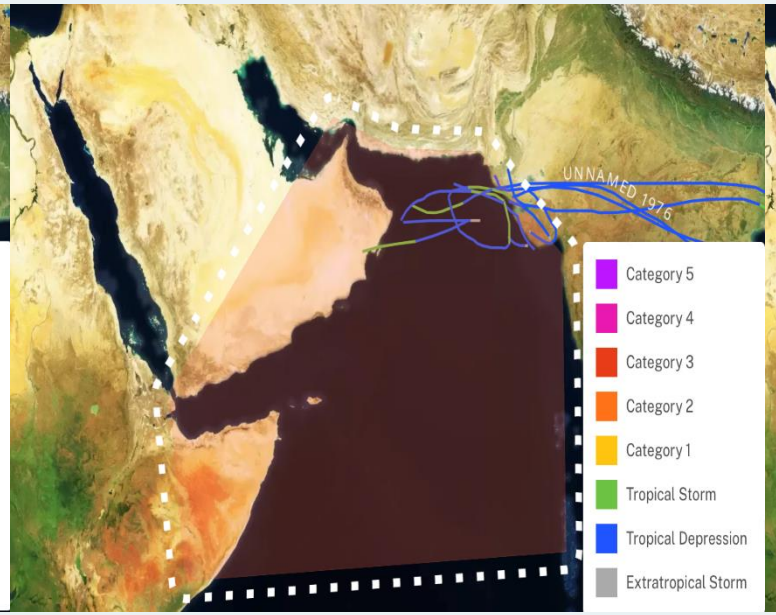
Climatology and history

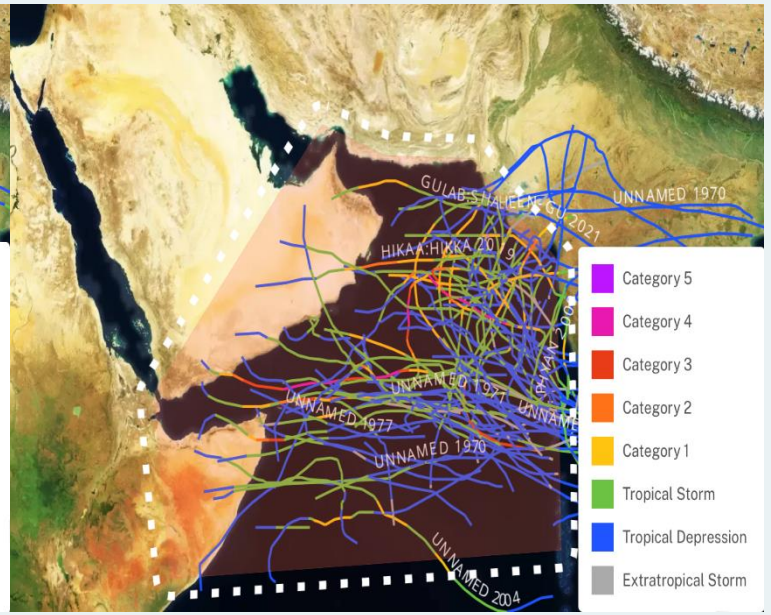
Pre-Monsoon



Monsoon



Post-Monsoon



See the historical tracks: https://coast.noaa.gov/hurricanes/#map=4/32/-80

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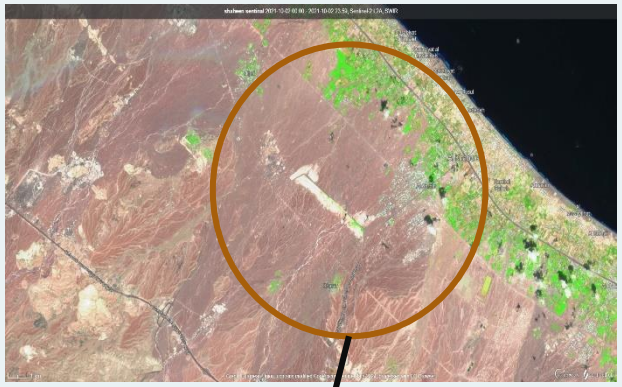
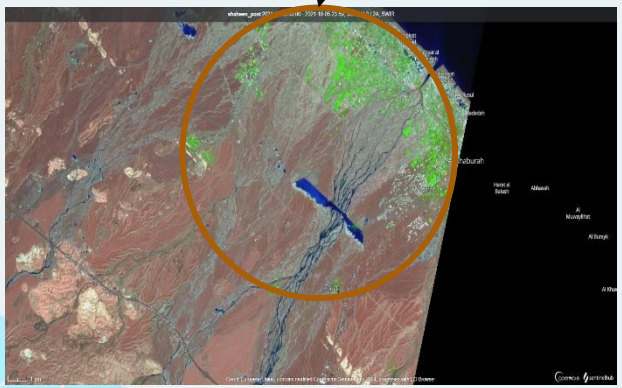
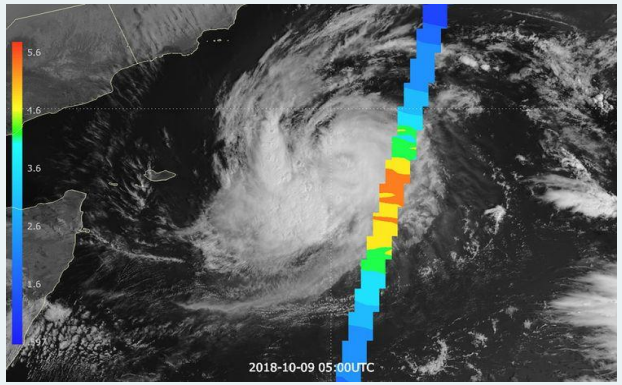
Impacts and devastations







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Reading list and useful links

Ahrens, C. (1997). *Essentials of Meteorology: An invitation to the atmosphere*. http://ci.nii.ac.jp/ncid/BA84206002

Evan, A. T., & Camargo, S. J. (2011). A Climatology of Arabian Sea cyclonic storms. Journal of Climate, 24(1), 140–158. https://doi.org/10.1175/2010jcli3611.1

Emanuel, K. (2003). Tropical cyclones. Annual Review of Earth and Planetary Sciences, 31(1), 75–104. https://doi.org/10.1146/annurev.earth.31.100901.141259

https://shorturl.at/dyDV0

https://wmo.int/content/tropical-cyclone-naming

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

https://shorturl.at/fxBUW

https://www.noaa.gov/jetstream/tropical/tropical-cyclone-introduction/tropical-cyclone-structure

Thank you

Kindly scan this “QR code”
to evaluate this lecture