Rapid Intensification of Cyclones

Why in News?

Recently Hurricane Milton rapidly intensified to Category 5 storm in less than a day on a path across the Gulf of Mexico toward Florida and became one of the strongest Atlantic storms.

How Cyclones are categorised?

- **Tropical Cyclone** – It is a rotational low-pressure system in tropics when the central pressure falls by 5 to 6 hPa(hectopascals) from the surrounding and maximum sustained wind speed reaches 34 knots (about 62 kmph).
- **Cyclone Movement** - It is a vast violent whirl of 150 to 800 km, spiralling around a centre and progressing along the surface of the sea at a rate of 300 to 500 km a day.
- **Names** - Tropical cyclones are called "Hurricanes" over the Atlantic Ocean and "Typhoons" over the Pacific Ocean.
- **Sustained Wind Speed** - India Meteorological Department (IMD) uses a 3 minutes averaging for the sustained wind that is highest 3 minutes surface wind occurring within the circulation of the system.
- **Categorization of Cyclones** - The low-pressure systems over Indian region are classified into Low, Depression and Cyclone based on
    - Maximum sustained winds speed associated with the system and
    - Pressure deficit/ number of closed isobars associated with the system.
- The pressure criteria are used when the system is over land and wind criteria is used, when the system is over the sea.
- **Pressure Criteria**
    - **Low** - If there is one closed isobar in the interval of 2 hPa. I
    - **Depression** - If there are two closed isobars
    - **Deep depression** - If there are three closed isobars
    - **Cyclonic storm** - If there are four or more closed isobars.
- **Wind Criteria**

System	Pressure deficient hPa w.r.t T No.	Associated wind speed Knots (Kmph)
Low pressure area	1.0	<17(<31)
Depression	1.0- 3.0	17-27 (31-49)
Deep Depression (DD)	3.0 - 4.5	28-33 (50-61)
Cyclonic Storm (CS)	6.1-10.0	34-47 (62-88)
Severe Cyclonic Storm (SCS)	15.0	48-63 (89-117)
Very Severe Cyclonic Storm (VSCS)	20.9-29.4	64-89 (118-166)
Extremely Severe Cyclonic Storm (ESCS)	40.2-65.6	90-119 (167-221)
Super Cyclonic Storm	≥ 80.0	≥ 120 (≥ 222)

- **Intensity of Cyclone -** It is near-surface maximum wind speed around the circulation centre, or as the minimum surface pressure at the tropical cyclone pressure centre.

Cyclone Category	Wind Speed in Km/h	Damage Capacity
01	120-150	Minimal
02	150-180	Moderate
03	180-210	Extensive
04	210-250	Extreme
05	250 and above	Catastrophic

Categorization of winds across the globe

knot	km/h	Beaufort	South West Indian Ocean*	Arabian Sea and Bay of Bengal**	North West Pacific**	North Atlantic and North East Pacific***	South West Pacific and South East Indian Ocean*
Average wind speed			knot km/h	knot km/h		Knot km/h mi/h	knot km/h
			Zone of disturbed weather	Low pressure area			Tropical disturbance
17 27	31 50	6	Tropical disturbance	Depression	Tropical depression	Tropical depression	Tropical low/depression
28 33	51 62	7	Tropical depression	Deep depression			
34 40 47	63 88	8 9	Moderate tropical storm	Cyclonic storm	Tropical storm	34 39 Tropical storm	Tropical cyclone (gale) / Category 1
48 52 63	89 117	10 11	Severe tropical storm	Severe cyclonic storm	Severe tropical storm	73	Tropical cyclone (storm) / Category 2
64	118	12	64 Tropical cyclone	64 Very Severe Cyclonic Storm	Typhoon	64 Hurricane CAT 1 82 153 95	64 Severe tropical cyclone (hurricane) / Category 3
						83 154 96 Hurricane CAT 2 95 177 110	
			89 165	89 166		96 178 111 Hurricane CAT 3 112 208 129	85 159
			90 166 Intense tropical cyclone 115 212	90 167 Extremely Severe Cyclonic Storm 119 221		113 209 130 Hurricane CAT 4 136 251 156	86 160 Tropical cyclone / Category 4 107 199
			116 213 Very intense tropical cyclone	120 222 Super cyclonic storm		137 252 157 Hurricane CAT 5	>107 >200 Tropical Cyclone / Category 5

What is Saffir-Simpson Hurricane Wind Scale?

- **Saffir Simpson hurricane wind scale** – It is based on the highest wind speed averaged over a ***one-minute interval 10 m above*** the surface and is used in Atlantic and Pacific basins.
- **Rating** - It is a 1 to 5 rating based only on a hurricane's maximum sustained wind speed.
- **Damage Factor** - This scale does not take into account other potentially deadly hazards such as storm surge, rainfall flooding, and tornadoes but it estimates potential property damage.
- While all hurricanes produce life-threatening winds, hurricanes rated Category 3 and higher are known as major hurricanes.

Saffir-Simpson Hurricane Wind Scale		
Category	**knots**	**km/h**
5	≥ 137	≥ 252
4	113–136	209–251
3	96–112	178–208
2	83–95	154–177
1	64–82	119–153
TS	34–63	63–118
TD	≤ 33	≤ 62

- **Super-typhoon** – In the western North Pacific, the term super typhoon is used for tropical cyclones with sustained winds exceeding 150 mph.
- This is the equivalent of a strong Saffir-Simpson category 4 or category 5 hurricane in

the Atlantic basin or a category 5 severe tropical cyclone in the Australian basin.

What causes hurricanes to rapidly intensify?

- **Rapid intensification** – It is the increase in a tropical cyclone's maximum sustained wind speed of at least 30 knots – about 35 mph within a 24-hour period.

Cyclone Milton's wind speed went from 80 mph to 175 mph from 1 p.m. Sunday to 1 p.m. Monday, and its pressure dropped from 988 millibars to 911.

- **Causes of Rapid Intensification** - Rapid intensification is difficult to forecast, but there are a few driving forces.
- **Ocean Heat**-Warm Sea surface temperatures provide the energy necessary for hurricanes to intensify and deeper the warm water, the more energy a storm can draw upon, enhancing its strength.
- **Low Wind Shear** - Strong vertical wind shear can disrupt a storm's organisation, while low wind shear allows hurricanes to grow more rapidly.

Wind sheer is the change in wind speed or direction with height.

- **Moisture**-Higher Sea surface temperatures and lower salinity increase the amount of moisture available to storms.
- This allows more sustained heat and moisture to transfer to the storm, driving faster and stronger intensification.

Warmer waters provide the heat needed for moisture to evaporate, while lower salinity helps trap that heat near the surface.

- **Thunderstorm Activity** - Internal dynamics, such as bursts of intense thunderstorms within a cyclone's rotation, can reorganize a cyclone's circulation and lead to rapid increases in strength.
- **Recent Trend -** A majority of hurricanes Category 3 and above tend to undergo rapid intensification within their lifetimes.
- The number of tropical cyclones experiencing rapid intensification over the past four decades is on the rise.
- That includes a significant rise in the number of hurricanes that rapidly intensify multiple times during their development.

How does global warming influence hurricane strength?

- Global warming significantly influences hurricane strength through various interconnected mechanisms.
- The interplay between warmer oceans, increased atmospheric moisture, and rising sea levels due to global warming is making hurricanes stronger and more destructive.

- **Warmer Ocean Temperatures** - As global temperatures rise, sea surface temperatures also increase, providing more energy for storms.
- **Rapid Intensification** - Warmer waters also facilitate rapid intensification of hurricanes.
- **Increased Atmospheric Moisture** - A warmer atmosphere can hold more moisture, which leads to heavier rainfall during hurricanes.
- Rainfall from tropical cyclones could increase by 11% by the end of this century if global warming is limited to 1.5°C.
- **Rising Sea Levels**-Higher Sea levels result from melting ice and thermal expansion of seawater due to warming and this sea level rise exacerbates the impact of storm surges during hurricanes.
- **Changes in Hurricane Behaviour** - Slower Movement of hurricanes lead to prolonged periods of heavy rainfall and wind in affected areas, increasing overall damage.

References

1. The Hindu | Climate change and hurricane Milton
2. IMD | Cyclones FAQ