

Marine heatwave fuelled super cyclone Amphan

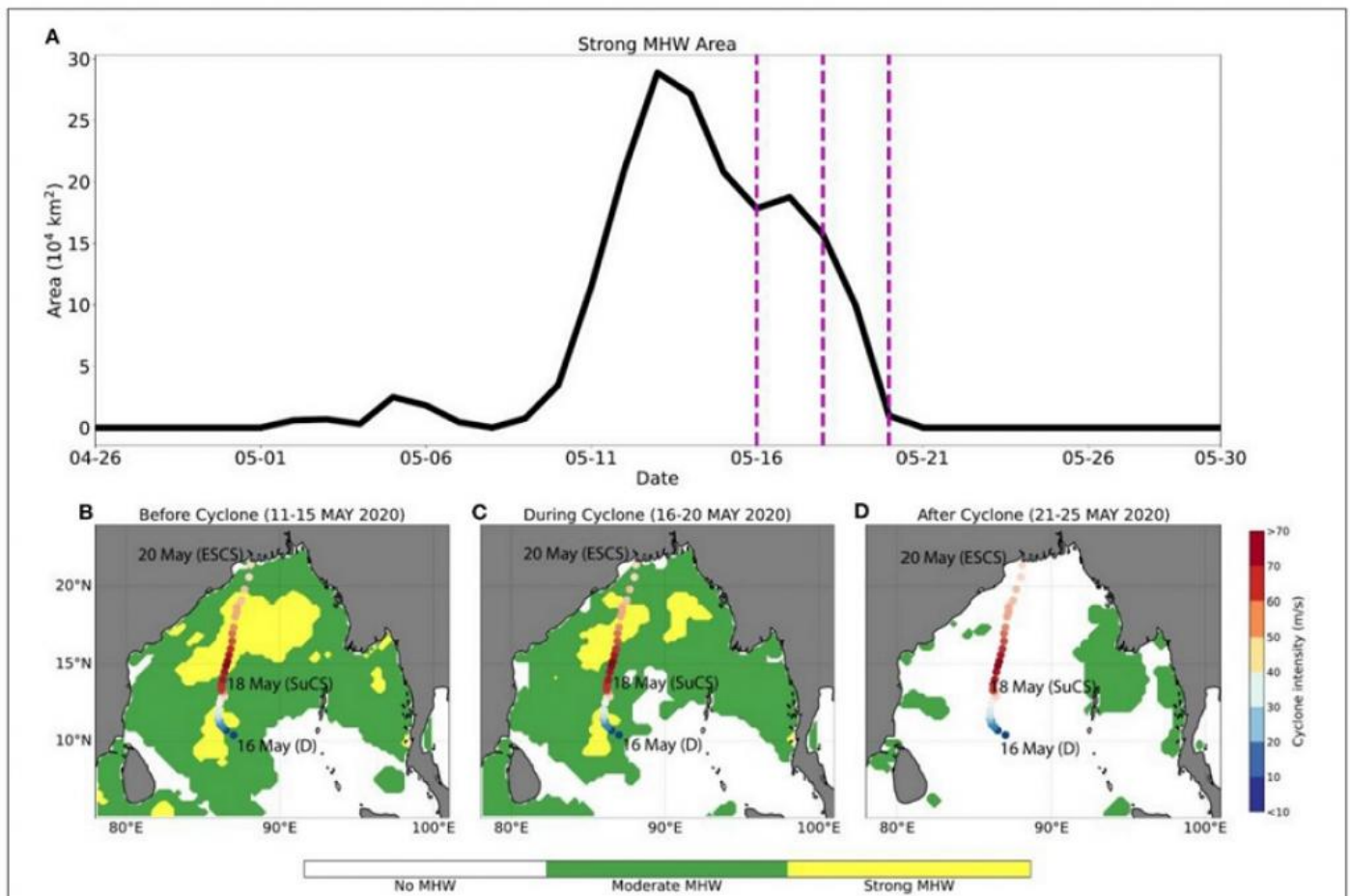
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Why in news?

- Recently, a first of its kind study was conducted in the Indian Ocean that investigates the interaction between a marine heatwave and super cyclone Amphan in the Bay of Bengal in May 2020.
- The co-occurrence of multiple extreme events (e.g. in this case the co-occurring marine heatwave and tropical cyclone) are termed compound extreme events.

Global warming:

- Rising greenhouse gas emission is the **primary factor for anthropogenic (human-induced) climate change**.
- The increase in carbon dioxide concentration can trap the radiation into the atmosphere and not let it go into space. This **trapping of the extra energy increases the average surface air temperature** and warms the climate that is known as global warming.



How GHG are responsible for warming of oceans?

- As the capacity of the atmosphere to absorb the heat is very less, **more than 90% of the extra heat that has been trapped** in the climate system has been **absorbed by the oceans since 1970**, according to IPCC AR5, and IPCC AR6 reports.
- Due to this, oceans are warming globally from the surface to deeper depths.
- The **warming of the oceans has severe consequences** such as increasing intensity and frequency of extreme events, rising sea levels, melting glaciers, and changing the weather pattern across the globe.

Marine Heatwaves (MHWs) in Indian Ocean:

- Previous studies have shown that due to global warming, the **tropical Indian Ocean**, at the surface, is warming at a faster rate as compared to the rest of the global ocean.

- The high sea surface temperatures are more susceptible to generating extreme temperature conditions that persist over days to months and are termed as **Marine Heatwaves (MHWs)**.
- This intense warming of the ocean due to MHW has **severe socio-economic consequences** such as fish mortality, and coral bleaching, and also has the potential to interact and modify other extreme events such as tropical cyclones.
- The anthropogenic warming of the oceans and atmosphere facilitates the generation and intensification of extreme events such as MHWs and tropical cyclones. Both marine heat waves and tropical cyclones are the extreme events of the ocean-atmosphere coupled system.

Tropical cyclones in Bay of Bengal:

- The Bay of Bengal exhibits high sea surface temperatures (about 28°C) throughout the year and is more prone to tropical cyclones.
- The Bay of Bengal is home to **about 5-7% of the total number of tropical cyclones occurring globally** each year and this makes the North Indian Ocean vulnerable to the highest number of fatalities globally.

Super cyclone Amphan:

- Amphan was the first super cyclone in the Bay of Bengal in the last 21 years and intensified from category 1 (cyclonic storm) to category 5 (super cyclone) in less than 24 hours.
- Amphan was also the **costliest tropical cyclone on record in the North Indian Ocean**, with reported economic losses of approximately \$14 billion in India, according to the World Meteorological Organisation and 129 casualties across India and Bangladesh.
- **According to the latest IPCC report (AR6), Amphan was the largest source of displacement in 2020**, with 2.4 million displacements in India alone, out of which around 8,00,000 was pre-emptive evacuation by the authorities.
- The study investigates the reasons that made this unusual and unprecedented rapid intensification of cyclone Amphan into a devastating super cyclonic storm.

Key findings:

- They found the presence of a **strong MHW beneath the track of the cyclone** with an extremely high anomalous sea surface temperature of more than 2.5°C that coincided with the cyclone track and facilitated its rapid intensification in a short period.
- They have also compared the super cyclone Amphan to a previous extremely severe cyclone Fani in May 2019 with a near similar trajectory. The total life span of Amphan over the ocean was five days as compared to Fani which was for seven days but Fani did not turn into a super cyclone as Amphan did.
- The main difference between these two cyclones was the **presence of MHW in the case of Amphan**, which was not there in the case of Fani.
- Despite short duration and unfavourable atmospheric conditions relative to Fani, Amphan turned into a super cyclone, primarily fuelled by a strong MHW on its way.
- Apart from the surface warming, the study also shows that ocean stratification and warming below the surface also play a crucial role during this phenomenon of compound extreme events.

Way Forward:

- The study along with previous studies also discusses that such compound or individual extreme events are going to increase in the future due to global warming and the Indian Ocean will witness the increased intensity and frequency of such climate extremes.
- Hence, it provides new perspectives on the interactions between different extreme events that could aid in improving the current understanding of compound extreme events that have severe socio-economic consequences in affected countries.