Marine Heat Waves and Twilight Zone

Source: IE

Why in News?

Recently, in a study researchers investigated **Marine Heatwaves (MHWs)** and cold spells within the largely **underexplored twilight zone of the ocean.**

- A cold spell refers to a period of unusually cold weather, often lasting several days or longer.

Marine Heat Waves (MHWs)

- An MHW is an extreme weather event. It occurs when the **surface temperature** of a particular region of the **sea rises to 3 or 4 degree Celsius** above the **average temperature for at least five days.** MHWs can last for **weeks, months or even years.**
- These events are linked to **coral bleaching, seagrass destruction**, and loss of kelp forests, affecting the **fisheries sector** adversely.
- The most common drivers of marine heatwaves include **ocean currents which can build up areas of warm water** and air-sea heat flux or warming through the ocean surface from the atmosphere.
- Winds can enhance or suppress the warming in a marine heatwave, and **climate modes like El Niño** can change the likelihood of events occurring in certain regions.

What are Key Findings Related to MHWs?

- **Marine heatwaves (MHWs) occurring in the deep ocean** are under-reported.
  - To monitor temperature changes at great depths, **specialized buoys suspended in the ocean were deployed globally** for extended data collection.
  - **Argo floats,** robotic devices that can dive to 2,000 meters and resurface, were **used to gather crucial temperature and salinity data**.
- Global warming is affecting surface ocean temperatures, while the impact on deep ocean waters reveals the deeper, less understood consequences of climate change on oceanic ecosystems.
- Unlike surface-level marine heatwaves, **atmospheric factors do not influence temperature changes in the deep ocean**.
  - Instead, **eddy currents**, which are **large, swirling loops of water that can extend hundreds of kilometers** and reach depths over 1,000 meters, **play a crucial role** in transporting warm or cold water across vast distances.
  - The overall ocean warming is leading to stronger eddy currents, amplifying these extreme temperature changes.
- **MHW impact on Biodiversity:**
  - Extreme temperature shifts in the **twilight zone** are alarming due to the presence of many **fish species and plankton,** which are **vital to the oceanic food chain** and serve as a key food source for small fish.
  - MHW can **reduce oxygen levels and deplete nutrients in the water,** endangering

marine life and the balance of the ecosystem.

Twilight Zone in the Ocean

- The twilight zone, also known as the **mesopelagic or dysphotic zone**, is a layer of the ocean that extends from 200 to 1,000 meters below the ocean's surface.
- It is a vast **ecosystem inhabited by extraordinary creatures**, including **organisms that live in darkness** and those that migrate to and from the surface.
- It **plays a vital role in the ocean's ability to absorb and store carbon dioxide** from the atmosphere. This region also hosts the largest animal migration on Earth.
- Organisms in the twilight zone have adapted in several ways, including **bioluminescence** (used for camouflage) and **large mouths (**help maximize rare encounters with prey in the dark).

Eddy Currents

- An eddy current in the ocean is a **small, circular water current that detaches from the main current** and **moves independently.**
    - They are **formed when segments of a current pinch off,** similar to small whirlpools seen in rivers while canoeing.
- Eddies can **span hundreds of kilometers and extend to depths** exceeding 1,000 meters. They **can be detected from space using infrared sensors.**
- They are responsible for several developments.
    - Cold-core eddies trap nutrient-rich water and transport it along with plankton.
        - Eddies can create swirling patterns in **phytoplankton blooms.**
    - It can **displace warm surface water downward or lift cold water upward,** leading to rapid temperature changes.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Q. With reference to Ocean Mean Temperature (OMT), which of the following statements is/are correct? (2020)

1. OMT is measured up to a depth of 26ºC isotherm which is 129 meters in the south-western Indian Ocean during January-March.
2. OMT collected during January-March can be used in assessing whether the amount of rainfall in monsoon will be less or more than a certain long term mean.

Select the correct answer using the code given below:

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Ans: (b)