Sea level rise and its impact

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Why in News: The World Meteorological Organization (WMO) has found in a new report that the world's sea level is rising at an unprecedented rate, portending potentially disastrous consequences for the weather, agriculture, the extant groundwater crisis, and social disparities.

Highlights of 'State of the Global Climate 2022'

The report, entitled 'State of the Global Climate 2022', was published recently.

The report highlights that The rate of global mean sea-level [GSML] rise has doubled between the first decade of the satellite record and the last

Along with accelerating sea-level rise, it focused on a consistent rise in global temperatures, record-breaking increases in the concentration of greenhouse gases as well as glacier loss, sustained drought-like conditions in East Africa, record rainfall in Pakistan, and unprecedented heat waves that struck Europe and China in 2022.

Droughts, floods and heat waves affected communities on every continent and cost many billions of dollars. Antarctic sea ice fell to its lowest extent on record and the melting of some European glaciers was, literally, off the charts

While the sea-level rise is one of several compounding disasters, it also merits individual attention for the unique crises it can precipitate, especially for coastal areas, the communities there that depend on life in the sea, and its ability to render the loss of land.

About Sea level rise

According to the WMO report, the sea level has been rising in the three decades for which satellite altimeter data is available (1993-2022). But while the rate of sea-level rise was 2.27 mm/year in 1993-2002, it shot up to 4.62 mm/year in 2013-2022.

Since the 1990s, scientists have been measuring sea-level rise using satellite altimeters. These instruments send radar pulses to the sea surface and measure the time they take to get back and the change in their intensity. The higher the sea level, the faster and stronger the return signal.

Researchers are able to determine GSML by collecting this data from different points on the earth and calculating the average.

To calculate the rate of change in the GSML – i.e. how fast or slow the sea level is changing – we can calculate the difference in the GSML across a few years, usually a decade, and then divide the difference by the number of years. This provides an estimate of the rate of sea-level change.

Causes of Sea level rise

The WMO report points to the following factors as being responsible for a rising GSML: "ocean warming, ice loss from glaciers and ice sheets, and changes in land water storage".

The report also quantifies the individual contribution of these factors to yield what researchers call the “GSML budget”. According to the report, in 2005-2019, loss of glaciers and ice sheets contributed 36% to the GSML rise.

Ocean warming – the phenomenon of rising mean ocean temperatures – contributed 55%, and changes in the storage of land water contributed less than 10%.

As increasing concentrations of carbon dioxide and other greenhouse gases drive global warming, 90% of the ‘extra’ heat is stored in the oceans. This leads to ocean warming.

And as the ocean heats up, it undergoes thermal expansion, which in turn leads to a rise in the GSML. One measure of ocean warming is the ocean heat content (OHC). Per the report, OHC measures in 2022 touched a new record.

The report also says that the earth’s ice cover, known as the cryosphere, has thinned. The cryosphere includes the Arctic and Antarctic regions (called “sea ice”), glaciers, the ice sheets of Greenland and Antarctica (area of ice on land covering more than 50,000 km 2), seasonal snow cover, and permafrost (mass of land that remains below 0º C for at least two straight years).

Impact of sea level rise

The accelerated pace will cause changes in land cover, i.e., “what will be land and what will be sea”, in the future. As rising seas swallow more of the land cover, particularly in coastal areas, coastal communities will face an “acute shortage of land for human use

This land crunchwill mean that those who are better off will be able to cope better than marginalised groups, leading to an increase in social disparities between people living in coastal areas.

Second, weather formations like cyclones are known to typically originate in the open seas. As the GSML continues to rise, along with a rise in ocean temperatures, the chances of cyclones could increase, affecting coastal communities and leading to large economic liabilities for tropical countries like India and South Africa, which have high population densities.

GSML continues to rise, more seawater could seep into the ground, leading to the groundwater – which is usually freshwater – turning more and more saline. This in turn can exacerbate water crises in coastal areas as well as agriculture in adjacent regions

Coastal ecosystems could be “completely changed”. For example in the Sunderbans delta in West Bengal, the world’s largest mangrove area, rising sea levels and coastal erosion, due to loss of land and sediment from coastal areas, has left more islands submerged under water, and that in turn has forced members of local communities to migrate

Since the lives of coastal communities, including their economic activities, is tied intricately with the coastal ecosystem, changes in the coastal ecosystem as a result of GSML rise – especially when it happens faster than rehabilitative policies and laws can catch up – will further endanger the socio-economic stability of these communities.

The Way Ahead

The collaborative efforts to reduce the global warming is the need of the hour to halt the glacier melting and subsequent sea level rising