

COMMENT

The great climate churn



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APRIL 18, 2017 00:15 IST

UPDATED: APRIL 17, 2017 22:32 IST

Regional and global planning is essential to combat extreme events

In recent months, [unprecedented rates of glacier melts](#) have been reported both in the Antarctic and the Arctic. “A massive crack in Antarctica’s fourth-biggest ice shelf has surged forward by at least 10 kilometres since early January,” said *Nature* magazine in a recent article. Glaciers cover the terrain in both these regions, which have the only permanent ice sheets that still exist on earth today.

The earth has enjoyed a more or less stable temperature for the last 10,000 years. Prior to that there were several ice ages and periods of warmer temperature, also known as inter-glacials. The ice ages are believed to have been caused by small shifts in the earth's orbit, but all the reasons for the temperature fluctuations observed are not yet entirely understood.

About 5.3 to 2.6 million years ago, during the Pliocene epoch, global sea levels were close to 30 metres higher than they are today, while average global temperatures were only about three to four degrees Celsius warmer. What could happen in the current century, as a result of anthropogenic climatic change, remains a matter of great interest within the scientific and policymaking community.

The melting Antarctic

The Antarctic ice sheet is 14 million sq km in area and holds a large amount of frozen fresh water. (In comparison, the area of India's land mass is about 1.3 million sq km.) If all the ice over the Antarctic were to melt, sea levels would rise by about 60 metres. Parts of the ice sheet also flow into the ocean and do so through ice shelves that protrude into the water. Several media reports over the last few months have covered the expanding rift or crack along the Larsen C shelf in the Antarctic, which is expected to break off at any time. Larsen A and B collapsed in 1995 and 2002 respectively. Normally, ice shelves lose mass by the breaking off, or calving, of some of the portions and also by melting.

When such large chunks break away from an ice shelf, they speed up the collapse of the entire shelf. Since this is attached to the rest of the glacier, these processes can increase the speed at which the glacier flows into the ocean. Thus, even though the Larsen C collapse by itself, since it is in the water, will not raise sea levels, it will hasten the melting of the glacier it is connected to.

In 2014, Eric Rignot, principal scientist for the Radar Science and Engineering Section at NASA's Jet Propulsion Laboratory, wrote that the retreat of ice in the Amundsen Sea sector of West Antarctica is inevitable, with major consequences for global sea levels. While the entire West Antarctic Ice Sheet (WAIS) may take a few hundred to a thousand years to completely melt, the process and the resultant collapse are now recognised as unstoppable.

Rising sea levels

In the Arctic, if all the ice in the Greenland ice sheet were to melt, it would raise global sea levels by about 7 metres (or 23 feet). For the last several years, glaciologists have noticed that ice melt in the summer has increased and covers a larger area than previous years. Scientists now realise that a lot of the recent melt has been due to increasing surface melt, in addition to calving or breaking off of chunks of ice.

Experts have known that there are feedback mechanisms that speed up glacier melt; exactly what these processes are and the rate by which they accelerate the melting remains an area of research. Soot and dust carried by air from various places, bacteria and algal pigments in the meltwater, any other pigments in the glacier can all reduce the reflection of the sunlight, thus increasing the absorption of heat energy by the ice. This consequently increases ice melt, which then absorbs more solar radiation, thus accelerating a feedback process. The meltwater flows into deep shafts, or moulins, that then speed up the flow of the glacier.

But there are also other phenomena that seem to have an influence on glacier melt. Temperatures in Northern Greenland have been much warmer and in fact, surface melt has doubled Greenland's contribution to sea level rise over the period 1992-2011 to 0.74 mm per year. Carbon dioxide concentrations have crossed 400 ppm in the atmosphere and are the highest they have been in the past 4,00,000 years.

Modelling glacier melt is very complex as it is affected by the temperature of the water, ocean currents and other factors still not entirely understood, along with various positive feedback mechanisms that can speed up the melting. The well-known climatologist James Hansen and his colleagues published a paper last year suggesting that sea level rise is a non-linear process and given what happened to sea levels in past geological periods, we should prepare for a rise of several metres over the next 50-150 years. This would imply that many of those alive today would likely see substantial increases in their lifetimes.

Global response needed

The global community is well aware that many large and densely populated cities are located along the coast and in low-lying deltas. Protecting the coast is an expensive undertaking and even then dikes, sea walls and similar structures

provide only partial protection, based on studies undertaken by the Dutch Delta Committee and others. For India, the east coast, especially certain low-lying districts, are extremely vulnerable to intensive storms, which then lead to flooding, salt-water intrusion, and loss of land and livelihoods. On the west coast, while there are generally fewer storms, the concern is coastal erosion and flooding from sea level rise. The discussion regarding sea level rise and potential coastal impacts needs also to be understood not just as a coastal phenomenon, but also as an issue that ripples through the entire economy. Flooding in Chennai two years back did not affect just the land, but went through the economy as a whole and Swiss Re, the reinsurance company, has estimated losses to the economy due to the floods to be \$2.2 billion.

Thus, enforcing the coastal regulation zone, protecting vulnerable districts and the most vulnerable communities which rely on ecosystems and the sea for their livelihoods are areas that need strengthening. Regional agreements related to refugees from climate effects need to be initiated. As a country which has generally been open to refugees from Tibet, Nepal, Afghanistan, Bangladesh and Sri Lanka, initiating and taking forward the conversation on regional planning for extreme events such as sea level rise would be important for India, the largest country in the region.

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Printable version | Apr 18, 2017 10:40:18 AM | <http://www.thehindu.com/opinion/op-ed/the-great-climate-churn/article18081125.ece>

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