

SHORT FEATURE

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Breaking Antarctica Icebergs: What Does It Mean For India?



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INDIA is far away from Antarctica and whatever happens there should not be of concern to us. But, the natural system that the Earth is operating and dealing with leaves no room for such complacency. The Earth is an integrated system and no two places on it are immune to seemingly isolated processes operating in those realms. Hence, what happens in Antarctica should necessarily be our concern.

India is carrying out many scientific investigations in and around the icy and dicey environments of the Antarctica since 1981. Even though India is an equatorial country, it has its presence in both the Polar Regions.

Antarctic geomagnetism has special importance for India since Maitri, Dakshin Gangotri and Bharti (all three located at about 70° S, 12° E geographic) are the only places where India can carry out research on high-latitude geomagnetism and other sciences. Direct deposition of solar wind energy occurs at latitudes exceeding 60° geomagnetic latitude. The lower latitudes, where India is located, are shielded from direct energy transfer by the closed magnetic field line structure prevalent in this part of the world. Most of the developed countries directly witness this solar-terrestrial energy transmission by virtue of their geographic location. The Indian Polar venture has given a rare opportunity to study this phenomenon *in situ*.

A magnificent phenomenon occurring around the Polar Regions is the aurora. These are curtains of coloured luminosity that are a treat to watch. The aurora is connected to the magnetic field of the Earth and the flares on Sun. The interaction of the charged particles from Sun and the atmospheric elements like oxygen, nitrogen, and hydrogen are responsible for the mix-and-match of light colours. The composition of the Polar atmosphere and the structure of magnetic field lines can be understood by studying the aurora.

The fundamental similarity between magnetism and electricity can also be observed in the atmosphere where the charged particles from Sun create currents that have a global and regional

sweep. The solar quiet currents are global in nature, while the Polar currents are regional and specific to the 'earthen' ends.

The solar quiet condition refers to the state of the Sun when there are no major explosions or activity on its surface. During such phases, the flow of charged particles towards the Earth is almost constant and steady. But when there is an explosion on the Sun, the charged particles gather tremendous speed and hurtle towards Earth with an incredible hustle.

The solar quiet current does not extend till the Polar Regions. But, it is not too far away from the magnetic Poles either. There are in fact two poles – geographic and magnetic. The aurora and other related phenomena are associated with the magnetic Polar Regions.

The Indian Antarctic station Maitri occupies a unique subauroral (near-aurora) location during the geomagnetic quiet condition and records the signatures of the southern limb of the solar quiet current system. With increasing magnetic activity, the auroral zone expands equatorwards and encompasses Maitri. During such periods, Maitri is temporarily influenced by auroral currents. This movement of shifting in and out of auroral zone makes Maitri an ideal location for space weather studies.

The enhanced geomagnetic activity, which is often called geomagnetic disturbance, releases excessive charged particles. This is the manifestation of dynamic processes active on the Sun. The passage of these charged particles through various atmospheric layers of Earth is monitored with the help of an instrument called imaging riometer. This riometer is placed at Maitri and is an integral part of space weather research.

Just like earthquakes, blizzards can be very destructive on the icy continent. It has claimed lives of many adventurous explorers and naturalists. These were found to be associated with currents and electromagnetic field at Antarctica. Studies on current pattern revealed that electric field decreases to zero or becomes negative just 2-3 hours before the onset of a blizzard. The existence of

atmospheric current was also found to be associated with global thunderstorm activity. Monitoring the current activity prevailing within the Antarctic domain can save precious lives.

The magnetic field of the Earth is not uniform everywhere. The magnetic observations carried out with the help of Proton Precession Magnetometer at Dakshin Gangotri and Maitri revealed the field was rapidly declining, at the rate of more than 110 nT per year. The global average decrease is 40 nT per year. These observations are important to carry out computer modeling and simulation processes that may be operative at the Earth's core-mantle boundary.

Magnetic anomaly map was also prepared for the new Antarctic station Bharati, situated on Larsmann Hills, East Antarctica. The studies show it to be a prominent high magnetic ridge with values of ~5000 nT higher than the surrounding area values.

So, the Antarctic region has much to offer. And, therefore, the recent breaking of the Larsen C ice shelf has attracted worldwide attention.

Breaking Iceberg

In July, an iceberg estimated to be 5,000 square kilometres in size and 1.12 trillion tons in weight broke off one of Antarctica's largest ice shelves, Larsen C. At 46,500 square kilometres, Larsen C is Antarctica's fourth largest ice shelf.

The first cracks had appeared nearly four years ago. In the past four years, the crack grew over 120 miles in length. Shortly after the iceberg broke off, scientists noticed a new rift forming in the ice shelves that scientists with Project MIDAS, a U.K. based Antarctic research project, fear "may result in further ice shelf area loss."

The secession of a large chunk of ice from its parent body is not just a spectacle that should be marveled and forgotten. It will have wide implications on the global climate whose effects will not be instantaneously evident. It will take time to percolate and influence the natural processes.

The thick ice shelves are prone to ceding from each other or breaking into

India's Maitri station in Antarctica



splinters. This process has been going on for years and will go on in the future as well. However, how much of the splintering is due to natural causes and how much because of anthropogenic activity remains to be seen.

The icebergs and their movement are being tracked by different methodologies and techniques by scientists from all over the world. India is also monitoring the movement of some of the ice chunks. The actual movement or the shrinkage is important to understand how much water is added to the sea. The relative sea level changes are related to the water addition from the glaciers. The ice sheets and ice shelves, as well as the icebergs, make it difficult for the melted glacier water to enter the ocean. The tiny fluid trickle from the glaciers gets deposited on the ice sheets, which progressively gain in size and thickness.

The accumulated ice sheets, in fact, are a treasure trove of climatic and environmental signatures that are hidden within their confines. The ice sheets, many a times, contain within them blobs of atmospheric gases and elements. It is like the Earth has written a small blog on the kind of environment present, at or before the time, of confinement of these elements. When this frozen water melts, due to various reasons, it has the potential to raise the sea level in many coastal parts of

the world. In the past, the eastern coastal belt of India was inundated quite a few times when the ice sheets at Antarctica started to melt away.

In the not so close neighbourhood of the current break-up at Larsen C, scientists from the Indian Institute of Geomagnetism have been monitoring the Schirmacher glacier in Antarctica with the help of GPS. The studies revealed the glacier was moving horizontally in the north-northeast direction, with an average velocity of approximately 6 m every year.

Monitoring the rate of growth or shrinkage of the glaciers is more important than the laceration of icebergs. The icebergs have a limited role to play in the climate cycle compared to the Polar glaciers.

The broken chunk of Larsen C iceberg will be floating and rafting through the waters for an appreciable period of time. It will be a minor nuisance to the ships voyaging through the Antarctic waters, before it melts completely when it comes in contact with the warm waters. It will then have some effect on the nearby coastal areas by way of rise in sea level.

Till then we need not worry on this count.

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