

Indian scientists improve know-how of factors that affect global climate change

New Delhi, August 13 (Vigyan Samachar): Past is the key to the future. In the field of ocean and polar research, studying sea ice variations over a period of time helps scientists to understand impact of sea ice dynamics on local and global climate. So far, such studies have been done with 30 to 40 thousand years old data on reconstructed Antarctic sea-ice dynamics. In a new development, researchers at the National Centre for Polar and Ocean Research (NCPOR), Goa, have studied Antarctic sea ice variations over the last 156 thousand years to arrive at some interesting and useful findings. With an analysis of sea ice variations at a much longer timescale spanning both ice ages (glacial) and inter-glacial periods, the findings have added value to the existing know-how of factors that affect global climate change.

The study reveals that during ice ages (glacial periods), Antarctic sea ice cooling extended northward, that is, water masses of specific temperature, pressure and salinity known as hydrological structures or fronts, and winter sea ice in Southern Ocean shifted towards the Earth's north. During the last interglacial period, hydrological fronts and winter sea ice have migrated poleward by only a couple of degrees of latitude. These movements have occurred from southern Antarctic circumpolar current front towards the Antarctic polar front located at nearly 46-degree South (°S) latitude. Winter sea ice had likely extended to almost 49°S latitude. These changes have likely impacted the Earth's climate significantly.

It is known that sea ice is an important component of the Earths' system. Seasonal cycle of sea ice formation and melting impacts global redistribution of heat; keeps the polar regions cool in freeze and enhances warming when it melts. This cycle affects global climate, life and ecosystems, ocean biology by reducing penetration of light into the ocean. Most importantly, sea ice controls the concentration of atmospheric carbon dioxide, which has deep linkages to increasing the rate of global warming.

NCPOR study adds that sea surface temperature has changed at nearly 1–2 degree Celsius (°C) and winter sea ice duration has shifted by almost 2 months per year during each glacial period. During this same time, a drop in productivity in permanently open ocean zone has occurred which is due to extended duration and extent of winter sea ice. During ice ages (glacial periods), more sea ice formed, which caused lesser salt concentration and stratification in ocean waters leading to low nutrient availability for life forms such as phytoplankton which grow on ocean and sea surface. This along with reduced growing season resulted in low productivity near Antarctica.

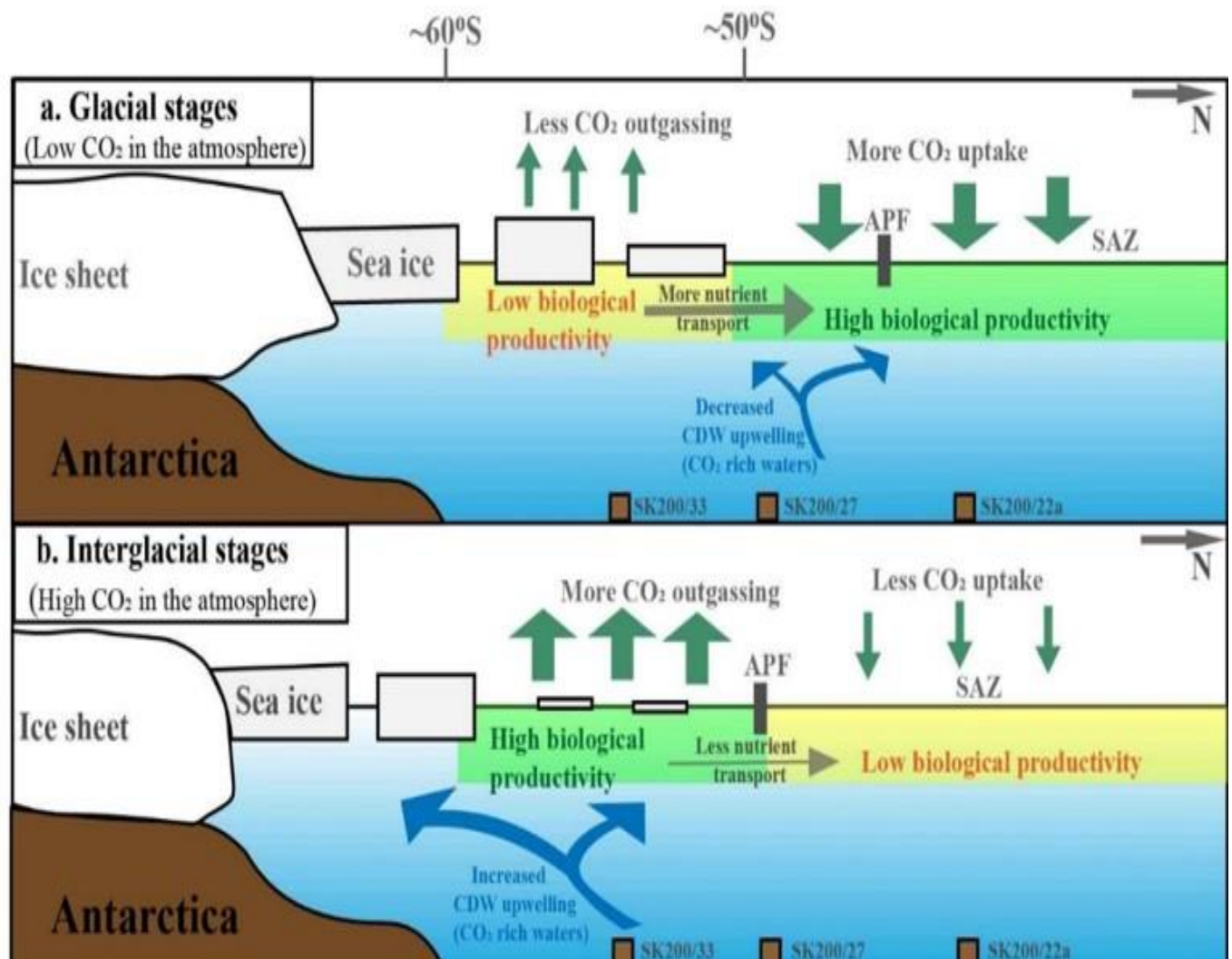
To arrive at these results, scientists at NCPOR carried out quantitative study of sea ice dynamics and its correlation with sea surface temperature and winter sea ice over the past 156 thousand years. By data modelling, they reconstructed the past sea surface temperature, winter sea ice and paleo-productivity.

Paleo-productivity studies were done using data on diatoms which were proxy preserved in the marine sediments core of the permanently open ocean zone of the south western part of the Indian sector of Southern Ocean. Diatoms are microscopic organisms encapsulated in a silica shell which contribute to the 75 per cent of the primary production of Southern Ocean (which includes southern parts of the Pacific, Atlantic and Indian Oceans). They are sensitive and record the subtle climatic changes in their shells. After their life cycle, their shells are preserved in the sediments. They have unique cell walls which helps in their identification. Their

abundance helps to infer the productivity, ecological preferences and to reconstruct past sea surface temperatures and winter sea ice. The productivity was estimated by comparing biogenic silica of diatoms with their absolute abundance.

The team who did this study included Pooja Ghadi, Abhilash Nair, Rahul Mohan and Thamban Meloth, scientists at NCPOR, Goa, who collaborated with Xavier Crosta, scientist at the University of Bourdeaux, France, and Manoj M C, scientist at the Birbal Sahnii Institute of Paleosciences, Lucknow. They have published their findings in a recent issue of the journal *Marine Micropaleontology*.

According to Dr Rahul Mohan, Scientist at the NCPOR, who led the study “this work will help improve the understanding of how sea ice dynamics impact the permanently open ocean zone, which affects global climate but remains to be elaborately studied till date. We plan to take up more such interesting projects in the future”, he said.



Schematic representation of past variability of sea ice and its potential impact on Southern Ocean biological productivity during glacial stages (top) and inter-glacial stages (below).

APF: Antarctic polar front, SAZ: sub-Antarctic zone, CDW: circumpolar deep water, N: North.