



## Proposed NASA-ISRO SAR Mission

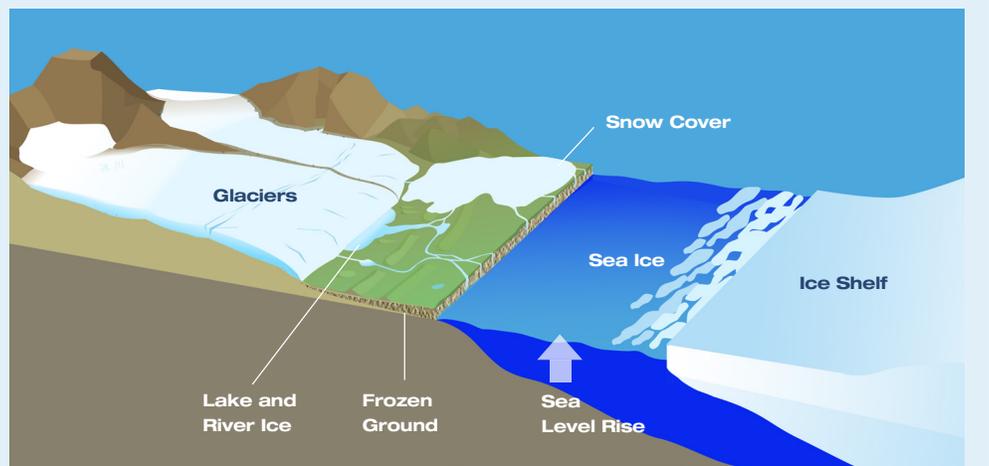


# Understanding Earth's Cold Regions

NISAR would determine how climate and ice masses interrelate and raise sea level and would measure changes in sea ice, snow extent, permafrost, and surface melting.

### Impacts of Earth's Remote Ice

Perhaps you imagine the polar ice sheets as icy white blankets at the ends of the Earth, static and majestic, but far removed from your daily life. In reality, these areas are among the most dynamic and rapidly changing places on Earth, where wind and currents move ice over the seas, and the forces of gravity disgorge huge icebergs to the ocean. These distant changes have very real local consequences of climate feedbacks and rising sea level.

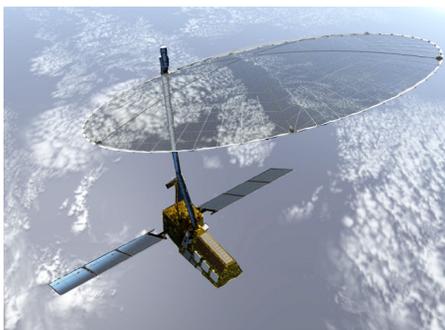


### Assessing Society's Exposure to Diminishing Ice

For over a hundred years, scientists have considered diminishing glaciers and sea ice to be an early indicator of global warming. Satellite observations collected over the past three decades now show that the summer sea ice cover is decreasing drastically and may vanish entirely within the next decades. At the same time, ice sheets and glaciers are already melting fast enough to be the largest contributors to sea level rise, with a potential

to raise sea level by several tens of centimeters or more in the coming century. The loss of sea ice cover will have a profound effect on life, climate, and commercial activities in the Arctic, while the loss of land ice will impact an important source of water for millions of people. Collectively, these effects mean that despite its remote location, changes in ice have global economic and health implications as climate changes.

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Artist's concept

### The Proposed NISAR Mission — All-Weather Day and Night Imaging

Orbiting radar captures extent and motions of land and sea ice over time and with enough detail to reveal subtle changes. Radar penetrates clouds and operates day and night. It produces images that are detailed enough to see local changes, and has broad enough coverage to measure regional trends. The proposed NASA-ISRO Synthetic Aperture Radar (NISAR) mission, a collaboration between the National Aeronautics and Space Administration (NASA) and the Indian Space Research Organization (ISRO), would acquire images of ice sheets, glaciers, and sea ice globally. Rapid sampling over years to decades would allow for understanding flow and changes over time. NISAR's unprecedented coverage in space and time would reveal response of ice masses far more comprehensively than any other measurement method. The detailed observations would reveal information that would allow us to better manage resources and prepare for and cope with global change.

## Improving Sea Level Projections

Disintegrating ice sheets and retreating glaciers raise sea level, yet predicting future sea level changes is difficult at present. Rising sea level will displace millions of people and adaptation will be costly. Recent observations provide only isolated snapshots of ice sheet velocity and changes, and current missions map large-scale ice sheet changes while missing many fast moving glaciers with large thinning rates. NISAR would provide systematic measurements allowing short-term variations and long-term trends to be measured. NISAR would provide a time history of ice sheet and glacier behavior. It would provide precise measurement of the changing position of ice sheet grounding lines. Understanding ice sheet and glacier behavior and changes would improve projections of sea level rise from melting glaciers and ice sheets. Accurate sea-level projection would improve planning of sea walls, dikes, and other mitigation strategies.

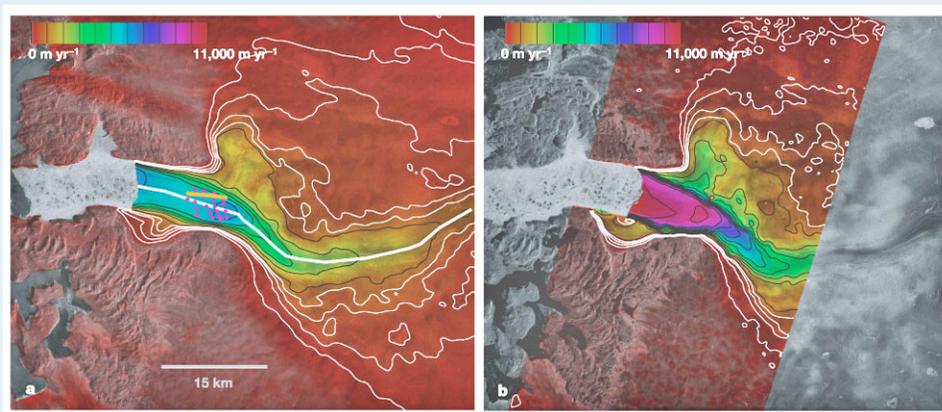
## Tracking Sea Ice and Monitoring Permafrost

Arctic sea ice has thinned and its summer extent has reduced by as much 50 percent over the last several decades. By contrast, sea ice cover in the Southern Ocean may be increasing slightly in extent, but there is very little information regarding its deformation and thickness distribution. The thinning and retreating Arctic ice cover is changing the economy of local communities by causing a shift in the patterns of marine ecology and an increase in winds and waves, as well as stimulating interest in petroleum development and shipping. NISAR would provide key data necessary to make informed environmental and economic decisions. NISAR would provide the most complete measurements of rapidly changing sea ice motion and thickness of both polar regions. Understanding the causes and mechanisms of its loss requires knowledge of ice thickness distribution, sea ice types, and sea ice dynamics. Melting permafrost releases methane to the atmosphere, erodes soil, and impacts surface water distribution and stability of infrastructure. NISAR would measure heave and thaw in the near-surface active layer of permafrost.

### Mapping Ice Sheet Flow

Radar measurements from the Canadian RADARSAT mission show the rapid speed up of Jakobshavn Isbræ in Greenland between February 1992 and October 2000. Over the last decade, glaciers in Greenland have sped up on average by more than 30 percent. NISAR would allow monitoring of ice sheets in Antarctica and Greenland as well as glaciers throughout the world.

The images are from Ian Joughin, Waleed Abdalati, and Mark Fahnestock, "Large Fluctuations in Speed on Greenland's Jakobshavn Isbrae Glacier," *Nature* 432: pp. 608–610.



**The economic impact of sea level rise on the US will exceed \$20B.**