Satellite radar keeps tabs on glacial flow

In all the concern over greenhouse warming, one doomsday scenario stands out as the most chilling: the melting of Earth's huge ice sheets. In this catastrophic vision, rising temperatures erode the glacial caps of Antarctica or Greenland, raising sea levels worldwide and inundating New York, Tokyo, and other major coastal cities.

While most scientists believe nothing so dramatic will happen, at least in the next century, they remain concerned because glaciologists lack all but the most basic knowledge about the workings of the vast ice sheets. Two research groups now report a means of revealing these glacial secrets. In separate studies announced this week, they show how different radar measurements made from satellites can detect changes within the icy mantles of Antarctica and Greenland.

In the Dec. 3 SCIENCE, Richard M. Goldstein of NASA's Jet Propulsion Laboratory in Pasadena, Calif., and his colleagues describe using a technique called satellite radar interferometry to study the Antarctic ice sheet. The satellite collecting the information was the Earth Remote Sensing Satellite-1 (ERS-1), operated by the European Space Agency. The craft carries a radar that emits radio waves and senses the rays as they bounce off Earth's surface.

"Interferometry is certainly a very exciting technique with a lot of promise," comments H. Jay Zwally at NASA's Goddard Space Flight Center in Greenbelt, Md.

The technique of interferometry involves comparing the phases of two different waves, somewhat like matching the sound from a tuning fork with that of a guitar. When the two notes are close but not identical, they oscillate in and out of sync, producing a "beating" pattern that guitar players use to tune a string.

The same rule applies to radar waves. To measure ice motion with interferometry, Goldstein's group compared two nearly identical images of the same location, taken six days apart. The ice's movement during that interval altered the phase of the radar waves returning to the satellite, creating an interference pattern of light and dark bands that are similar to the beats used by guitar players. By counting the bands, the researchers can judge how far out of sync the images are, which provides a measure of how far the ice has moved.

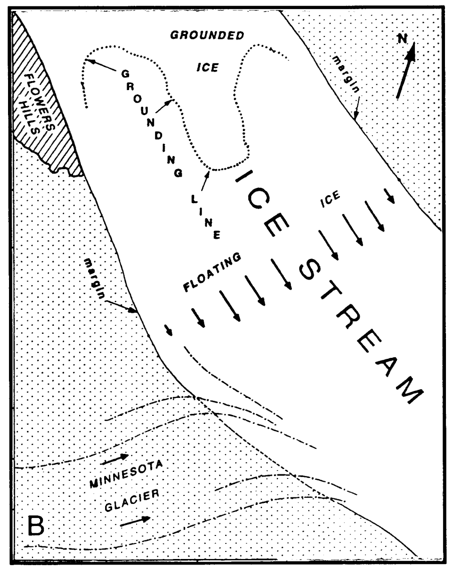
Goldstein and his co-workers used radar interferometry to clock the speed of a feature in Antarctica called the Rutford Ice Stream, which flows into Ronne Ice Shelf. Unlike glaciers, which move through mountain valleys, ice streams are wide rivers of fast-moving ice that flow through regions of much slower ice.

The radar study showed that the Rutford Ice Stream cruises along at a speed of 390 meters per year, roughly 100 times faster than the ice bordering it. By repeating such measurements, scientists can track changes in the ice's speed.

Glaciologists are focusing attention on the Rutford and other Antarctic ice streams because these pipelines carry ice from the stable continental interior toward the ocean. There they form floating ice shelves that break apart into icebergs. Scientists have posited that a dramatic acceleration of the ice streams could cause a major section of Antarctica's ice sheet to collapse into the ocean (SN: 2/13/93, p.104).

Aside from providing a means of monitoring speed, satellite interferometry can also measure the position of an ice stream's grounding line, the boundary where the ice goes afloat. If the grounding line were to retreat rapidly upstream, that could hasten an ice sheet's demise, according to some researchers.

R. Keith Raney of the Canada Centre for Remote Sensing in Ottawa says that satellite interferometry complements other radar techniques. In the same issue of SCIENCE, Goddard's Mark Fahnestock and his colleagues report making high-resolution images of Greenland's ice sheet, also with radar data from the ERS-1 satellite.



Adapted from Goldstein/SCIENCE

Map of Rutford Ice Stream shows position of grounding line. Stippled areas are slow-moving ice that borders the stream.

They found what appears to be an ice stream in the northeast corner of the island. Some 550 kilometers long, this feature resembles the ice streams that previously had been identified only in Antarctica. By comparing images taken several months or years apart, the researchers say they can track the behavior of ice sheets. *—R. Monastersky*

Saturated fats may foster lung cancer

Lung cancer claims more lives in the United States than any other malignancy. Though smoking poses the single greatest risk, studies have suggested that other factors, including dietary fat, may predispose people to lung cancer. But because most such studies contained large numbers of smokers, data on diet's role have proved confusing at best (SN: 10/12/91, p.237).

Now, researchers with the National Cancer Institute in Bethesda, Md., and the Missouri Department of Health in Columbia have entered the fray with an analysis of lung-cancer risks in nonsmokers. While reinforcing concerns about fat, their study highlights several new risks and contradicts previously reported associations with factors such as dietary cholesterol.

Michael C.R. Alavanja and his co-workers surveyed 1,450 female nonsmokers age 30 to 84. Of these, 429 had been diagnosed with lung cancer between 1986 and 1991. The researchers interviewed each of these women at least once and surveyed in detail their eating habits four years previously (before any cancer might have changed consumption patterns).

The 20 percent of women who ate the most saturated fat faced more than six times the risk of developing lung cancer as the 20 percent who ate the least. This rate "was greater than expected," based on earlier studies, Alavanja's team reports in the Dec. 1 JOURNAL OF THE NATIONAL CANCER INSTITUTE.

Moreover, in women with high-saturated-fat diets, the risk of adenocarcinoma—a cancer not strongly linked to smoking but accounting for half the cancers in this study—was more than 11 times the rate observed in women with diets low in this fat.

While previous studies had hinted at a protective effect of fruits and vegetables, the new study found that the more citrus fruit and juice a woman consumed, the greater her chance of developing lung cancer. The study also identified a new class of protective foods: Women eating the most beans and peas had a 40 percent lower lung-cancer risk than those eating the least.

Though fat is an established tumor promoter in animals, no study — even this one — has proved that fat affects lung-cancer risk, notes Laurence N. Kolonel of the Cancer Research Center of Hawaii in Honolulu. Indeed, he notes in an editorial accompanying the new paper, fat could serve merely as a marker for some other risk, such as the carcinogenic heterocyclic amines that form when red meat is cooked. *—J. Raloff*