

Startling amounts of ice slipping into the sea have taken glaciologists by surprise; now they fear that this century's greenhouse emissions could be committing the world to a catastrophic sea-level rise

# A Worrying Trend of Less Ice, Higher Seas

**HAVE AN URGE LATELY TO RUN FOR** higher ground? That would be understandable, given all the talk about the world's ice melting into the sea. Kilimanjaro's ice cloak is soon to disappear, the summertime Arctic Ocean could be ice-free by century's end, 11,000-year-old ice shelves around Antarctica are breaking up over the course of weeks, and glaciers there and in Greenland have begun galloping into the sea. All true. And the speeding glaciers, at least, are surely driving up sea level and pushing shorelines inland.

Scientists may not be heading for the hills just yet, but they're increasingly worried. Not about their beach houses being inundated anytime soon; they're worried about what they've missed. Some of the glaciers draining the great ice sheets of Antarctica and Greenland have sped up dramatically, driving up sea level and catching scientists unawares. They don't fully understand what is happening. And if they don't understand what a little warming is doing to the ice sheets today, they reason, what can they say about ice's fate and rising seas in the greenhouse world of the next century or two?

That uncertainty is unsettling. Climatologists know that, as the world warmed in the past, "by some process, ice sheets got smaller," says glaciologist Robert Bindshadler of NASA's Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. But "we didn't know the process; I think we're seeing it now. And

it's not gradual." Adds geoscientist Michael Oppenheimer of Princeton University, "The time scale for future loss of most of an ice sheet may not be millennia," as glacier models have suggested, "but centuries."

The apparent sensitivity of ice sheets to a warmer world could prove disastrous. The greenhouse gases that people are spewing into the atmosphere this century might guarantee enough warming to destroy the West Antarctic and Greenland ice sheets, says Oppenheimer, possibly as quickly as within several centuries. That would drive up sea level 5 to 10 meters at rates not seen since the end of the last ice age. New Orleans would flood, for good, as would most of South Florida and much of the Netherlands. Rising seas would push half a billion people inland. "This is not an experiment you get to run twice," says Oppenheimer. "I find this all very disturbing."

## A rush to the sea

Much of the world's ice may be shrinking under the growing warmth of the past several decades, but some ice losses will have more dramatic effects on sea level than others. Glaciologists worried about rising sea level are keying on the glaciers draining the world's two dominant ice reservoirs, Greenland and Antarctica. Summer-time Arctic Ocean ice may be on its way out, but its melting does nothing to increase the volume of ocean water; that ice is already floating in the

ocean. The same goes for floating ice shelves around Antarctic. The meltwater from receding mountain glaciers and ice caps is certainly raising sea level, but not much.

The truly disturbing ice news of late is word that some of the ice oozing from the 3-kilometer-thick pile on Greenland has doubled its speed in just the past few years. In the 17 February issue of *Science*, for example, radar scientists Eric Rignot of the Jet Propulsion Laboratory in Pasadena, California, and Pannir Kanagaratnam of the University of Kansas, Lawrence, analyzed observations made between 1996 and 2005 by four satellite-borne radars. These synthetic aperture radars measure the distance to the surface during successive passes over a glacier. The changing distance can then be extracted by letting successive observations form interference patterns. The changing distance, in turn, translates to a velocity of the ice toward the sea.

In central east Greenland, Kangerdlugssuaq Glacier more than doubled its speed from 2000 to 2005, Rignot and Kanagaratnam found, from 6 kilometers per year to 13 kilometers per year. That made it the fastest in Greenland. To the south, Helheim Glacier accelerated 60%. And on the west of Greenland, Jakobshavn Isbrae almost doubled its speed between 1996 and 2005. The accelerations are "actually quite surprising," says glaciologist Julian Dowdeswell of the University of Cambridge in the United