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Irminger Sea: Oct 17
Melting by Dallas Murphy

The climate is an angry beast, and we're poking it with sticks.
Wallace Broecker, Lamont Droughty Earth Observatory

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We introduced the Greenland Ice Cap in the October 7 dispatch. To review: Greenland is by far the largest island on Earth, just a bit smaller than Western Europe. But only the thin coastal strip, 15 percent of the landmass, is habitable by animals and people—everyone inGreenland has a waterfront view. All of the rest of the island is subsumed beneath a gigantic dome of ice, in area about twice the size of California, climbing 10,000 feet above sea level. As each annual layer of snowfall accumulates it is compacted into ice by the weight of ensuing snowfalls, and the ice sheet slowly grows. But the ice sheet can't grow indefinitely, like a mountain, because ice is plastic stuff.

At some point, gravity takes over, and the ice begins to spread outward away from the central dome—not uniformly, not like a spreading stain on the carpet, but in individual, irregular tongues of ice that follow the course of least resistance down through mountain valleys. These rasping, gouging *outflow glaciers* dig their way to the sea, creating a new geographical feature, a flooded valley with its mouth open to the saltwater, a *fjord*. Then, shoved constantly from behind by upstream ice, the glacial tongues float out over the water, where their leading edges break off as icebergs, and inevitably melt. The entire coast of Greenland—about 6,800 kilometers from Cape Farewell in the far south to Cape Morris Jesup and back around to Cape Farewell—is composed of the same pattern: fjord-headland-fjord repeating endlessly.

Greenland's identity is ice.

The ice in the Greenland Ice Cap is made up of freshwater. But there is another kind of ice around Greenland and in the rest of the Arctic, that is, sea ice, or frozen saltwater. The Arctic Ocean has always been frozen, winter and summer; its identity is also ice. However, it is vanishing, melting at an alarming rate. "Astounding," "mind-boggling," "incredible"—those were among the uncharacteristic adjectives applied by levelheaded, big-name scientists to the record meltback of 2007. The previous, then-startling record—shattered in 2007—was set in 2005. The records began to topple in 1998. The pattern is clear, and serious scientists such as Mark Serreze, James Hansen, and Wieslaw Maslowski are trying to tell us that an ice-free Arctic in summer is inevitable. The only open question is how soon. Very soon, according to Maslowski, who at last year's meeting of the American Geophysical Union predicted we'd see an ice-free Arctic Ocean by 2012. Mark Serreze put it baldly: "The Arctic is screaming."

Don't let anyone tell you that global warming isn't real or that it won't affect our lives. The entire world is warming, but the warming in the Arctic is ten times greater than anywhere else.

All right, so what? How does it matter to those of us living south of the Arctic Circle that Arctic sea ice is vanishing? Almost every animal living in the Arctic has adapted over tens of thousands of years to the presence of ice. When it vanishes, they will have to adapt in tens of years to its absence or go extinct. The endangered polar bears have received the most publicity, but they are only one of many animals whose natural habitat is sea ice; without it they cannot survive.

But then there is another larger matter. Arctic ice is a geophysical force. Like tropical rainforests, polar ice shapes, moderates world climate. If the ice goes out of the Arctic Ocean in summer, then world climate will change. Just how and what form the changes will take are not entirely clear. The impacts will fall first and hardest on the poorer nations of the world, but all of us everywhere will feel the change.

And then there is the Greenland Ice Sheet, which is composed of frozen freshwater. It's not exactly accurate to say that the ice sheet is melting. But those outflow glaciers are sprinting to the sea at twice the velocity of a decade ago. In 2007 alone, the ice sheet lost enough ice to cover an area the size of the United States—twice. Is the ice sheet itself breaking up? Or are rising sea surface temperatures causing the disintegration of the outflow glaciers at their mouths? Or both at once? (On this cruise, Dr. Bob has found traces of warm Gulf Stream at the very mouth of the East Greenland fjord we measured last week.)

That convection, that sinking, we've been talking about on which the sustained circulation in the North Atlantic depends is itself dependent on the formation of dense water. Temperature is a factor in the formation of dense water, but so is salinity. No serious scientist is contending that the Gulf Stream will shut down unless the wind stops blowing and Earth stops rotating or that north-south circulation will cease. However, serious scientists wonder just what will happen to our climate if the freshwater outflow from the Greenland Ice Sheet and the Arctic is sufficient to diminish significantly the vital convection in these very waters on which *Knorr* now floats.

Many questions remain, and that's why it's so important that Dr. Bob and his colleagues have adequate funding to continue their important work. But one thing is clear. All parts of nature's great systems are inextricably connected. If you chop down the tropical

rainforests, the global climate system will change. If the Arctic sea ice vanishes and the ice cap continues to dump massive quantities of freshwater into the North Atlantic, the global climate system will change.

Angalanitta affaa by Nick M?ller

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angalanerput nalilerneqarsinnaanersoq, qanoq angusiffiusimanersorlu.

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Mail: Woods Hole Oceanographic Institution, 266 Woods Hole Road, Woods Hole, MA 02543, USA.
E-Contact: info@whoi.edu; press relations: media@whoi.edu, tel. (508) 457-2000
Problems or questions about the site, please contact webdev@whoi.edu