



from the March 24, 2006 edition - <http://www.csmonitor.com/2006/0324/p01s03-sten.html>

## Little time to avoid big thaw, scientists warn

**Arctic temperatures near a prehistoric level when seas were 16 to 20 feet higher, studies say.**

By [Peter N. Spotts](#) | Staff writer of The Christian Science Monitor

Global warming appears to be pushing vast reservoirs of ice on Greenland and Antarctica toward a significant, long-term meltdown. The world may have as little as a decade to take the steps to avoid this scenario.

Those are the implications of new studies that looked to climate history for clues about how the planet's major ice sheets might respond to human-triggered climate change.

Already, temperatures in the Arctic are close to those that thawed much of Greenland's ice cap some 130,000 years ago, when the planet last enjoyed a balmy respite from continent-covering glaciers, say the studies' authors.

By 2100, spring and summer temperatures in the Arctic could reach levels that trigger an unstoppable repeat performance, they say. Over several centuries, the melt could raise sea levels by as much as 20 feet, submerging major cities worldwide as well as chains of islands, such as the present-day Bahamas.

The US would lose the lower quarter of Florida, southern Louisiana up to Baton Rouge, and North Carolina's Outer Banks. The ocean would even flood a significant patch of California's Central Valley, lapping at the front porches of Sacramento.

These estimates may understate the potential rise. The teams say their studies provide the first hints that during the last interglacial period, ice sheets in both hemispheres worked together to raise sea levels, rather than the Northern Hemisphere's ice alone. This raises concerns that Antarctic melting might be more severe this time, because additional melt mechanisms may be at work.

"It sounds bad," acknowledges Jonathan Overpeck, a University of Arizona researcher who led one of the two studies. He notes that rising temperatures are approaching a threshold. But "we know about it far enough in advance to avoid crossing it." The challenge, he and others say, is to take advantage of the remaining window by reducing emissions of greenhouse gases substantially.

The two studies were published in Friday's issue of the journal *Science*.

Ice on Greenland and Antarctica is already thinning faster than it's being replaced - and faster than scientists thought it would, notes Richard Alley, a paleoclimatologist at Penn State University and member of one of the research teams. Only five years ago, he notes, climate scientists expected the ice sheets to gain mass through 2100, then begin to melt. "We're now 100 years ahead of schedule," he says.

The new results aren't the end of the story. The researchers will refine the models, improve the measurements, and find other sources of data to verify the modeling. Coral data pointing to sea-level changes in the last warm period remain controversial, the team acknowledges. And the team's assumption that the amount of carbon dioxide would triple by 2100, although moderate among climate forecasts, is not a done deal. It

depends on how quickly industrial and developing countries adopt low-emission technologies and take long-term steps to reduce greenhouse gases.

But the window for action is relatively short, Dr. Overpeck says. CO<sub>2</sub> remains in the atmosphere for more than a century after it's first emitted. And it takes time to implement policies and adopt technologies. Thus for all practical purposes, the tipping point may come sooner than atmospheric chemistry would suggest.

The studies required some in-depth sleuthing. Researchers realized that changes in Earth's tilt and orbit intensified the sunlight reaching the Arctic during interglacial periods, notes Bette Otto-Bliesner, a scientist at the National Center for Atmospheric Research in Boulder, Colo. But when it came to the effect on the Arctic's ice, "no one knew how big the response would be."

So she and her colleagues first tested the center's newest climate model against temperature information gleaned from pollen, insects, ocean plankton, and other remnants of the period. The results matched closely.

Confident that they could reproduce the period's climate by computer, they linked the results to a second model with a reputation for accurately simulating ice sheets. Using ice-core samples and other evidence as a reality check, they concluded that within 1,000 to 2,000 years of the warming's onset, Greenland's ice sheet dwindled to a steep lump covering the island's central and northern parts. The melt water raised sea levels by seven to 11 feet.

But coral records from geologically stable parts of the ocean suggested that sea levels during that time rose 16 to 20 feet - a level that held for roughly 11,000 years. Overpeck, who had been working with Dr. Otto-Bliesner on the initial modeling exercise, says several lines of evidence led him to suspect that the balance came from Antarctica.

From there, the team used the climate model to estimate the warming that could occur by 2130 if CO<sub>2</sub> emissions rose by 1 percent per year. In the pantheon of emissions scenarios, this represents a moderate one, he holds. But it's enough to triple CO<sub>2</sub> concentrations by 2100, leading to summers that are 5 to 8 degrees F. warmer than today - levels that appear to have melted the ice 129,000 years ago.

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