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Arctic Warming Faster Above Ground Level, Study Finds

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Global warming in the Arctic is mysteriously occurring more quickly 1.2 miles (2 kilometers) above the surface than at ground level, a new study says.

Scientists have long known from ground-level measurements that the Arctic is warming at nearly twice the global average rate.

Experts had presumed that this was an effect of solar heating, in which melting snow reveals darker underlying land and water that better absorb heat—an effect that escalates as snow and ice continue to shrink. (Related: "Warming Oceans Contributed to Record Arctic Melt" [December 14, 2007].)

So the finding that the air is warming even more rapidly higher up is especially surprising, reports a team led by Rune Graversen of Stockholm University in tomorrow's issue of the journal *Nature*.

Graversen's team drew on decades of weather data, mostly from satellites and trans-Arctic airplane flights, to examine temperature changes at various elevations across the Arctic.

They found that during the summer, the rate at which the upper atmosphere was warming up was two times faster each decade.

"It's a remarkable result," Graversen said. "I think nobody expected that."

The finding also means that solar heating can't be the only cause, because that should produce the greatest warming close to the surface.

"Retreating snow and ice cannot explain the vertical structure of the warming that we show," Graversen said. "So snow and ice retreat is not as important as we previously thought."

The effect also occurred in winter, when there is little sunlight to warm the surface.

Northward-Flowing Heat

Graversen theorizes that the upper-elevation warming is linked to changes in atmospheric circulation, such as heat flow northward each month.

Such patterns can be calculated using weather balloon data for winds and air temperature data from above meteorological stations in Europe and Canada.

(Related: "Pollution From U.S., Europe, Others Speeding Arctic Warming, Study Says" [March 16, 2007].)

"This assumption is that if this [heat flow] has increased—which we see in the data that it has—then it has contributed to the warming in the Arctic, not only at the surface, but higher in the atmosphere," Graversen said.

Increased moisture in northward-moving air also plays a role, he said, because when the water vapor condenses into clouds and snow, it releases energy, warming the air.

Nobody knows how much of this change is the result of human emissions of planet-warming gases such as carbon dioxide, but it's likely that they play a role.

"Many models suggest an increase in energy transport when more greenhouse gases are introduced into them," he said.

"Changes in the circulation in the atmosphere might have had a much larger effect than previously thought, but these changes may also have been induced by greenhouse gases."

The new finding doesn't downplay the effects of declining snow and ice. In fact, the scientists wrote, solar heating of denuded landscapes might become increasingly important as ice continues to retreat.

"Much of the present warming, however, appears to be linked to other processes, such as atmospheric energy transports," the authors conclude.

That's an important message, said John Walsh, President's Professor of Global Climate Change at the International Arctic Research Center for the University of Alaska, Fairbanks, who was not involved in the study.

"Were it not for this increase in poleward heat transport, the Arctic might have warmed less and the middle latitudes might have warmed more than actually happened over the past several decades," he said via email.

In other words, he added, "warming might have been more apparent in the heavily populated areas of the world, i.e., the middle latitudes, if there had not been the increase of heat transport identified" by Graversen and his colleagues.