

Focus On Arctic's Climate Changes

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Melting ice in Svalbard, Europe's northernmost territory. The archipelago is part of the Kingdom of Norway.

The signs are seen in shrinking summer sea ice, the northward march of tree and shrubs, and longer periods from spring to fall when the ground is snow-free. But perhaps more telling, scientists say they see evidence that the changes are beginning to feed on themselves, building momentum for which researchers say they currently see no effective brakes.

Scientists say this acceleration comes from "positive feedbacks" — self-reinforcing trends, which are the climate's version of irritating squeals from mishandled sound gear at a rock concert. If left unchecked by countervailing forces, positive feedbacks have the potential to destabilize the Earth's climate, tipping it into a new regime.

"What used to be whispered in a speculative way — hey, do you think the feedbacks are kicking in — is more like: It's starting to look like the feedbacks may be kicking in," says Donald Perovich, an Arctic sea-ice specialist at the U.S. Army Corps of Engineers' Cold Regions Research and Engineering Laboratory in Hanover, N.H.

The Arctic's sensitivity to change lies in its two seasons — frozen and thawed, researchers say. Everything from whole ecosystems to foundations for buildings and pipelines are tailored to those two states. With so much hanging on the freezing point of water, a three-degree change in average temperature in Barrow, Alaska or Fairbanks can have a far more profound effect than a three-degree change in Houston. And those changes are likely to reverberate far beyond the top of the world, Hinzman adds. "This isn't just an Arctic issue. The changes up here are going to cascade to the temperate regions around the world."

Researchers cite two broad categories of change as examples — summer ice cover in the Arctic Ocean and snow cover on land. Both are responsible for reflecting sunlight back into space, cooling the region.

A research group which includes Jonathan Overpeck, with the University of Arizona at Tucson, recently published an overview of sea-ice research indicating that the Arctic Ocean is likely to be ice-free in the summer within a century — a situation that the region

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hasn't experienced for at least a million years, the team says. "Probably the biggest surprise ... was that no one could envision any interaction ... that would act naturally to stop the trajectory," Overpeck notes.

Less summer ice allows the darker oceans to absorb more sunlight and thus more heat. More heat, in turn, means still less summer ice and thinner ice when it starts to re-form in the fall.

Many scientists expect that the additional fresh water from the summer melt could work its way into the North Atlantic, possibly slowing a major ocean conveyor belt that drives currents — and hence regional climates — worldwide. And these reductions in sea ice are occurring long after natural fluctuations in climate have shifted to states that would favor less summertime loss.

As with ice, snow cover performs the same reflective function. But a longer snow-free season allows the ground to warm earlier and stay warm longer, further lengthening the snow-free period. With warmer ground comes a range of effects to soil, plants, and permafrost that can further boost the region's ability to absorb sunlight and warm up.

Researchers also are concerned about Greenland's slowly melting ice cap. If current trends continue over several centuries, the cap could add as much as seven meters to the average sea level.

"There has to be some environmental controls to slow these effects," Hinzman says. The Arctic has undergone warming trends in the past, he notes, and recovered. "So something must regulate these processes."

Finding them, then determining whether they can blunt the changes under way, he says, will be critical to providing the forecasts that will help the region adapt.

Things to think about:

- What could be some of the regulating processes to steady the changes?
- What effects could the rising sea level cause?
- Is there anything we could do to stop this change?