That sequence of events suggests to Esposito and Shemansky that half a million tons of water ice crystals were suddenly added to the E ring, which already contained an equal mass of 1-micrometer ice particles. Colliding energetic ions would have knocked oxygen atoms free of the newly released ice. The resulting neutral oxygen atoms could then pick up charge from magnetospheric ions and eventually be ejected from the saturnian system, leaving the E ring much as it was.

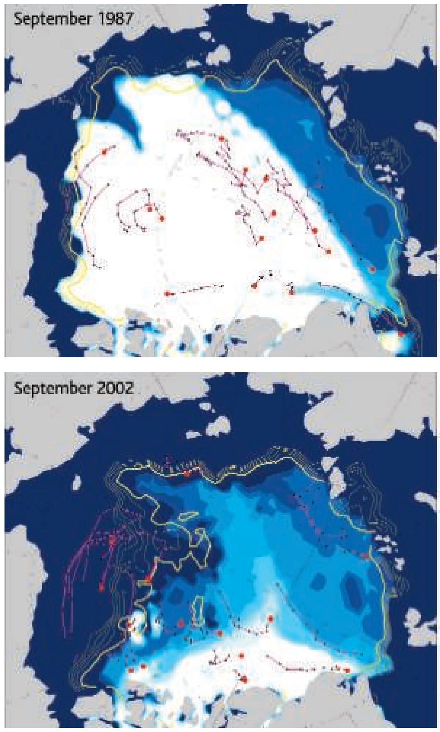
What could have injected that much ice into the E ring so suddenly? Esposito favors a catastrophic collision of two unseen icy bodies orbiting in the E ring. Such embedded moonlets sustain the faint ring of Jupiter, but they do it through continual erosion by impacting micrometeoroids, not by collisions among themselves. It would take an improbable coincidence or a great many embedded moonlets to explain a major collision just as Cassini approached. Ring specialist Joseph Burns of Cornell University doubts that there are enough E ring moonlets. A Cassini camera search for such bodies larger than 1 to 2 kilometers in diameter is 95% complete, he says, but none has been found.

Alternatively, the water might have been blasted off the moon Enceladus in a volcanic eruption. But the two Voyager spacecraft found no signs of ongoing eruption there in the early 1980s, although they did find plains that might have been smoothed by geologically recent watery volcanism. "You've got several bad alternatives," says Burns. Puzzled ring scientists hope that three Cassini close flybys of Enceladus this year, the first on 17 February, will improve their choices.

Scary Arctic Ice Loss? Blame the Wind

The past three Septembers have seen the Arctic ice pack shrink dramatically to a record low amid signs that greenhouse warming could be melting the ice, threatening to clear the Arctic Ocean within decades. Researchers are still worried, but a study presented at the meeting offers some reassurance. A natural, temporary shift in the wind may have been largely to blame for the recent shrinkage.

Winds of the high northern latitudes are the domain of the Arctic Oscillation (AO), an erratic atmospheric pressure seesaw (*Science*, 9 April 1999, p. 241). Over weeks, years, or even decades, pressure can fall over the pole while rising around a circle near the latitude of Alaska. The resulting steeper pressure drop across high latitudes increases the generally westerly winds blowing there. When the pressure seesaws the other way, the winds drop to weaker than average.



Ice lost. A wind-driven model loses much of its older, thicker Arctic ice (white) in 5 years.

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Wondering how the AO had been influencing Arctic ice, meteorologists Ignatius Rigor and J. Michael Wallace of the University of Washington, Seattle, created a model that keeps track of ice as it forms and blows around the Arctic Ocean, thickening with time. In the 1980s, the AO was in its so-called low-index phase, with higher than average pressure over the pole and therefore weaker westerly winds. In the model, those winds tended to drive the ice around in circles off the Alaskan and Siberian coasts, giving it a chance to thicken for an average of 10 years or more. But in the 1990s, the AO swung into its strong-wind phase. In the model, the new circulation tended to blow old, thick ice out of the Arctic Ocean through the Fram Strait and into the North Atlantic. The remaining ice was thinner than under the opposite AO phase and thus easier to melt away. In fact, ice did surge through Fram Strait in the early 1990s, and the ice has thinned, culminating in the record low ice extents of recent years.

At least some of the recent ice loss is indeed "a hangover effect" of the early '90s swing in the AO, says meteorologist Mark Serreze of the University of Colorado, Boulder. The AO index fell back toward more normal levels in the late '90s, he notes, but the ice hasn't recovered yet. Because Arctic warming has been lengthening the period in the summer during which ice can melt, he says, Arctic ice may well continue to shrink, although probably not as rapidly as it did recently.

In the long term, Serreze adds, climate models predict that greenhouse warming should lead to increased melting over coming decades. Some models even have the intensifying greenhouse pushing the AO into a permanent positive phase, he says, which would favor still-greater ice losses.

–Richard A. Kerr

Snapshots From the Meeting

No vestige of a beginning. Seismologists got their most detailed look at an earthquake last fall when 30 kilometers of the San Andreas fault ruptured through the town of Parkfield, California, and its dense array of instruments, but they still missed something. "This is the best data we've got," said geophysicist Malcolm Johnston of the U.S. Geological Survey in Menlo Park, California, but there is still no sign of the slow, hesitant onset of the fault rupture that some seismologists have been looking for (*Science*, 6 January 1995, p. 28). If earthquakes were to begin as slow slippage on a small patch of fault, well-placed instruments might detect it days or even weeks before the slippage took off and produced a quake. But the Parkfield data limit any such nucleation patch to a few tens of meters or less in size, says Johnston. So, even if nucleation occurs, detecting it looks improbable.

A nudge toward magnetic flip-flop. Two paleomagnetists found themselves presenting adjacent posters that argued for a previously unrecognized precursor to the most recent reversal of Earth's magnetic field. Researchers had thought that the field generated by the churning molten iron of the outer core had simply weakened and reorganized itself for a few thousand years as it got ready to flip about 775,000 years ago. Not so fast, say Laurie Brown of the University of Massachusetts, Amherst, and Bradley Singer of the University of Wisconsin, Madison. Brown, working on the paleomagnetic record frozen into lavas of central Chile, and Singer, studying lavas in Tahiti, found that the field had actually weakened and moved toward a reversal 18,000 years earlier. The prolonged precursory move toward reversal may have given the liquid outer core time to overcome the stabilizing influence of the solid inner core.

–R.A.K.