Arctic Replenished Very Little Thick Sea Ice in 2005

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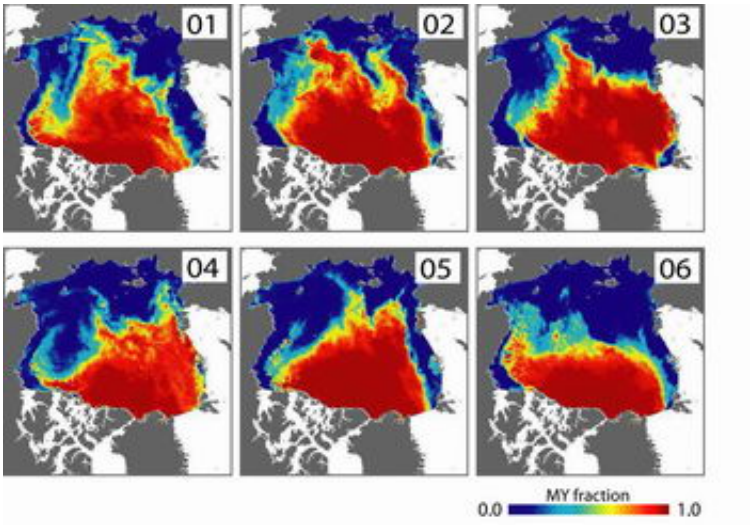

QuikScat measurements of Arctic perennial sea ice coverage (shown in red) in winter 2006 were 14-percent less than in winter 2005. Image credit: NASA/JPL

A new NASA study has found that in 2005 the Arctic replaced very little of the thick sea ice it normally loses and replenishes each year. Replenishment of this thick, perennial sea ice each year is essential to the maintenance and stability of the Arctic summer ice cover.

The findings complement a NASA study released in fall 2006 that found a 14-percent drop in this perennial ice between 2004 and 2005. The lack of replenishment suggests that the decline may continue in the near future.

Perennial ice coverage fluctuates seasonally for two reasons: summer melting and the transport of ice out of the Arctic. When perennial ice, which is 10 or more feet thick, is lost in these ways, new, thinner, first-year seasonal ice typically replaces it. Some of this seasonal ice melts in the following summer, and some is thick enough to survive and replenish the perennial ice cover.

"Recent studies indicate Arctic perennial ice is declining seven to 10 percent each decade," explained Ron Kwok of NASA's Jet Propulsion Laboratory, Pasadena, Calif. "Our study gives the first reliable estimates of how perennial ice replenishment varies each year at the end of summer. The amount of first-year ice that survives the summer directly influences how thick the ice cover will be at the start of the next melt season."

Using satellite data from NASA's QuikScat and other data, Kwok studied six annual cycles of Arctic perennial ice coverage from 2000 to 2006. The scatterometer instrument on QuikScat sends radar pulses to the surface of the ice and measures the echoed radar pulses bounced back to the satellite. These measurements allow scientists to differentiate the seasonal ice from the older, perennial ice.

Kwok found that after the 2005 summer melt, only about four percent of the nearly 965,000 square miles of thin, seasonal ice that formed the previous winter survived the summer and replenished the perennial ice cover. That was the smallest replenishment seen in the study. As a result, perennial ice coverage in January 2006 was about 14 percent smaller than the previous January.

Kwok examined how movement of ice out of the Arctic affected the replenishment of perennial sea ice in 2005. That year, the typically small amount of ice that moves out of the Arctic in summer was unusually high - about seven percent of the perennial ice coverage area. Kwok said

the high amount was due to unusual wind conditions at Fram Strait, an Arctic passage between Antarctic Bay in Greenland and Svalbard, Norway. Troughs of low atmospheric pressure in the Greenland and Barents/Norwegian Seas on both sides of Fram Strait created winds that pushed ice out of the Arctic at an increased rate.

The effects of ice movement out of the Arctic depend on the season. When ice moves out of the Arctic in the summer, it leaves behind an ocean that does not refreeze. This, in turn, increases ocean heating and leads to additional thinning of the ice cover.

These findings suggest that the greater the number of freezing temperature days during the prior season, the thicker the ice cover, and the better its chances of surviving the next summer's melt. "The winters and summers before fall 2005 were unusually warm," Kwok said. "The low replenishment seen in 2005 is potentially a cumulative effect of these trends."

Kwok also examined the 2000-2006 temperature records within the context of longer-term temperature records dating back to 1958. He found a gradual warming trend in the first 30 years, which accelerated after the mid-1980s. "The record doesn't show any hint of recovery from these trends," he stated. "If the correlations between replenishment area and numbers of freezing and melting temperature days hold long-term, its expected the perennial ice coverage will continue to decline."

Kwok points to a possible trigger for the declining perennial ice cover. In the early 1990s, variations in the North Atlantic Oscillation, a large-scale atmospheric seesaw that affects how air circulates over the Atlantic Ocean, were linked to a large increase in Arctic ice export. It appears the ice cover has not yet recovered from these variations.

"We're seeing a decreasing trend in perennial ice coverage," he said.

"Our study suggests that, on average, the area of seasonal ice that survives the summer may no longer be large enough to sustain a stable perennial ice cover, especially in the face of accelerating climate warming and Arctic sea ice thinning." Data from the 2005-2006 season have not yet been analyzed. The study appeared March 2 in *Geophysical Research Letters*.

Source: NASA