



Vanishing Arctic Sea Ice

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Typically, the absolute minimum Arctic sea ice cover occurs during the second week in September. However, during summer 2007, Arctic sea ice extent surpassed all previous records for the lowest absolute minimum sea ice extent by the middle of August. Until 2007, September 2005 had set the record for the least amount of sea ice during the most reliable period of observations (1953-2007), with a September average ice extent of 5.56 million sq-km. In 2007, the ice cover during September dropped an additional 23% compared to September 2005, ending up with a final monthly mean value of only 4.28 million sq-km. Sea ice conditions in September 2007 represented a 50% reduction compared to conditions in the 1950s - 1970s.

The unprecedented low ice conditions during summer 2007 raise concern that the Arctic is on the verge of a fundamental transition towards a seasonal ice cover. A key factor in helping to explain the large ice losses in 2007 is a transition from old, thick ice to younger and therefore, thinner ice in recent decades. Global climate models (GCMs) suggest that as the ice thins to a vulnerable thickness in response to rising greenhouse gas concentrations, a reinforcing kick from natural variability may trigger an initial, abrupt ice loss. However, abrupt loss in ice cover comparable to the changes seen in 2007 do not occur until mid century, when ice has melted enough to produce large areas of open water that in turn accelerate the ice-albedo feedback. The fact that current models tend to underestimate the observed rate of ice loss suggests that the GCMs may not fully capture the combined effects of factors such as wind-driven ice

and ocean heat transport in reducing ice thickness and creating open water areas that strengthen the ice-albedo feedback.

Whether the overall loss of the oldest and thickest ice indeed predisposes the Arctic to future sustained loss of summer ice cover as what we saw in 2007 remains to be seen. The time series of ice extent shows considerable year-to-year variability, suggesting that the ice cover could certainly recover at least partially under the right conditions, as occurred in 1996. However, following a sequence of summers such as those since 2001, and in particular the summer of 2007, enhancement of the ice-albedo feedback along with other factors, such as modification of the ocean mixed layer, combine to limit the ability of the ice pack to reestablish the thick, old ice cover present in the 1980s. This suggests that rather than being part of natural variability on decadal time scales, the changes in 2007 may reflect conditions that are approaching, or have passed, the tipping point.