Geophysical Research Abstracts, Vol. 8, 10449, 2006
SRef-ID: 1607-7962/gra/EGU06-A-10449

What drives the rapid decline of arctic sea ice over the past decades?

Jinlun Zhang
Polar Science Center, Applied Physics Laboratory, University of Washington

Significant changes in the arctic environment have been detected over the past decades. One of the most striking changes is the rapid decline of arctic sea ice. Observations of ice thickness from submarines over the past several decades reveal a possible 40% decrease in arctic sea ice volume over a broad area of the central Arctic. Satellite passive microwave data since the 1970s show a 3% decrease per decade in arctic sea ice extent. Ice extent in 2002 was observed to be a minimum for the period 1978-2002, and very low ice cover persisted during the summers of 2003, 2004, and again 2005, four years in a row with a record or near-record lows in summer ice extent. What drives such a rapid decline of arctic sea ice over the past decades? Certainly the rapid thinning is a coupling effect of changing ice dynamic and thermodynamic processes, such as ice growth and decay, ice advection (outflow), lateral melting, ice deformation, and ice ridging. How do these processes change in response to shifts in atmospheric circulation, often character-ized by either the North Atlantic Oscillation (NAO) or the Arctic Oscillation (AO) that moved to more positive phases during the late 1980s and most of the 1990s and has now returned to more neutral conditions. How do they respond to changes in arctic surface air temperature that has been increasing faster than the global average? And how are they linked to the Atlantic water whose signature in the Arctic was strong in the 1990s and has since lessened, but still stronger than the pre-1990s level? Is the reduction in ice volume/extent mainly due to an elevated atmospheric and oceanic heating that leads to increased ice melting, or due to a shifted wind circulation pattern that leads to increased ice export? These are the questions we will try to address. We will also examine the effect of the positive ice-albedo feedback that, together with the influence of the incoming warm Atlantic water, continues to drive the decline of arctic sea ice even though the NAO/AO has shifted to more neutral phases since the late 1990s.