A new insight into the decline of the Arctic sea ice cover

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The mechanical behavior of the Arctic sea ice cover appears to favor its rapid decline. Scientists from INSU-CNRS, Université J. Fourier and Université de Savoie, France, have analyzed the trajectories of drifting buoys anchored in the ice and found that the mean drift rate and deformation rate of Arctic sea ice has strongly increased over the last three decades. These effects, related to the mechanical properties of the cover, contribute to the faster- than-expected decline of Arctic sea ice. This work is published in the 14 may 2009 issue of the *Journal of Geophysical Research - Oceans*.

Scientists from the Laboratoire de Glaciologie et Géophysique de l'Environnement of Grenoble (CNRS/Université J. Fourier) and the Laboratoire de Géophysique Interne et Tectonophysique of Chambéry (CNRS/Université J. Fourier/Université de Savoie), inspired by the 2006-2007 expedition of the polar schooner Tara, which drifted along the transpolar drift more than twice as fast as Nansen's Fram ship 115 years earlier, analyzed the trajectories of more than 600 buoys anchored into the ice over the last 30 years.

They observed a substantial increase in the mean drift rate of the sea ice, equivalent to +10% per decade. Looking at the dispersion rate of the buoys, they also measured a strong increase in the mean deformation rate of the sea ice, equivalent to +50% in both winter and summer. This combined acceleration of Arctic sea ice drift and deformation appears to be related to, and would actually strengthen, the thinning of the cover.

A close link between sea ice deformation and fracturing had previously been revealed by scientists from LGGE. Increased deformation leads to greater fracturing, which in turn leads to Arctic ocean warming through solar radiation in summer. This process accelerates sea ice thinning in summer and delays refreezing in early winter, decreasing the mechanical strength of the cover and leading to even more fracturing and greater drift speed and deformation. In addition, a more fractured, and hence more mobile, sea ice cover will be exported at a faster rate out of the Arctic towards the Atlantic. These two effects, combined with the mechanical properties of the sea ice cover,probably participate to the general decline of the Arctic sea cover.

The spectacular, and largely unexpected sea ice shrinkage observed in the summer of 2007 might be a good illustration of the interplay between sea ice deformation and decline, as the exceptional deformation rates measured by scientists in the winter of 2006-07 most likely contributed to the levels of deformation measured the following summer and therefore to the observed shrinkage.

These complex processes and interactions, which are difficult to model in climate simulations, might partly explain why scientists have been unable to calculate the rate of decline of the Arctic sea ice cover.

More information: Rampal, P., Weiss, J. and Marsan, D., Positive trend in the mean speed and deformation rate of Arctic sea ice, 1979-2007, J. Geophys. Res., doi:10.1029/2008JC005066, 14 May 2009

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