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Changing Marine Access in the Arctic Ocean – A Strategic View for the 21st Century

ACIA Symposium Extended Abstract

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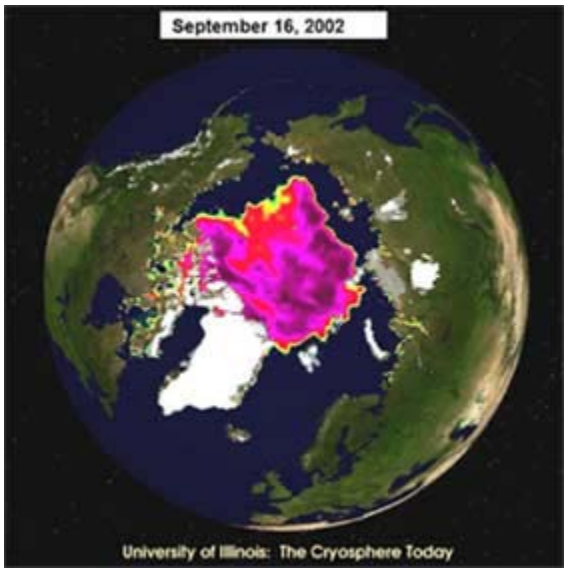
Marine access in the Arctic Ocean changed in unprecedented ways during the second half of the 20th century. The Arctic Climate Impact Assessment (ACIA) has documented substantial observational evidence that the sea ice cover is undergoing profound changes including: a steady decrease in extent with larger areas of open water during summer; decreasing coverage of multi-year sea ice in the Central Arctic Ocean; and, thinning of sea ice throughout the Arctic Ocean. These changes have implications for a host of marine uses such as shipping, offshore development, fishing, indigenous hunting, tourism, and scientific exploration.



Arctic sea ice extent on September 16, 2002, a summer minimum for 1900-2002. Note the large areas of open water north of Alaska and Siberia which are already occurring in the Summer Arctic. From the University of Illinois.

In addition to these well-documented environmental changes, icebreaker access to nearly all regions of the Arctic Ocean has been attained by the end of the 20th century. During 1977-2004, 52 transits have been made to the Geographic North Pole by the icebreakers of Russia (42), Sweden (4), Germany (2), USA (2), Canada (1), and Norway (1) [remarkably, eight successful transits by surface ships to the North Pole were conducted during the summer of 2004]. Thirteen of the voyages were in support of scientific research and the remaining 39 were devoted to tourist voyages to the North Pole and across the Arctic Ocean. Only one voyage of the 52 was not conducted in summer and that was the nuclear icebreaker Sibir's (Russia) celebrated voyage which supported scientific operations 8 May to 10 June 1987 (reaching the North Pole 25 May 1987). During the decade of the 1990's, five historic trans-Arctic voyages were accomplished: a transit across the Central Arctic Ocean by the nuclear icebreaker Sovetskiy Soyuz (Russia) with tourists in August 1991; transits by the Louis S. St Laurent (Canada) and the Polar Sea (USA) during July and August 1994 from Bering Strait to the North Pole and to Svalbard - the first scientific transect of the Arctic Ocean conducted by surface ship; and, two crossings by the nuclear icebreaker Yamal (Russia) with

tourists in 1996. During the late summer of 2004, a small 'armada' consisting of the nuclear icebreaker Sovetskiy Soyuz, the icebreaker Oden (Sweden) and the icebreaking ship Vidar Viking (Norway), out-fitted for drilling, conducted a unique scientific drilling voyage in the remotest reaches of the Arctic Ocean. A review of these pioneering voyages provides substantial confirmation that marine access in summer throughout the Arctic Ocean has been achieved by highly capable icebreaking ships.

Within ACIA, projected changes in Arctic sea ice coverage were evaluated in the context of potential improvements in marine access. The evaluation is based on monthly fields of sea ice from simulations by five different global climate models (GCMs), each forced by the conservative, Intergovernmental Panel on Climate Change (IPCC) B2 scenario of increasing greenhouse gas concentrations. While continued greenhouse warming reduces sea ice coverage in the five model simulations, especially during summer and in all the coastal Arctic seas, there is a considerable range among the retreats projected. One model projects an ice-free Arctic Ocean in summer by mid-century. Overall, the seasonality of the retreats projected by the models (largest in summer) is consistent with trends in the observed sea ice coverage during the past five decades. The suite of plausible, alternative futures of Arctic sea ice during the ACIA time periods (2010-2030, 2040-2060, and 2070-2090) represents a first-order, strategic guide to future marine access in the Arctic Ocean.

The work of ACIA also included first-order attempts at regional assessments for the Northwest Passage (NWP) in the Canadian Arctic and the Northern Sea Route (NSR) along the northern Eurasian coast. Two serious constraints limited an adequate ACIA assessment of the NWP: the GCMs could not resolve the complex geography of the Canadian Archipelago; and, the observed sea ice trends analyzed by the Canadian Ice Service, although negative for sea ice extent since the late 1960's (in both the eastern and western regions of the NWP), indicated a very high inter-annual variability of coverage. Sea ice simulations conducted for the NSR (analyzing the region from Kara Gate in the west to Bering Strait) were more successful and these indicated decreasing sea ice coverage and plausible increases in the length of the NSR navigation season throughout the 21st century. Many of the simulations show retreating ice conditions along the NSR, but with ice consistently present at the northern tip of Severnaya Zemlya; such model results imply, for example, a potential reliance on a transit route through Vilkitskii Strait between the Kara and Laptev seas , rather than a more northernly route in the open Arctic Ocean.

The sea ice analyses conducted during ACIA have provided the foundation for an initial attempt at construction of an 'Arctic sea ice atlas of the future.' Climatological sea ice atlases of the Arctic Ocean and regional seas have been developed by several Arctic nations during the 20th century. Unlike these earlier atlases based on the observed record, this new atlas will be based primarily on GCM projections of Arctic sea ice conditions for the remainder of the 21st century. Illustrated will be the 5-model median Arctic sea ice simulations for the ACIA time slices, and simulations for single models over a complete annual cycle. Although some uncertainty remains in the projections, the intent of the atlas will be to provide a strategic, long-range view of plausible futures of sea ice and potential marine access throughout the Arctic Ocean. The atlas will be designed as a strategic planning tool and potentially can be a vehicle to provoke wide-ranging discussions about the future of the Arctic Ocean.

Find more information (references and websites):

- ACIA Symposium