Sea Ice Variability

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THE ISSUE

The impacts of global climate change are amplified in the Arctic which has warmed at approximately double the rate of the global mean in the last century[1]. A significant impact of this warming trend has been a decline in Arctic sea ice. In addition to becoming more scarce, future sea ice will be thinner, more salty, less rigid, and more mobile than today's[2]. These changes will have far reaching impacts for Arctic ecosystems and the people that live and work in the Arctic. Reliable, comprehensive, and timely information is critical to local and regional planning efforts. Information pertinent to decision-making comes from Western science as well as local and indigenous knowledge. While there have been substantial advances in our understanding of Arctic change, significant knowledge gaps remain.

WHAT WE KNOW

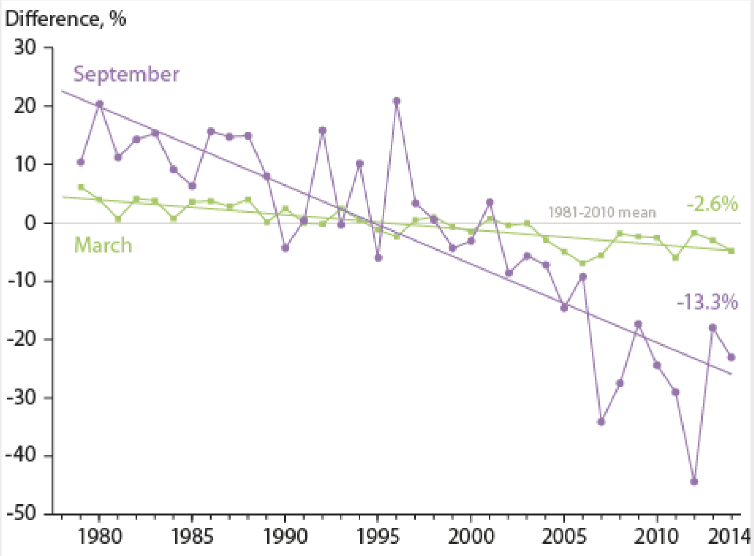
The timing of sea ice formation and break-up is changing:
The number of days with sea ice on the ocean and snow on the ground has seen a significant decline. As the climate warms, the accumulation of snow and ice in the fall is delayed, and its springtime melt occurs earlier. The Chuckchi Sea average melt season, the period between the onset of surface melt and surface freezing, lengthened by 13.2 days per decade from 1979 to 2013 (Table 1). This is significantly greater than the average increase across the Arctic as a whole, which was 5 days per decade[3]. Travel along the ice edge during the melt season can be dangerous due to uneven ice deterioration. Longer melt seasons negatively impact the mobility of Arctic residents and can reduce access to subsistence resources.

Table 1: Trends in Freeze-up, Melt Onset, and Length in the Melt Season from 1979-2013, Expressed in the number of days per decade^{-1}
Adapted from Stroeve et al., 2014

Region	Early Freeze Onset (EFO)	Melt Onset (MO)	Melt Length (EFO-MO)
All	3.0	-2.1	5.0
Bering	3.0	0.4	2.6
Hudson Bay	3.4	-3.1	6.5
Baffin Bay	1.3	-4.6	5.9
E. Greenland	2.4	-6.1	8.5
E. Siberian	8.4	-1.3	9.7
Chuckchi	10.7	-2.3	13.2
Beaufort	6.5	-2.7	9.2
Canadian Archipelago	2.2	-1.0	3.2

Sea ice coverage is declining:
The extent of sea ice, especially at the time of its regular annual minimum in September, has been declining over the past few decades (Figure 1)[4]. The Beaufort and Chuckchi seas have seen extreme summer ice loss, with declining trends in September ice extent of approximately -20% per decade through 2015[2]. Spring declines in sea ice extent are also significant (Figure 2). This impacts the timing that important subsistence animals (such as bowhead wales and walrus) arrive in the region.

Figure 1: Historical trends in Arctic sea ice extent for March (month of maximum extent) and September (month of minimum extent). Each value is the difference in ice extent relative to the mean values for 1981–2010. The straight lines show least squares linear regressions and indicate ice losses of 2.6% (March) and 13.3% (September) per decade (Perovich et al., 2015)[4]



WHAT WE KNOW (continued)

Sea ice thickness is declining:
Sea ice thickness is among the most difficult geophysical parameters to measure at large scales and, because of large variability and limited observational data, evaluation of ice thickness trends is difficult. However, based on subsurface sonar data, aircraft-mounted sensors, and satellite lidar or radar data, it is estimated that the annual mean ice thickness in the broad region of the central Arctic basin where submarine data is available has decreased from 3.59m in 1975 to 1.25m in 2012, a 65% reduction[5] .

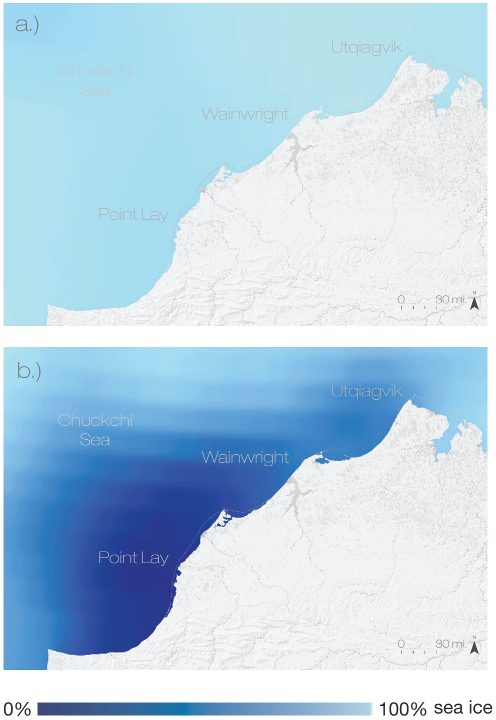


Figure 2: Average May sea ice coverage in the Chuckchi Sea (a) May 2013, (b) May 2016. Based on data from the Scenarios Network for Alaska and Arctic Planning (SNAP) Historical Sea Ice Atlas, 2016.

IMPACTS ON LOCAL FOOD SECURITY

In the Iñupiat worldview, food security is synonymous with environmental health and encompasses a wide range of concerns from availability (ability of the Arctic ecosystem to maintain a high variety of life) to accessibility (having the ability to live off the land and to obtain sufficient access to diverse sources of healthy food)[6] (Figure 3). Sea ice variability has significant impacts on all dimensions of food security, necessitating an adjustment in traditional hunting and management strategies[6].

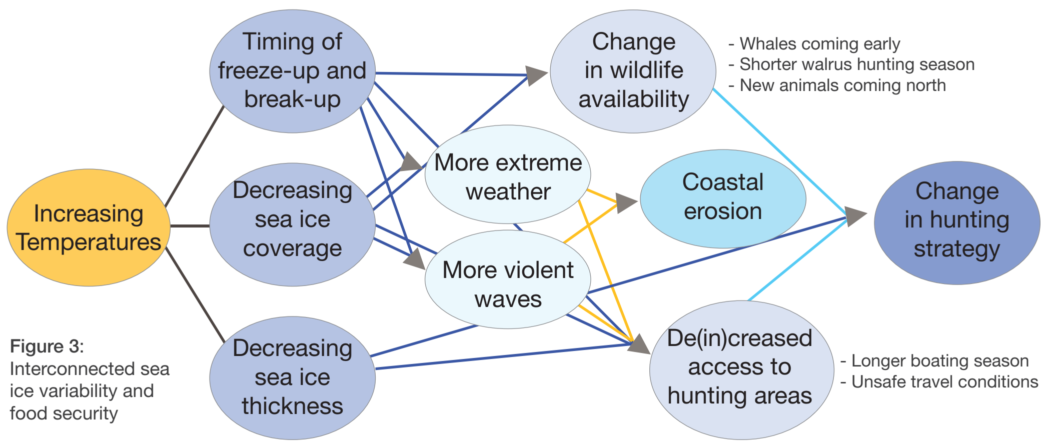


Figure 3: Interconnected sea ice variability and food security

KNOWLEDGE GAPS

Sea ice research is limited by the availability of reliable long term data sets. In contrast to readily available sea ice coverage data, Arctic sea ice thickness observations are temporally and spatially discontinuous[5]

Available sea ice data primarily covers free floating ice in the open ocean. Reliable data for the near-shore environment is lacking[7]

There is a need for high resolution data, which is often not available via remote sensing, to assist local decision-makers[8]

RECOMMENDATIONS

- Support Arctic communities to identify local solutions to environmental challenges[6]
- Adapt traditional management methods to changing environmental conditions[6]
- Collaborate with Arctic coastal residents for near-shore sea ice monitoring and other high resolution data needs[9]
- Increase synergy of information generated from natural and social science[6]
- Develop organizational capacity to make the best use of all available information for decision-making[10]

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