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Variability, Trends and Predictability of Arctic Sea Ice: Insights from Observations, Modeling and Remote Sensing at the National Snow and Ice Data Center

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Satellite data maintained at the National Snow and Ice Data Center (NSIDC) documents downward trends in Arctic sea ice extent in all months, strongest at the end of the summer melt season, with the largest summer retreats in the Beaufort and Chukchi seas. Data from various forms of remote sensing, including lidar, also documents a sharp decline in ice thickness and volume. Climate models project that a seasonally ice-free Arctic Ocean will be realized well within this century, perhaps as early as 2040. However, for years to come, sea ice conditions will be highly variable, especially on a regional basis. Regional variability in end-of-summer ice extent is closely tied to summer weather patterns; the prevailing weather patterns strongly determine whether or not the Northern Sea Route or the Northwest Passage will open in a given summer. Recent research at NSIDC has also shown that summer ice conditions in the Chukchi Sea – a key choke point for ships entering or leaving the Arctic Ocean, is strongly controlled by variability in the Bering Strait oceanic heat inflow. Knowing the oceanic heat flow provides a potential avenue via a simple linear model to predict the dates of seasonal sea ice retreat and advance several months in advance. Another source of predictability in this key area is seasonal ocean heat uptake and albedo feedback – early ice retreat means more absorbtion of heat in the upper ocean through summer, which then delays autumn freeze up. However, the vagaries of summer weather will always limit predictability. Along with conducting research on Arctic sea ice variability, trends, and projected future conditions, NSIDC maintains a number of satellite-based sea ice data sets that can support Arctic marine operations. MASIE (Multisensor Analyzed Sea Ice Extent), which mainly uses visible-band data, provides accurate information on the sea edge. MASIE products are developed in collaboration with the US National Ice Center. NSIDC also holds daily (and continuously updated) fields of sea ice concentration (October 1979 onwards) from the satellite passive microwave time series at a coarser 25 km resolution. A growing concern at NSIDC is a potential gap in data coverage; the record uses data from the US Defense Meteorological Satellite Program (DMSP) F-Series of satellites. F-18, the youngest and last in the series, is well past its design life, and the Advanced Microwave Sounding Radiometer 2 (AMSR-2) is also getting old. New platforms with appropriate passive microwave sensors are unlikely to launch until 2022.