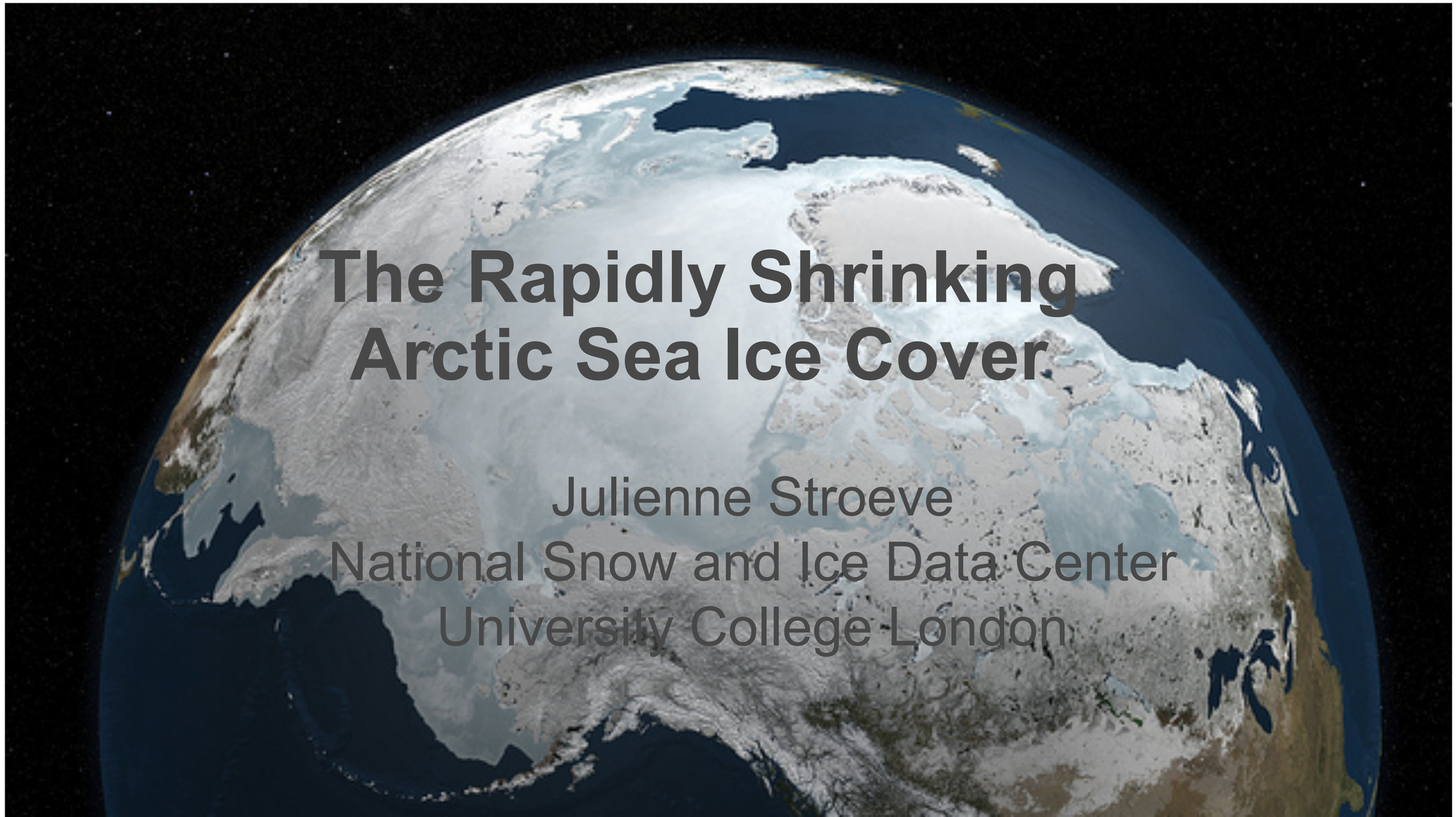
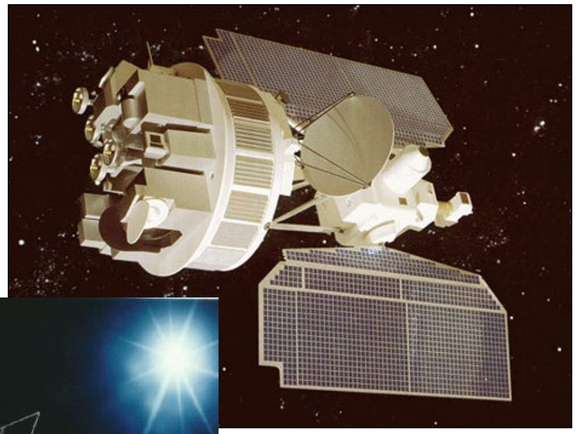


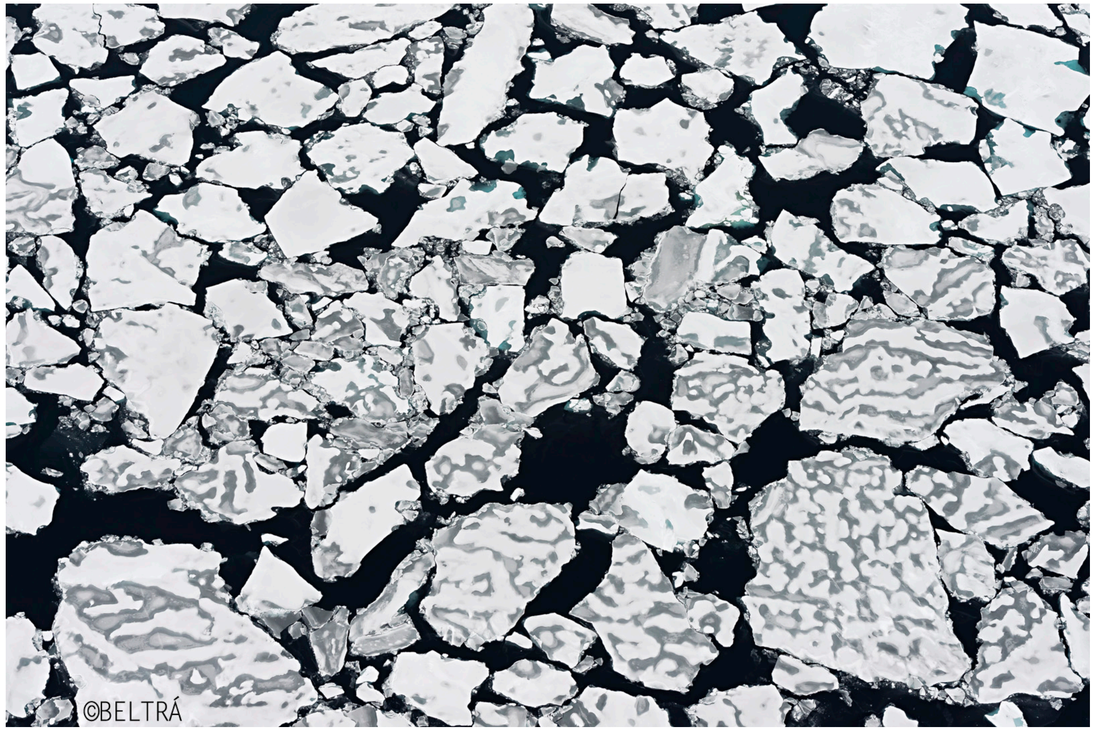
The Rapidly Shrinking Arctic Sea Ice Cover

Julienne Stroeve
National Snow and Ice Data Center
University College London

The Modern Satellite Data Record

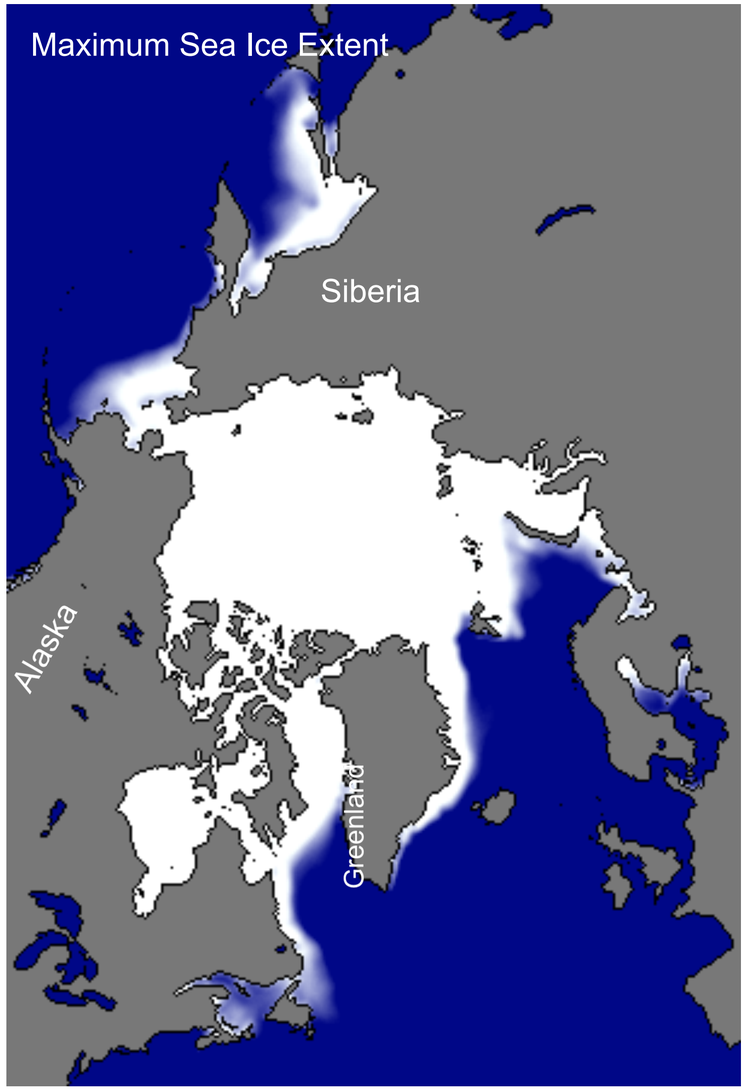
The longest and most consistent data record of sea ice conditions comes from a series of successive multi-channel passive microwave radiometers, flown by the NASA Nimbus Program and the US Defense Meteorological Satellite Program (DMSP)

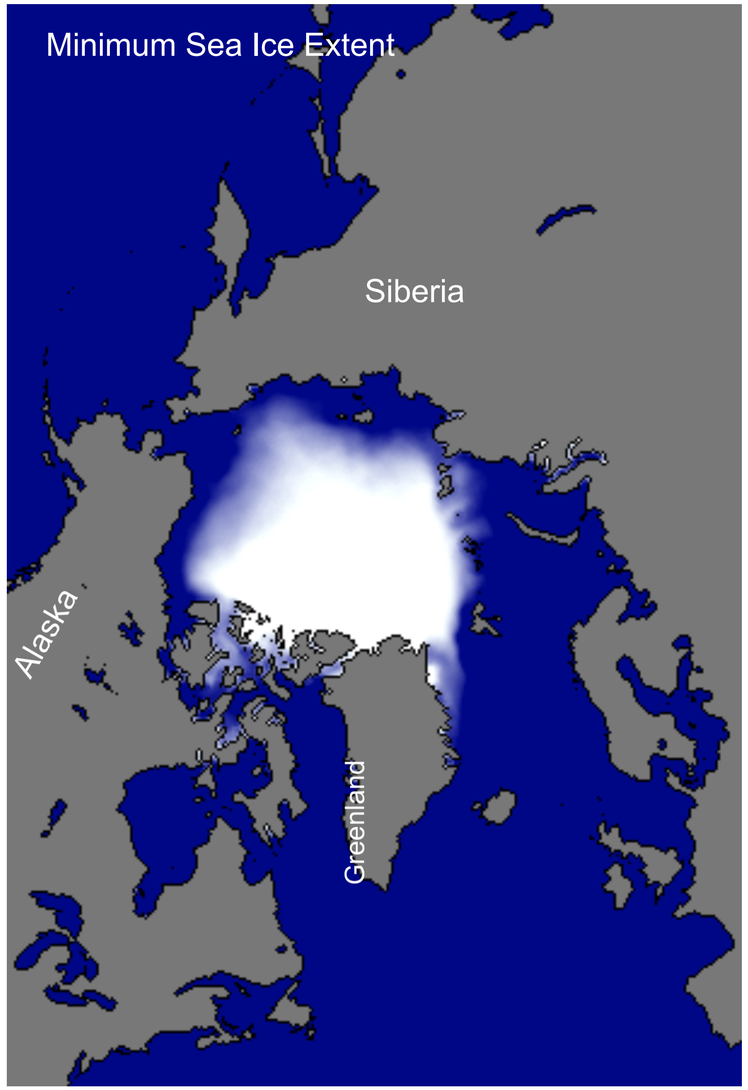




This record provides us with estimates of sea ice concentration and total ice extent from October 1978 to present.

Seasonal Variability in Arctic Sea Ice

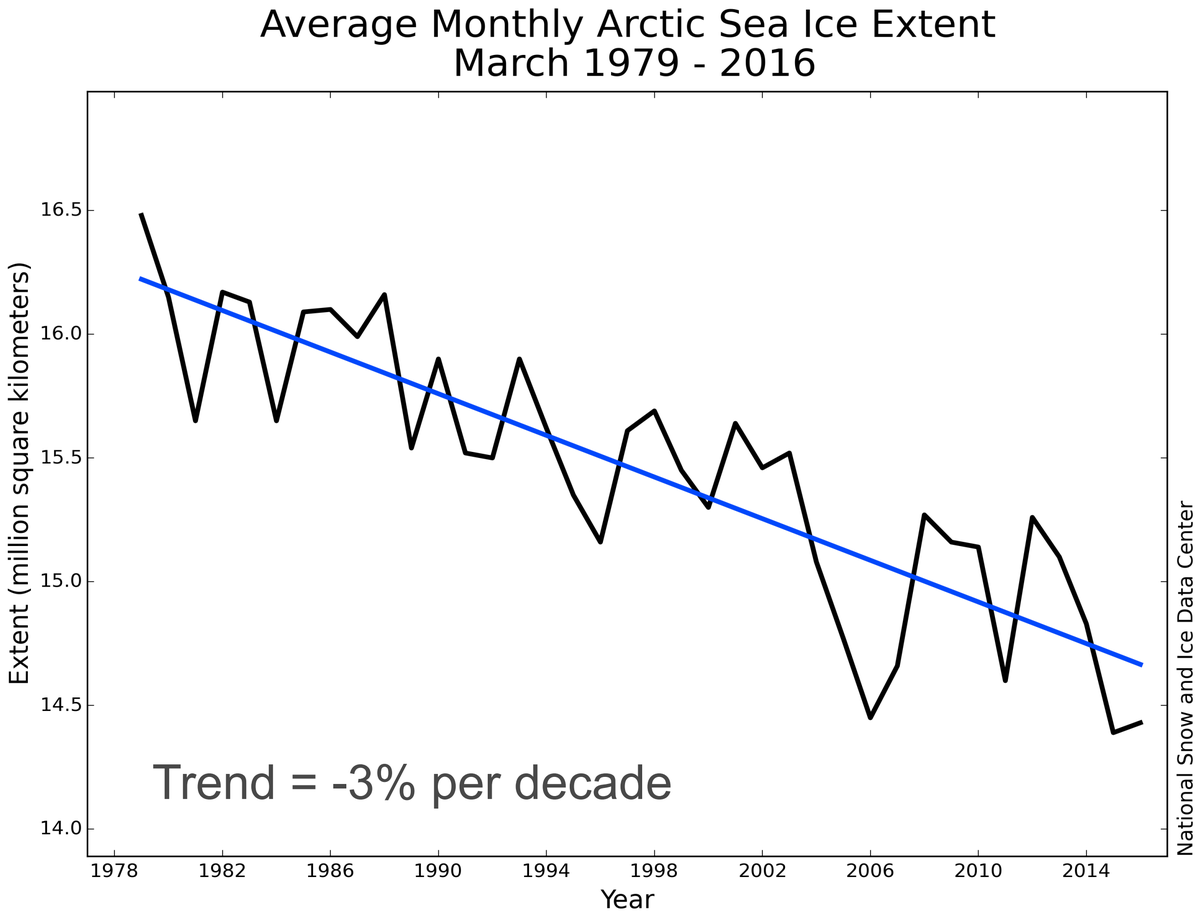


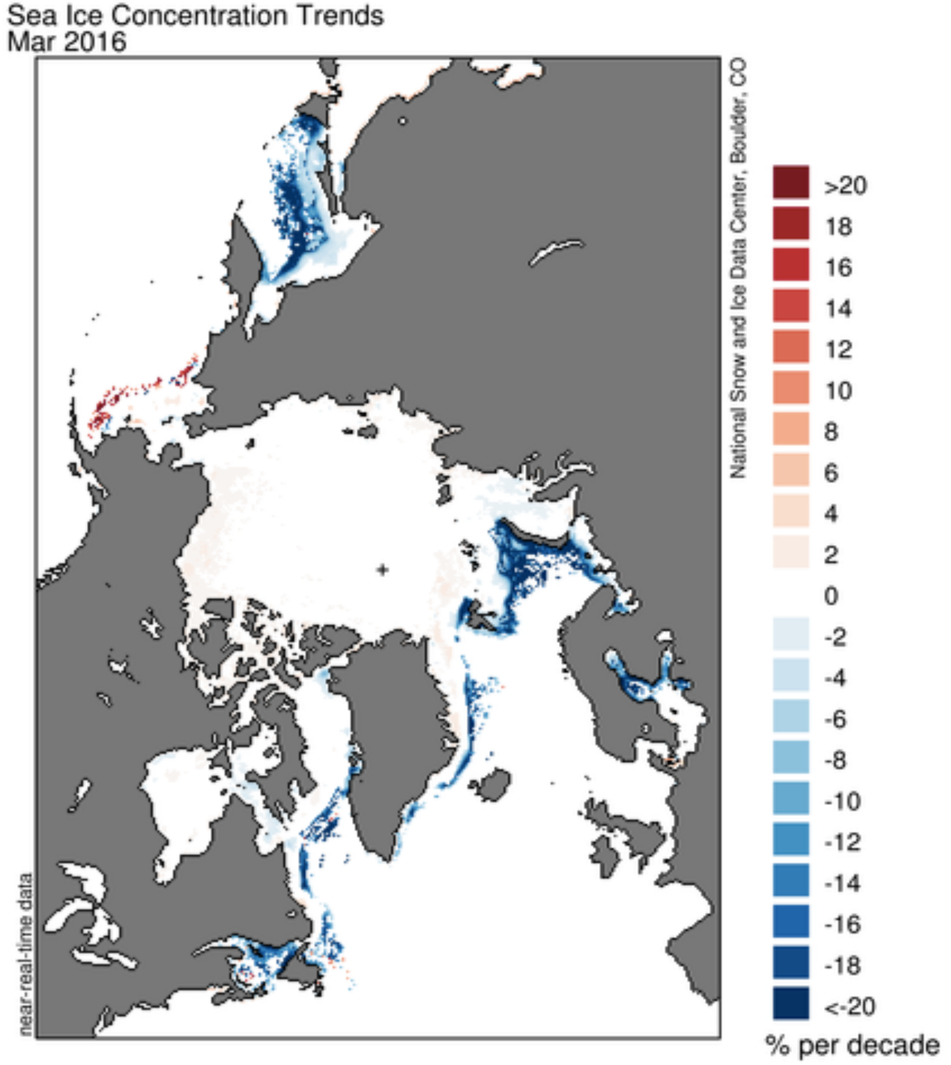


Maximum extent occurs in February/March (14-16 million km^2 or 5-6 million square miles) , minimum extent occurs in September (7-8 million km^2 or about 3 million square miles)

Observed changes over the satellite data record

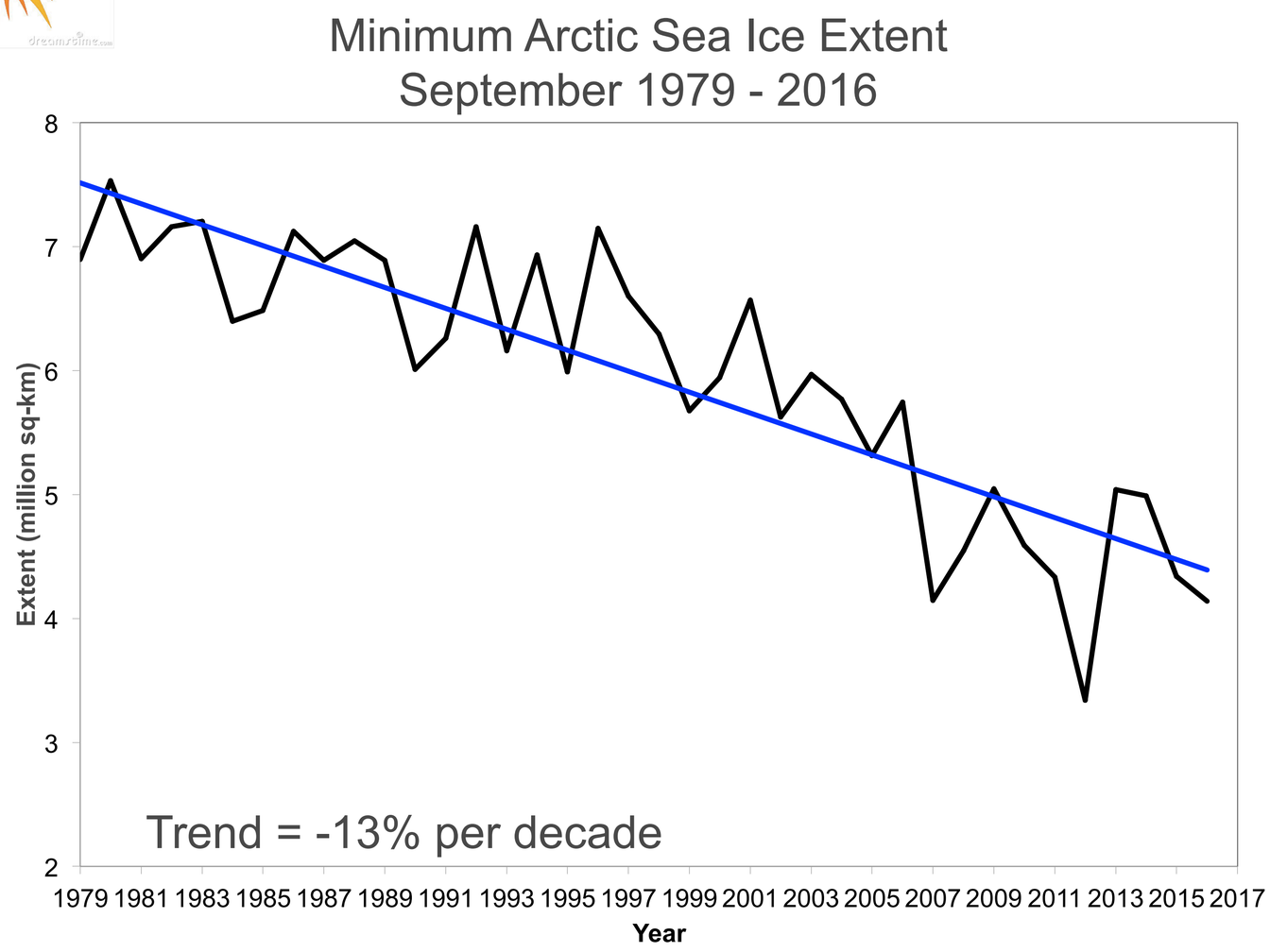
Changes during winter (March)

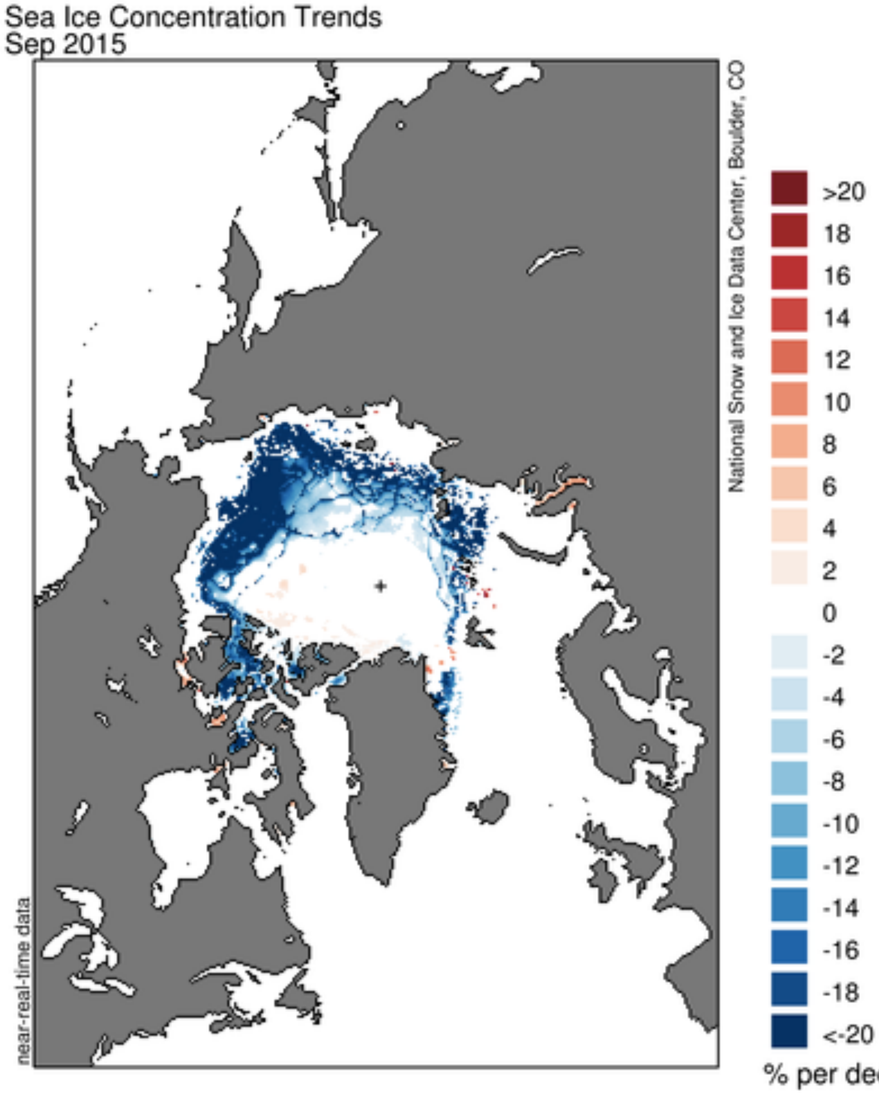




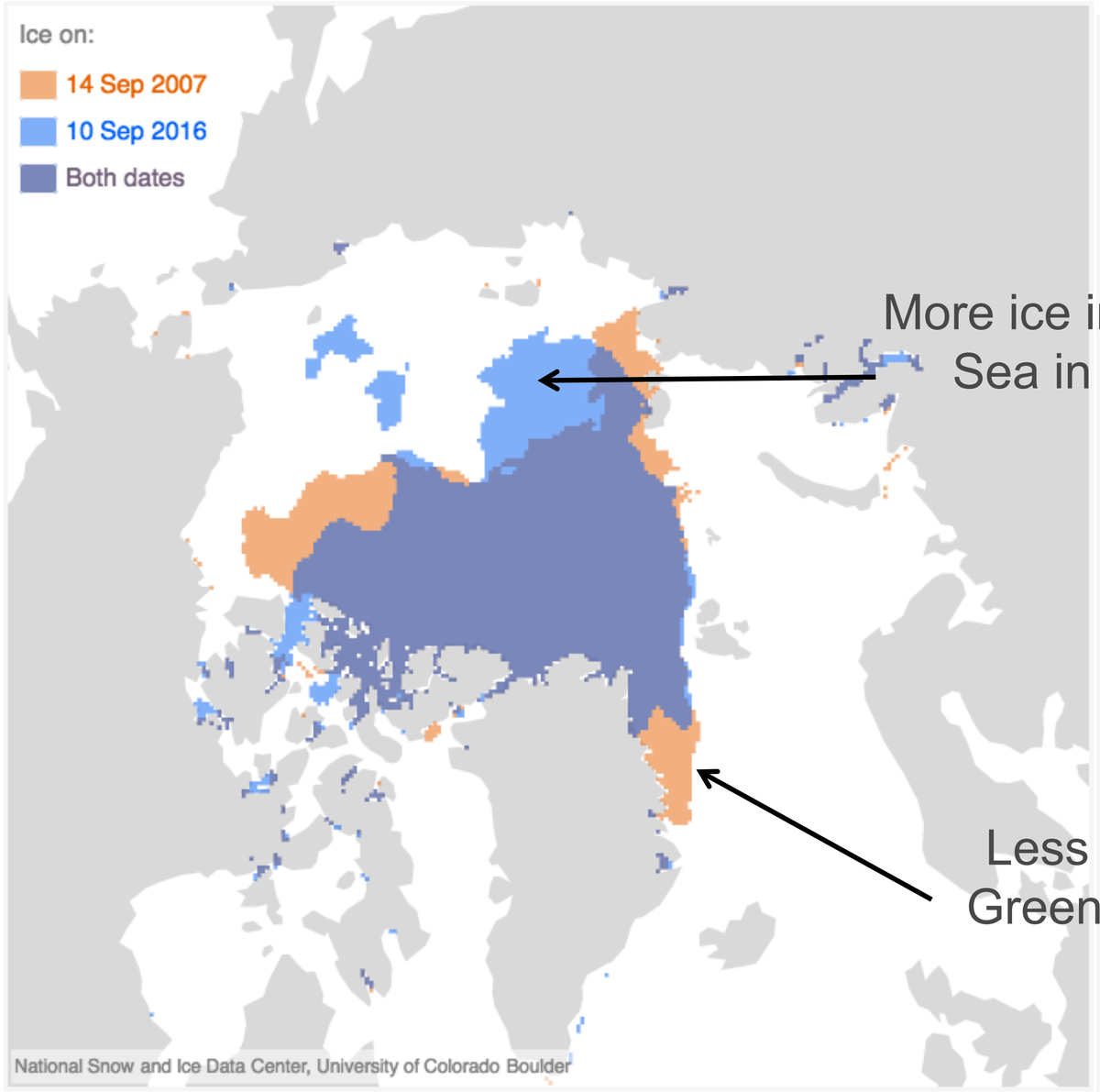
Observed changes over the satellite data record

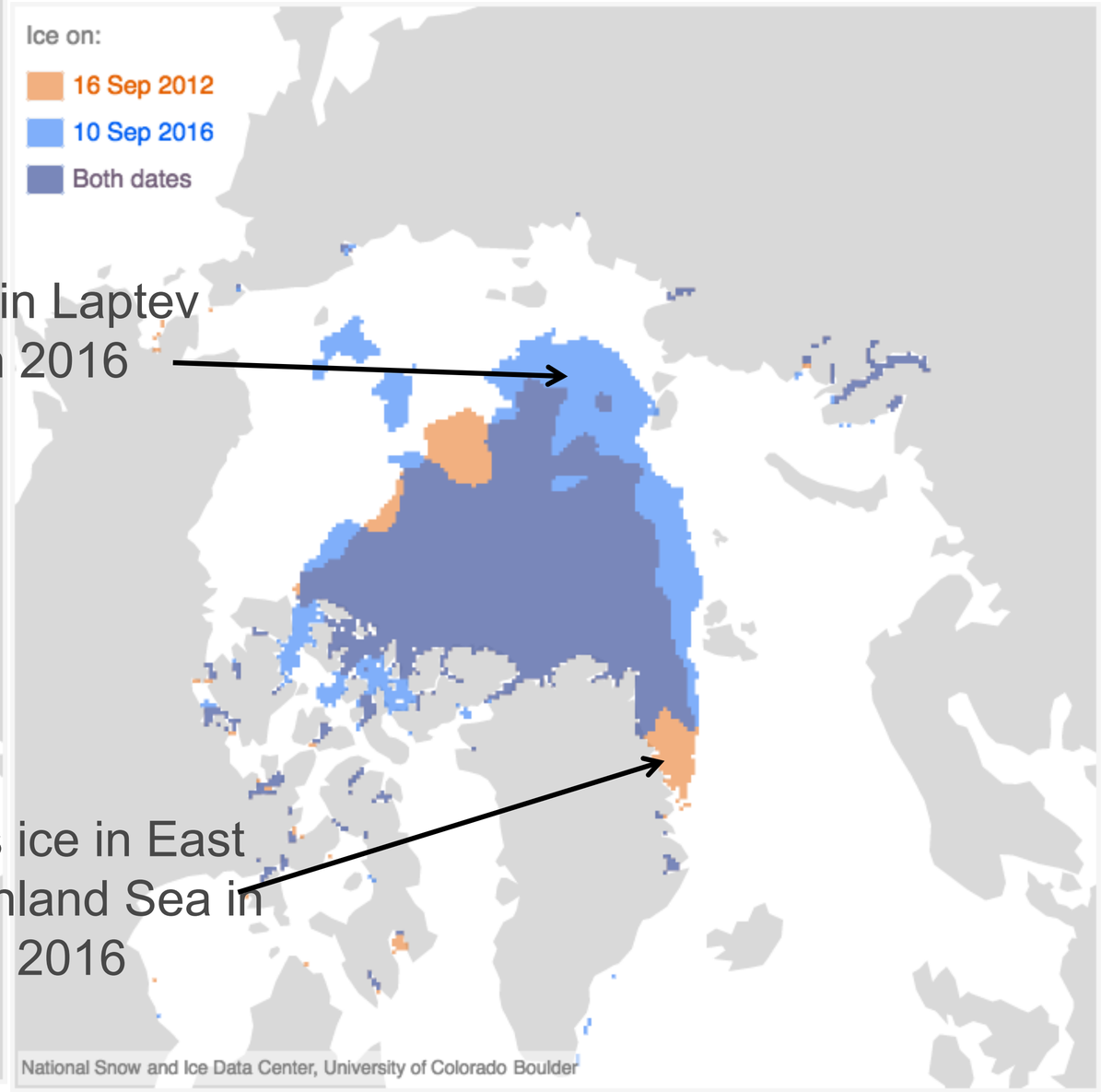
Changes during summer (September)





2016 Compared to 2007 and 2012



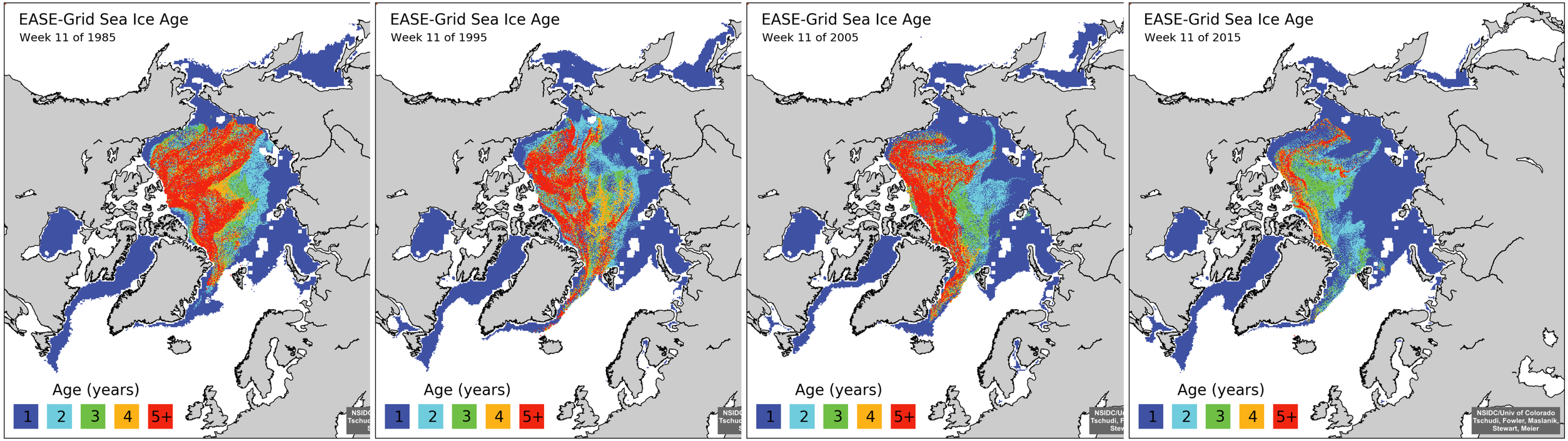


More ice in Laptev Sea in 2016

Less ice in East Greenland Sea in 2016

Other Indicators of Change

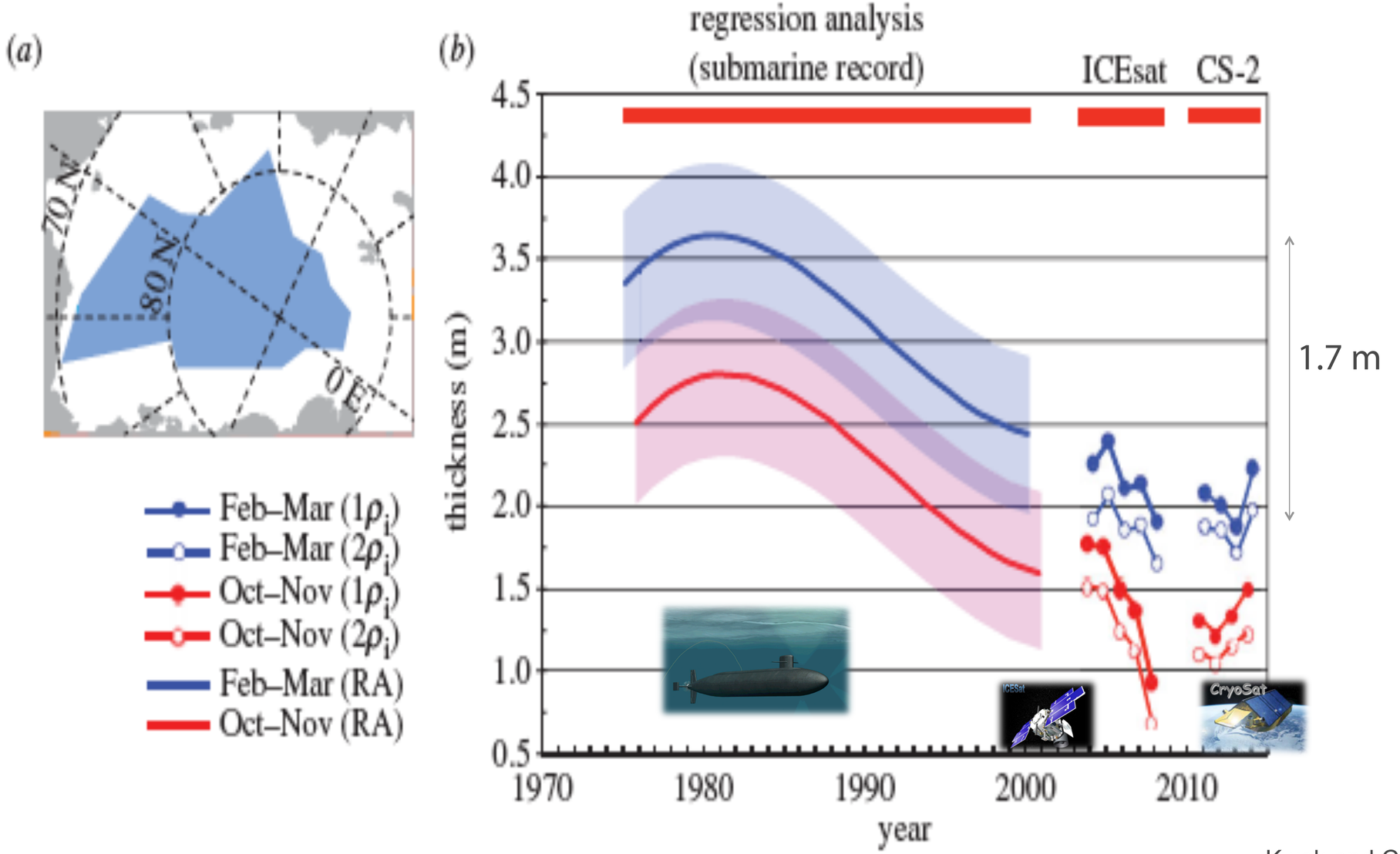
Loss of Old, Thick Ice



Today less than 5% of the Arctic Ocean consists of ice 5 years or older compared to > 20% in the 1980s and early 1990s

Other Indicators of Change

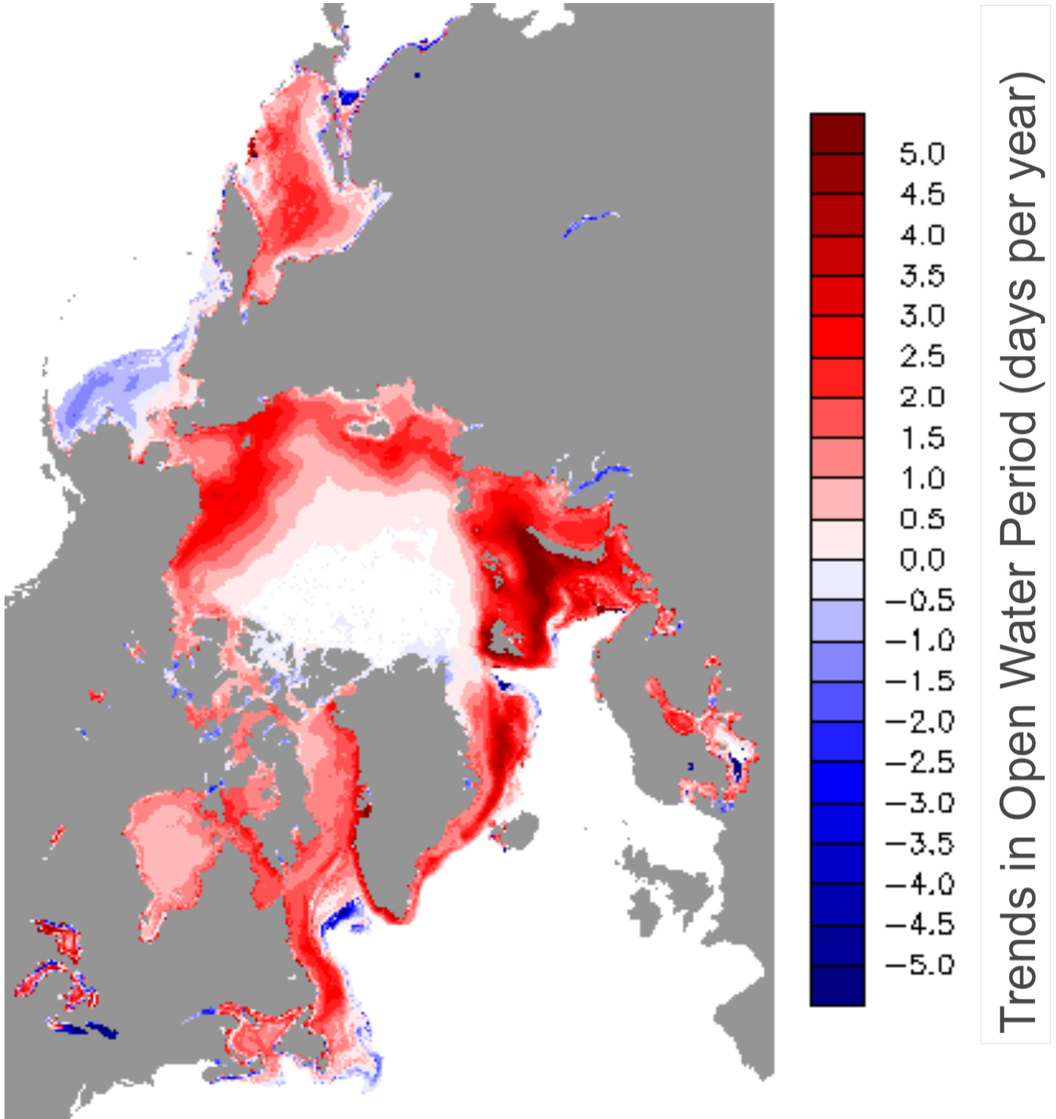
Thinning of Ice Cover



Kwok and Cunningham (2015)

Other Indicators of Change

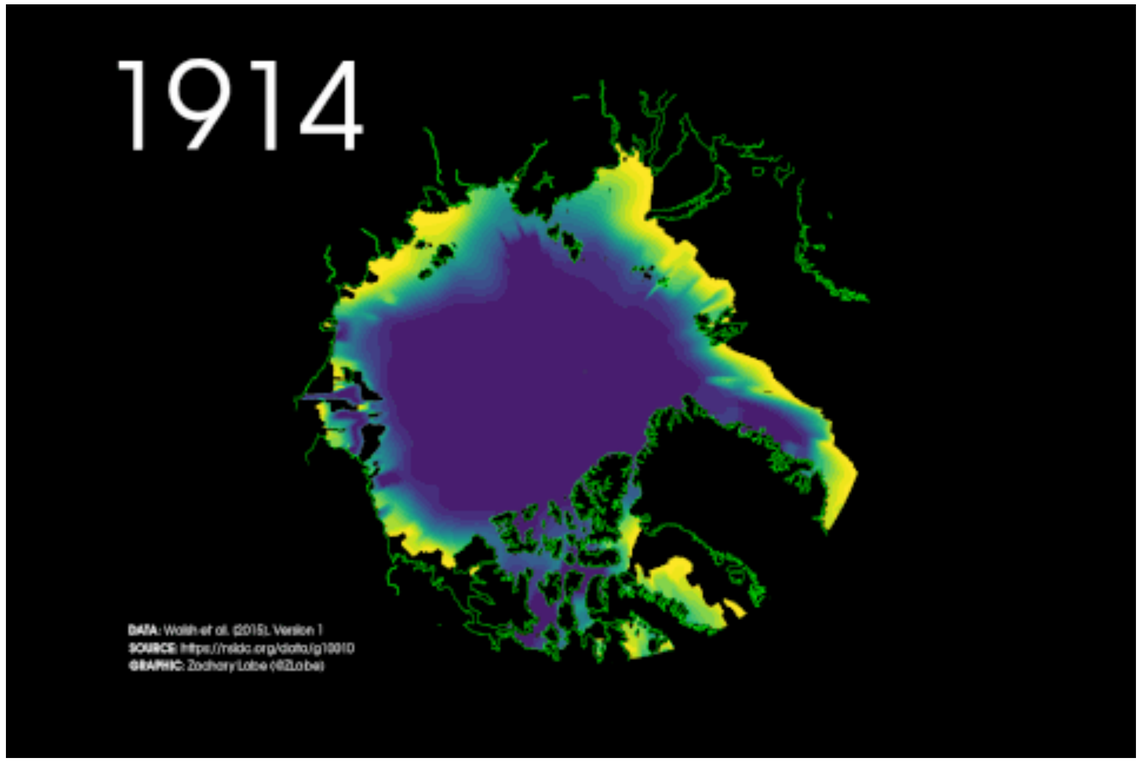
A longer ice-free season



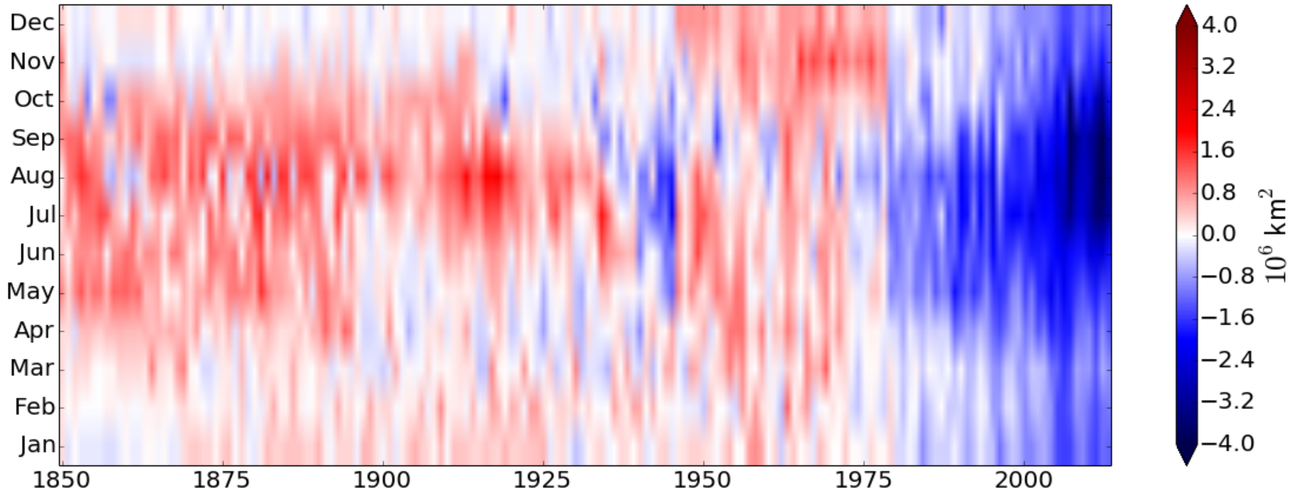
- Negative sea ice concentration trends are reflected in trends towards longer open water periods.
- Largest trends are found in Barents Sea and E. Greenland Sea (Odden) of about 5 days each year, or 50 days per decade.

Todays Changes in Longer-term Context

Todays Changes in Longer-term Context

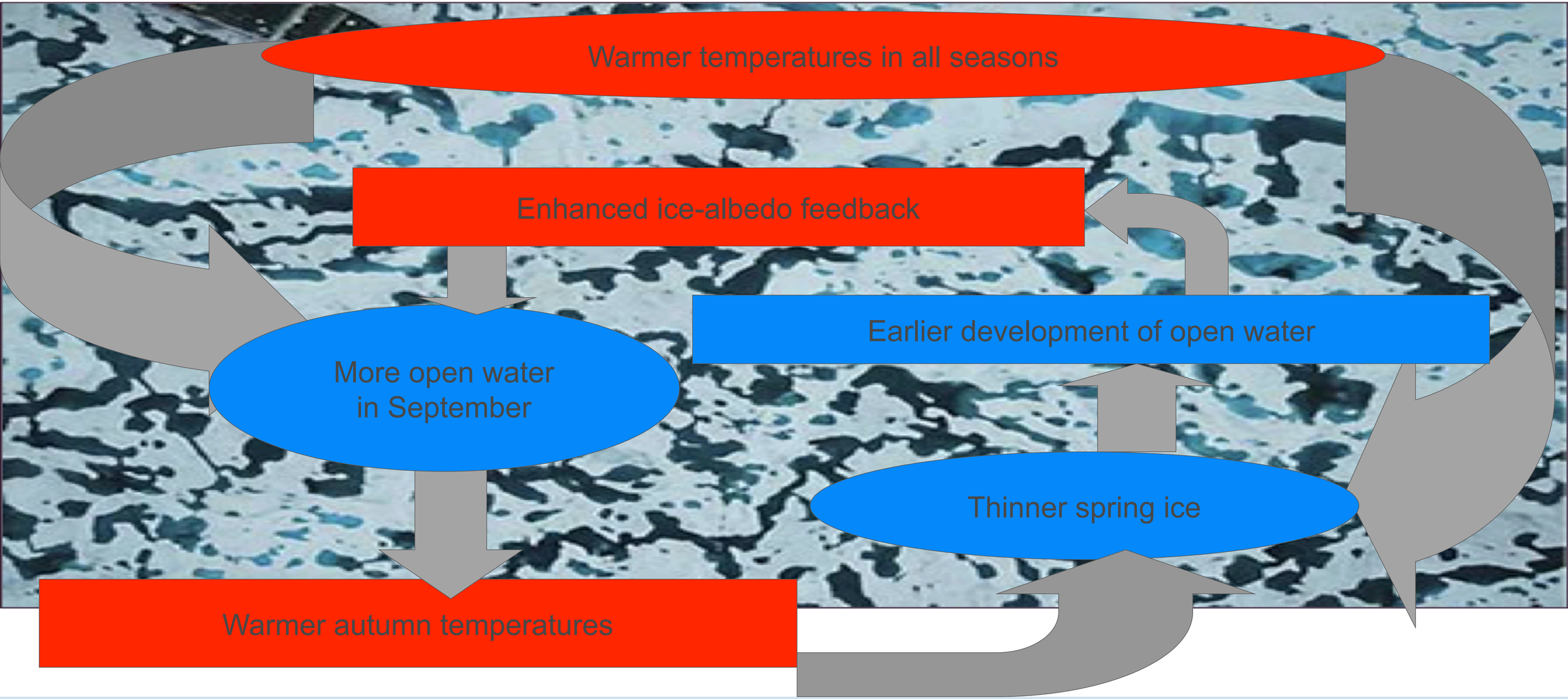


Anomalies in Arctic Sea Ice Extent 1850-2014



Using data from Walsh et al. 2016: updated sea ice record back to 1850

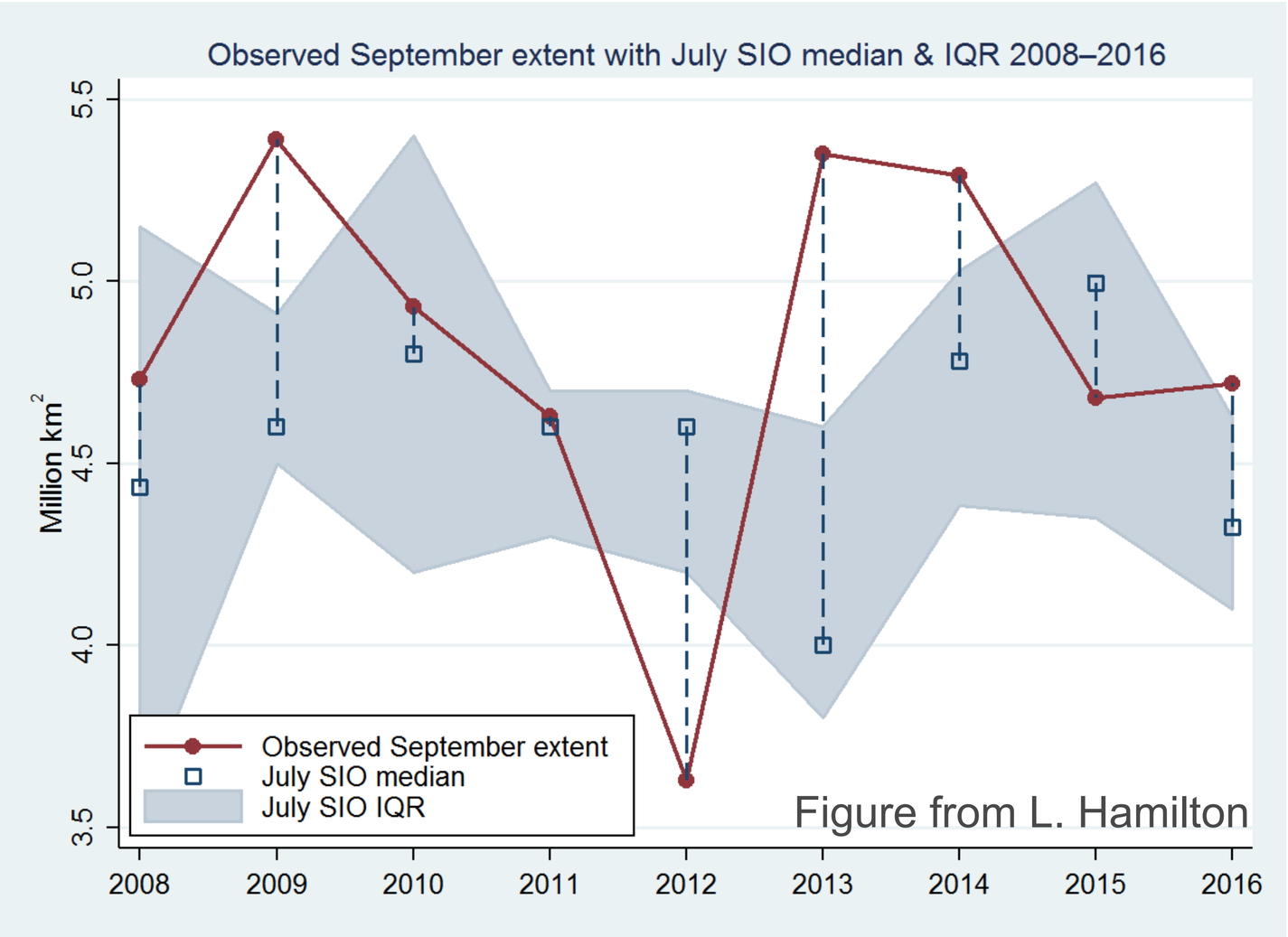
Why is the ice disappearing?



Many Stakeholders want to know Ice Conditions Months in Advance

Are our forecasts any good?

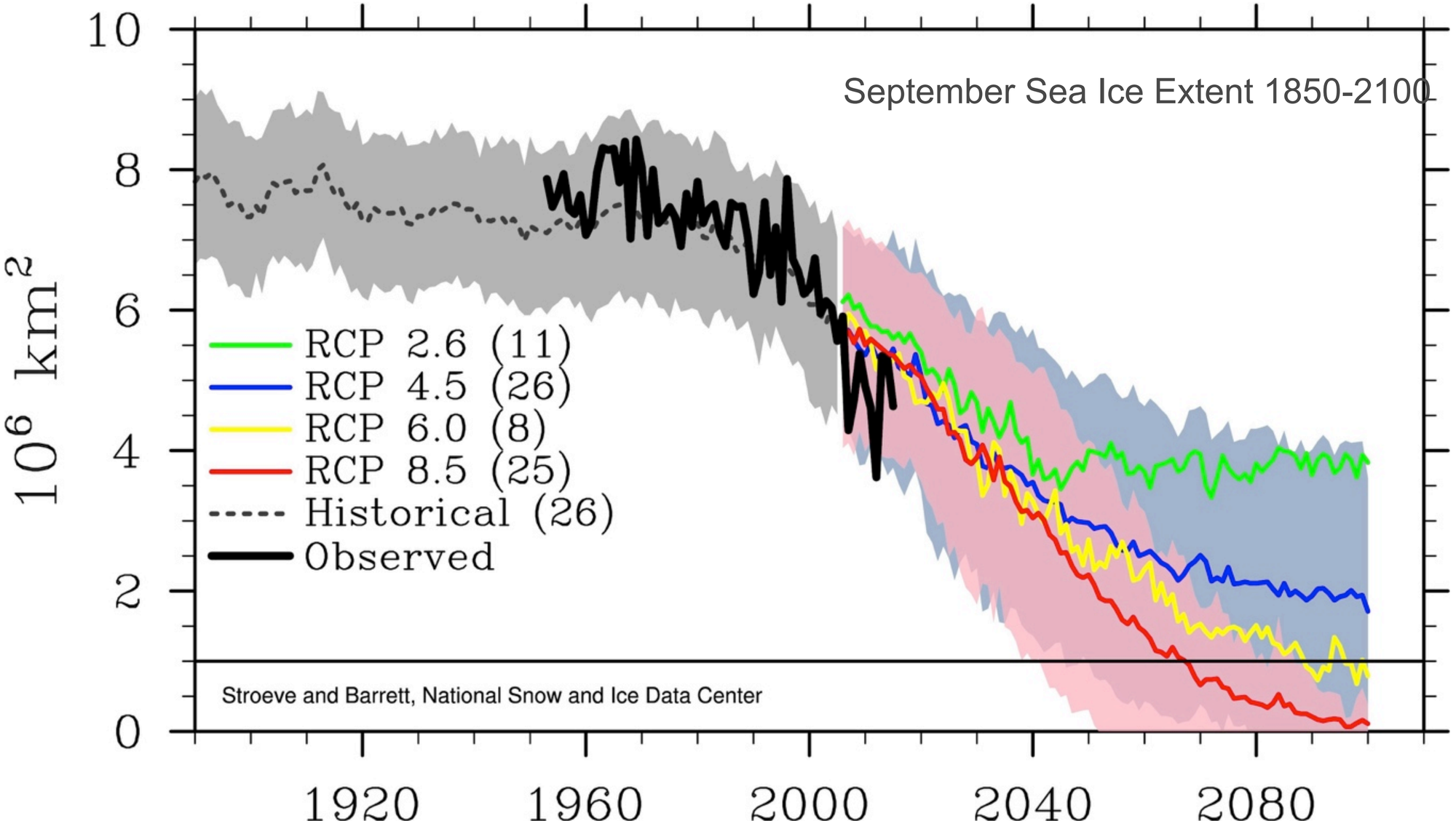
Forecasts of September Sea Ice Extent (2008-2016)



- Forecasts are made using any method: Heuristic, statistical or dynamical models.
- More than 500 forecasts received since 2008.
- Results disseminated through the Sea Ice Prediction Network (http://arcus.org/sipn)

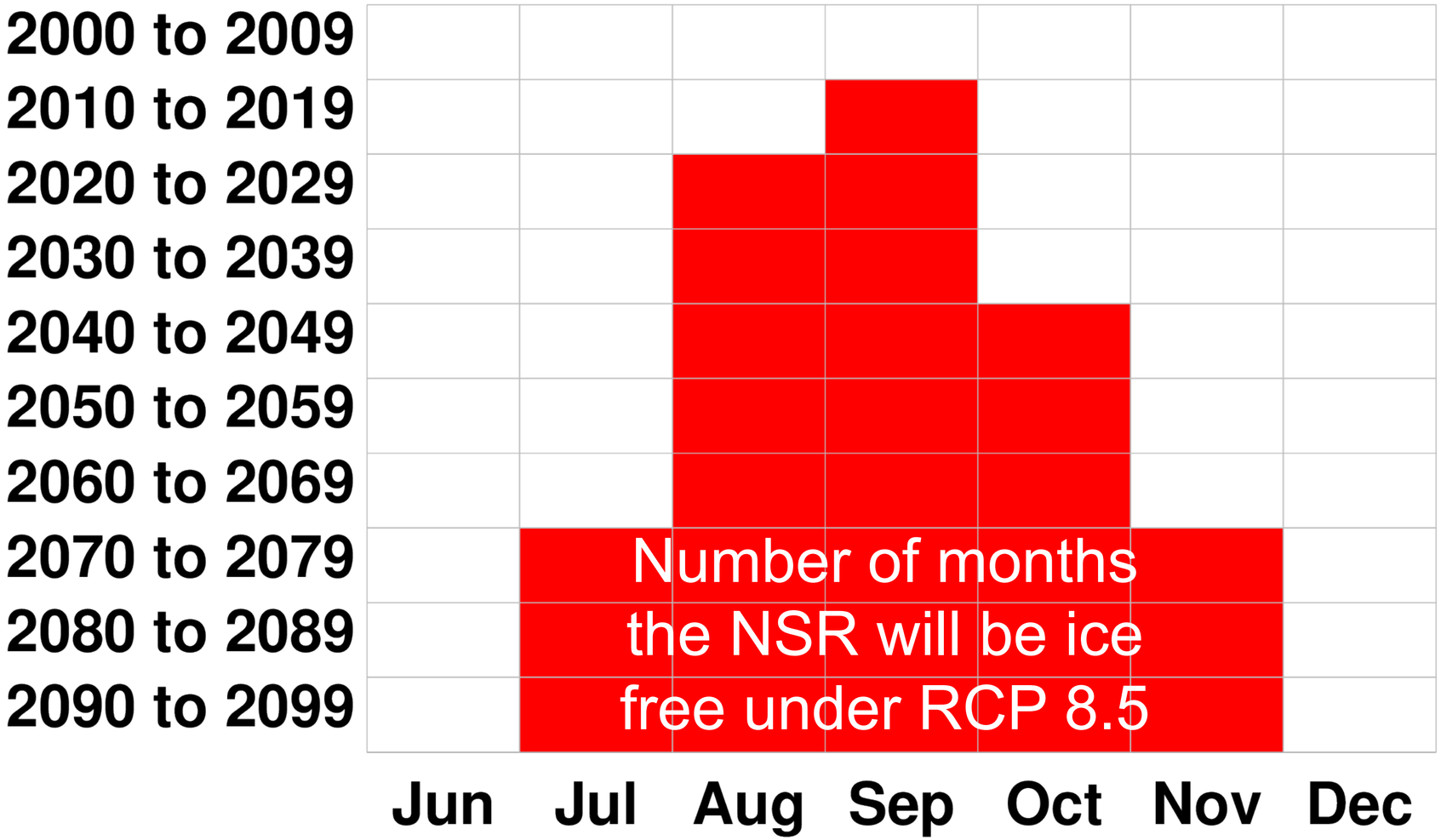
Can we Imagine a World without Sea Ice?

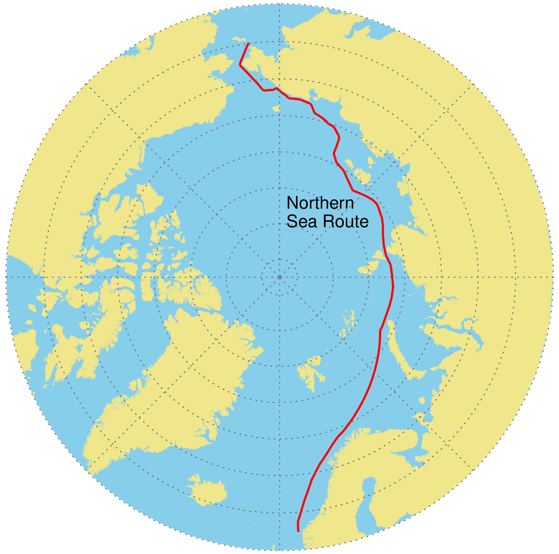
All Climate Models Forecast Loss of Summer Sea ice with Increasing GHGs



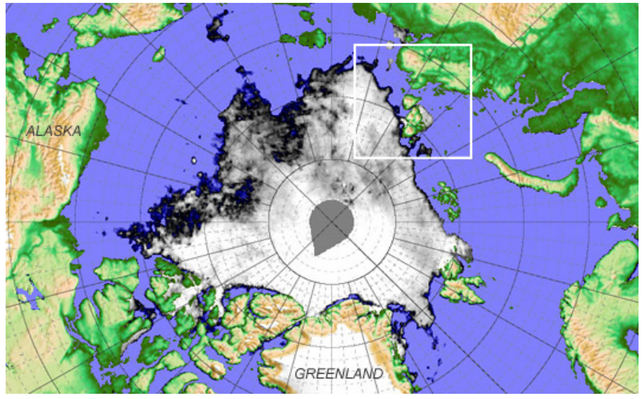
- Large uncertainty between models and emission scenarios.
- Uncertainty from natural variability is ~20 years

Arctic Ocean will become increasingly accessible for shipping and resource extraction



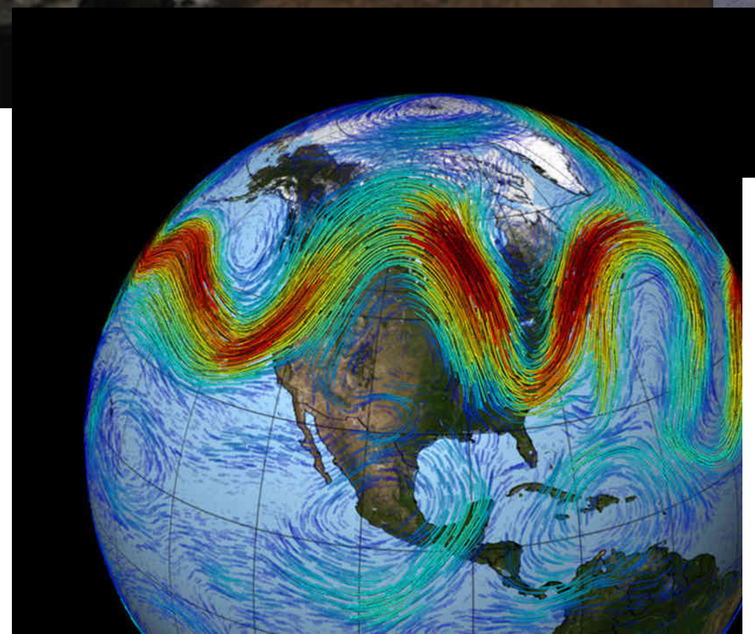


NSR open (2008-2016)



Conditions in 2008

Loss of sea ice has local and large-scale impacts



The Northwest Passage
Expedition Cruise 2016