

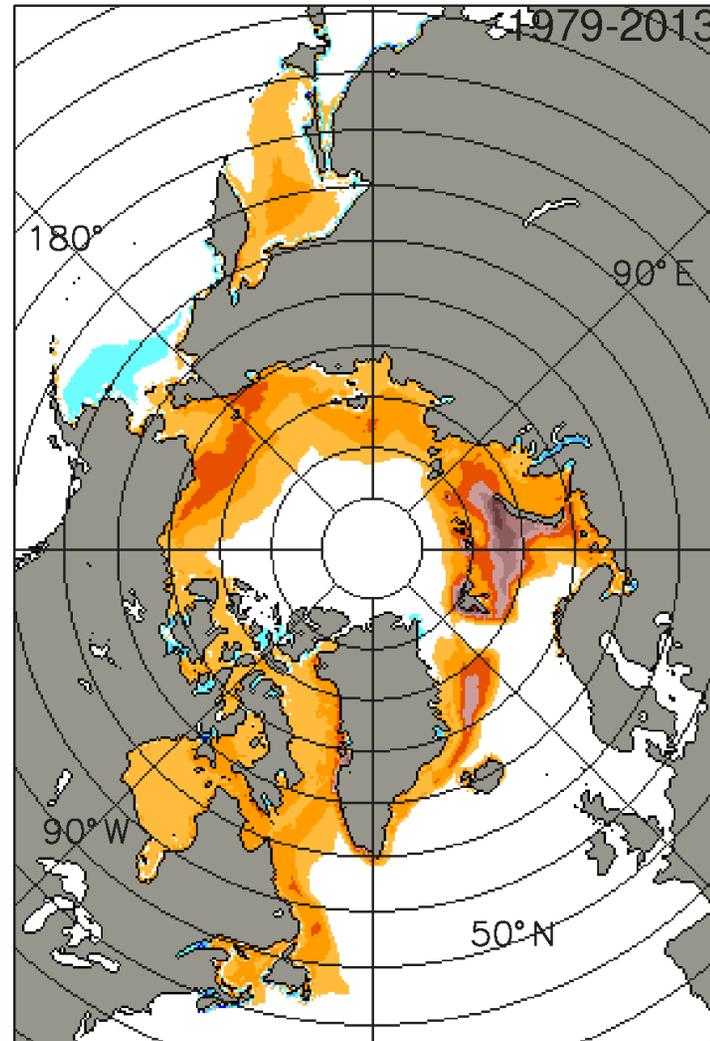


Marked Decreases in the Length of the Sea Ice Season Throughout Most of the Arctic Seasonal Sea Ice Zone, 1979-2013

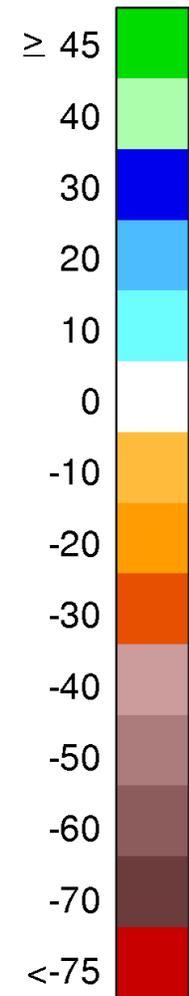
Claire L. Parkinson, Code 615, NASA GSFC

Analysis of the satellite-derived trends in the length of the sea ice season in the Arctic show a dramatic change from the first 10 years of the record, when there were sizeable areas both of lengthening and of shortening ice seasons, to the current 35-year record, for which almost the entire Arctic seasonal sea ice zone except the Bering Sea has shortening ice seasons. The area with sea ice seasons shortened by at least 5 days/decade is 12.4 million km², while only 1.1 million km² have ice seasons lengthened by that much.

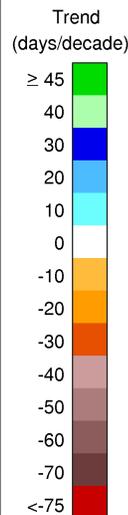
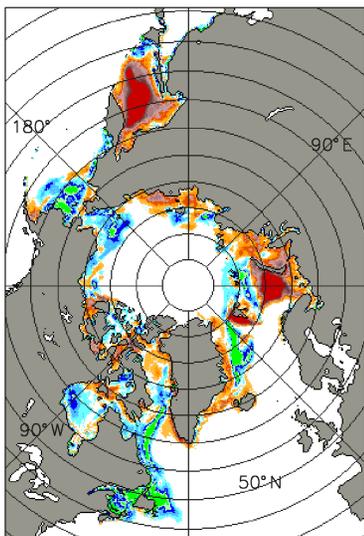
Trends in the length of the sea ice season for the full 35-year record



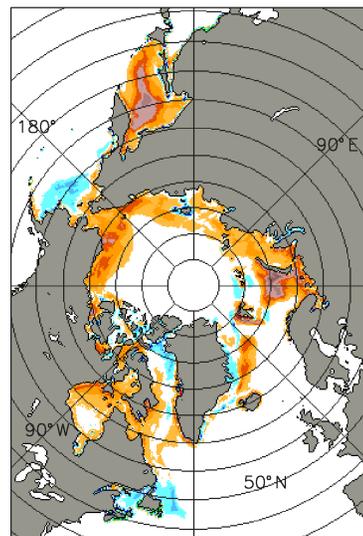
Trend (days/decade)



10-Year trends, 1979-1988



20-Year trends, 1979-1998





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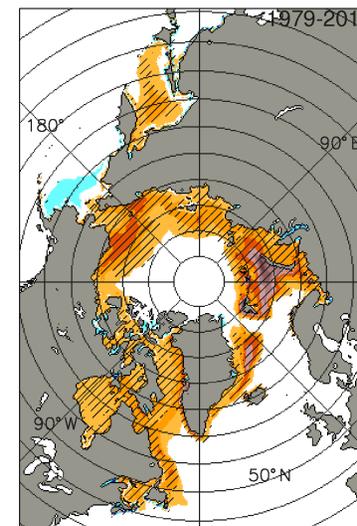
Reference:

Parkinson, C. L. (2014), Spatially Mapped Reductions in the Length of the Arctic Sea Ice Season, *Geophysical Research Letters*, 41, 4316-4322, doi:10.1002/2014GL060434.

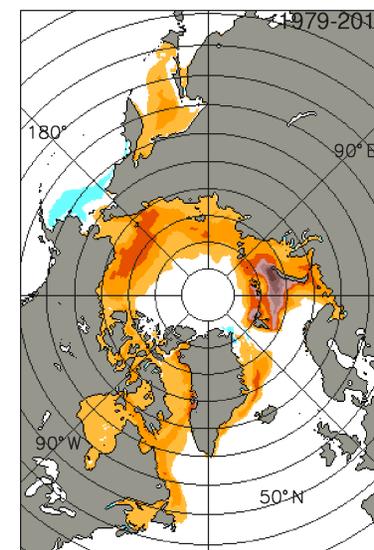
Data Sources: NASA Nimbus 7 Scanning Multichannel Microwave Radiometer (SMMR) and Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave Imager (SSM/I) and SSM/I Sounder (SSMIS).

Technical Description of Figures: This study took a well-established sea ice concentration data set generated from passive-microwave satellite data (using the NASA Team algorithm) and used it to determine and map for each year the length of the sea ice season, defined as the number of days with ice concentration at least 15%. Linear least-squares trends in these lengths were then calculated for each 25 km x 25 km pixel (or grid square). Maps on slide 1 show the trends for the first 10 years, the first 20 years, and the full 35 years of the record. Supplemental figures on this slide show (1) the 35-year trends with hatching added where the trends are significant at a 99% confidence level and (2) the 35-year trends when calculated using a 50% ice-concentration cutoff rather than a 15% cutoff.

Scientific significance: Earlier studies have revealed significant decreases in Arctic sea ice extents over the course of the multichannel satellite passive-microwave record. Here the satellite data are used to examine changes in the length of the sea ice season, which allows detailed spatial maps of the changes, something not possible when considering only the ice extents. The maps of the trends in the length of the sea ice season are extremely coherent spatially, with no speckling of positive and negative values even though no smoothing was done on the trend data. The lack of speckling shows that despite the movement of the ice floes, the Arctic ice cover shows high spatial coherence. This is also reflective of the choice of a well-defined variable (the length of the sea ice season, defined as the number of days with ice coverage of at least 15%) that purposefully avoids such messy complications as having to determine exactly when the ice season begins or ends. The results are overwhelming in terms of showing that by far the majority of the seasonal sea ice zone has ice seasons that have shortened since the late 1970s, with 12.4 million km² having ice seasons shortened by at least 5 days/decade (versus only 1.1 million km² having ice seasons lengthened by that amount). Furthermore, the results are highly statistically significant, with the trends over most of the seasonal sea ice zone being statistically significant at the 99% level (top figure, this slide), and are very robust to the choice of the % ice-concentration cutoff used, showing very close to the same results even when the cutoff is raised from 15% to 50% (bottom figure).



35-Year trends in the length of the sea ice season, with hatching indicating statistical significance at a 99% confidence level.



35-Year trends calculated with a 50% ice-concentration cutoff.