Edge of Antarctica: Two differing perspectives on where ice and water mix

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Introduction

The marginal ice zone, or MIZ, is that outer band of ice cover where sea ice concentration ramps up from open ocean (0%) to "close pack", or 70%-80% ice concentration.

It is a region of rapid change in atmospheric and oceanographic profiles of temperature, pressure, and other parameters, and of energy exchange between the ocean and atmosphere.

Sea ice concentration (SIC) from satellite data can be used to map the MIZ. The popular passive microwave-derived SIC data tend to underestimate ice concentration. Thin ice and areas with a low concentration of ice often go undetected.

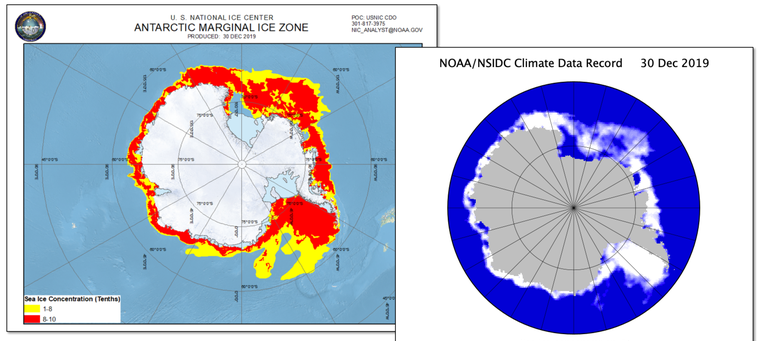
U.S. National Ice Center Daily Marginal Ice Zone Products offer an alternative. To make these maps, analysts draw SIC contours on workstations aided by satellite imagery, derived products, and buoy data. Manual analysis allows USNIC sea ice experts to draw on experience and use contextual information like local weather and climate.

How does the USNIC MIZ compare with the MIZ drawn from passive microwave SIC?

Method

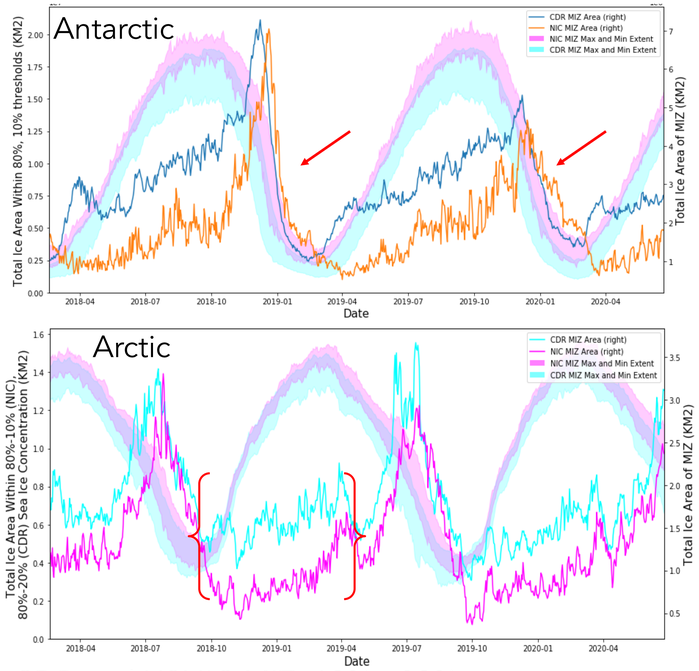
Compare the areas mapped by the USNIC MIZ product contours with 10% and 80% contours from the *NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration* (the CDR). We start with Antarctica, then compare with the Arctic.

The MIZ is mapped in yellow.

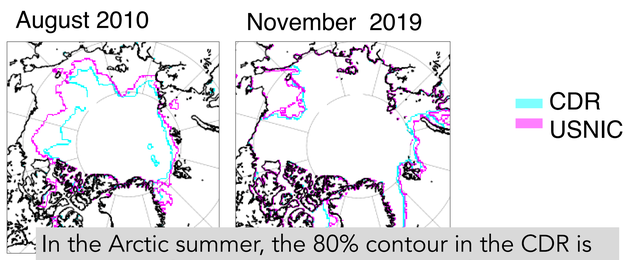


The MIZ can be mapped using the CDR by finding the area between 10% and 80% SIC contours

Results



CDR and USNIC MIZ 10% - 80% contour areas



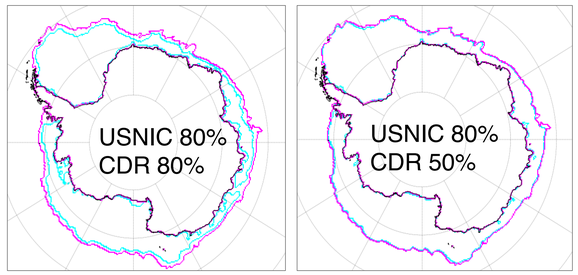
In the Arctic summer, the 80% contour in the CDR is well north of that of the USNIC MIZ. Surface meltwater causes satellite data to underestimate SIC.

Most of the year, the CDR MIZ is wider than the USNIC MIZ, reaching its widest in the austral winter.

In summer, USNIC and CDR MIZ are both narrow, but the USNIC MIZ is slightly wider (arrows).

In the Arctic, CDR MIZ and USNIC MIZ are largely overlapped throughout the year.

The width of the MIZ is at a minimum right after freeze-up (left bracket). It grows slowly until about the time of the seasonal ice extent maximum (right bracket) and then grows rapidly until the seasonal minimum in September.



The 50% CDR contour is the best match for the 80% USNIC contour in the handful of cases we tested.

Conclusions

The USNIC *MIZ band* covers less area than that covered by the CDR MIZ. The CDR MIZ is broader. This could be because of the edge smearing effect caused by the poor resolution of the passive microwave data – the "mixed pixel problem" for ice and water that results in poorly resolved contours.

The USNIC 10% *ice edge* is almost always "outboard" of the CDR 10% edge in both hemispheres.

The USNIC product does a better job of capturing all the ice in the MIZ and pack.

If you use a passive microwave record to study ice extent or change in the MIZ, take into account differences in how the MIZ is drawn by analyst versus algorithm.

Acknowledgments

Michael Dorfman conducted the analysis as a Data Analytics class project at CU. https://github.com/mikedorfman/NSIDC-MIZ-Comparison

Further information

U.S. National Ice Center Daily Marginal Ice Zone Products in shapefile, Google Earth KMZ, and ASCII formats, beginning in September 2004 in the Arctic and January 2010 in the Antarctic. Search "NSIDC G10017".