Lead detection with Sentinel-1 in the Beaufort Gyre using Google Earth Engine (GEE).

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Introduction

Motivation & Objectives

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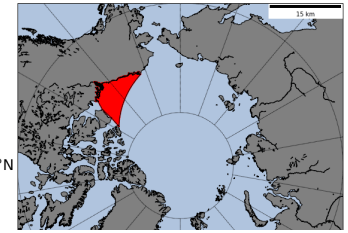
Plate 1: NASA/Goddard Space flight center courtesy of Stockli, R. "Annual Arctic Sea Ice minimum 1979-2020."

1. Create a cloud computation algorithm for sea ice classification.
2. Estimate lead fractions and dynamics during polar night-time in the Beaufort Sea.

Study Area



Data and Methodology

Sentinel-1: Synthetic Aperture Radar

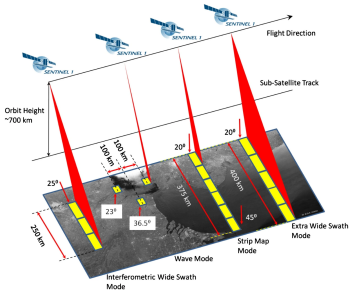
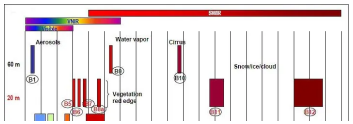


Figure 2: Sentinel-1 SAR acquisition.

- Frequency: C-band (4-8 Ghz, 7.5 - 3.75 cm).
- S1 A and S1B: 6-day revisit period; 12-day crossover.
- S1A & S1B: launched 2014 and 2016 respectively.
- Right looking.

Sentinel-2: Multi-spectral Imager



Results and Discussion

GEE Sea ice lead extraction

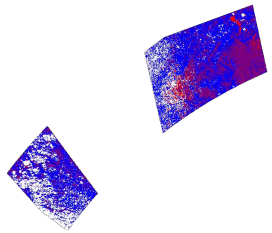
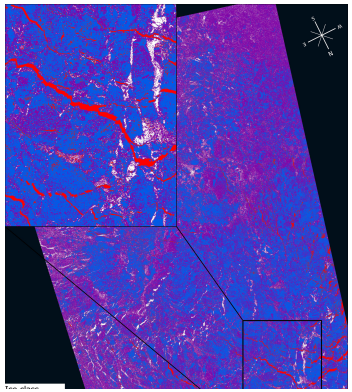


Figure 7: Daily mosaic classification output.



Conclusions

Leads can be geometrically and spectrally defined.

1. Leads can be characterized by their lenticular shape and spectral properties.
2. Ice ridges are similar in shape and (sometimes) brightness in SAR scenes. However, they have no preferred orientation.
3. SAR is ambiguous; the more polarizations, the better.
4. Image variance (GLCM) supported by ice thickness and visual inspection information can improve class accuracy.
5. The Beaufort Sea contains negligible open water coverage.

Thick ice cover in the Arctic continues to decline.

1. Maximum thick ice coverage has reduced by 12% between 2017 and 2020.
2. Sea ice production and dynamics are controlled by the circulation of the basin.
3. Weekly ice fractions throughout the frost minimum and maximum generally increase in thin ice lead production.
4. Leads display a westerly preferred orientation.
5. The Beaufort Gyre's efficiency in producing new ice is declining.