Girls Get Math
School of Engineering, Brown University
Summer 2022

Sea Ice Image Analysis

Objectives

1. Discuss importance of sea ice in the climate system.
2. Learn how we can use satellite imagery in sea ice research.
3. Exercise: Identify sea ice floes in imagery.

1 Introduction

1.1 Sea Ice in the Climate System

Sea ice plays an important role in the Earth system for a number of reasons:

- Albedo: snow covered sea ice is a highly reflective surface, reflecting about 85% of the incoming radiation from the sun. This keeps temperatures cool in the Arctic.
- Barrier between ocean and atmosphere : sea ice inhibits heat and moisture transfer, insulating the warm ocean from the cold atmosphere
- Ocean circulation : As the sea ice forms, the salt is pushed below the ice, and because this very salty water is more dense than the ocean water, it sinks. This is a key process to driving the global conveyor-belt ocean circulation.
- Ecosystem : Animals rely on sea ice for breeding, shelter, and hunting
- Socioeconomics : sea ice is a platform for fishing and hunting, but also impedes ship passage

The sea ice extent in the Arctic is in decline, with less old, thick ice, and more young, thin ice. This has implications for the climate regulating ability of the sea ice and the ecosystem services it provides. Therefore, it is essential we understand why and in what ways the Arctic sea ice extent, thickness, and age are declining.

1.2 Satellite Imagery for Sea Ice Research

The Arctic is challenging to study because it is remote, dangerous, and expansive. We can use satellite imagery to remotely study the sea ice. Let's go to the NASA Worldview browser to check out global, daily satellite imagery: `https://worldview.earthdata.nasa.gov/`

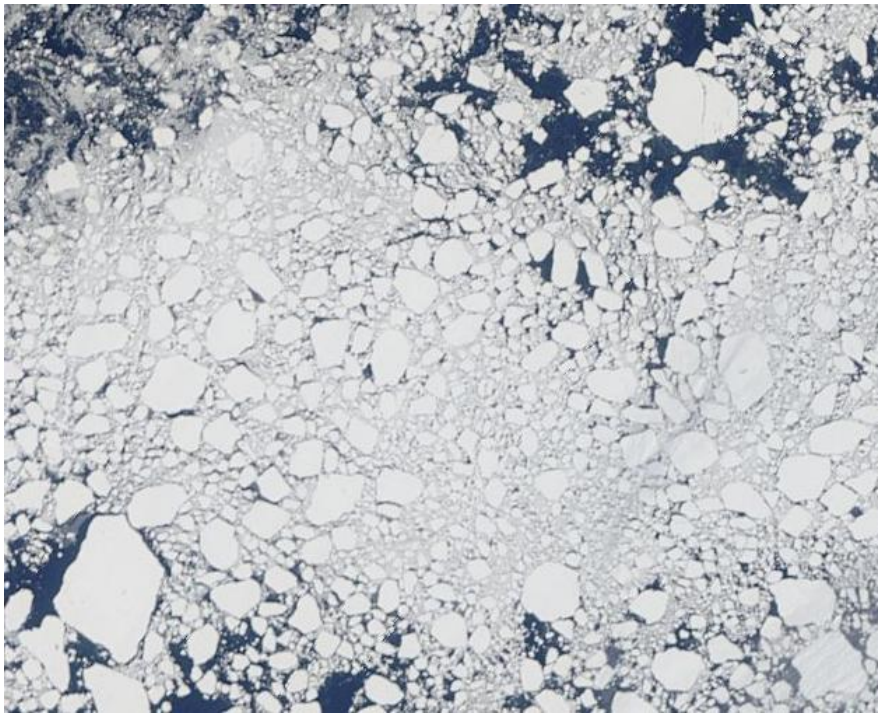

Figure 1: Image captured from NASA Worldview MODIS data on 4 September 2019, west of the Canadian Archipelago, near Banks Island.

2 Image Processing Exercise

- Explore MODIS imagery in the Arctic using the NASA Worldview interface
- Use MATLAB to detect floes in the imagery

3 Discussion

- Why do you think we are interested in identifying individual floes?
- What other information can we extract from sea ice imagery?
- Can you think of other types of research that could use image processing techniques and this object identification code?

4 Additional Information

The code from this workshop can be found at: `https://github.com/ellenbuckley/GirlsGetMath`

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Please do not hesitate to reach out!