Earth Observation
Tracking Thwaites Glacier Calving Front Motion

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Summary

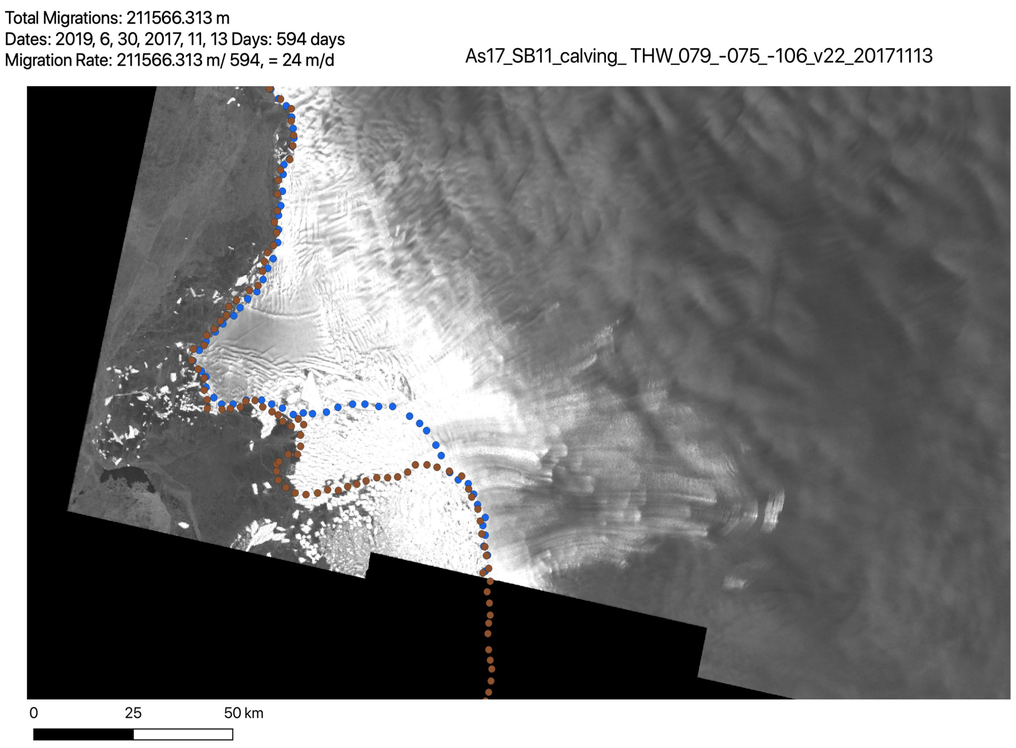
Our research shows that Thwaites Glacier had a migration rate of 24 meters per day between 2017 and 2019. This speed is alarmingly fast and is the result of deep warm water melting and global warming.

Research aims

- Learn how to track the migration rate of a glacier
- Discover the reason behind Thwaites' alarming migration
- Find out how we can slow the rapid melting

Method

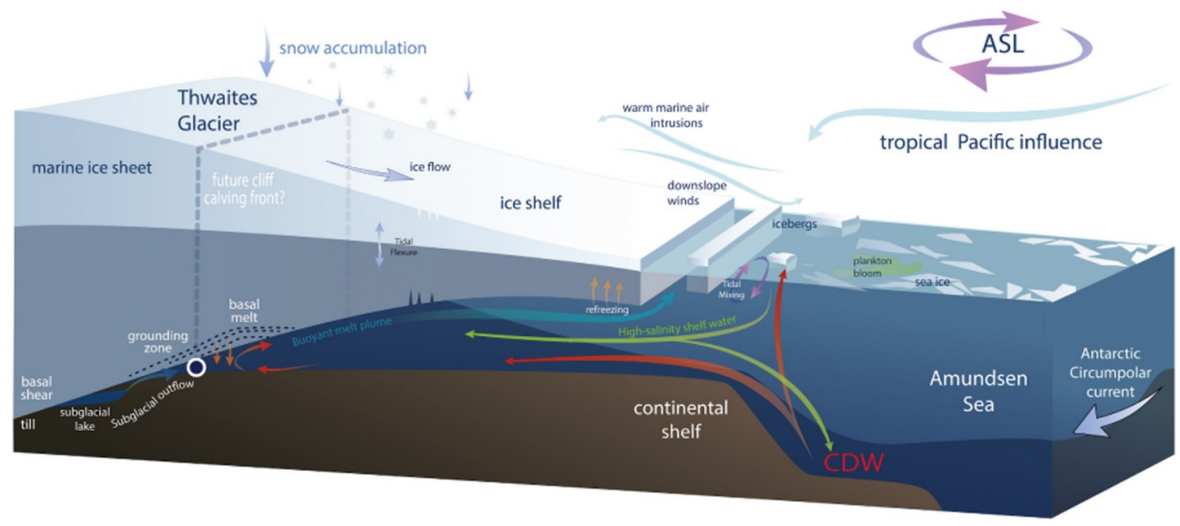
We studied glacier photos provided by ESA's Sentinel 1-B satellite. The images were uploaded as raster layers in QGIS. First, we made map files and determined key geological features on the glaciers. Then we mapped the calving fronts as shape files. By comparing two shape files of the same glacier, we could then calculate the migration rate.



Thwaites Glacier's Migration Rate
Thwaites' calving front from November 13th, 2017, was mapped with blue markers, and the calving front from June 30th, 2019, was marked with orange in QGIS. (Satellite photo credit: Hogg et. al.[1])

Results

Over the span of 594 days, Thwaites Glacier's calving front moved approximately 211,5 kilometres. This equated to a migration rate of 24 meters per day, which is alarmingly fast. Icebergs usually melt 1-2 meters daily at most on land. Thwaites lacks much of the supporting land and is also affected by the Antarctic Circumpolar Current (Karlsen, 2017).



Deep Warm Water Melting: The Antarctic Circumpolar Current moves intro crevasses hundreds of meters deep, below the ice shelves. As it rises and rotates, the salt water grinds against the bottom of the ice shelf. This creates holes beneath shelves such as Thwaites. If the sea current digs further, the shelf will not be supported by any land and eventually break off (Image credit: Scambos et. al., 2017).

Analysis

The cause behind Thwaites' rapid migration rate is deep warm water melting. A majority of the Western Antarctic's land lies below the sea surface. As a result, Thwaites and neighbouring glaciers mostly float on the sea surface as ice shelves. The Antarctic Circumpolar Current flows beneath these ice shelves and melts them from below. If this process continues, the bedrock beneath Thwaites will start to slope downward. Once the warm water reaches the bottom of the slope, then the rapid melting will continue self-sufficiently until the bedrock reaches an upward hill. While this happens, a majority of Thwaites will break off into the ocean (Klimastiftelsen, 2021).

Consequences and further research

The seas will rise by 1.5 to 3 feet if Thwaites melts. Furthermore, the larger neighboring glaciers will then meet warmer water and break off as well (Nemo, 2020). Scientists believe the entirety Thwaites will collapse within 200 to 600 years, depending on the development of climate change in the next few years (Neilson, 2020). Until that happens, the higher amount icebergs may pose a threat to southern ship traffic. To slow down this development we need to reduce carbon emissions, which prevents the sea currents from getting warmer.

References
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