Earth Observation -Glacier Melt

Mullion School

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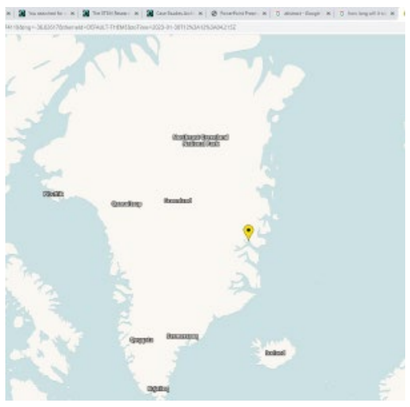
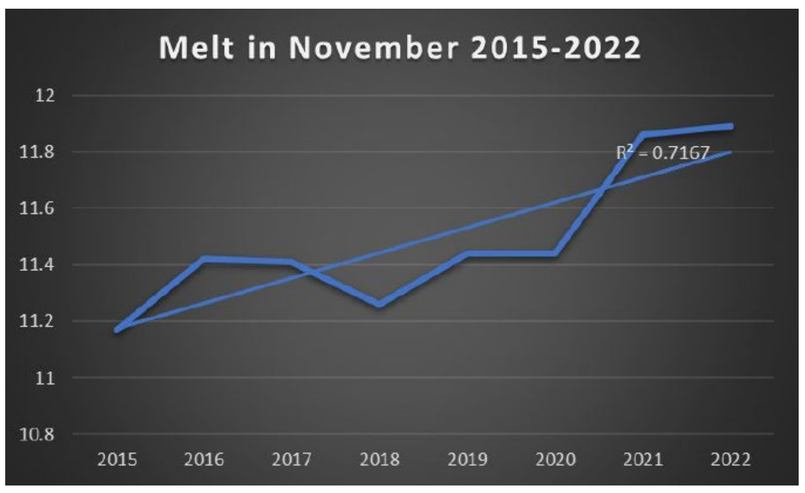
Introduction

The temperature of our planet is rising on average at 0.18 degrees centigrade per decade since 1981[1]. As a result, this will have a devastating effect on the icy landscapes - such as Greenland.
We wanted to see if we could demonstrate this reduction of a glacier through the use of EO Browser. Thus looking into whether there is a monthly correlation over the years. We then continued to see if there was a link between the annual temperature and the rate of melt.

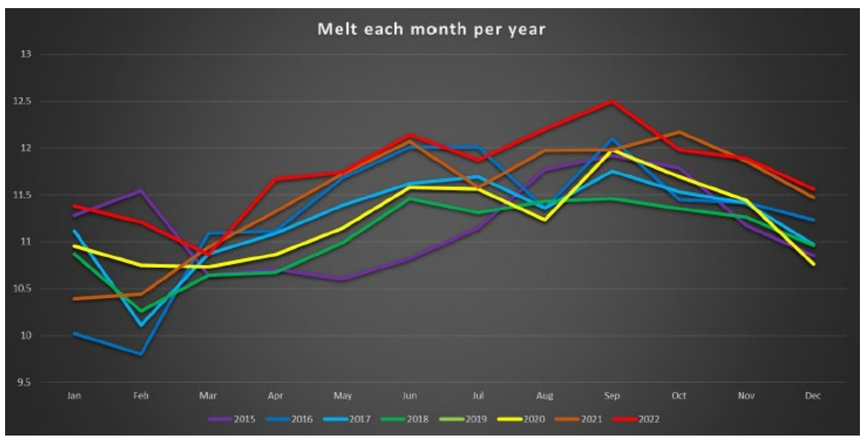


We monitored a glacier from this location: Lat: 73.82 Long: -24.21.

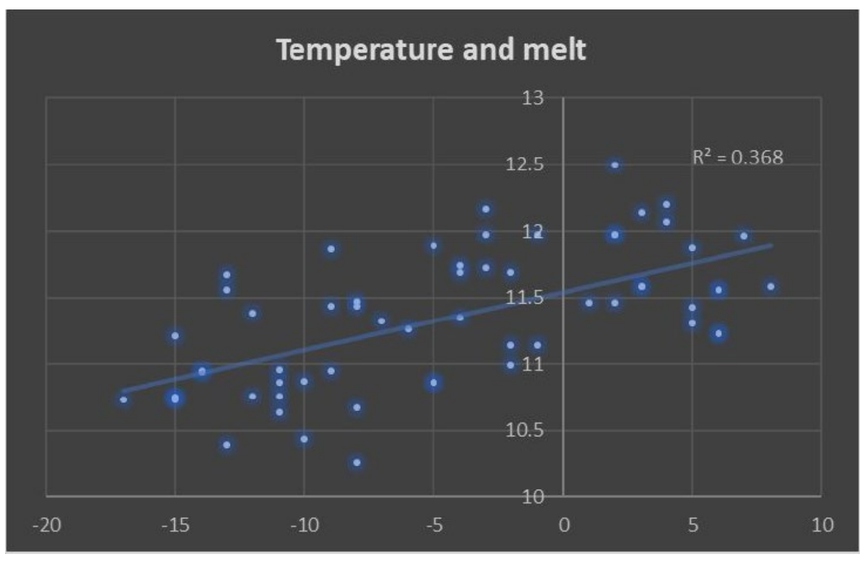
Results



Average melt in November from 2015 - 2022: In November, the R2 value was 0.717 (3 d.p). This shows that there is a 71.7% chance that the data has a correlation. This is important because it is suggesting that the ice melt is increasing each year.



Melt each month per year: This graph shows how the melted area changes every year. As you can see the amount of melt increases every year - shown by the rainbow colour system. We can observe that there is a clear seasonal trend.



Temperature vs Melt: The scatter graph has a weak positive correlation. The regression line only has an R2 value 0.3 which is weak. Despite this it is still interesting to observe that there is a positive correlation.

Method

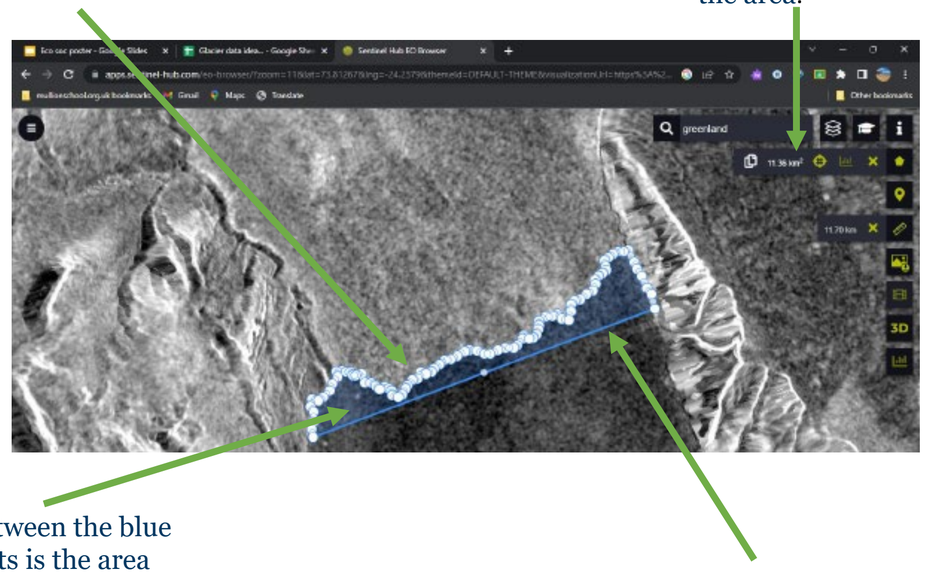
We conducted our investigation using data between 2015 and 2022, taking one reading per month. To do this we used EO Browser's Sentinel-1 satellite.

First, we placed a baseline across (see fig 2), ensuring we kept this in place for every reading to reduce the chance of a systematic error. Then using this as an anchor, we traced the glacier front from 500m away so that we could detect the small changes over the months. The software would then measure the area between the fixed line to the glacial front. We then recorded this measurement in Excel.

After looking at the glacier melt data, we also thought it would be interesting to compare this to the temperature of the air in this area. We used the website "time and date" to find the air temperatures at the glacier and recorded this for the same day on the same month each year. The air temperature in December 2016 wasn't present on our source, so has been left blank

This is the glacier front, with each dot representing a change in the shape of the front.

Down the side are the tools used to measure the area.



The gap between the blue line and dots is the area measured.

This is the baseline which we kept the same for each reading over the period of years.

Conclusion

From looking at the data we have collected, it is evident that:

- The glacier is melting over this 10 year period and that we are able to record that change on a PC from home. This substantial melt we have recorded is inline with the Guardian article[2] by Jonathan Watt and Niko Kommenda which is titled "Speed At Which World's Glaciers are Melting has Doubled in the Last 20 years."
- The melting follows a seasonal pattern with increased melt in the summer and decreased melt in the winter.
- On average, at higher temperatures there is a greater amount of melt. This is shown in Lily Roberts' paper from Colombia Climate School[3] where she states that melting in July was: "35% higher than the average for that time of year"

Next step

We only had access to a short period of satellite images which means we couldn't access many data points going back in time, therefore if we wanted to look at the melting trends of this glacier in more depth we would require a greater number of data points over a longer period of time. Going forward, we would try and access some more data over the years to build a bigger and clearer picture, as well as this, it could be useful to look at other glaciers in this area to see if they follow similar patterns. We could also look at how latitude affects the amount of annual melt in other glaciers

References:
1:https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature#:~:text=Earth's%20temperature%20has%20risen%20by,0.18%C2%B0%20C)%20per%20decade
2:https://www.theguardian.com/environment/2021/apr/28/speed-at-which-worlds-glaciers-are-melting-has-doubled-in-20-years
3:https://news.climate.columbia.edu/2022/09/29/greenlands-long-and-intense-melt-season-is-a-worrying-sign-for-sea-level/

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