Title of the manuscript

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Abstract. Please use only the styles of this template (MS title, Authors, Affiliations, Correspondence, Normal for your text, and Headings 1–3). Figure 1 uses the style Caption and Fig. 1 is placed at the end of the manuscript. The same is applied to tables (Aman et al., 2014; Aman and Bman, 2015) adipiscing elit. Mauris dictum, nibh ut condimentum pharetra, quam ligula varius est, sed vehicula massa erat ut metus. In eget metus lorem

1 Introduction

The near-future evolution of the Greenland Ice Sheet (GrIS) is of considerable scientific and societal interest, given the expectation that GrIS will significantly contribute to global sea-level rise in the coming decades and centuries (REFERENCES LIKE THE IPCC REPORT). In addition to affecting sea level rise rates, retreating GrIS will expose new land area along its margins, lead Analyses of the changes that GrIS experienced in the last several decades when it was forced by warming atmospheric and oceanic conditions (CITATIONS TO PAPERS ON RECENT REGIONAL CLIMATE CHANGES) contribute to improving scientific models used to predict the future trajectory of GrIS evolution.

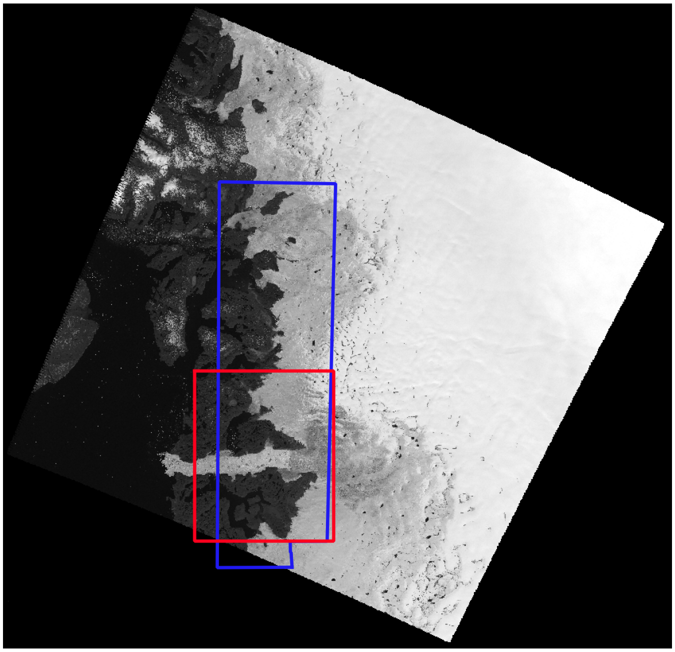

Figure 1: The area covered by the Landsat 7 (ETM+) (2001) dataset, with the area covered by the DEM and orthophotographs of Greenland based on aerial photographs (1985) and the Sentinel-2 Satellite outlined in blue and red respectively.

2 Methods

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2.1 Satellite and Aerial Image Data

Basic information for each dataset used in the study is compiled in Table 1.

Dataset Name (Year)	Region (UTM Zone 22W)	Resolution	Source	Additional Info
Sentinel-2 Satellite (2020)	X: 504017-559471 Y: 7642099-7709695	10 m	sentinel-hub.com	the SWIR (842 nm) band 8 was primarily used
Landsat 7 (ETM+) (2001)	X: 430060-681565 Y: 7603774-7846031	15 m		the panchromatic (520-900 nm) band 8 was used
DEM and orthophotographs of Greenland based on aerial photographs (1985)	X: 513095-556861 Y: 7631994-7781221	2 m	data.nodc.noaa.gov	

Table 1: Compilation of basic information for each dataset used in the study.

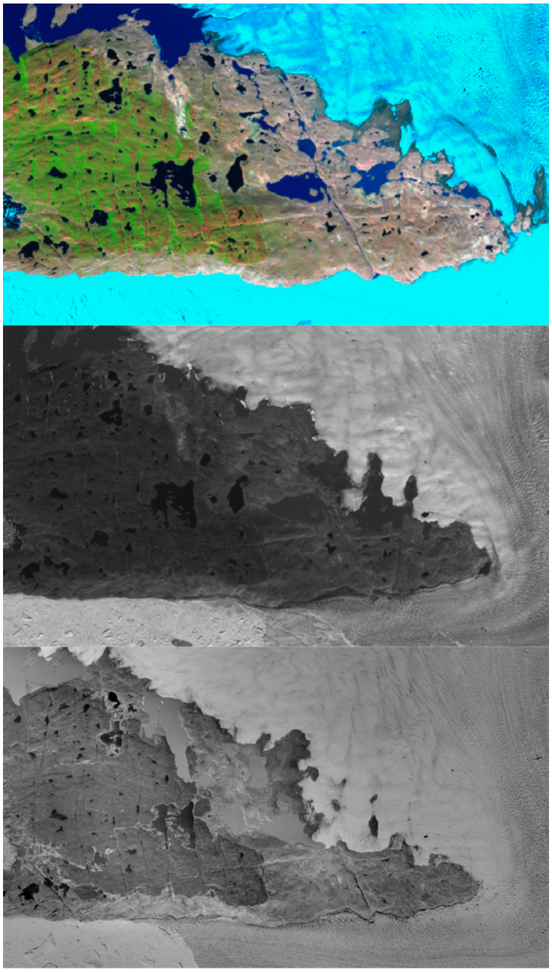

Figure 2: From top to bottom: images of the region just North of the Jakobshavn Glacier in 2020, 2001, and 1985. Obtained from the datasets described in Table 1.

2.2 Retreat Area Data Collection

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2.2.1 Polygons and Area

To quantify the retreat by area, the datasets were loaded into QGIS, and sections of the retreat were mapped by creating polygons. Four sets of polygons were made by hand: two sets of polygons for each of the sets of years of retreat. Both the 1985 to 2001 and the 2001 to 2020 retreats had one set for the peninsula to the north of the fjord and one set for the land to the south--as seen in Fig. 3. These polygons covered both the land and water-terminating margins of the ice.

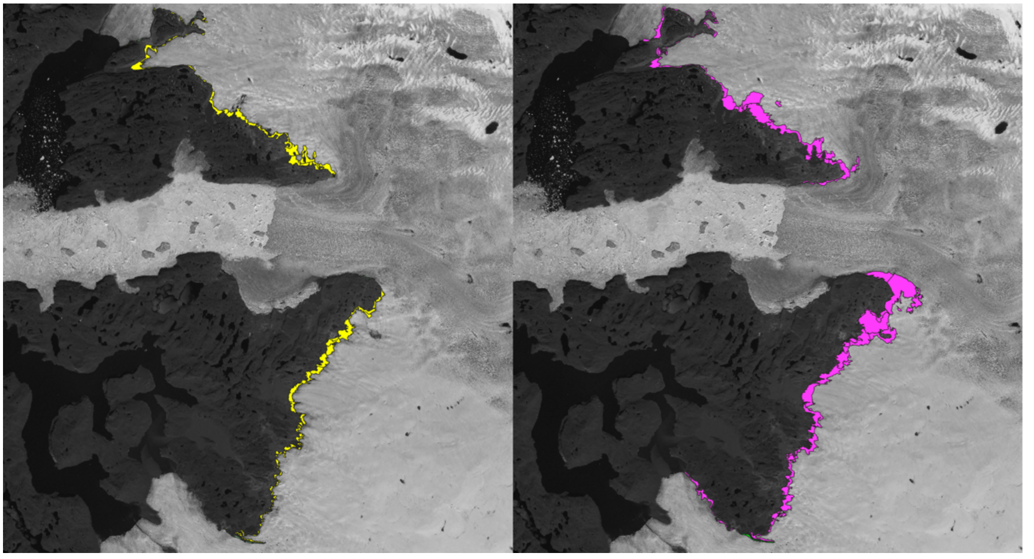

Figure 3: Polygons marking the margin retreat for 1985-2001 North and South in yellow (left), margin retreat for 2001-2020 North and South in pink (right).

2.2.2 Centers, Latitude, Retreat Rate

To calculate the retreat rate of each polygon, the UTM Zone 22W x and y coordinates of the centroid were noted for each polygon. Then, the length of the polygon was approximated to be the distance to the surrounding polygons' centroids halved and combined. For polygons where this was not applicable, such as those on "islands," this method was not used. Rather, a line was drawn along the long axis of the polygon, and its length recorded. The retreat rate was then quantified as the area of retreat for each polygon divided by the length of the polygon.

3 Results

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3.1 Main Results

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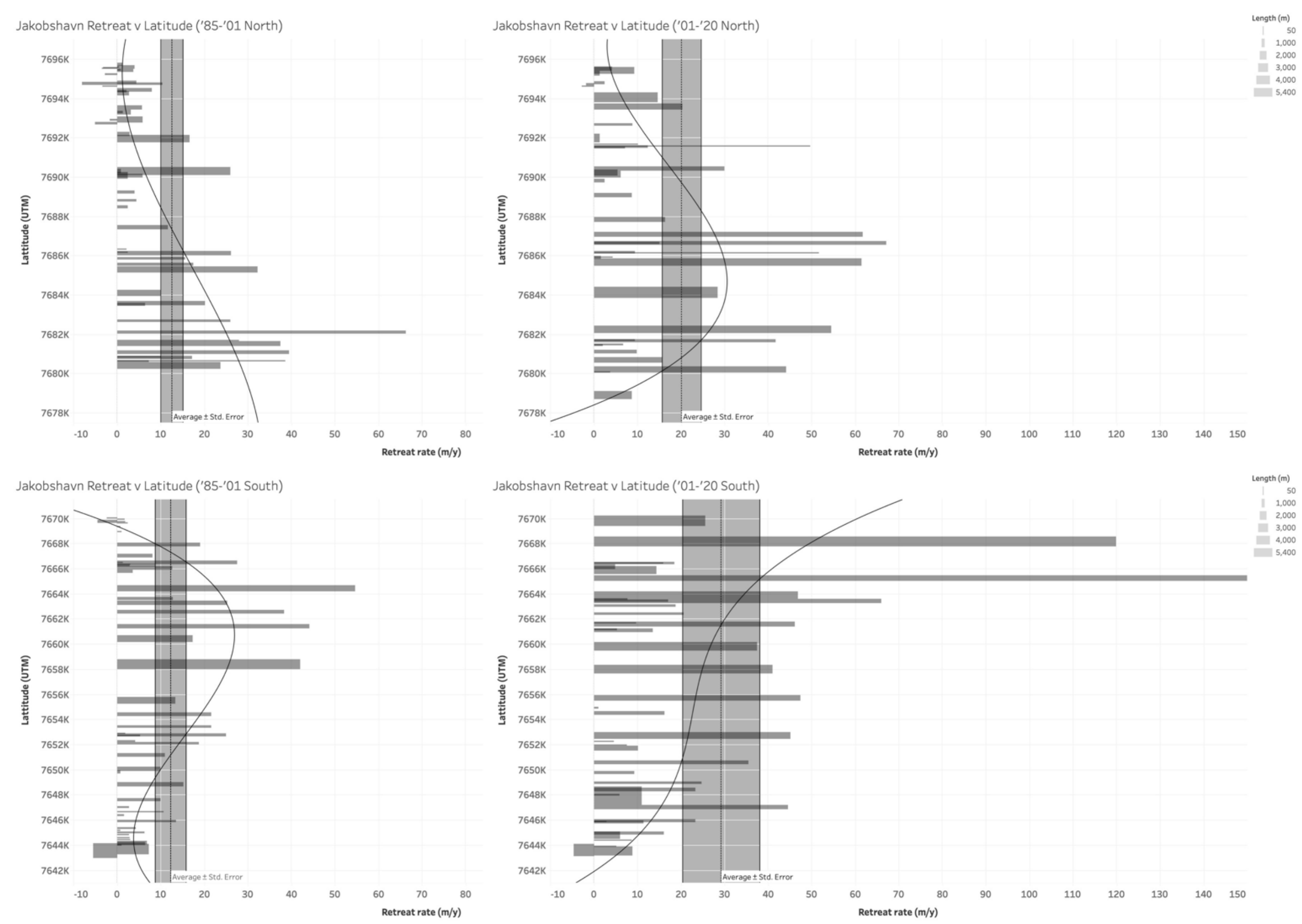

Figure 4: Starting from the top-left and going clockwise, graphs showing approximate retreat rate v latitude: 1985-2001 North, 2001-2020 North, 2001-2020 South, and 1985-2001 South. Each is plotted with a 3rd degree polynomial trend line and an average retreat rate across the region ± std. error of the mean.

3.1.1 Retreat Acceleration

The ice sheet retreat has accelerated in both the northern and southern adjacent regions. The average retreat rate as seen in the figures for each region, was:

1985-2001 North: 12.490 ± 2.554 m/y

1985-2001 South: 12.280 ± 3.503 m/y

2001-2020 North: 20.118 ± 4.483 m/y

2001-2020 South: 29.212 ± 8.901 m/y

Thus, there has been an average acceleration of the retreat of about 0.722 meters per year squared from around 1993 to 2010.

3.1.2 Spatial Retreat

The retreat rates as related to the UTM y-coordinate for ’85-’01 North and South were respectively described by the trend lines following Eq. (1) and Eq. (2):

$$r = 8.32451 * 10^{-12} * \mathrm{y}^3 - 19.1932 * 10^{-4} * \mathrm{y}^2 + 1475.07 * \mathrm{y} - 3.77882 * 10^9 \ , \tag{1}$$

$$r = -1.09149 * 10^{-11} * \mathrm{y}^3 + 2.50584 * 10^{-4} * \mathrm{y}^2 - 1917.62 * \mathrm{y} + 4.89162 * 10^9, \tag{2}$$

And for ’01-’20 North and South following Eq. (3), and Eq. (4):

$$r = 3.19678 * 10^{-11} * \mathrm{y}^3 - 7.37563 * 10^{-4} * \mathrm{y}^2 + 5672.36 * \mathrm{y} - 1.45414 * 10^{10} \ , \tag{3}$$

$$r = 7.93457 * 10^{-12} * \mathrm{y}^3 - 1.82206 * 10^{-4} * \mathrm{y}^2 + 1394.7 * \mathrm{y} - 3.55857 * 10^9, \tag{4}$$

where r is the retreat rate estimated by the trend line in meters per year and y is the value of the y-coordinate in UTM Zone 22W at the point for which this estimation is being made.

In broad terms, these equations and trend lines show that (generally speaking) as the y-coordinate moves closer to the fjord, the retreat rate increases significantly. We notice that the main exceptions to this rule appear at large bodies of water.

4 Discussion

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4.1 Subsection

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5 Conclusion

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5.1 Subsection

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References

Aman, A. A. and Bman, B. B.: The test article, J. Sci. Res., 12, 135–147, doi:10.1234/56789, 2015.

Aman, A. A., Cman, C., and Bman, B. B.: More test articles, J. Adv. Res., 35, 13–28, doi:10.2345/67890, 2014.