



DEPARTMENT OF
GEOLOGY

Comparing Changes in Meltwater Accumulation to Glacial Flow in Northwest Greenland

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Introduction

The ice sheet surrounding the subglacial lake at 78.0573° N, -68.4670° W, in northwest Greenland near the town of Qaanaaq, showed displacement over the course of the summer of 2018 (Moy, 2019). Supraglacial lakes also were spotted in the nearby region in prior years, primarily 2015.

Figure 1: Map of Greenland featuring the study area around the subglacial lake on Google Earth.



Hypothesis

The amount of meltwater accumulated in glacial lakes is directly correlated to the changes in glacial flow, primarily mass loss, displacement, and ice thickness.

Giovanni Climate Data

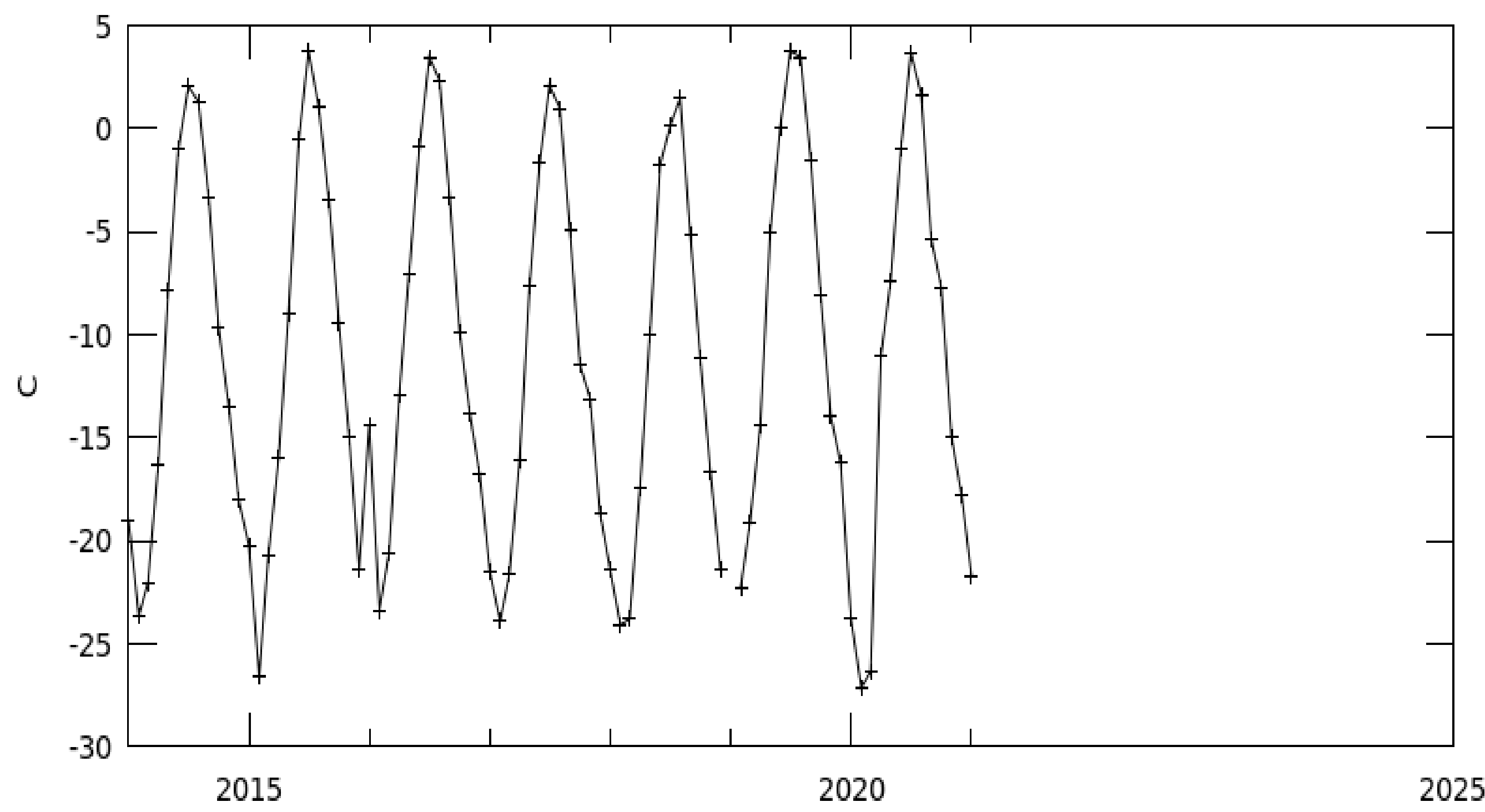


Figure 2: The Giovanni atmospheric monthly temperature data from the study area shown in Figure 3 (Acker, 2007).

Satellites

Gravity Recover and Climate Experiment (GRACE)
USGS Landsat-8 Reflectance Tier 1
MEaSUREs Greenland Ice Velocity Quarterly Mosaic
Cryosat-2

Landsat Imagery



Figure 3: (LEFT) Subglacial and supraglacial lake locations from Landsat 8 imagery from the summer of 2015. Imagery from Google Earth Engine.

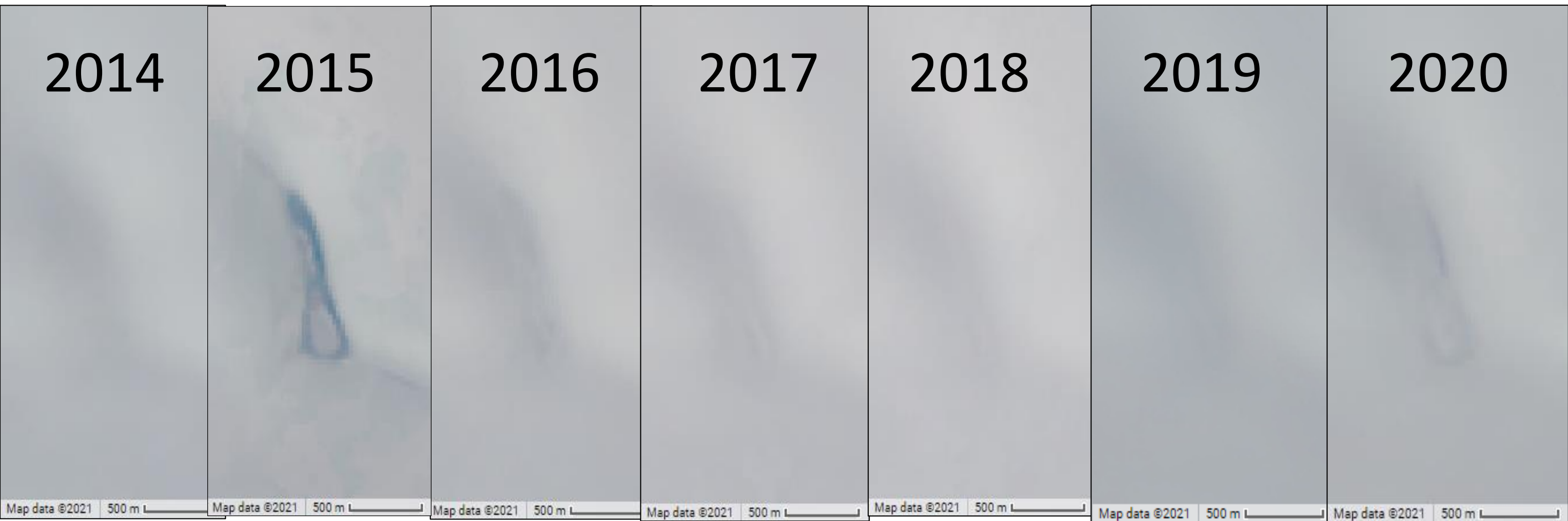


Figure 4: (ABOVE) Lake C annual time-lapse using Landsat 8 data for months June to August.

GRACE Data



Figure 5: GRACE data values from 2015, 2019 and 2020 summers were subtracted from the smallest value in June in order to compare linear slopes 2015 had the lowest mass loss rate of these three years despite the high presence of supraglacial lakes.

InSAR Data

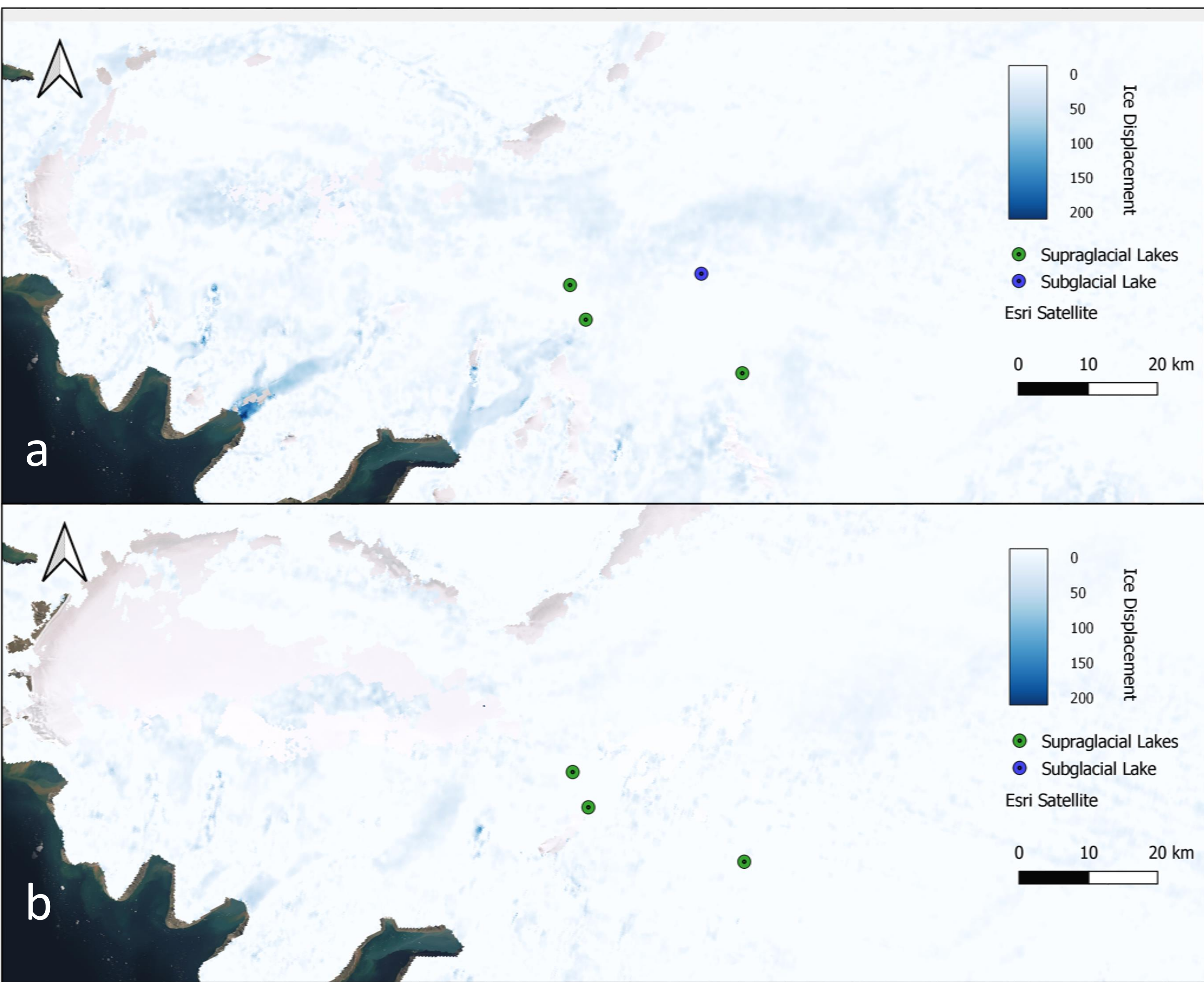


Figure 6: Ice velocity difference from a. Summer 2019 and 2015 and b. Summer 2016 and 2015 (Joughin, 2020).

Conclusion

Despite the amount of meltwater accumulation being much higher in 2015, it had roughly the same amount of mass loss as 2019 during the month of June, and about 77% of the amount of mass loss during 2020. Meanwhile, the ice displacement for the years 2015-2018 were roughly the same despite differences in air temperature. From displacement and mass loss, there was no direct correlation between any of the changes in glacial movement to the formation of supraglacial lakes.

References

Acker, J.G., & Leptoukh, G. (2007). Online Analysis Enhances Use of NASA Earth Science Data, Eos, Trans. AGU. 88, 2, 14 & 17.

Joughin, I. (2020). MEaSUREs Greenland Quarterly Ice Sheet Velocity Mosaics from SAR and Landsat, Version 2. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. <https://doi.org/10.5067/3ZMCUIFDYJG4>.

Moy, E. (2019). In-situ GPS Measurement of the Ice Flow Velocity Near an Ice Divide Overlying a Subglacial Lake in Northwestern Greenland. Undergraduate Senior Thesis, University of Maryland GEOL 394.