Monitoring glacier changes in Disko Island, Greenland Using Object-based Image Analysis in Google Earth Engine

*Asim Ali, Paul Dunlop, Sonya Coleman, Dermot Kerr, Robert W McNabb, and Riko Noormets

*Email: ali-a18@ulster.ac.uk

Ulster University

UNIS — The University Centre in Svalbard

1. Introduction

- Climate change has significant impact on glaciers around the world.
- Arctic is warming faster.
- Glacier melt has significant impact on sea level.
- To understand the impact of climate change temporal changes of glaciers are necessary.
- Multi-temporal evolution of Arctic glaciers is not well-constrained.
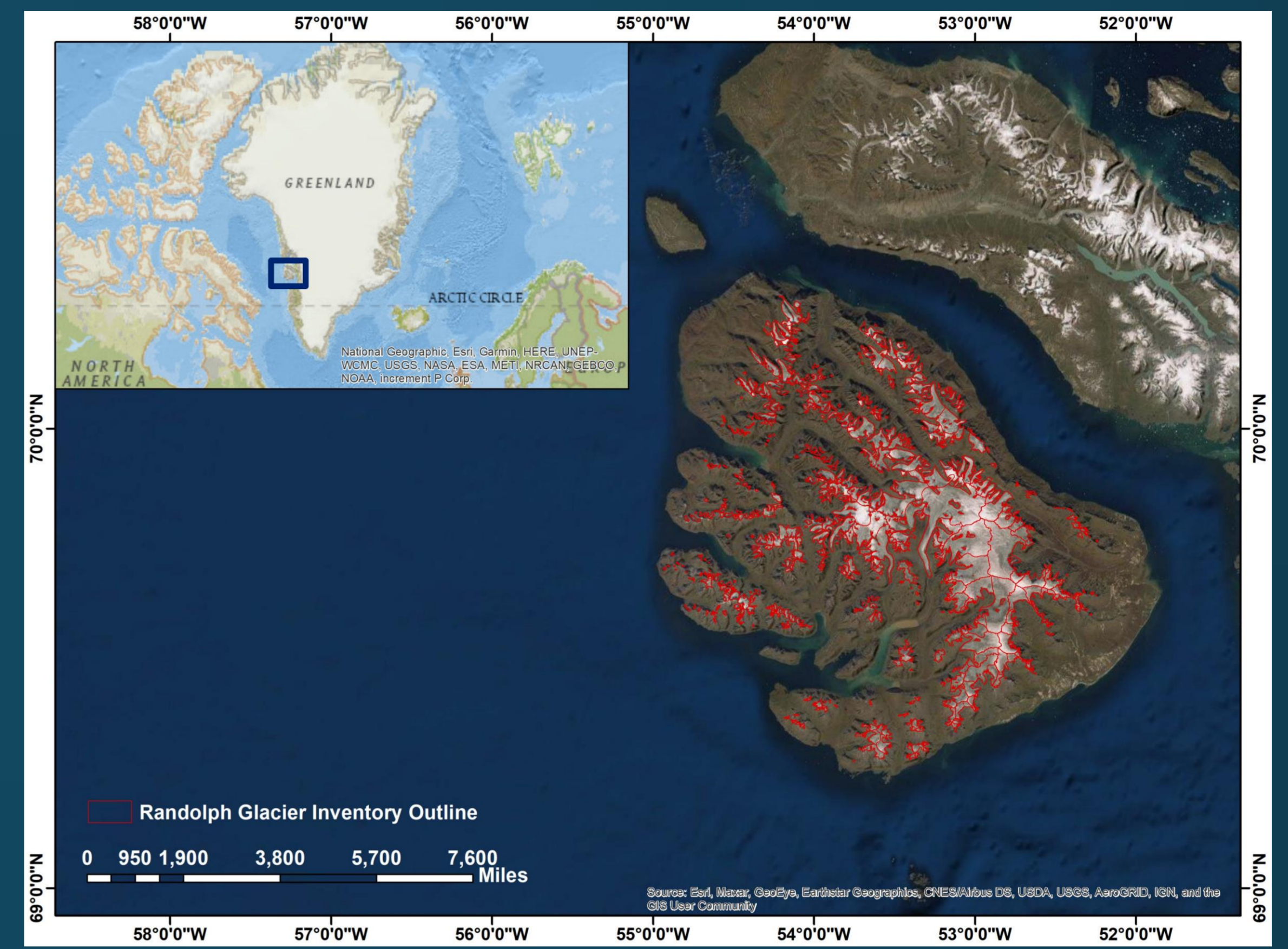
Study area map: The blue box shows the location of Disko, Island, Greenland. On the right side, Randolph Glacier Outlines (RGI) are overlayed.
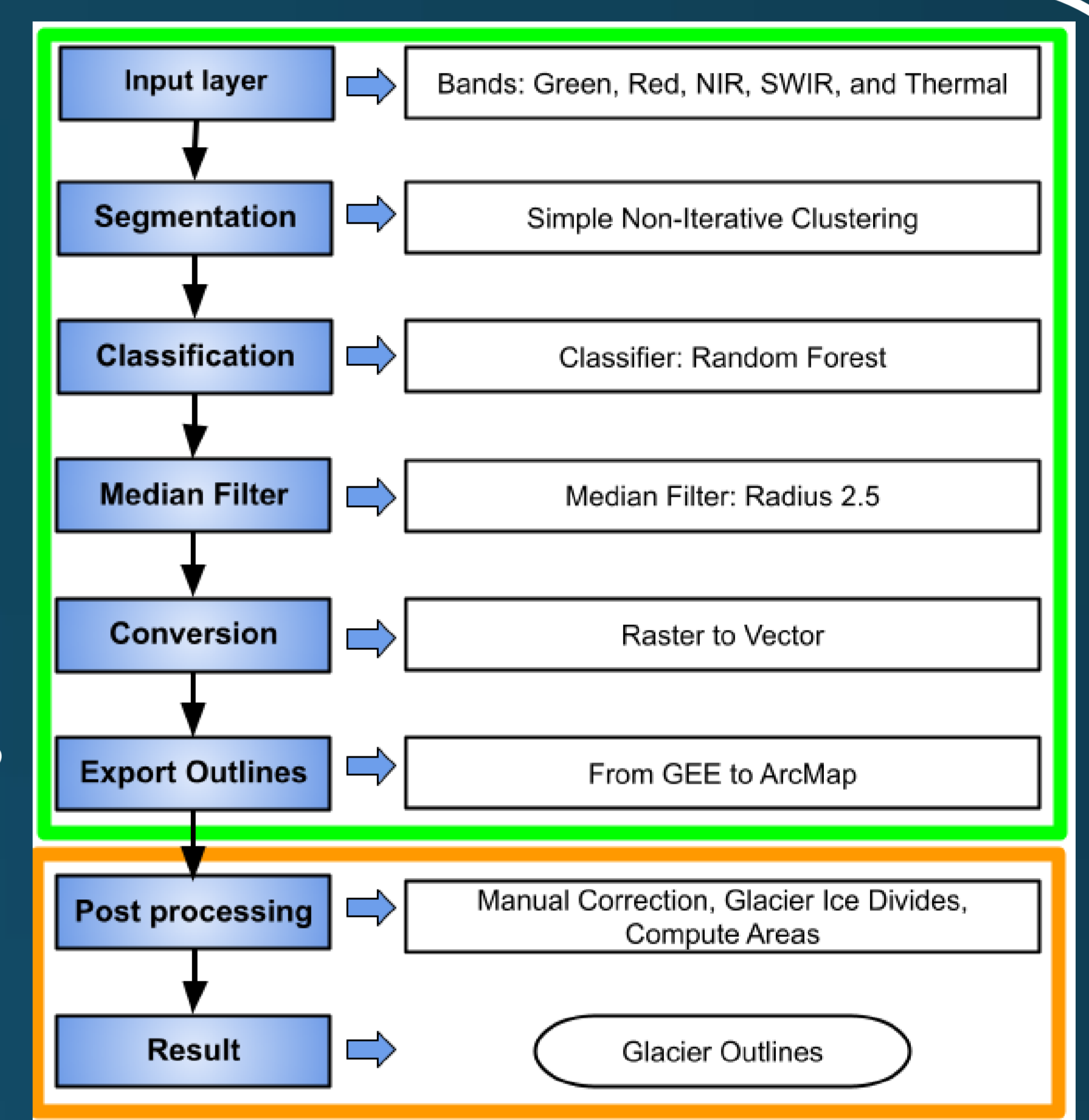
2. Data and Method

Datasets

- Landsat 5-Surface Reflectance
- Landsat 7-Surface Reflectance
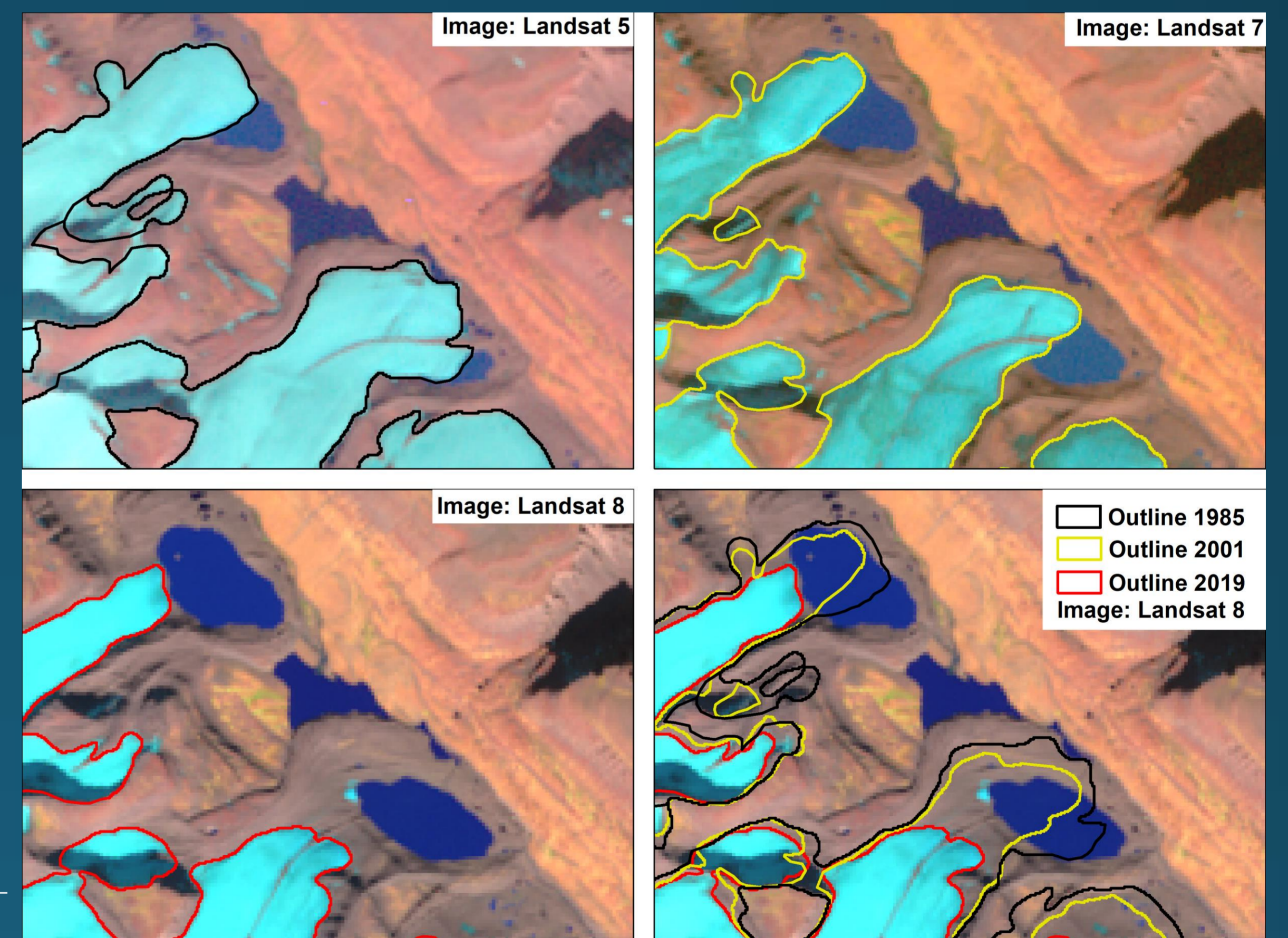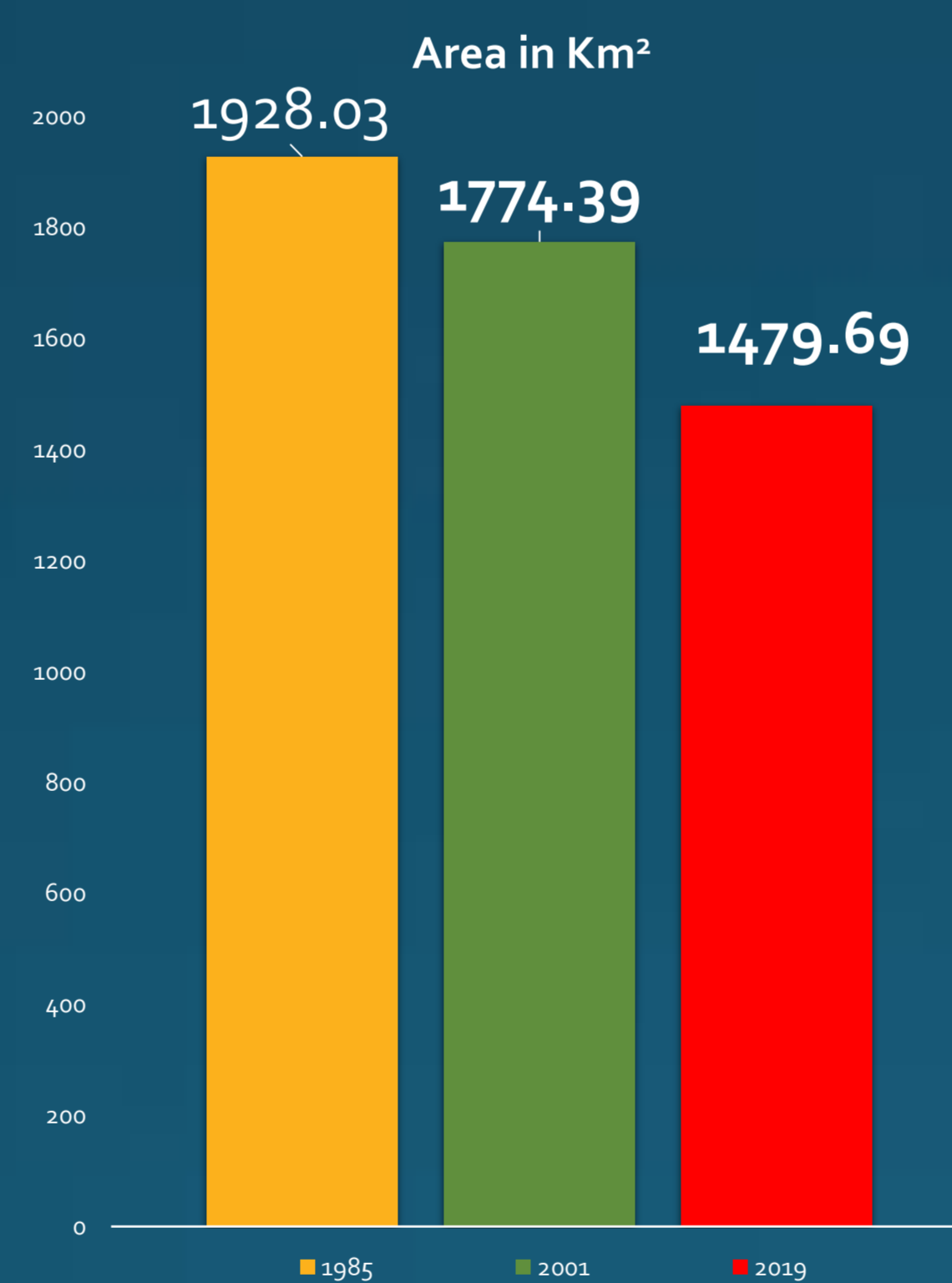- Landsat 8-Surface Reflectance

Method

- Object-based image analysis (OBIA)
- Developed in Google Earth Engine (GEE).
- Green box in the flowchart represent the automated steps in GEE while orange shows the manual processing in ArcMap 10.5.1.

Input layer	→	Bands: Green, Red, NIR, SWIR, and Thermal
Segmentation	→	Simple Non-Iterative Clustering
Classification	→	Classifier: Random Forest
Median Filter	→	Median Filter: Radius 2.5
Conversion	→	Raster to Vector
Export Outlines	→	From GEE to ArcMap
Post processing	→	Manual Correction, Glacier Ice Divides, Compute Areas
Result	→	Glacier Outlines

3. Results

- Method was applied to images at three different times: 1985, 2001, and 2019.
- Multi-temporal outlines of 732 glaciers are created.
- Total estimated area of glaciers in 1985 was 1928.03 km^2, 1774.39 km^2 in 2001, and reduced to 1479.69 km^2 in 2019.

Area in Km^2 — 1928.03 (1985), 1774.39 (2001), 1479.69 (2019)

Outline 1985, Outline 2001, Outline 2019, Image: Landsat 8

4. Discussion and Conclusion

- Glaciers are retreating
- OBIA Accuracy 90.26%
- OBIA outline was compared with manually digitized outline.
- OBIA is a promising method that can be applied to another region

	Total Area Lost Km^2	Change in Percentages
1985-2001	153.64 km^2	7.96%
2001-2019	294.7 km^2	15.28%
1985-2019	448.34 km^2	23.25%

Robson, Benjamin Aubrey, Tobias Bolch, Shelley MacDonell, Daniel Hölbling, Philipp Rastner, and Nicole Schaffer. 2020. 'Automated Detection of Rock Glaciers Using Deep Learning and Object-Based Image Analysis'. *Remote Sensing of Environment* 250. doi: 10.1016/j.rse.2020.112033