

Exploring the Relationship Between Snow Albedo Change and Ice Sheet Height Change at Troll Station

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Introduction

Finding a relationship between seasonal change in surface albedo and ice sheet surface height change at Troll Station

- To predict ice sheet mass and volume changes

Albedo: a measure (0-1) of how much sunlight is reflected away by a surface

- Higher albedo = less surface melt
- Lower albedo = more surface melt
- Melting causes surface lowering through mass loss (runoff) or volume loss (firn compaction)

Data

- Location: Troll Station
- Date: 2019-2025 (middle of February, May, August, and November)
- Height change: ICESat-2 ATL15 satellite data¹
- Albedo: Copernicus ERA5 reanalysis data²

Methods

- Calculated change of albedo over time from ERA5
- Matched the dates from ERA5 to dates from ATL15



Figure 1. Where Troll Station is located (near South Africa)

Results

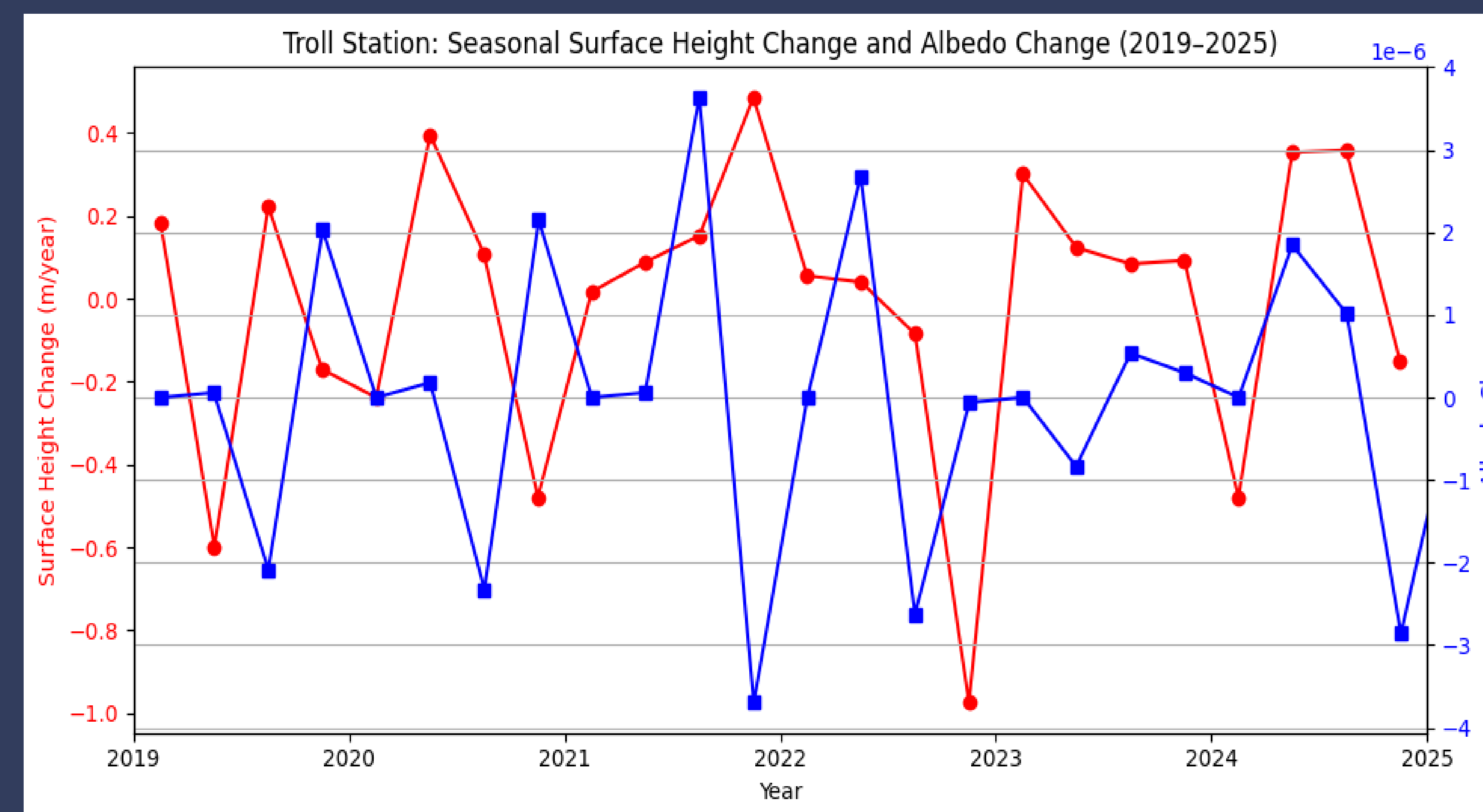


Figure 2. Seasonal time series of ice sheet height change (red) and snow albedo change (blue).

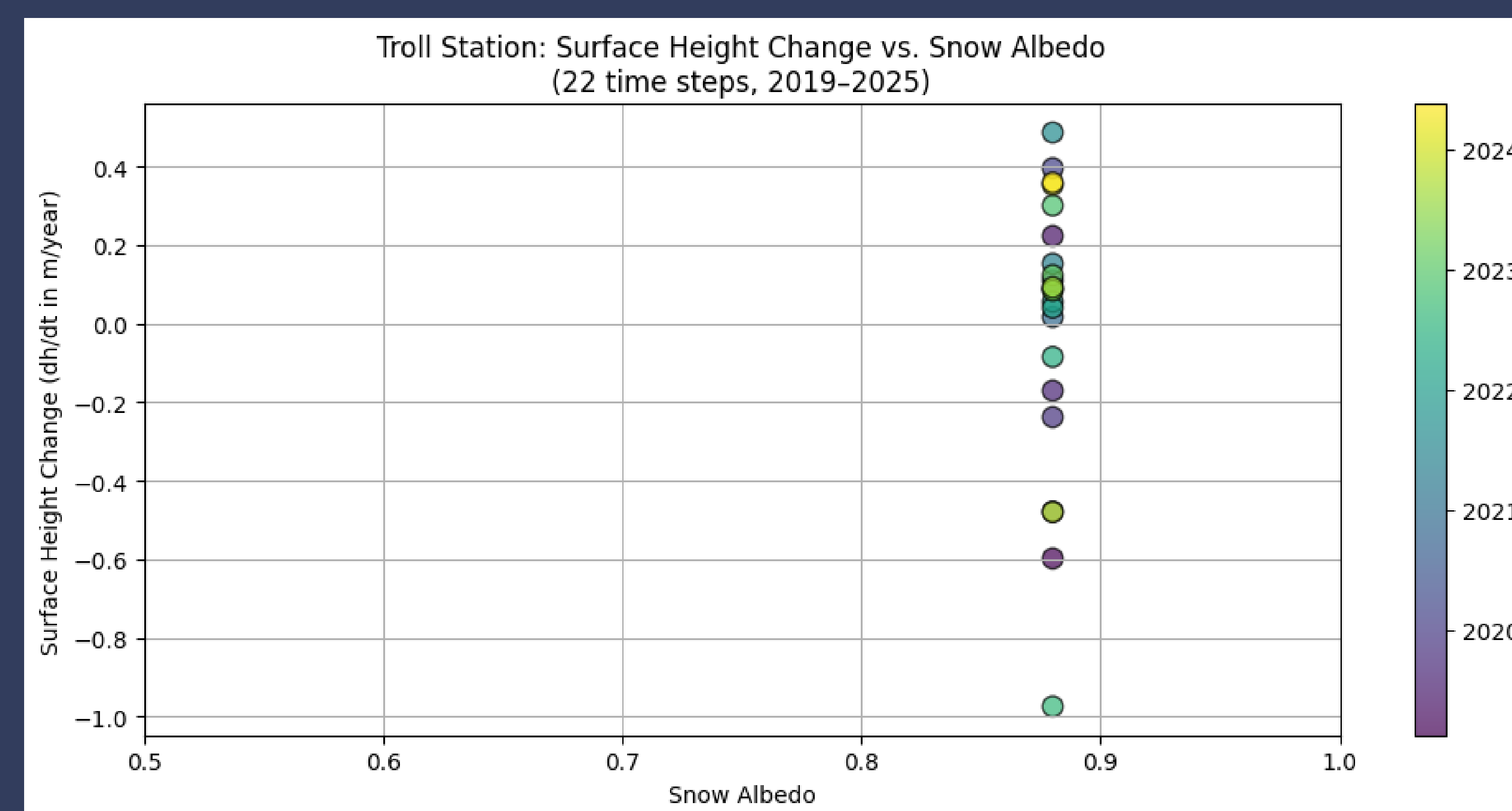


Figure 3. Scatter plot of snow albedo values vs surface height change across time steps.

Discussion and Conclusion

- No clear relationship shown in both Figure 2 and 3
 - Expected more height change with lower albedo in Figure 3
- ERA5 albedo values are constant in this region (Figure 4) at ~0.85
 - Limits the ability to analyze actual variation
 - Suggests that ERA5 reanalysis data doesn't capture albedo variability well

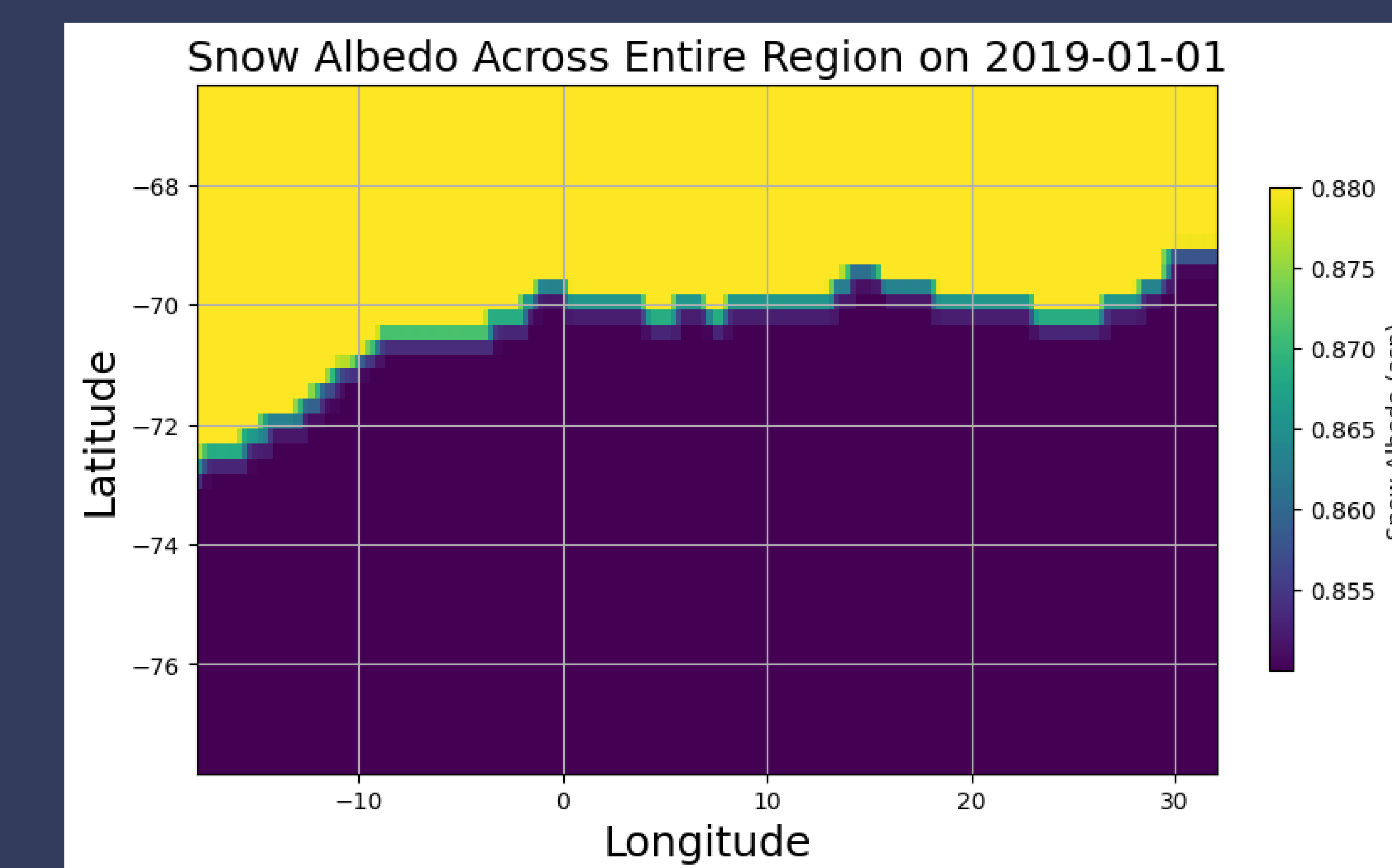


Figure 4. Map of albedo value (purple) at Troll Station on the coast of Antarctica.

Future Work

- For better albedo variability
 - Using a satellite data set like MODIS
 - Expanding to a wider region for analysis
- Use albedo to predict ice sheet height change related to climate change if a clear relationship is found

References

¹"ATLAS/ICESat-2 L3B Gridded Antarctic and Arctic Land Ice Height Change, Version 4: National Snow and Ice Data Center." *ATLAS/ICESat-2 L3B Gridded Antarctic and Arctic Land Ice Height Change, Version 4* | National Snow and Ice Data Center, nsidc.org/data/atl15/versions/4. Accessed 13 July 2025.

²Hersbach, H., Bell, B., Berrisford, P., Biavati, G., Horányi, A., Muñoz Sabater, J., Nicolas, J., Peubey, C., Radu, R., Rozum, I., Schepers, D., Simmons, A., Soci, C., Dee, D., Thépaut, J.-N. (2023): ERA5 hourly data on single levels from 1940 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), DOI: [10.24381/cds.adbb2d47](https://doi.org/10.24381/cds.adbb2d47) (Accessed on 13 July 2025)

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