

Rock Glacier Inventory of Utah

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Abstract

With the progression of climate change and an increased need for water, water resource management is becoming a critical issue, especially in the American West. Rock glaciers are a potentially significant, yet often overlooked, component of hydrologic systems, as well as mass wasting processes. Despite their significance, they are understudied and under identified. As managing water becomes more integral in our community, different aspects of the hydrologic cycle become more important to address and integrate when solving water issues. Rock glaciers are a hidden storage source of water, potentially contributing to watersheds, rivers, snowpack, and melt in the water budget. In addition to being a role in the hydrosphere in Utah, rock glaciers can be an important climate relevant variable, as well as a source of geologic hazards, through the transportation of loose rocks and disruption of slope stability in mountainous areas.

This research, in conjunction with the UGS, aims to quantify the existence of rock glaciers in the state of Utah, in the effort to contribute to a greater understanding of the hydrology, cryosphere, and water budget of Utah.

What are Rock Glaciers?

Rock glaciers are geomorphic landforms created from the (current or former) movement of subsurface ice (permafrost). This ice is overlain by debris and talus. This rock and debris shields them from ablation (melting), which means they can persist in areas where meltwaters might be too high to sustain large alpine glaciers. For this reason, they can be found in many mountainous areas where there are not normal glaciers.

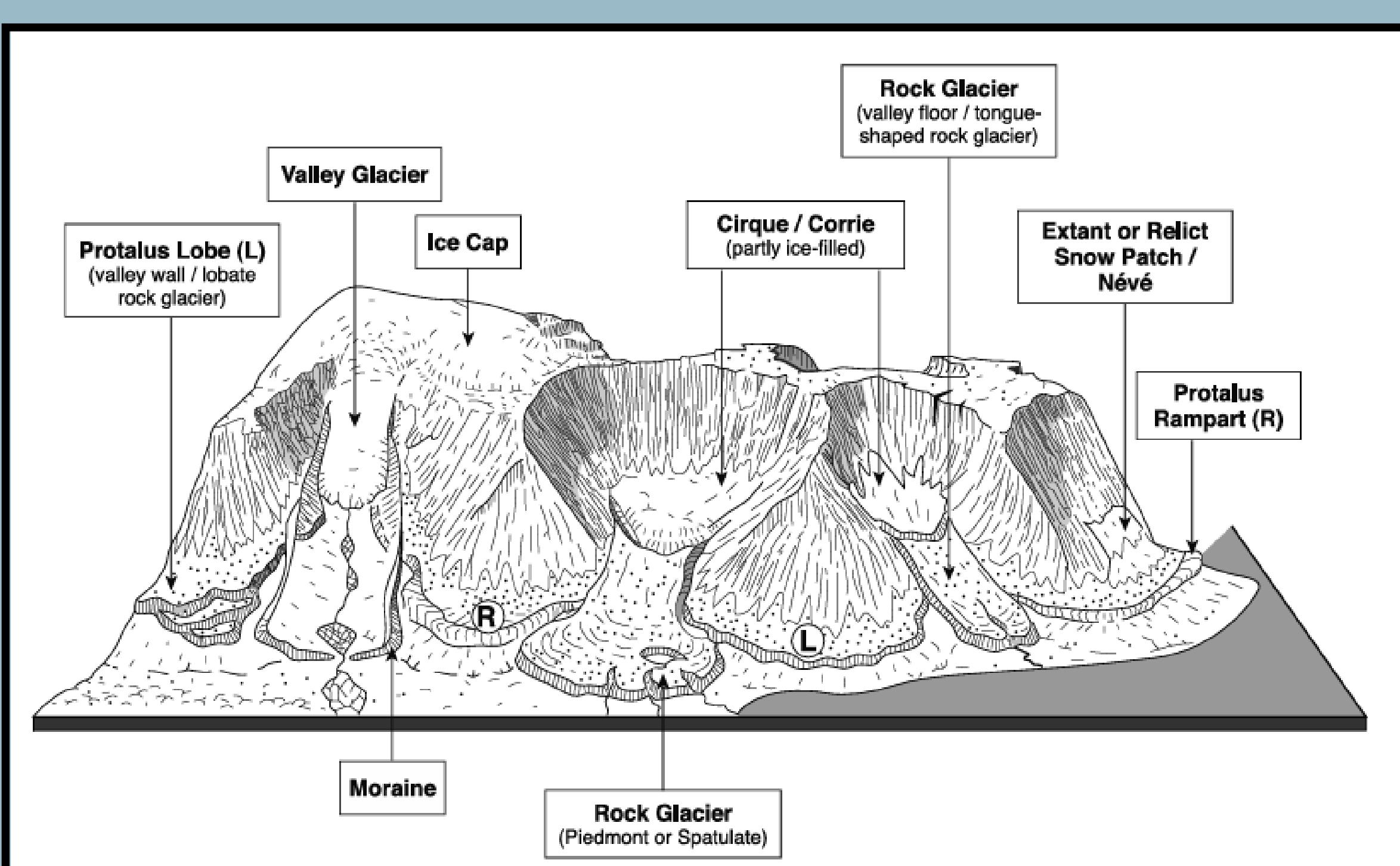


Figure 1: Diagram depicting alpine glacial features from Whalley et al. 2003. Landforms in this research that were identified were protalus lobes, protalus ramparts, and rock glaciers.

Location

The goal of this research is to create an inventory of rock glaciers for the entire state of Utah. Currently, we have identified rock glacier and rock glacier features in the Lone Peak Segment of the Wasatch range. Other ranges to be completed are the entire Uinta-Wasatch range, the Manti-La Sal range, and the Logan-Nephi Wasatch range.

Methods

Due to their subsurface nature, rock glaciers must be manually identified using a geomorphological lens. Manual identification can be highly variable; to minimize variations and maintain consistency we followed the rock glacier identification process recommended in the Rock Glacier Inventories and Kinematics, published by the International Permafrost Association. Rock glaciers are manually identified and digitized using satellite imagery. Software used are Google Earth Pro and ArcGIS Pro. Additional tools used were lidar and hillshade imagery from OpenTopography and CalTopo.

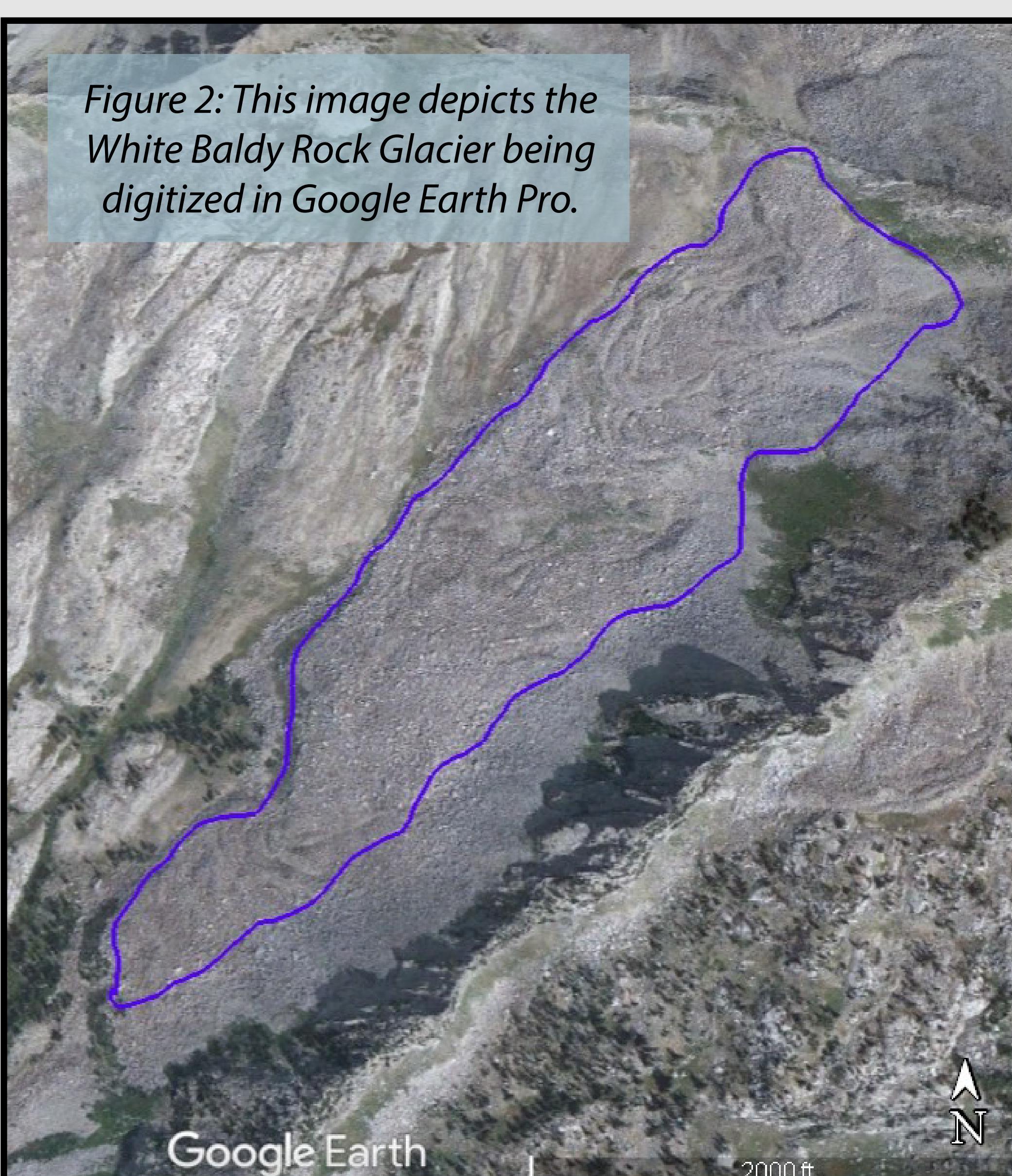


Figure 2: This image depicts the White Baldy Rock Glacier being digitized in Google Earth Pro.

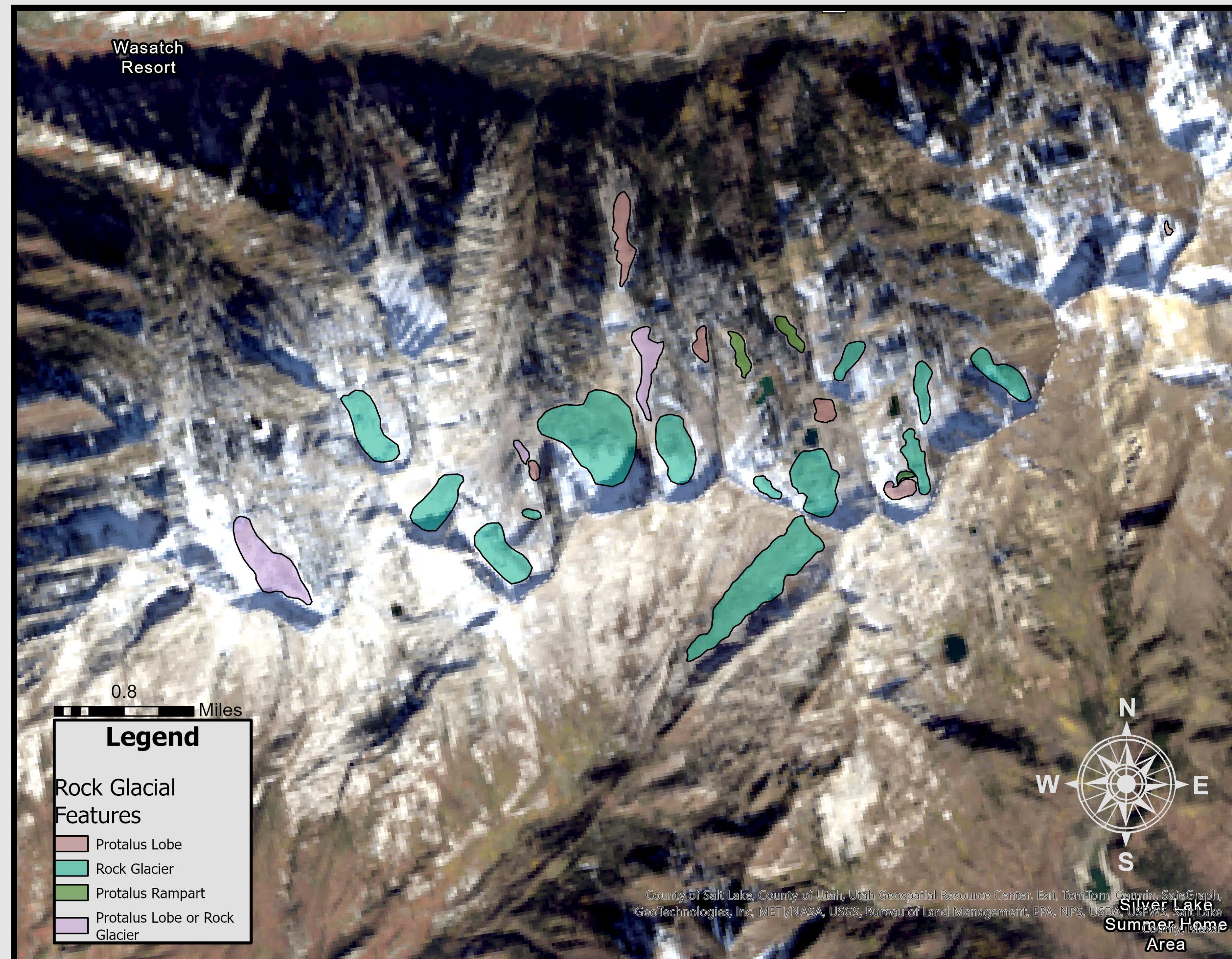


Figure 3: This figure depicts the current rock glacier and rock glacier features identified in the area between Lone Peak and Mt. Baldy. Features include rock glaciers and features created by rock glacial activity: protalus lobes and protalus ramparts.

White Baldy Rock Glacier

The North facing slope rock glaciers have an average area of 0.16 km^2 . The White Baldy Rock Glacier is of interest due to its aspect and area. Most glacial features face the North, getting less sun. This rock glacier has an area of 0.46 km^2 , which is almost 3 times larger than the average North facing rock.

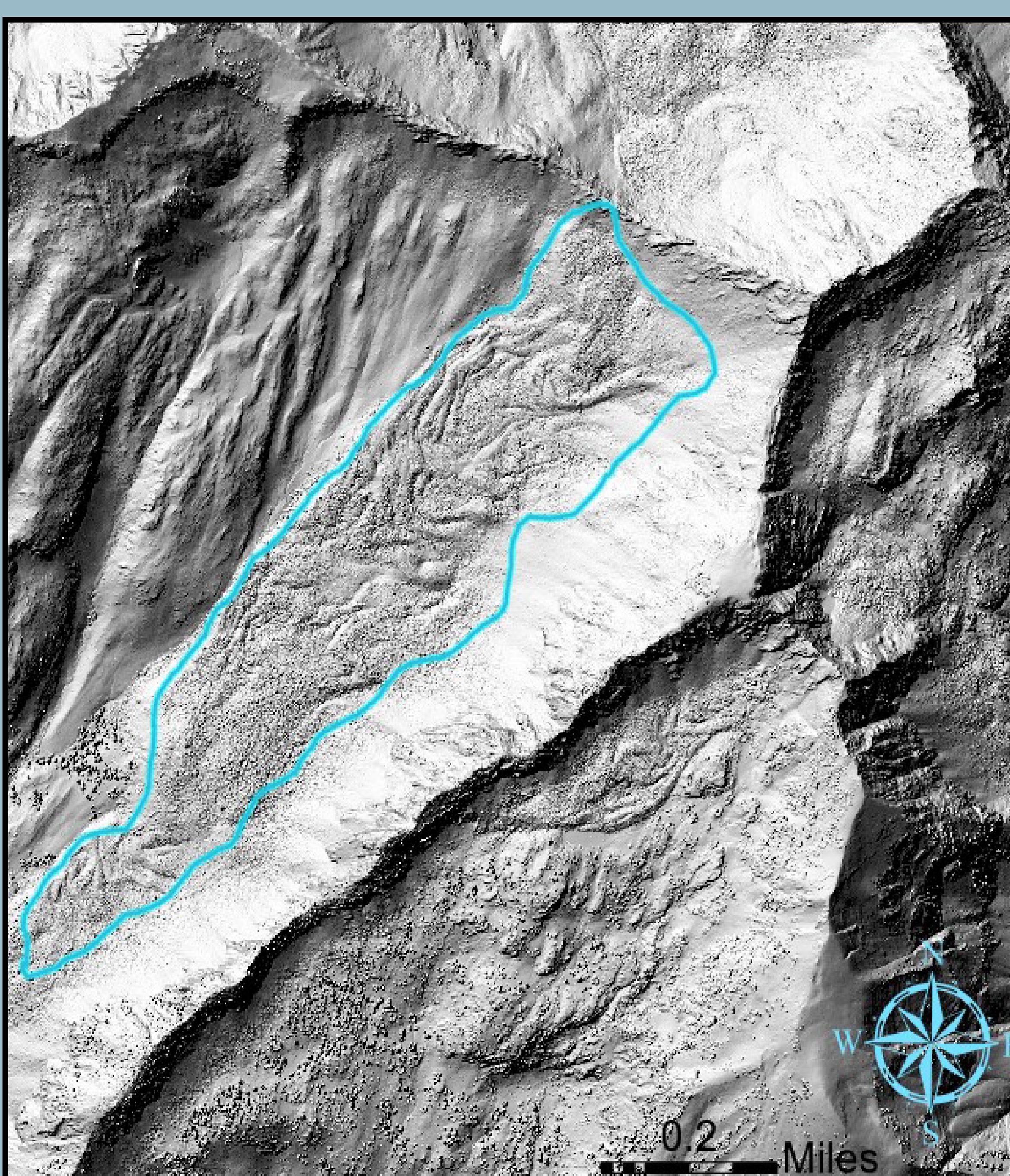
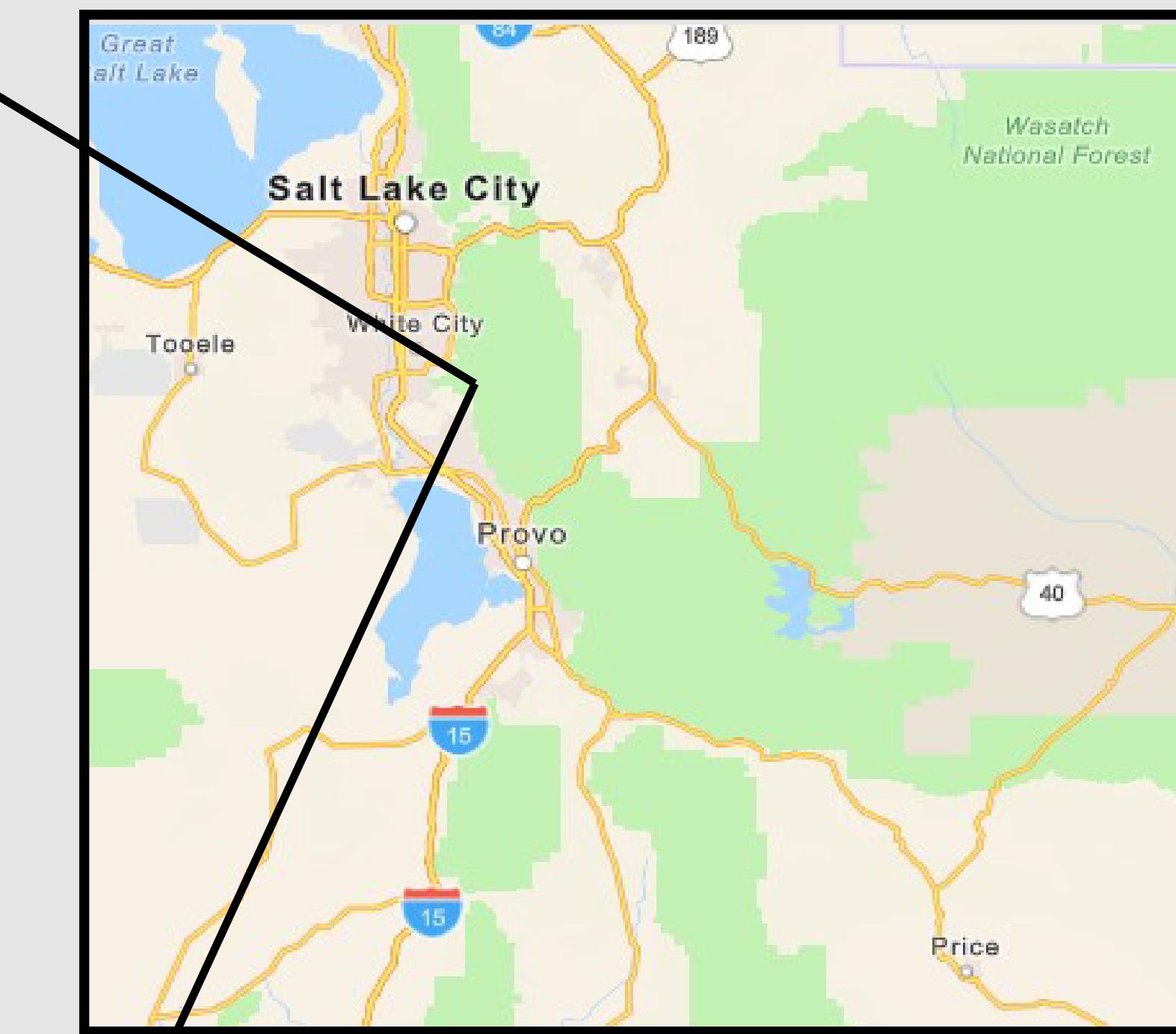


Figure 4: Lidar imagery of the White Baldy rock glacier



Future Work

An extension of this work will be to collect water samples of rock glaciers, specifically the Mt Timpanagos and the White Baldy rock glaciers, and conduct isotopic analysis. We anticipate this data will provide valuable information on the hydrology of the rock glacier. Specifically, the timing of snowpack accumulation, melt, and summer precipitation. On a larger scale, we anticipate this information will provide insights on how rock glaciers affect the overall hydrology of the area, such as contribution to local rivers and streams.

Citations

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