# 3D Mapping of Glacially-Eroded Bedrock

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Understanding glacial melt and sliding rates, a key influence on sea level rise, requires understanding the interaction between the ice and the bedrock beneath it. Ground penetrating radar surveys conducted through an ice sheet cannot achieve the cm-scale resolution necessary to detect many sub-ice hydrological features. 3D mapping of a deglaciated area can resolve these features and aid studies of the processes that created them. This survey uses Agisoft Photoscan, a structure from motion photogrammetry software, to map Umpire Rock in New York's Central Park. 3300 photographs taken at a separation of roughly one meter cover the 1000 square meter surface of the survey area. Sections of the rock are imaged in separate chunks and the point clouds generated are each aligned with a central section using Photoscan's align chunks tool, allowing additional surveys to easily be added to the 3D model. The scale of the final model generated is accurate to 1mm across the survey area and the texture mapping produces a surface resolution of up to 5mm. Digital elevation models, orthophotos, and 3D meshes can be generated, allowing analyses such as overlaying roughness and curvature fields on the mesh, signal processing to identify striation frequencies, and 3D vector drawing to analyze ice flow direction. Three dimensional flow directions can help determine whether all features were eroded over the same period of time, or whether sections of the rock were at some point covered by sediment or water.