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Lab 5 Report: Structure from Motion (SfM) Photogrammetry & Metashape

The objective of this lab was to create a 3D model of a soil deflation patch (LLGRID5) in western Greenland with Structure from Motion Photogrammetry in Metashape. Structure from Motion (SfM) Photogrammetry is the process of converting a set of 2D images into 3D images, based on the differing orientations of the camera when capturing the photographs, and the relative positioning of the objects in the photos. The overall goal in using SfM to study these soil deflation patches is to learn about "aeolian soil erosion processes, the ecology of biological soil crusts, and the regional climate history", so our lab is a reconstruction of the methods used to do so. We were given photographs and control point measurements provided by Dr. Ruth Heindel to conduct this lab process. Rather than using high-precision GPS on the control points to create the model, we used measured distances between the control points to create a local coordinate system.

After starting Metashape, setting preferences, and downloading the data from canvas, I added the photos into the software and filtered for only photos with quality above 0.5. I then aligned the photos with high accuracy and generic pair preselection, and examined the point cloud, learning the functionality of the app (how to change the viewing perspective). I then trimmed down the point cloud, deleting all outlying points, along with the 1-2% of points with the lowest Projection Accuracy. Next, I used the transform region tool to change the shape of my bounding box. I then got the XY coordinates for the ABC set of control points via the Excel spreadsheet, after inputting the distances between the points, and imported the coordinate file into Metashape. Next, I placed markers on the control points in the photos, starting with A and continuing through B and C. I placed the pins directly on the cross-hash on the black mats. After, I built the dense point cloud (as opposed to the original sparse point cloud), now that I had confirmed geo-locations of known points, their relative locations to each other and the camera. Next, I used the free-form selection tool to again select and delete (inverting the selection) more points outside of the main surface/scraggly, sparse sections along the edges. After that, I used the Build Mesh tool based on the dense point cloud, which creates a polygonal mesh of the surface using a Triangulated Irregular Network (TIN). I then used the Build Texture tool and exported the model as an OBJ file. What resulted was the 3D mesh and texture.

I learned a lot during this lab- going through this process visually and experientially helped me understand the concepts of photogrammetry much better. I found it fascinating how easily I could convert a set of 2D photos into a 3D model that a user can interact with. The potential/implications of this software and workflow are unimaginable. It was cool to navigate around the finished model and look closely at the small objects (rocks, patches of vegetation, etc) that were successfully made 3D. The only problem I encountered was during the Build Mesh step, it didn't work the first few times I tried it and presented me with an error "Empty Surface". Aletha tried rebuilding the point cloud in the previous step, and then the Build Mesh step (and following steps) worked, so we aren't quite sure what that error was caused by. I would be curious to rerun all of these steps without narrowing down any points, both in using the Freeform selection tool, in deleting the 1-2% of points with the lowest Projection Accuracy, and in deleting all photos with quality lower than 0.5. I wonder if that would affect the quality of my model products- both the mesh and the texture. Overall, I was very happy with how my model turned out, and would be interested in learning more about the next steps after 3D modeling- like how a scientist would use such a model in their research, and the capabilities it would provide them.