A few notes on exploring Digital Elevation Models using the GEON LiDAR Workflow

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Introduction

The GLW gives us a wonderful opportunity to explore airborne laser swath mapping data and the production of DEMs. I wanted to first test it a bit in terms of downloads, and then also to explore DEM production using ArcMap. See the end of this report for ideas for more work.

Study site

I chose a study area along the second fault zone from the west of Mike Oskin's study area. I selected the area and ran the default gridding parameters in the GLW (Figure 1).

DEM construction

Overview

While the main dataset I downloaded was about 700,000 points, I could not grid it on my 4 year old laptop using some of the algorithms. I converted it to a shapefile (took tens of minutes), loaded it into the ArcMap project, and then selected a study area with a hill, adjacent drainage, and some flat terrain in the area, extracting 115,175 points (Figure 1). Figure 2 shows the blanket of points at the site, and then Figure 3 shows a few across the site with a 1 m grid behind.

Gridding test in ArcMap

Figure 4 shows two endmember "grids" of the study area (note that as much as possible, all grids are show with the same color map and a 50% transparency over their hillshade). The GLW spline shows the area in a fairly smooth rendition, while the TIN with the default ArcMap coloring is a rough portrayal of the topography. Using the 115,175 point 3D shapefile as input, I fairly quickly produced 1 m grids using Inverse Distance Weighting (about 1 minute), Nearest Neighbor (21 seconds), Spline (47 seconds), and TIN (25 seconds) (Figure 5). I could not get the data to be Kriged after about 2 hours of running.

The results of the comparison are shown in Figure 5. All of the grids from Arc look less smooth than the GLW spline. The differences between the GLW spline and the Arc methods are small–mostly less than a few tens of cm. Their spatial distribution implies to me that they are actually dominated by "error" in the GLW spline, rather than in their own methods. However, when I differenced the TINGRID and the Arc spline, I had similar magnitude error ranges, but the spatial variation was significantly different.

Ideas for more work

Here are some ideas that came to mind as I was doing this exercise:

1. We should somehow (?) label or otherwise indicate which fault zones are which in the Eastern California Shear zone dataset. Would it be worth seeing how good the USGS Qfaults are through there?

2. It might be nice to redo this with larger datasets, different terrain, and more algorithms.

3. The difference comparisons are ok, but it would be better to figure out how to take the point position from the shapefile and compare its z value with the estimated one from the grid. That is the better way to do it. We should show the histogram for the error too.

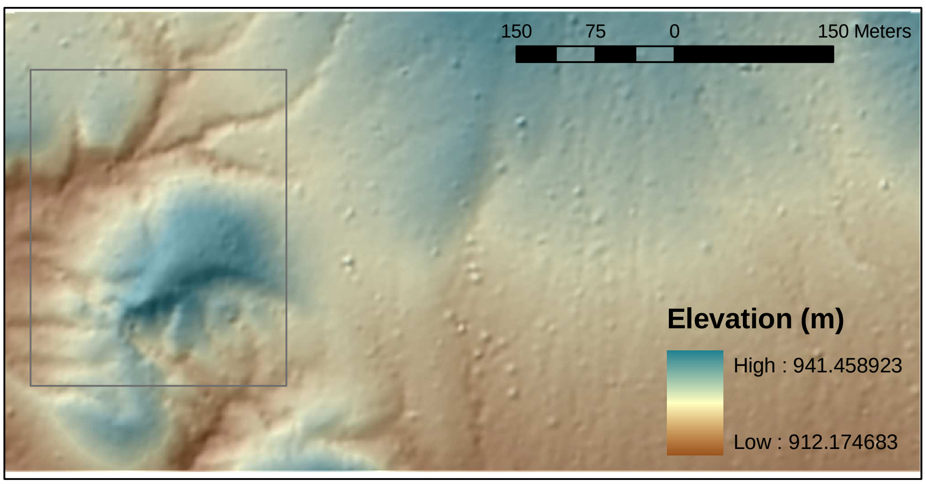

Figure 1: Piece of Eastern California Shear zone ALSM data gridded at 1 m resolution in GLW. Rectangle shows subset for gridding, etc. test.

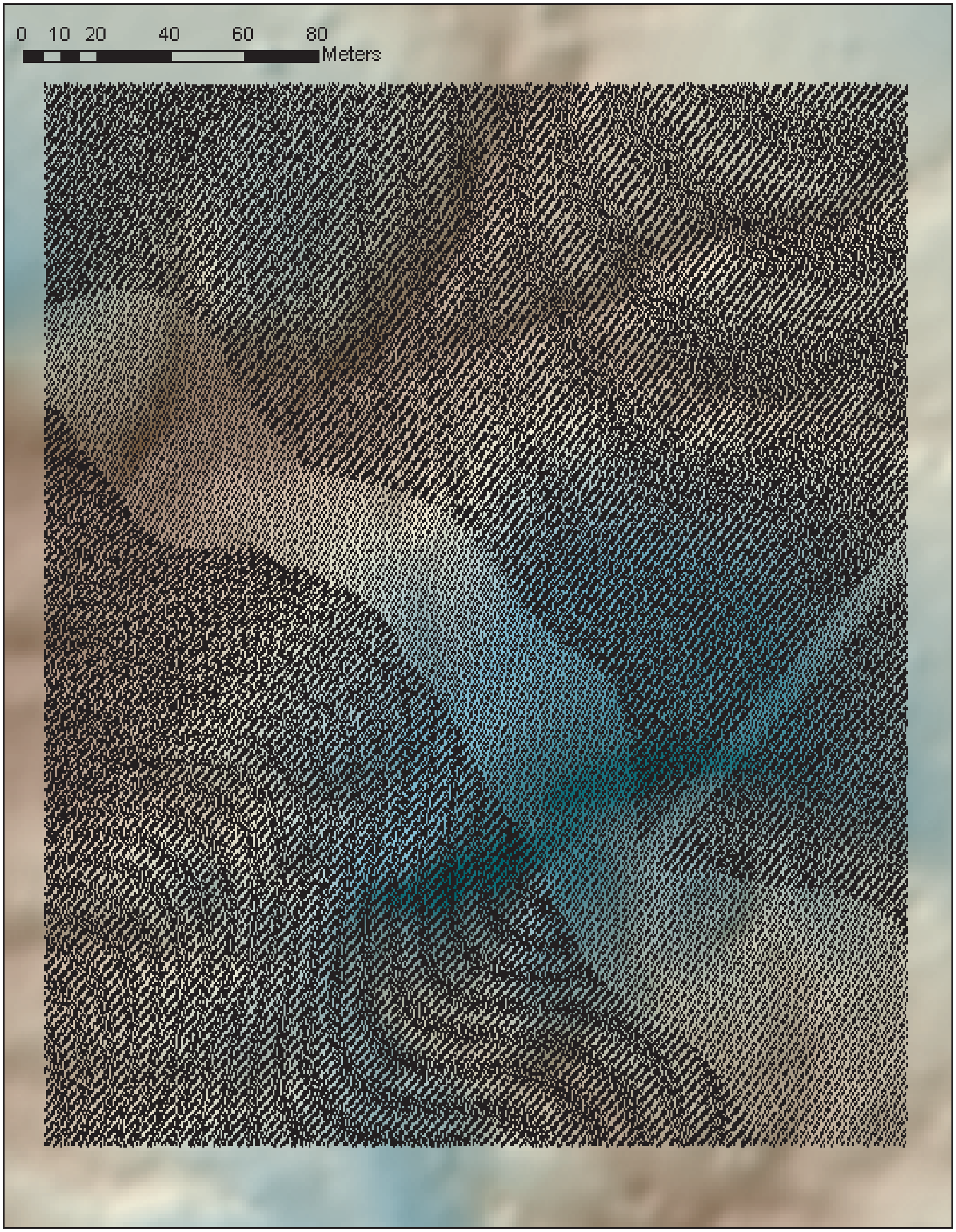

Figure 2: Zoom to 115,175 points for study.

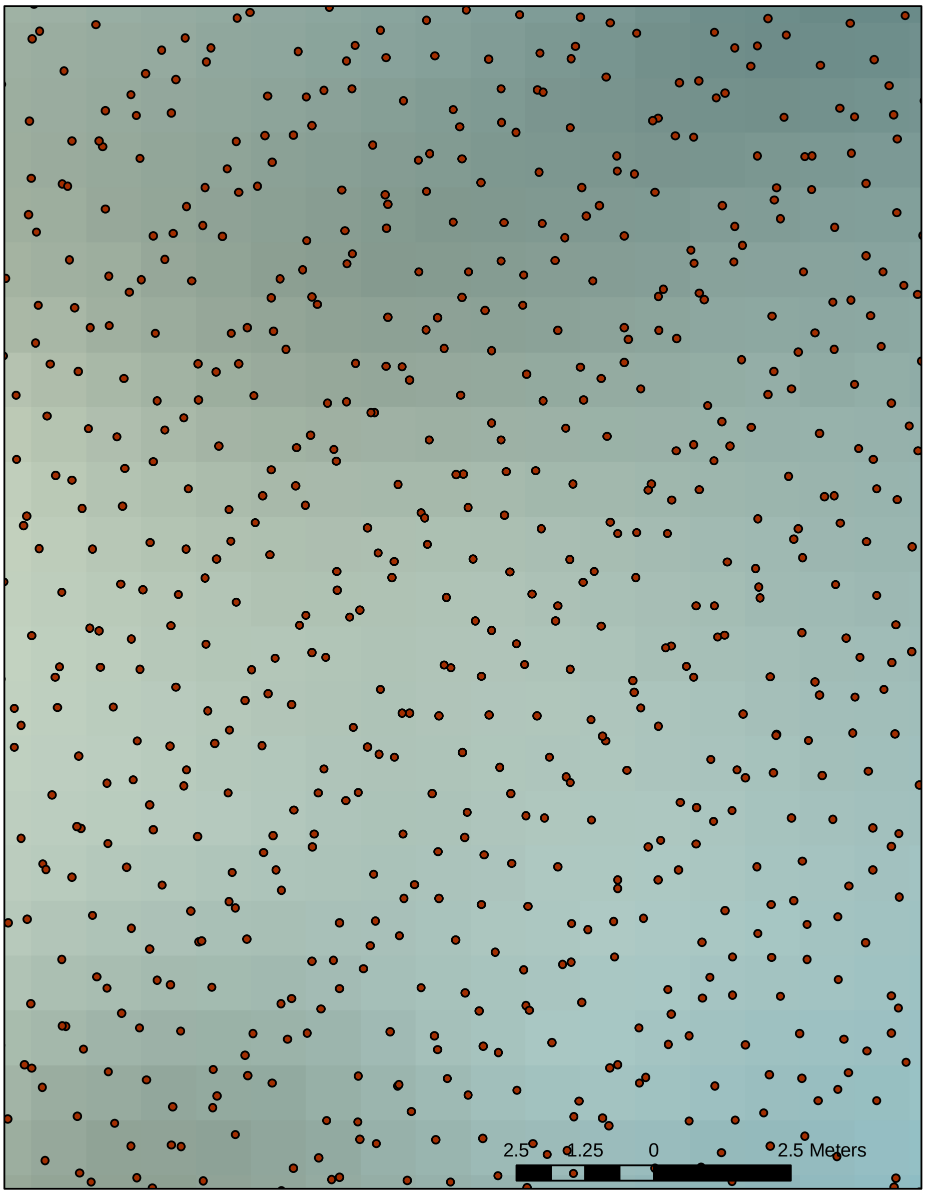

Figure 3: Zoom deep to see point cloud over 1 m grid.

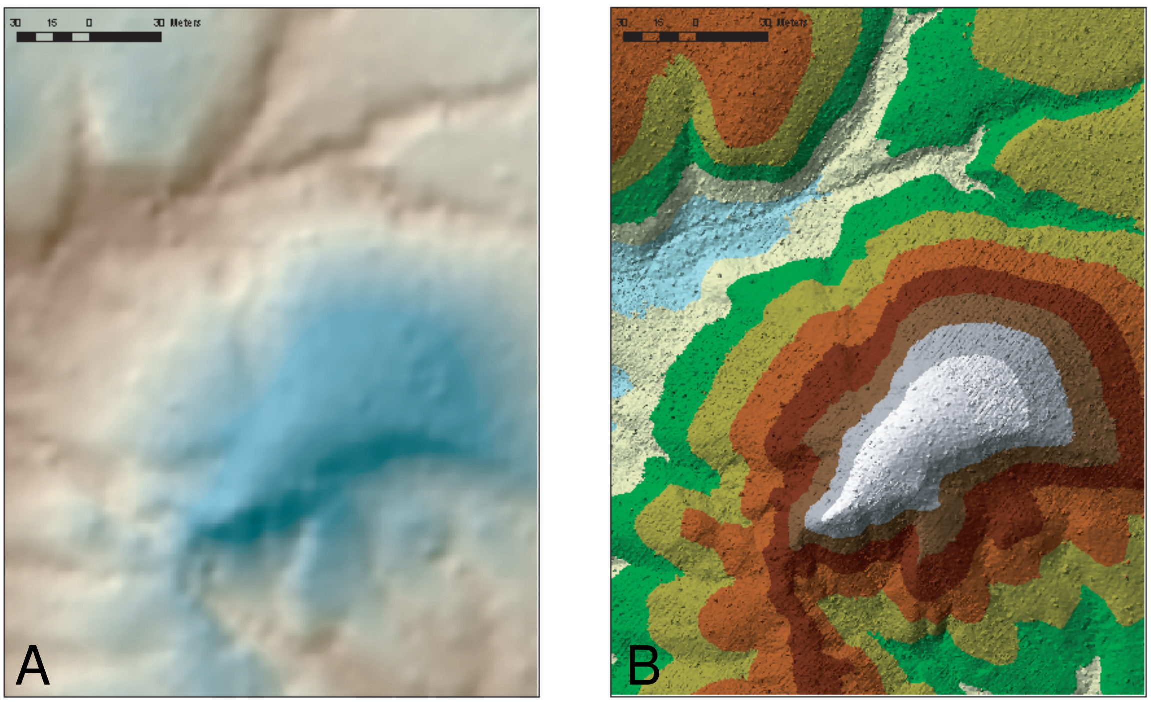

Figure 4: Study area end member grids. A) GLW spline–rather smooth. B) Arc TIN–rather rough.

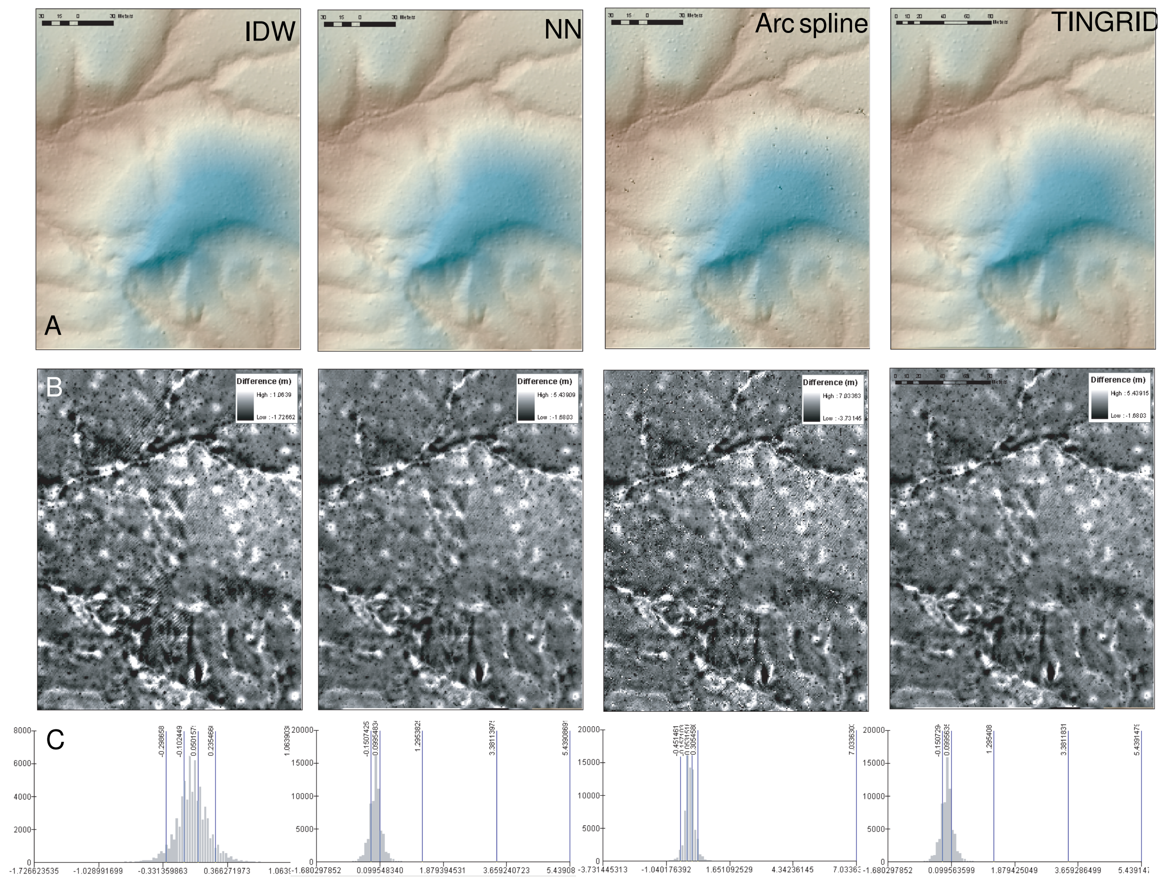

Figure 5: Arc-produced grids and differences relative GLW spline. A) Row of grids: Inverse Distance Weighted (IDW), Nearest Neighbor (NN), Arc Spline, and the TIN shown in Figure 4B converted to a 1 m grid. B) Differences between grids and the GLW spline. Most differences show artifacts probably coming from the (overly ? smoothed) GLW spline. C) Histograms of differences shown in B–most are less than a few 10s of cm. Fortunately, the GLW spline - Arc spline has small error.