3D Modeling of UWT Campus Buildings

INTRODUCTION

Lidar (light detection and ranging) is an optical remote-sensing technique that uses laser light to densely sample the surface of the earth, producing highly accurate x,y,z measurements.

Using LiDAR data, this project aims to a) perform spatial analysis to ascertain the elevation of both the building roofs/peaks and the ground they are on, b) compare use of the analysis's primary tools: zonal statistics and extract values to points, and c) create 3D representations of UWT campus buildings. After that, d) further information is gathered, via ground truth, to add towards the campus map.

RESULTS

Table 1: Building Heights (feet)

Building	Extracted Values	Zonal Statistics	Final Height
(1) Dougan	39.2	25.2	25.2
(2) Tacoma Paper & Stationery	59.5	49.3	49.3
(3) Joy	44.3	36.9	36.9
(4) West Coast Grocery	70.2	63.1	63.1
(5) Birmingham Hay & Seed	46.8	30	30
(6) Garretson Woodruff & Pratt	65.5	64.9	64.9
(7) Keystone	44.2	37.6	37.6
(8) Snoqualmie	12.2	25.7	25.7
(9) Tioga	32.6	37.5	37.5
(10) Walsh Gardner	49.8	36.7	36.7
(11) William Philips Hall	46.0	37.2	37.2
(12) Cherry Parkes	52.4	51.3	51.3
(13) McDonald Smith	54.8	51.2	51.2
(14) Harmon Brewery	108	96.3	96.3
(15) School of the Arts	31.2	28.3	28.3
(16) The Rock Pizza	15.1	13.4	13.4
(17) Buzzards	39.6	35.0	35.0
(18) Swiss Complex	42.2	39.2	39.2
(19) Pinkerton	17.5	25.2	25.2
(20) Carlton Center	67.6	63.8	63.8
(21) Gary E. Milgard Family Office	30.6	23.8	23.8
(22) Mattress Factory	51.5	44.3	44.3
(23) Science	54.9	45.8	45.8
(24) Birmingham Block	46.8	30	26.9
(25) Zeek's Pizza	0	0	20
(26) Court 17	0	0	100
(27) University Y Student Center	0	0	80
(28) Pinkerton Turnaround	0	0	12
(29) Laborer's Hall	0	0	15
(30) The Whitney	0	0	30
(31) Academic Innovation	0	0	80

Figure 3: UWT Campus Map

The two methods used for Part I analysis, netted different results for building heights (Table 1). Something of interest is the range between values for certain buildings; Birmingham Hay & Seed, Dougan, and Snoqualmie have the greatest ranges of values, respectively being 16.8, 14, and 13.5 feet. Buildings with the shortest ranges (3 feet or less) include: Garretson Woodruff & Pratt, Cherry Parkes, School of the Arts, The Rock Pizza and Swiss Complex. Part I analysis used UWT BLDG Footprints (Figure 4). Ground truthing resulted in a more updated campus footprints image (Figure 5.) and a new column for updated height values (Table 1) for part II analysis. Zeek's Pizza, Court 17, University Y Student Center, Pinkerton Turnaround, Laborer's Hall, The Whitney, and the Academic Innovation Building were newly added to the campus map.

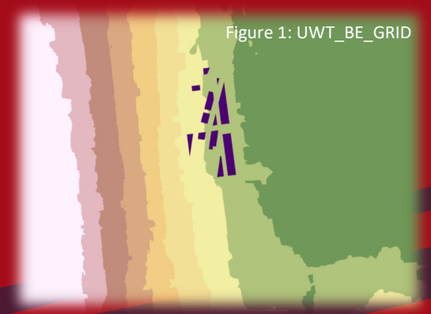

Figure 1: UWT_BE_GRID

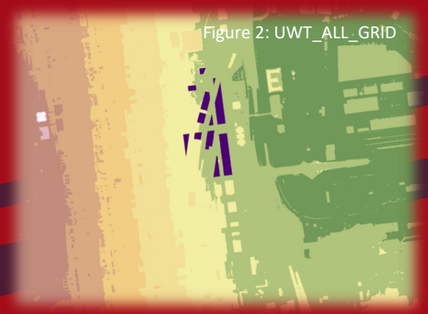

Figure 2: UWT_ALL_GRID

Figure 4: UWT BLDG Footprints

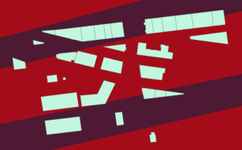

Figure 5: Updated Campus Footprints

METHODS

This analysis comes in two parts. **Part I:** This part of the analysis uses two types of LiDAR data. "AllReturns" represents all points created and placed in the LiDAR point cloud. "Bare Earth" (BE) represents LiDAR points on the ground surface, removing the vegetation and forestry. After adding XY Data for each LiDAR table and interpolating each using IDW, (Figure 1 & 2) this results in the creation of two raster images with cells values based on averaged sample data values.

After using zonal statistics and extract values to points, with the raster images serving as input for each, one can then ascertain building heights (subtracting results from All Returns with BE). Zonal statistics as table "summarizes the values of a raster within the zones of another dataset" while extract values to points "extracts the cell values of a raster based on a set of point features and records them". These are different approaches to ascertaining building heights, with the key difference being the zonal statistics values used in the calculations are averages.

Part II: Given the fact the Part I building data was incomplete, it is contingent one ground truths and a) determine the heights of buildings relative to the ones around it, and b) split or create new building footprints to produce a more accurate campus map. This involves using a set of higher resolution orthophotos as guides, utilizing ArcMap's draw features to digitize footprints, and updating values to the building attribute table.

DISCUSSION AND CONCLUSION

This project aimed to a) perform spatial analysis to ascertain the elevation of both the building roofs/peaks and the ground they are on, b) compare use of the analysis's primary tools: zonal statistics and extract values to points, and c) create 3D representations of UWT campus buildings, and d) gather further information, via ground truth, to add towards the campus map. It cannot be stressed enough that the campus map served as a model that reflects empirical reality. UWT may constantly experience urban development, and thus, there may come a point where this campus map becomes less accurate. The more users and cartographers ground truth these models, and make adjustments to them, the more useful and relevant they become.

References/Resources • **Name:** Kevin Tran • **Date Created:** 4/29/2019 • **Software Used:** ArcMap 10.6.1, ArcScene, and Publisher • **Geographic Coordinate System:** GCS North American 1983 HARN • **Projected Coordinate System:** NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet • **Data:** University of Washington Tacoma, LiDAR, Lab 7 Data

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