Lab 3: Exploratory LiDAR Applications

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Deliverables

The single most important aspect of this research is to display ecological changes to a rapid and dynamic moving riverbed. Visualizing these changes over a span of significant time suggests that it would offer ease in delivering truly eye-opening data. Therefore, my choice was to go with something that is in constant flux, such as a volcano, glacier, or major inlet.

Since this is close to home and offers insight to my community, I chose the Carbon River, just northwest of Carbon Glacier, the lowest elevation glacier in the contiguous US at around 3500 feet. Carbon Glacier, specifically near the trail head (N 46° 56.744 W 121° 47.441) to reach it's vaulted suspension bridge, is known for rapid rivers and long hikes.

My recollection of taking a hike in my early teen years to a suspension bridge with a view of the lowest glacier in the contiguous US is the inspiration. It was originally about 2-4 hours round trip by foot from parking lot. Then I returned in my early twenties after finding out that the roadway had washed out (mid to late 2000s). The new route to reach the bridge is now further and takes about 9 hours round trip to hike.

My initial intent was assessing changes to the land closer to the glacier, but this area provided the best overlapping data among the three years that was able to find for digital elevation models and digital terrain models; 2001, 2007 and 2011.

The following data was pulled from several sources:

- Article : De Rose, R. C., & Basher, L. R. (2011). Measurement of riverbank and cliff erosion from sequential LIDAR and historical aerial photography. Geomorphology, 126(1-2), 132-147.
- Overhead Images from Google Earth. (1994, 2003, 2006, 2012, 2014, 2018).
- 2007 & 2011 DTMs from Department of Natural Resources (DNR)

- [2001 DEMs]()
- [River thalweg]()
- [2018 Flood Evaluation Data]()

I do have some concerns about the accuracy and resolution of the data. It seems as if lidar is very subjective in a situation as rapidly changing as river flow, especially in a region where there are so many different elements to take into consideration such as the melt and land cover from new snow. After looking at a series of satellite images and comparing it to the few pieces I was able to collect, it really is hard to gather exact details based on lidar alone. I'm not even sure what time of year the lidar was collected, despite the metadata report for 2011 being December and the metadata report for 2007 being March 25, 2009.

The 2001 data is least accurate, probably due to data collection limitations. However, there is an apparent change between the five year span from 2007 to 2011. These changes exemplify our improvements in lidar collection techniques and technology allowing us to gather further detail and/or there is truly an ecological change occurring, but there are far too dramatic changes for us to dictate without collecting more data. It certainly makes me wonder what kind of impact these rapid changes have on the local ecology.

Since this is a very mountainous region, any rapid changes shown could be due to weather patterns during the time of the imagery collection. Feeling the need to compare apples with apples, I included satellite imagery of the area specifically for the months of July-September, which typically tend to be the hottest months of the region, between 1994 and 2018.

I began by reading through the suggested article *Measurement of River Bank and Cliff Erosion from Sequential LIDAR and Historical Aerial Photography*. In their third figure they lay out four different overhead images side-by-side (pg 135). Two sets are old Lidar DEMs and the other two are newer examples of orthophotography. This was my inspiration for placing three sets of Lidar DEMs (2001, 2007, 2011) on a single page and displaying flood plain data with river bank data. My intent is to show the rapid advancement of lidar technology over the span of 10 years. So, the figure the article shows for determining this change is from how they calculate across-valley widths (page 134). I utilized a similar scenario in my display of the 2007 Hillshade in *Figure 1* below. Additionally, I show figures of Google Earth overheads, as previously mentioned.

Notice that the riverbed streams change regularly and there is both significantly noticeable erosion and accretion, but not in the areas you would expect based on the how the hillshades display the data.

Lidar & Quantitative Data

Below is a small breakdown of each across-valley width based on the river thalweg and distances from the estimated riverbanks in 2007 and 2011 as seen in *Figure 1*. This data provides an average erosion of nearly *60m over the 5 year span* or *approximately 5m per year*.

Segment	**Segment from thalweg to 2011 riverbank (m)**	**Segment from thalweg to 2011 riverbank**	**Approximate Erosion**
Q	194	84.04	110.04
R	144.91	58.27	86.64
S	156.24	111.17	45.07
T	186.21	143.21	43.00
U	127.42	53.81	73.61
V	102.43	63.08	39.35
W	125.09	67.01	58.08
X	154.60	95.96	58.64
Y	177.53	130.58	46.95
Z	187.02	152.24	34.78
Average			**59.613m**

Carbon River Lidar Analysis

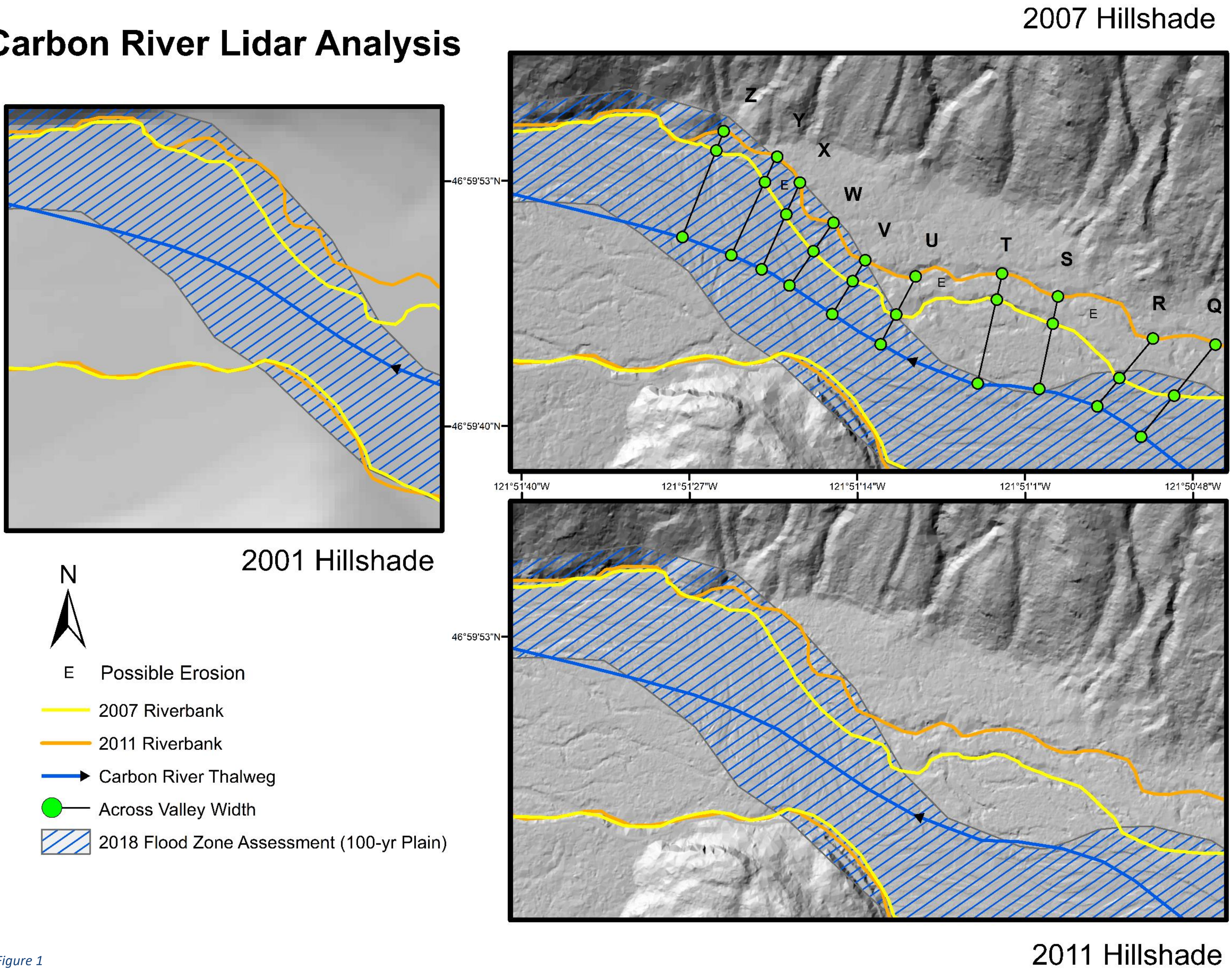

Figure 1

Satellite Imagery

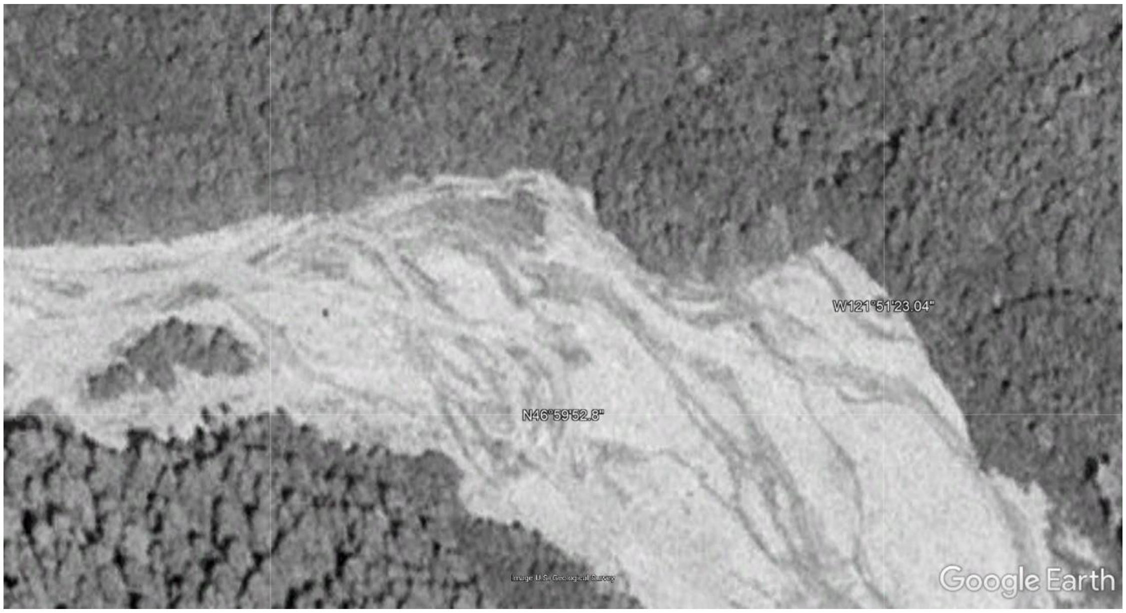

Figure 2. Image Taken: July 18, 1994

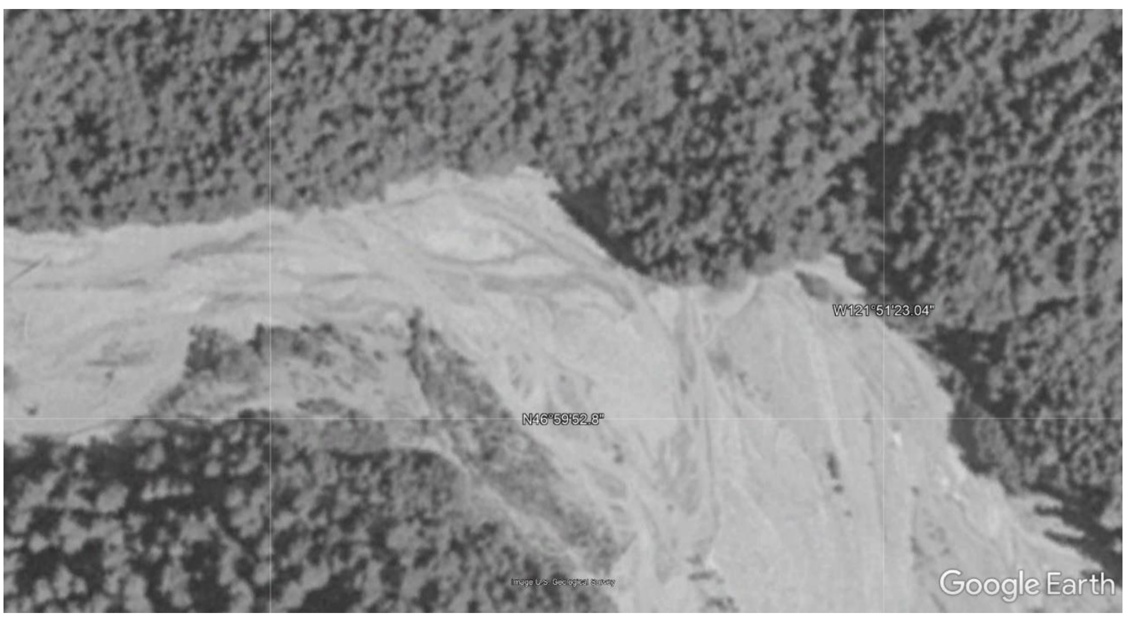

Figure 3. Image Taken: July 21, 2003

Figure 4. Image Taken: June, 30 2006

Figure 5. Image Taken: August 14, 2012

Figure 6. Image Taken: July 15, 2014

Figure 7. Image Taken: July 25, 2018