Vegetation Penetration - Comparisons between the 2016 and 2018 Puerto Rico Lidar data.

Flight Parameters

2016 data:
Riegl Q680i and Q780i
Altitude: 800 - 1100m
Overlap: 50-55%
Average density 6 ppsm (reqd: QL2 2 ppsm)

2018-19 collect:
Riegl VQ1560i
Altitude: ~1000 m
Overlap: 20%
Average density 9 ppsm (reqd: QL1 8 ppsm)

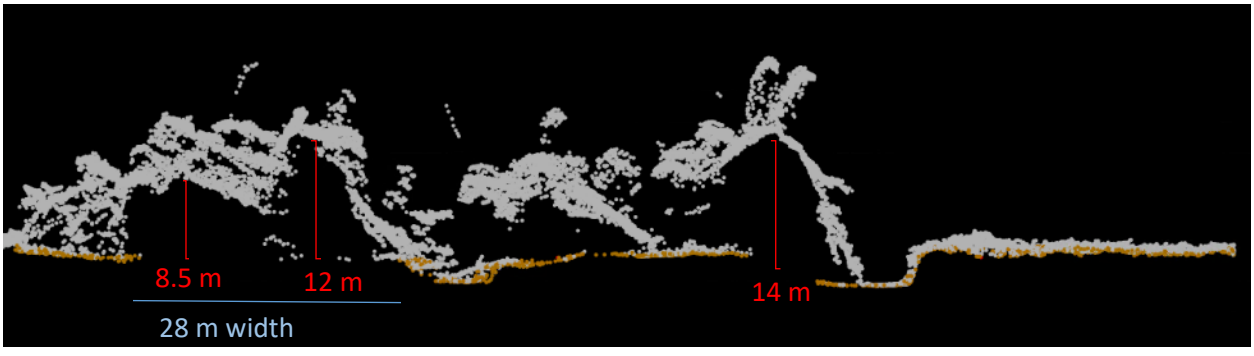
Lidar profile and DEM images are labeled as current (2018 PR) or previous (2016 PR). Dates are provided for each Google Earth image.

Lidar profiles show ground points in orange and unclassified as grey. Width of profile is provided for each profile.

There has been a complete change in canopy/vegetation structure. The Google Earth imagery shows pre-hurricane vegetation where vegetation is upright and "normal" looking. Post-hurricane imagery where trees are knocked over, foliage is less, and often trunks/branchs, and streams edges are now visible where they were not previously. Note that we did not collect lidar data immediately after the storm so this set of Google Earth imagery do not have any corresponding lidar data. And then usually between 10/2017 and 11/2017 as seen in the 3rd set of Google Earth images just prior to our lidar data collection, there is an explosion of new growth, either some of the fallen trees are still alive or there is new growth on top of the piles or both.

EXAMPLE 1: Tile 19QGA29504050

Location where vegetation has significantly changed causing few to now points reaching the ground.



Dewberry

Figure 1: Cross Section from the 2018 LiDAR collection showing vegetative structures and respective heights. The profile width is 1.7 meters.

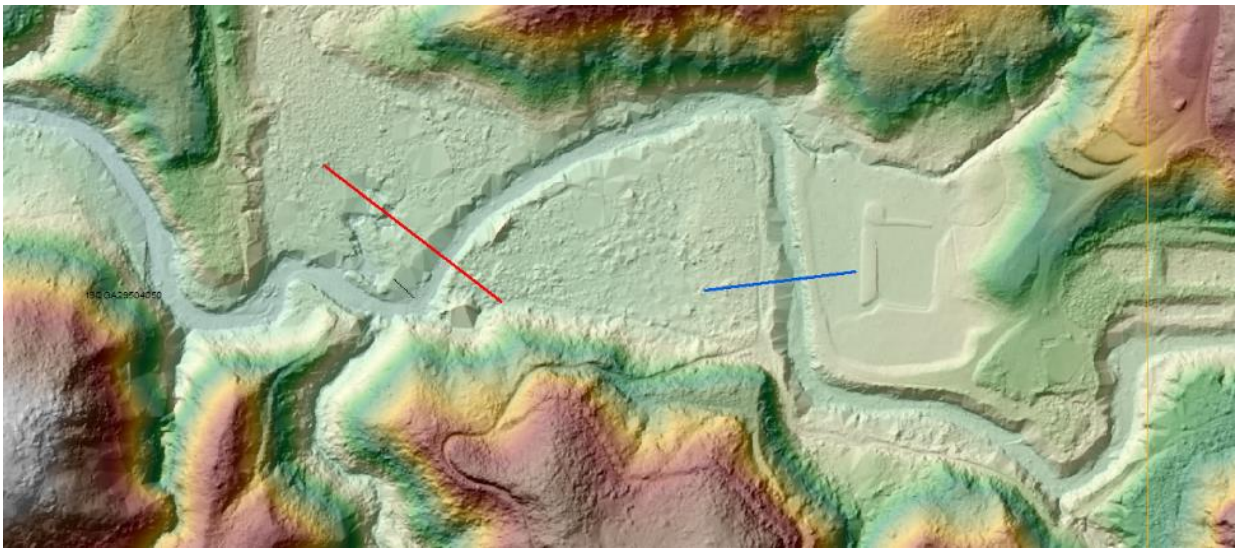


Figure 2: DEM and Hillshade from 2018 LiDAR collection. The red profile is for this example.

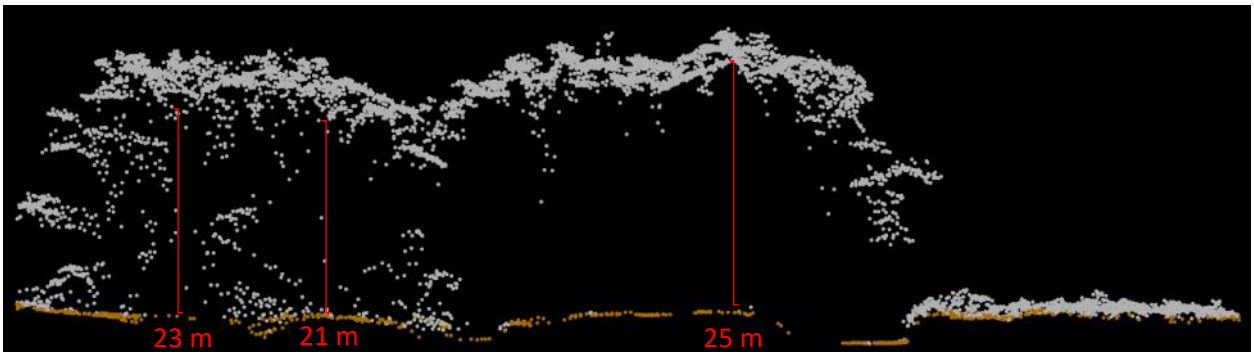


Figure 3: Cross Section from the 2016 LiDAR collection showing vegetative structures and respective heights. The profile width is 1.7 meters. This graphic is to illustrate the substantial differences between the two dataset.

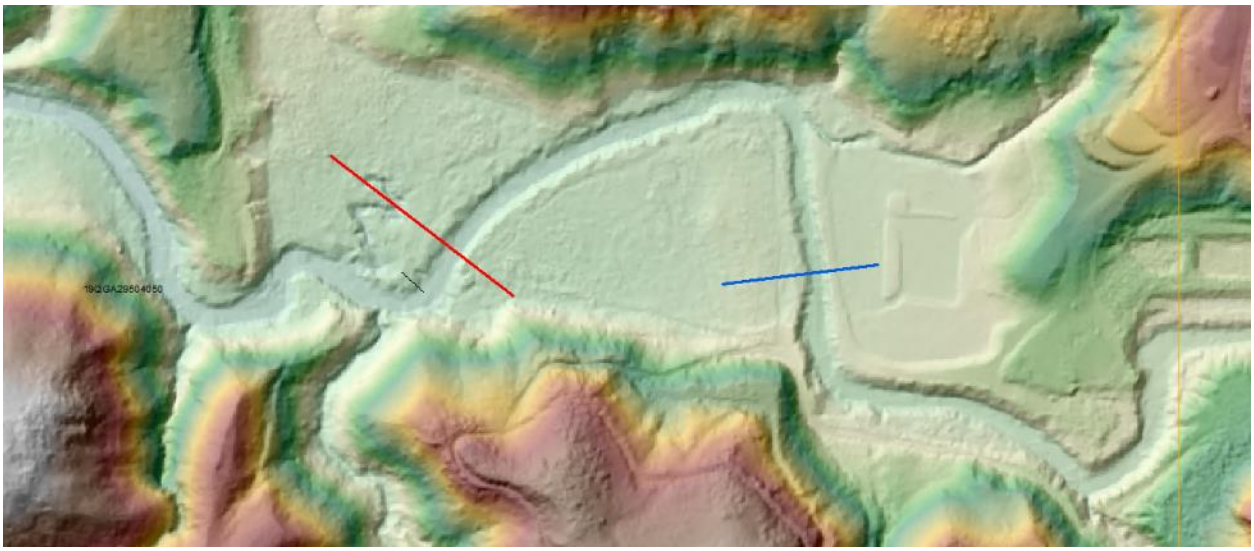


Figure 4: DEM and Hillshade from 2016 LiDAR collection. The red profile is for this example. Fewer areas of triangulation caused by voids are visible in the 2016 DEM.

EXAMPLE 2: Tile 19QGA29504050

Location where vegetation has significantly changed causing few to now points reaching the ground.

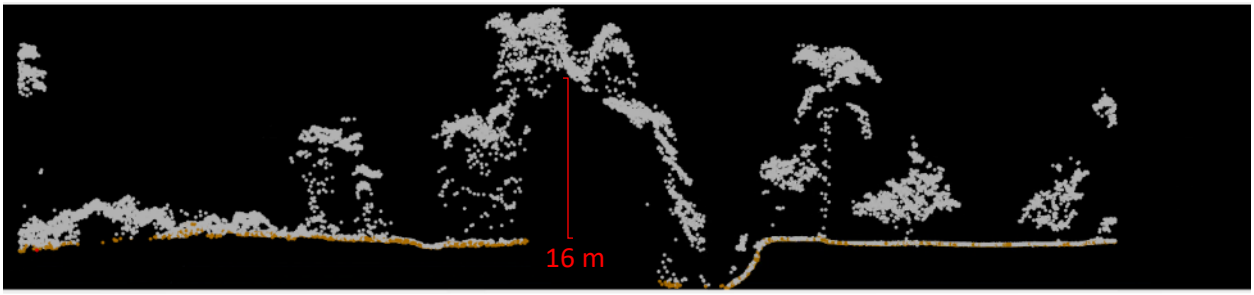


Figure 5: Cross Section from the 2018 LiDAR collection showing vegetative structures and respective heights. The profile width is 3.2 meters.

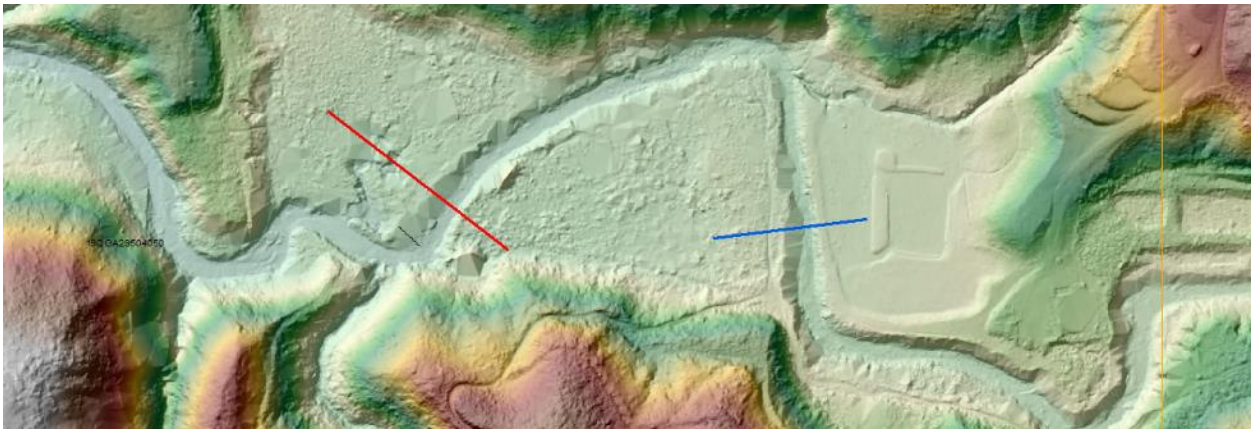


Figure 6: DEM and Hillshade from 2018 LiDAR collection. The blue profile is for this example.

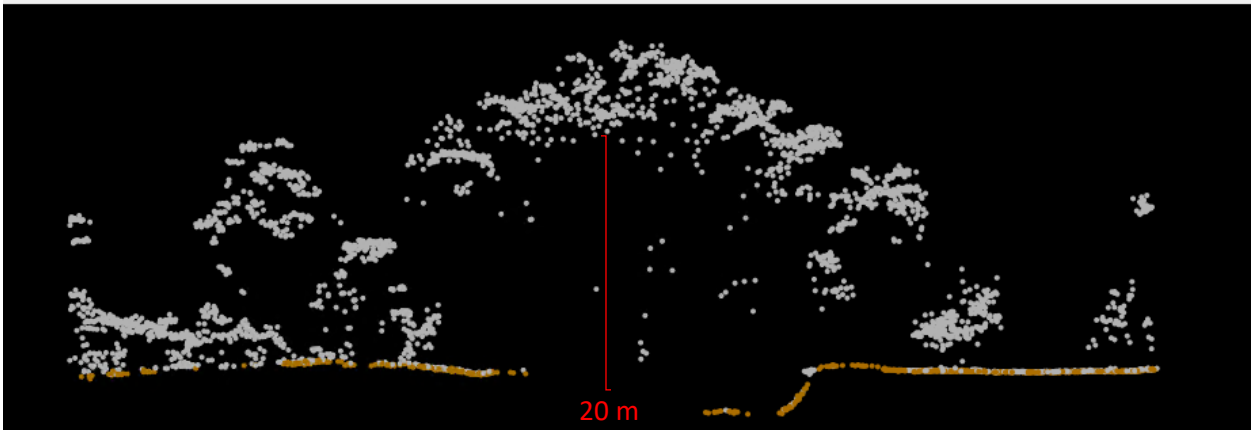


Figure 7: Cross Section from the 2016 LiDAR collection showing vegetative structures and respective heights. The profile width is 3.2 meters. This figure illustrates the substantial change in the makeup of the vegetation. A clear tree is visible in 2016 that spans the depression. The 2018 image (Figure 5) shows a very different vegetative structure. In both examples the palm tree to the right is visible and with significantly more detail in 2018.

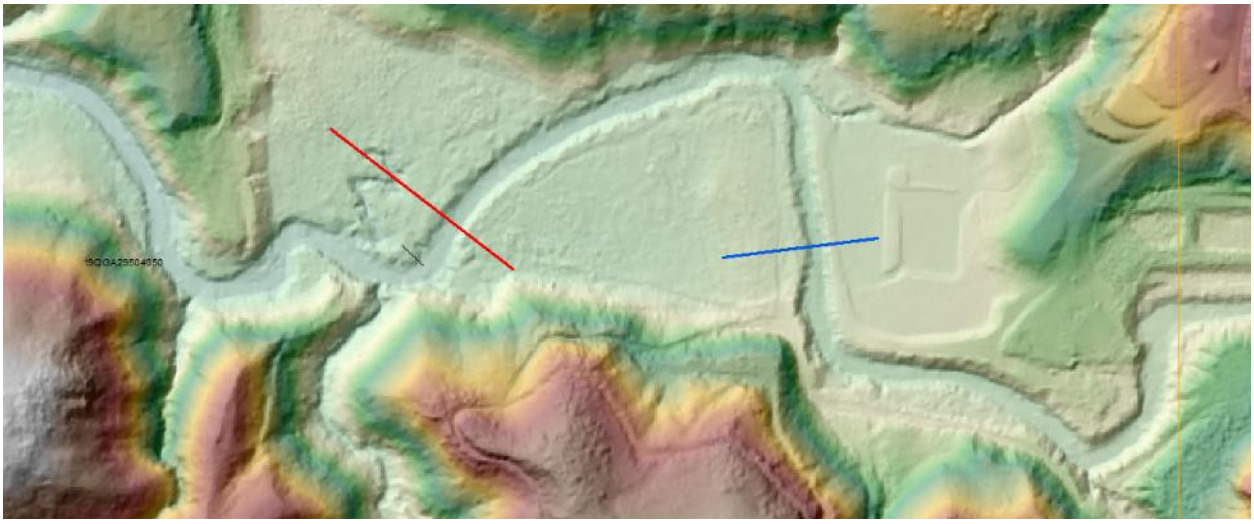


Figure 8: DEM and Hillshade from 2016 LiDAR collection. The blue profile is for this example. Voids areas are less visible in the 2016 dataset.

Figure 9: Imagery from February 2017 shows the pre event vegetative conditions similar to how they were during the 2016 collection.

Figure 10: Imagery from early October 2017 shows the post event vegetative conditions with minimal growth and many trees being knocked over.

Figure 11: Imagery from later in the year or early 2018 shows the post event vegetative conditions with significant regrowth of the vegetation and what appear to be fairly dense areas growing up around or on fallen trees.

EXAMPLE 3: Tile 19QGA29504050

Location where vegetation has significantly changed causing few to now points reaching the ground.

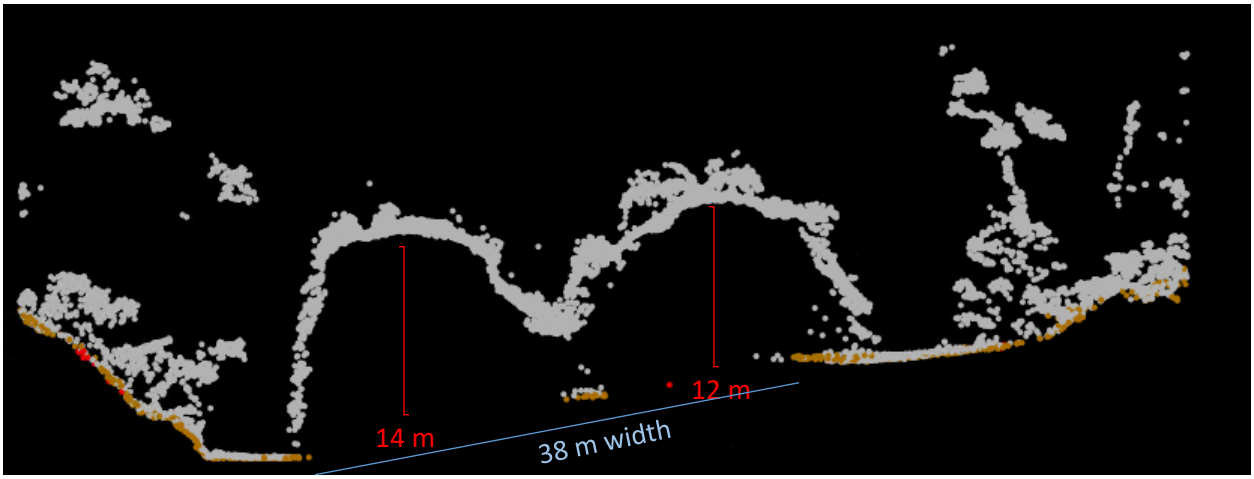


Figure 12: Cross Section from the 2018 LiDAR collection showing vegetative structures and respective heights. The profile width is 3 meters.

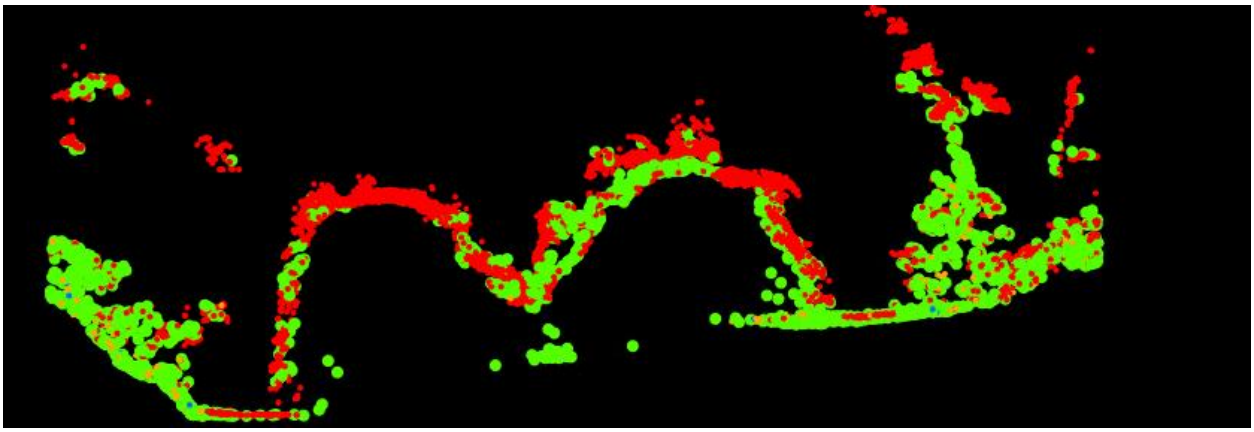


Figure 13: Cross section from 2018 displayed by return. Red points are first returns and green represent points other than 1st return. The majority are 2nd return points with some being 3rd, 4th, or 5th.

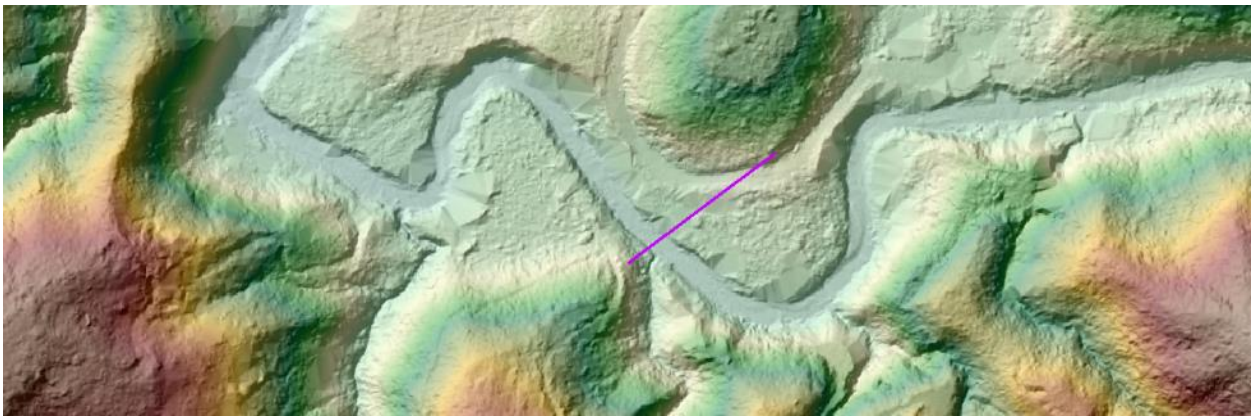


Figure 14: DEM and Hillshade from 2018 LiDAR collection. The purple profile is for this example.

Figure 15: Cross Section from the 2016 LiDAR collection showing vegetative structures and respective heights. The profile width is 3 meters.

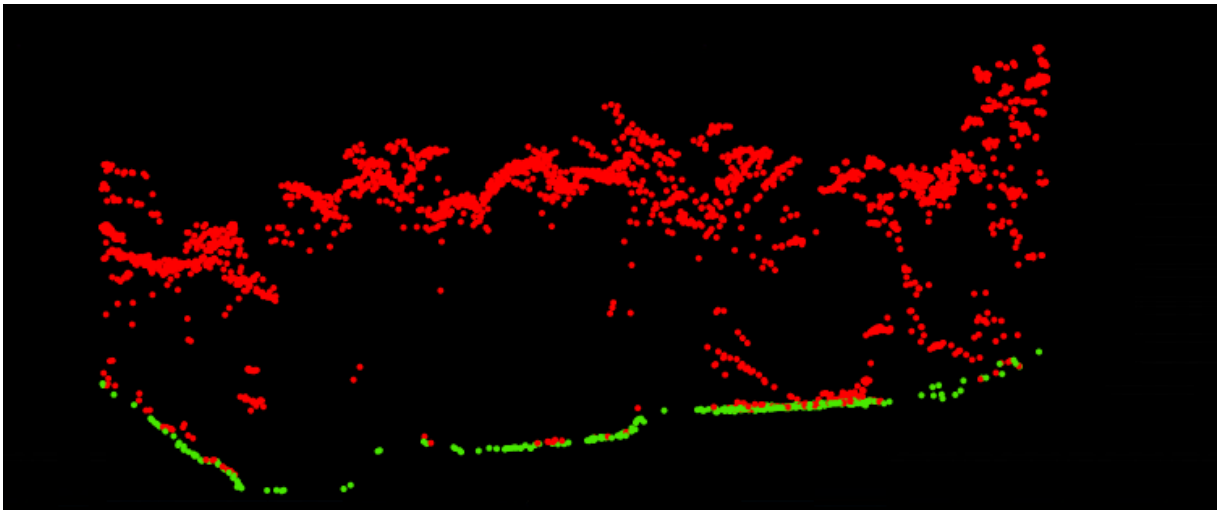


Figure 16: Cross section from 2016 displayed by return. Red points are first returns and green represent points other than 1st return. The majority are 2nd return points with some being 3rd, 4th, or 5th.

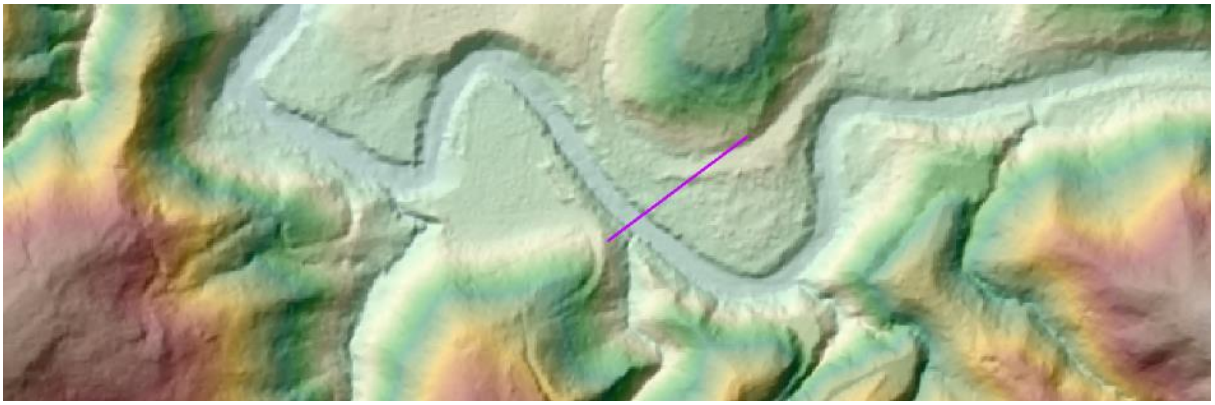


Figure 17: DEM and Hillshade from 2016 LiDAR collection. The purple profile is for this example. Voids areas are less visible in the 2016 dataset.

Figure 18: Imagery from February 2017 shows the pre event vegetative conditions similar to how they were during the 2016 collection.

Figure 19: Imagery from early October 2017 shows the post event vegetative conditions with minimal growth and many trees being knocked over.

Figure 20: Imagery from later in the year or early 2018 shows the post event vegetative conditions with significant regrowth of the vegetation and what appear to be fairly dense areas growing up around or on fallen trees.

EXAMPLE 4: Tile 19QFA23503900

Example where the vegetation has substantial change and it is possible that some has formed dense debris piles or altered the ground. It's difficult in many of these types of areas to differentiate the ground from potential vegetation because of the lack of ground points.

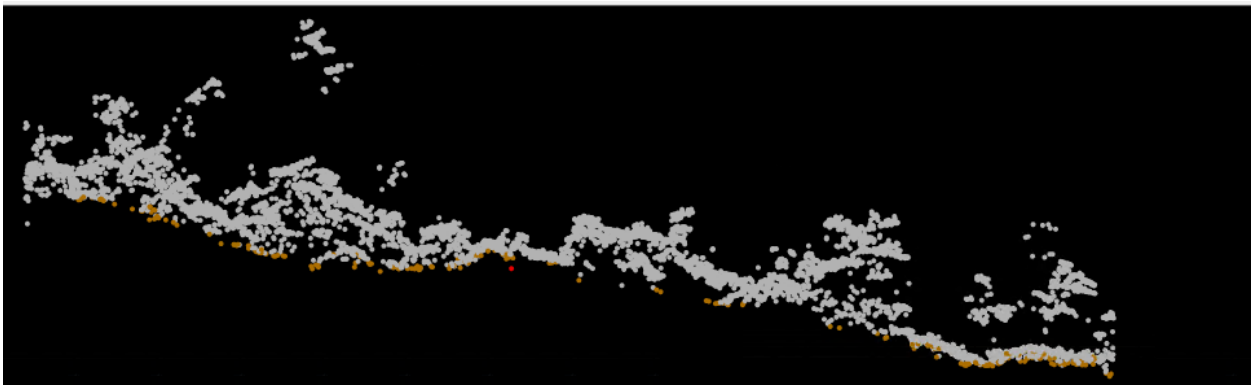


Figure 21: Cross Section from the 2018 LiDAR collection showing vegetative structures and respective heights. The profile width is 3 meters.

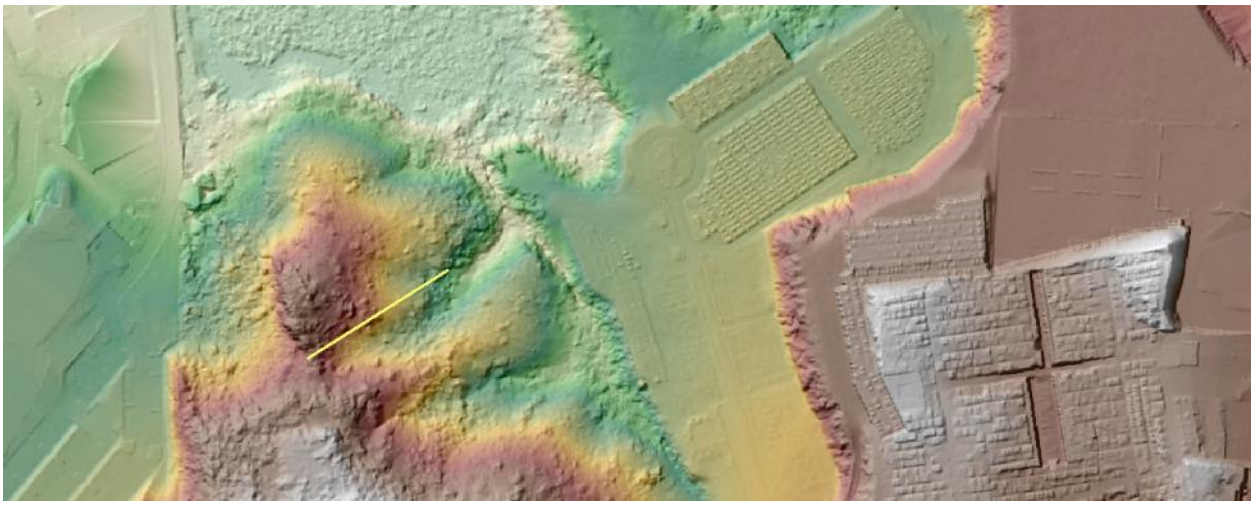


Figure 22: DEM and Hillshade from 2018 LiDAR collection. The yellow profile is for this example.

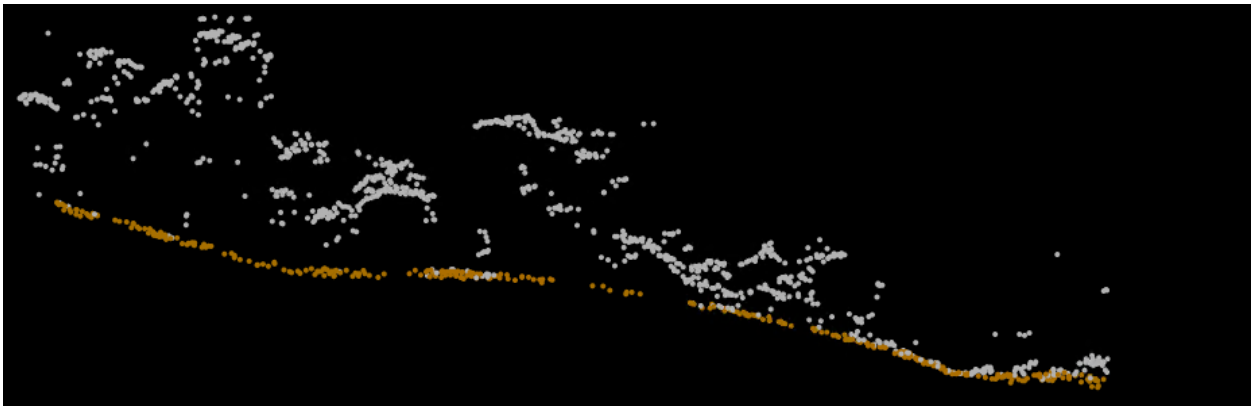


Figure 23: Cross Section from the 2016 LiDAR collection showing vegetation has changed substantially. The profile width is 3 meters.

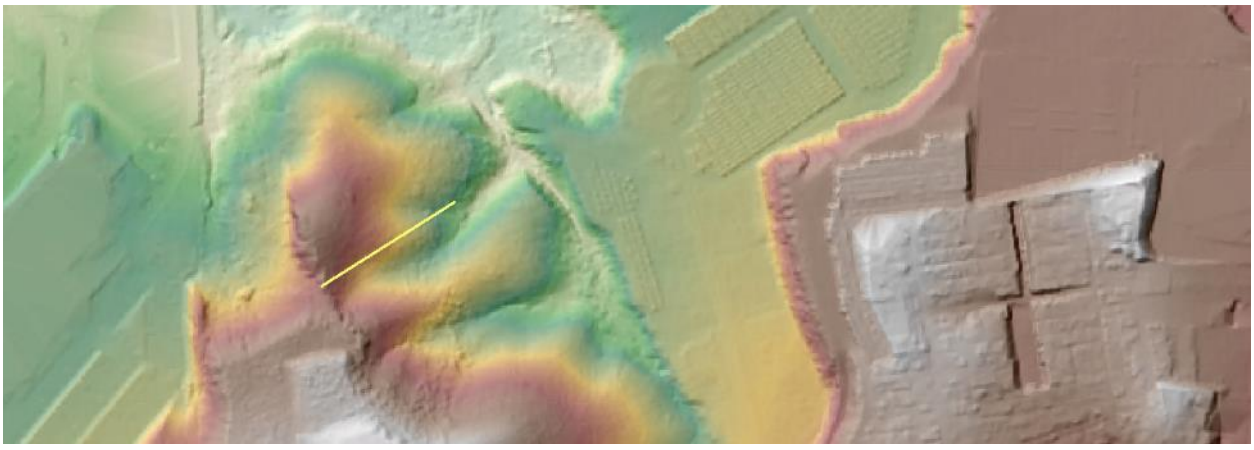


Figure 24: DEM and Hillshade from 2016 LiDAR collection. The yellow profile is for this example. The 2016 data appears much more regular with a well-defined smooth surface when compared to the 2018 dataset.

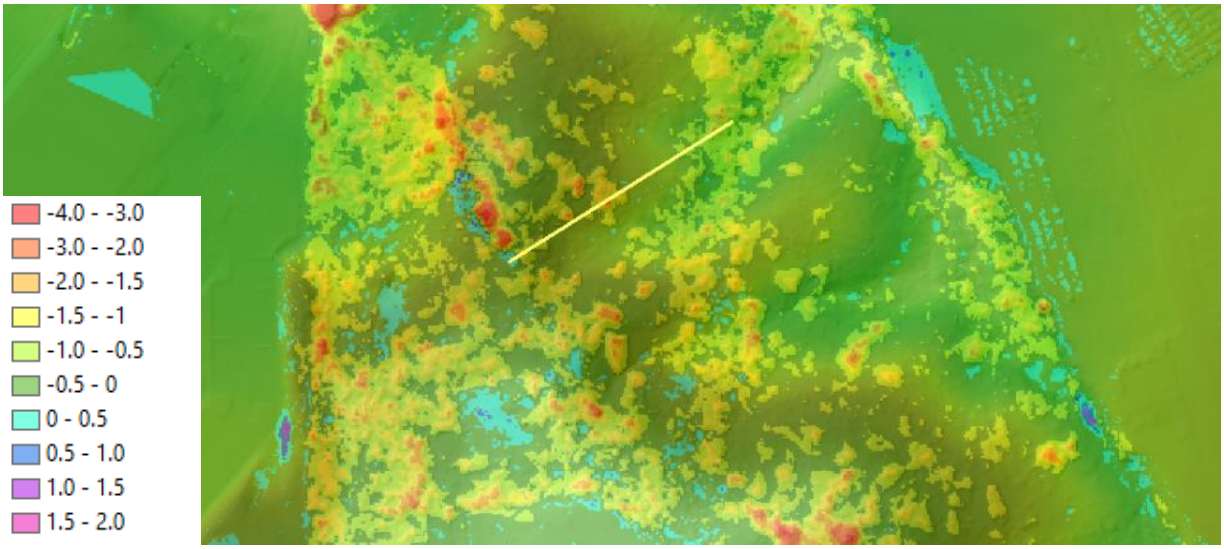


Figure 25: Difference raster showing changes in the ground surface between the 2016 and 2018 datasets. While the average change in this area is approximately 35 centimeters there are specific areas with elevation differences in the 2-3.5 meter range. The majority is where the 2018 data is above the 2016 data which may represent areas of vegetation or debris.

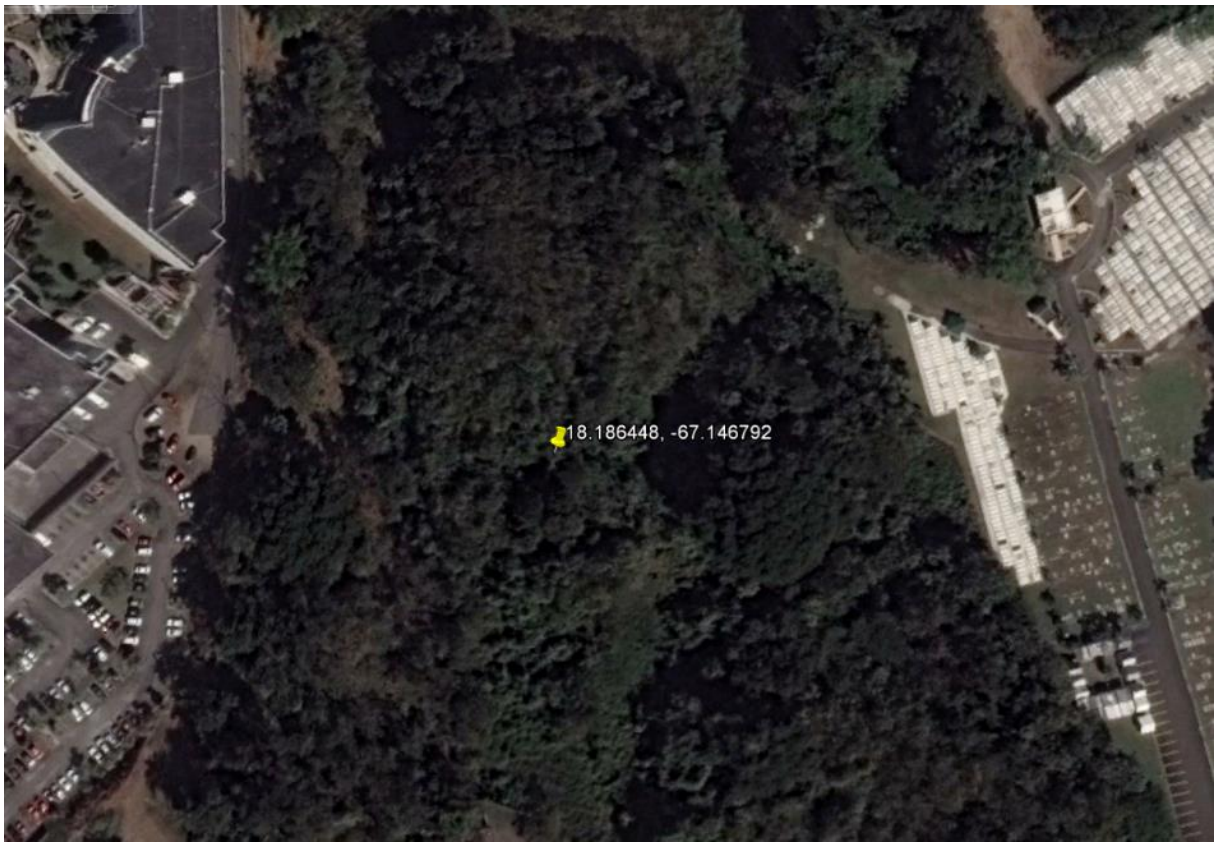


Figure 26: Imagery from February 2017 shows the pre event vegetative conditions similar to how they were during the 2016 collection.

Figure 27: Imagery from early October 2017 shows the post event vegetative conditions with minimal growth and many trees being knocked over.

Figure 28: Imagery from later in the year or early 2018 shows the post event vegetative conditions with significant regrowth of the vegetation and what appear to be fairly dense areas growing up around or on fallen trees.