

Mapping UNB Walking Paths To Compare Elevation Data Sources

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Overview

- Motivation
- Data Sources Used
- Control Points Used
- Methodology
- Results
- Summary

Motivation

- Various data source available
 - Some Public, Some Private
- How do they compare and which one should be used?

Data Sources

- City Of Fredericton
- GeoNB
- LiDAR
- Google Elevation Application Program Interface (API)

Point Selection

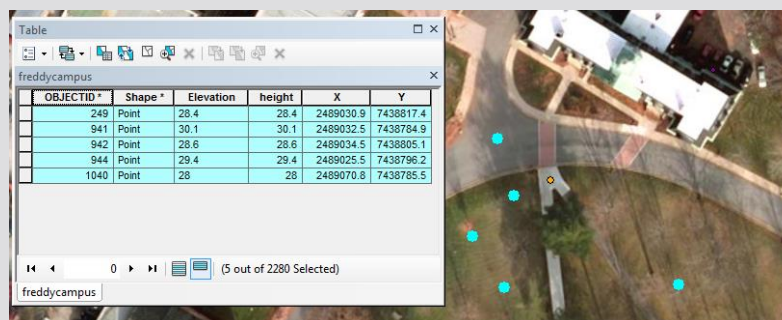


Methodology

- Obtain heights on each point
- Test for Outliers
- Compute Mean Elevations, Standard deviations and Root Mean Square Error (RMS Error)
- Create thematic Maps
- 3D Profiles

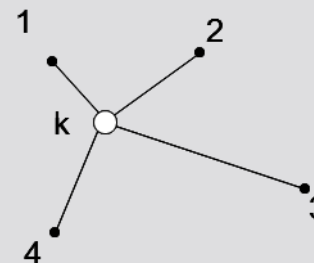
Nearest Point Method (NPM)

- City Of Fredericton
- GeoNB



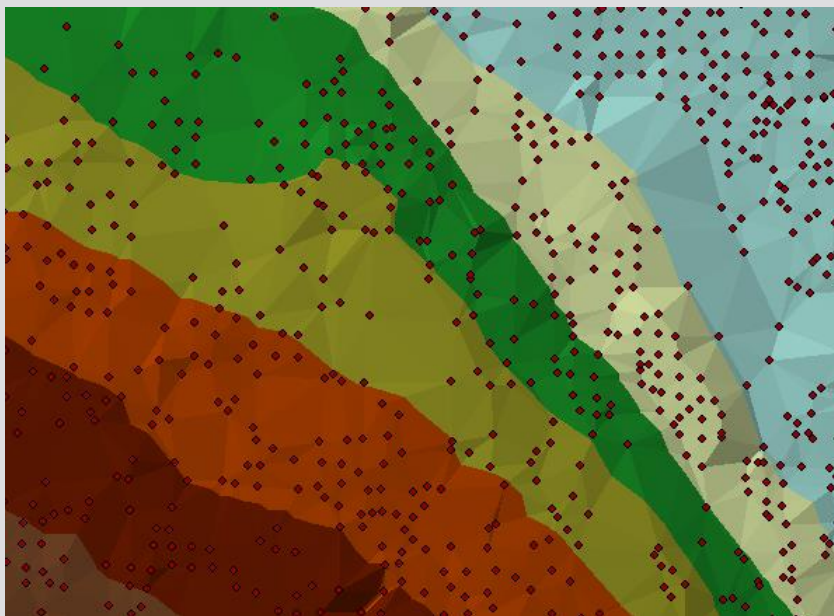
OBJECTID*	Shape*	Elevation	height	X	Y
249	Point	28.4	28.4	2489030.9	7438817.4
941	Point	30.1	30.1	2489032.5	7438784.9
942	Point	28.6	28.6	2489034.5	7438805.1
944	Point	29.4	29.4	2489025.5	7438796.2
1040	Point	28	28	2489070.8	7438785.5

$$Z_k = \frac{\sum_{i=1}^v Z_i / D_{ik}^n}{\sum_{i=1}^v 1 / D_{ik}^n}$$

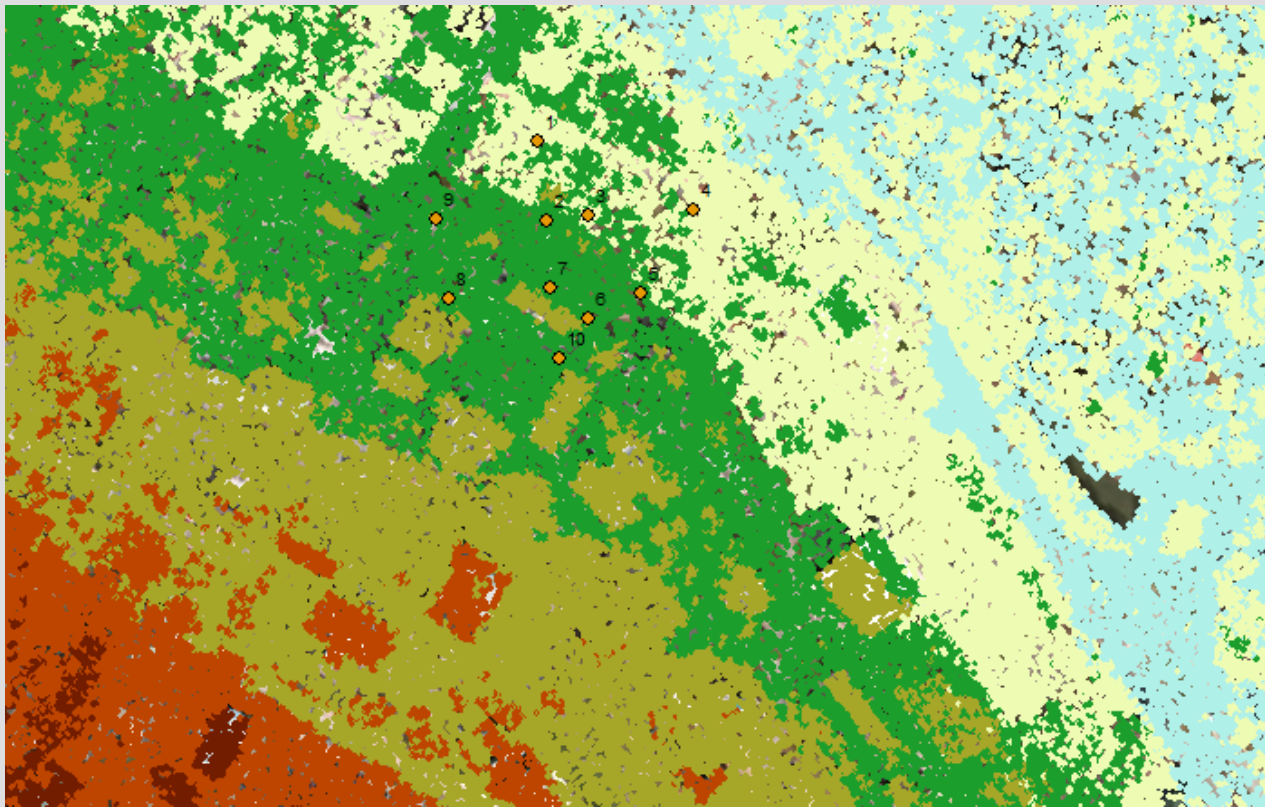


Created TIN


- City Of Fredericton
- GeoNB
- LiDAR



LiDAR



Google Elevation API

 <https://maps.googleapis.com/maps/api/elevation/xml?locations=45.9493730,-66.6413330&key>



```
▼<ElevationResponse>
  <status>OK</status>
  ▼<result>
    ▼<location>
      <lat>45.9493730</lat>
      <lng>-66.6413330</lng>
    </location>
    <elevation>29.4036045</elevation>
    <resolution>38.1758080</resolution>
  </result>
</ElevationResponse>
```

Outliers

- Tau Test – 95% confidence

Point 1		
Number of Observations =	7	
Degrees of Freedom =	6	
t-value =	2.571	
tau =	1.848	
Sample mean =	28.57590	
Sample standard dev. =	0.46848	
Lower limit =	27.77432	
Upper limit =	29.37748	
	Elevation	Test Result
COF TIN	27.8761	Test Passed
COF NPM	28.7232	Test Passed
GeoNB TIN	28.7232	Test Passed
GeoNB NPM	28.5195	Test Passed
Lidar	28.7541	Test Passed
Lidar TIN	28.32	Test Passed
Google API	28.4348	Test Passed

$$Upper\ Limit = Mean + \sqrt{\frac{DOF}{N}} * St.Dev * Tau$$

$$Lower\ Limit = Mean - \sqrt{\frac{DOF}{N}} * St.Dev * Tau$$

Results Data Sources

	COF TIN	COF NPM	GNB TIN	GNB NPM	LiDAR	LiDAR TIN	Google API
1	28.8761	28.7232	28.5195	28.7541	28.32	28.4348	29.4036
2	33.1083	33.5515	33.2783	34.2162	33.485	34.943	32.97262
3	30.2979	30.5012	29.5017	30.1705	30.597	35.4653	30.4036
4	20.1371	20.0213	20.9925	23.1496	19.503	19.6855	19.86456
5	32.5664	32.2232	32.3575	32.8479	32.842	34.0405	30.09544
6	37.9636	38.0551	35.9905	35.4451	38.195	38.7467	35.32412
7	37.7414	37.2708	37.1296	36.5286	38.378	41.9381	36.27948
8	38.2198	37.7441	38.3554	36.9088	38.231	38.8948	39.4109
9	33.1713	33.8357	33.373	34.4064	33.862	36.1045	35.46074
10	38.8607	38.4237	37.9694	38.1792	38.442	38.575	39.48186

RMS Error

	COF TIN	MEAN	DIFF
1	27.8761	28.5759	0.6998
2	33.1083	33.2793	0.171
3	30.2979	30.3942	0.0963
4	20.1371	19.8425	0.2946
5	32.5664	32.5674	0.0010
6	37.9636	37.1030	0.8606
7	37.7414	37.4097	0.3317
8	38.2198	38.2521	0.0323
9	33.1713	34.3164	1.1451
10	38.8607	38.4084	0.4523

$$RMS = \sqrt{\frac{\sum_i^N (DIFF)^2}{N}}$$

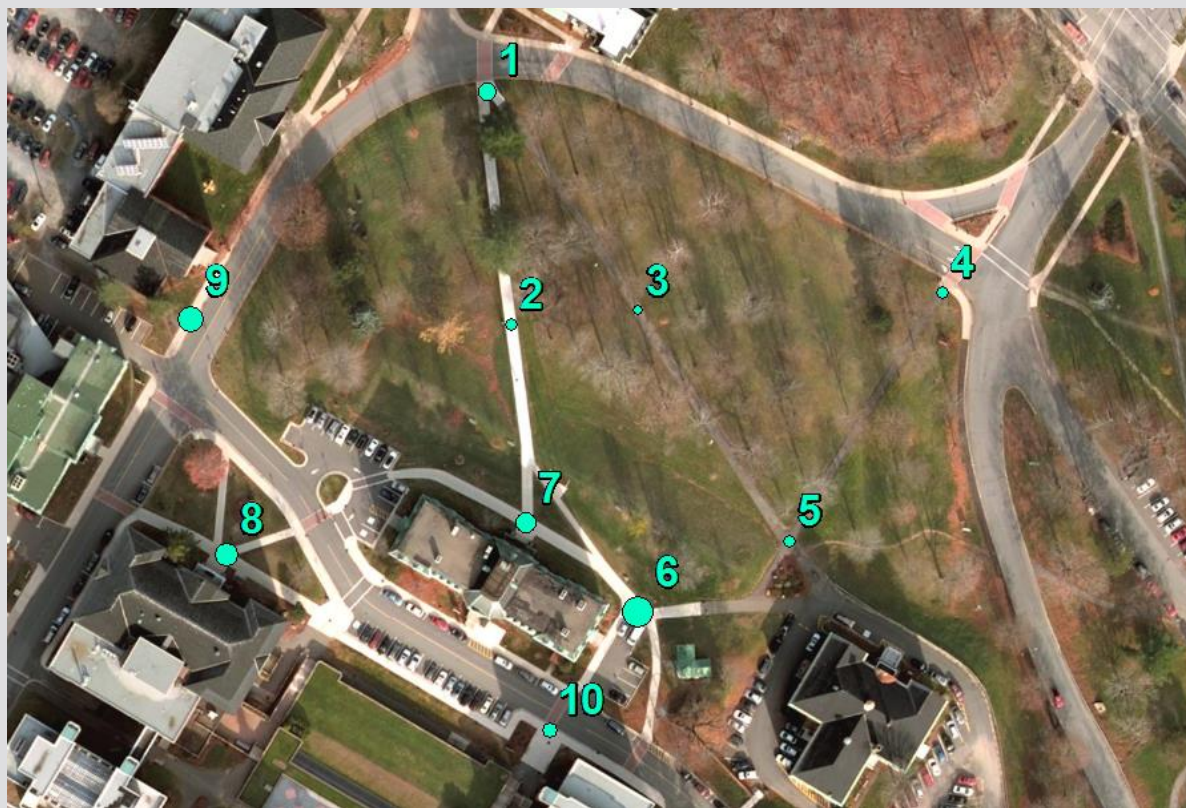
$$RMS = 0.5461$$

Results RMS Error

Data Source	RMS
City of Fredericton NPM	0.4090
City of Fredericton TIN	0.5461
GeoNB NPM	1.3178
GeoNB TIN	0.6765
LiDAR	0.5176
LiDAR TIN	2.3988
Google Maps API	1.2303

Results

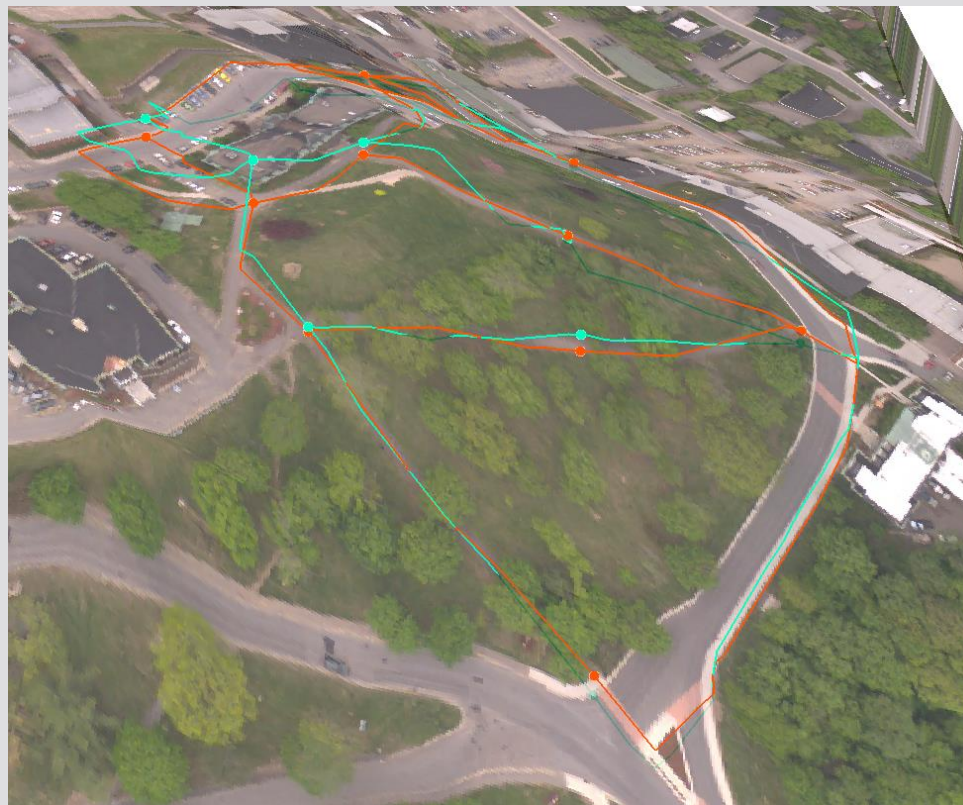
Standard Deviations



Results 3D Profile



Results 3D Profile



LiDAR TIN



Summary

- City of Fredericton Nearest Point Method and LiDAR interpolation were the most consistent
- LiDAR TIN and GeoNB Nearest Point Method were the least consistent
- These results do not apply across the province
- However the same methodology could be applied to determine the ideal data source for a given area

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