Improving Large Area Surface Models Using Remote Sensing Data

William Fernandez

FDOT Photogrammetry Supervisor

William.fernandez@dot.state.fl.us / 850.245.1707

Purpose

For this presentation, readily available USGS surface data will be utilized to augment 3D design surface models of a project area. This is particularly conducive to a Project Development and Environment Study (PD&E Study).

The PD&E Study is part of the FDOT's transportation improvement process that allows projects to be developed from an identified need to a construction project

Why improve the surface

- Be advised that data from an independent source will have to be scrutinized for integrity and may require updating the surface.
- This is where the Surveying & Mapping office may be of assistance.
- The lay of the land is particularly important from a hydrological standpoint.
- Geomorphology and the vertical component are key in depicting the drainage impact upon the project.

Integrating surface models

Gather and collect 3D design data available from in house and consulting services that encompass the immediate project area.

The data may be derived from

- Land Surveys (DTM) Digital Terrain Models
- Photogrammetry (DTM, DEM) Digital Terrain & Elevation Models
- LIDAR - (airborne or mobile) Point Clouds
- Auto-correlation - (RGB-LAS) Point Clouds

Where to acquire USGS surface data.

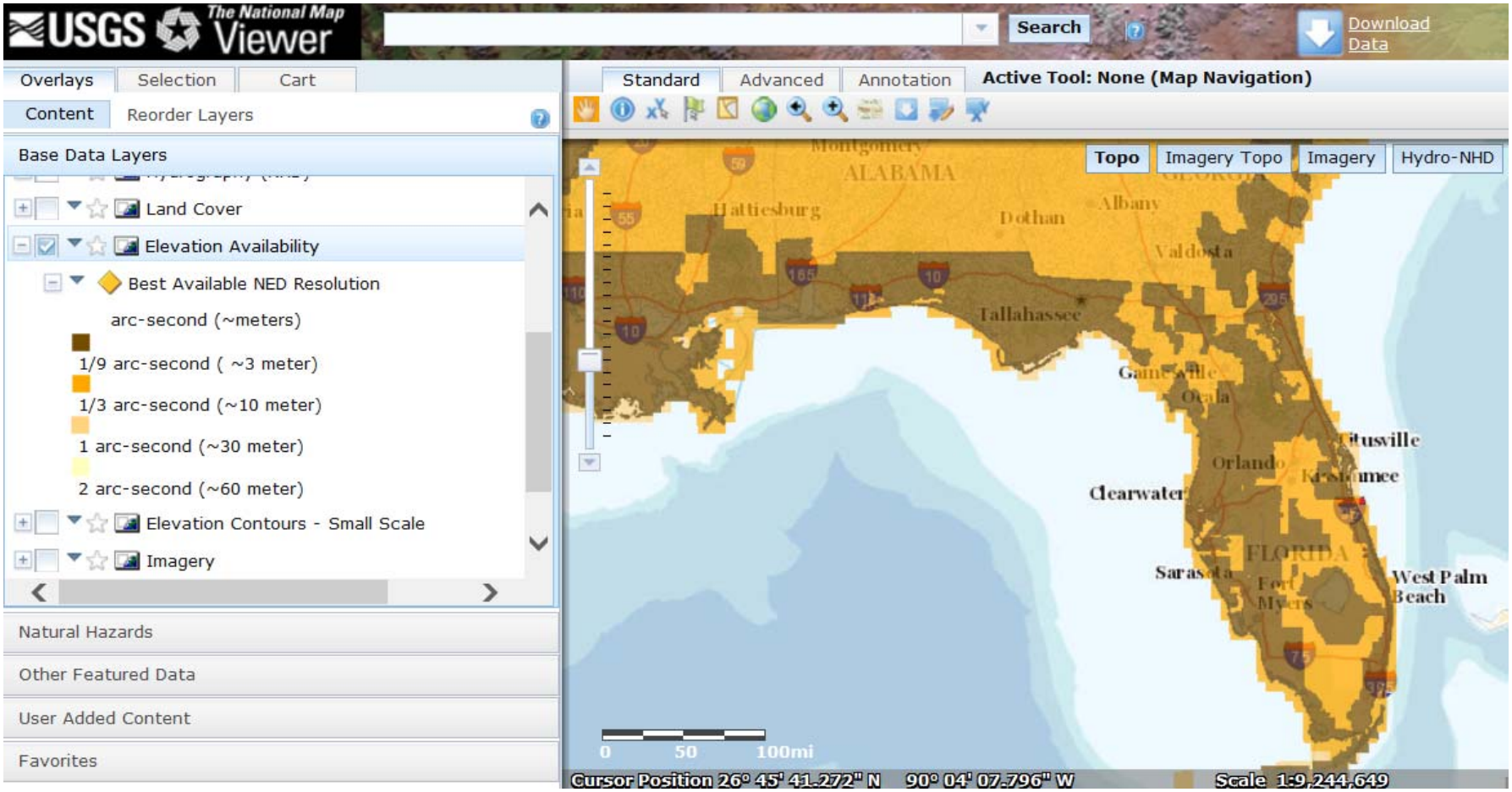
The USGS National Map website is where you can obtain digital elevation data derived from remote sensing systems. Primarily, LIDAR and SRTM data form the elevation GRID.

Most available elevation data for the state of Florida is the 1/9 Arc.

- 1/9 Arc Grid – approximately equal to a 10’ x 10’ GRID
- 1/3 Arc Grid – approximately equal to a 33’ x 33’ GRID

USGS National Map - http://viewer.nationalmap.gov/viewer/

Here you'll find primarily 1/9th and 1/3rd arc data for the State of Florida



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Begin the process of evaluating independent source data

- Perform the NSSDA for a positional accuracy test in the horizontal and vertical component utilizing Survey Control.
- Utilize a DSM (digital surface model) derived from auto-correlation methods where stereo imagery is available.
- Evaluate the metadata – acquisition source and dates, for example.
- Utilize the current 3D surface data for the project.

The NSSDA (National Standard for Spatial Data Accuracy)

The NSSDA was developed with the intent to update the United States Map Accuracy Standards.

It is a common reporting mechanism for users to directly compare datasets for their applications.

- http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3

The NSSDA Vertical Analysis

	A	B	C	D	E	F
1	Vertical Accuracy Comparison of vertical coordinates for Digital Surface ID points in:					
2	FDOT Photographic Designation (PD) Number =			0000		
3	Coordinate DATUM:	xxxx NAD83 / 86/90/99/2007/ CORS / etc.xxxx				
4	Coordinate Units =	xxxxxx US feet or meters xxxx				
5						
6	**NSSDA Vertical Accuracy Statistic Worksheet**					
7			z	z		
8		Point	Ground Check	Digital Surface		
9	Point Name	Point Description	(Independent)	(Test)	Δz	$(\Delta z)^2$
10	D512P001	Photo ID	18.957	19.000	-0.043	0.002
11	D512P002	Photo ID	7.699	7.000	0.699	0.488
12	D512P003	Photo ID	9.026	9.000	0.026	0.001
13	D512P004	Photo ID	9.819	10.000	-0.182	0.033
14	D512P005	Photo ID	4.439	4.000	0.439	0.193
15	D512P006	Photo ID	7.530	7.141	0.389	0.151
16	D512P007	Photo ID	5.271	5.066	0.205	0.042
17	D512P008	Photo ID	5.610	5.070	0.539	0.291
18	D512P009	Photo ID	2.838	3.000	-0.162	0.026
19	**D512P010**	Photo ID	**5.367**	**1.791**	3.576	12.785
20	D512P011	Photo ID	7.554	7.000	0.554	0.307
21	D512P012	Photo ID	5.312	5.299	0.013	0.000
22	D512P013	Photo ID	5.355	5.214	0.141	0.020
23	D512P014	Photo ID	14.823	15.000	-0.177	0.031
24	D512P016	Photo ID	18.323	18.000	0.323	0.104
25	D512P017	Photo ID	15.705	15.063	0.642	0.412
26	D512P018	Photo ID	21.267	21.000	0.267	0.071
27			Total Check Points =	**17**	Sum	14.958
28					Average	0.880
29		Project RMSE Requirement ≤ 4.4 feet		[	RMSE	0.938
30		Horizontal Positional Accuracy in feet at 95% Confidence Level. Project requirement is ≤ 5.06 feet		[	NSSDA	**1.839**

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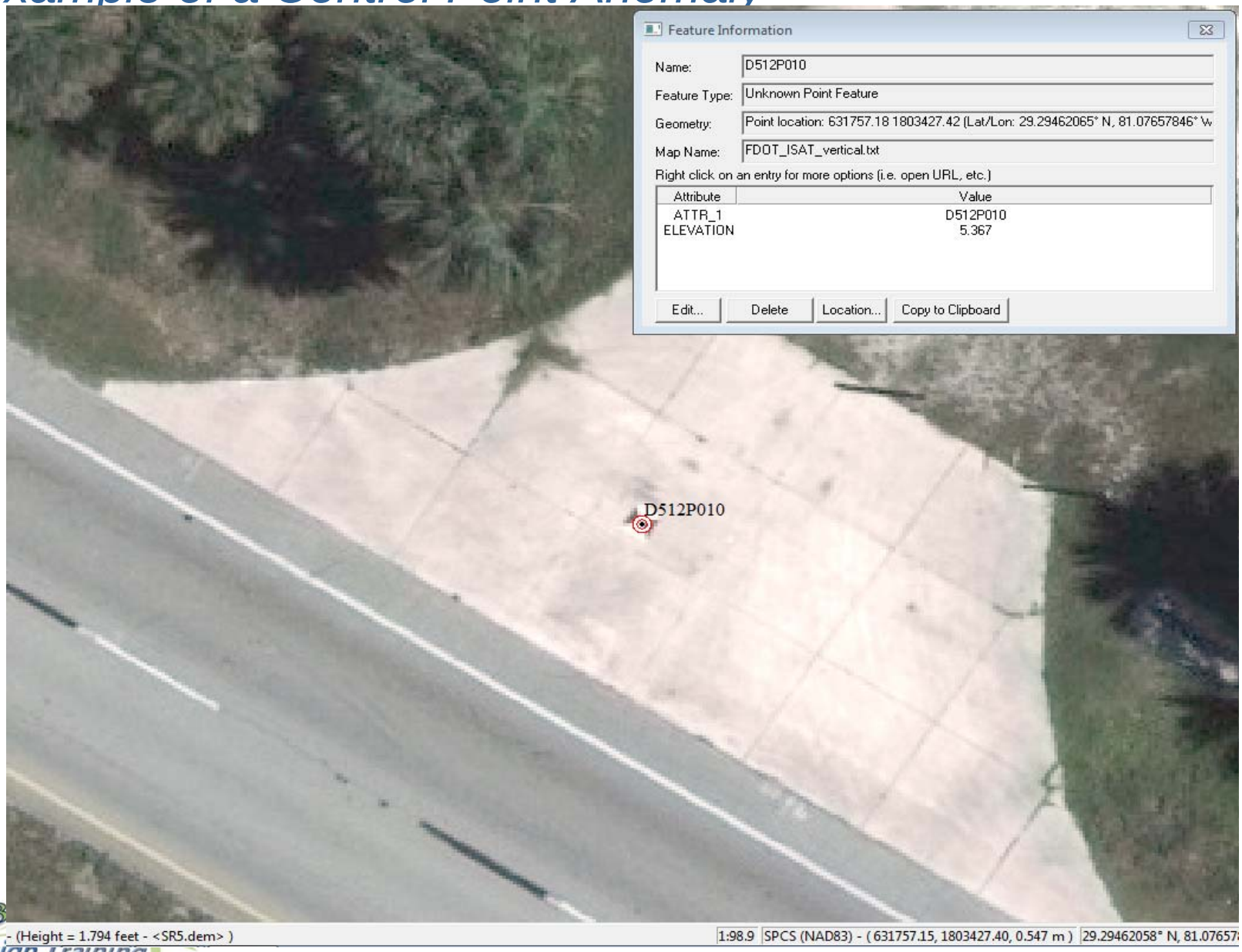
Example of a Control Point Anomaly



Control Point on USGS DEM

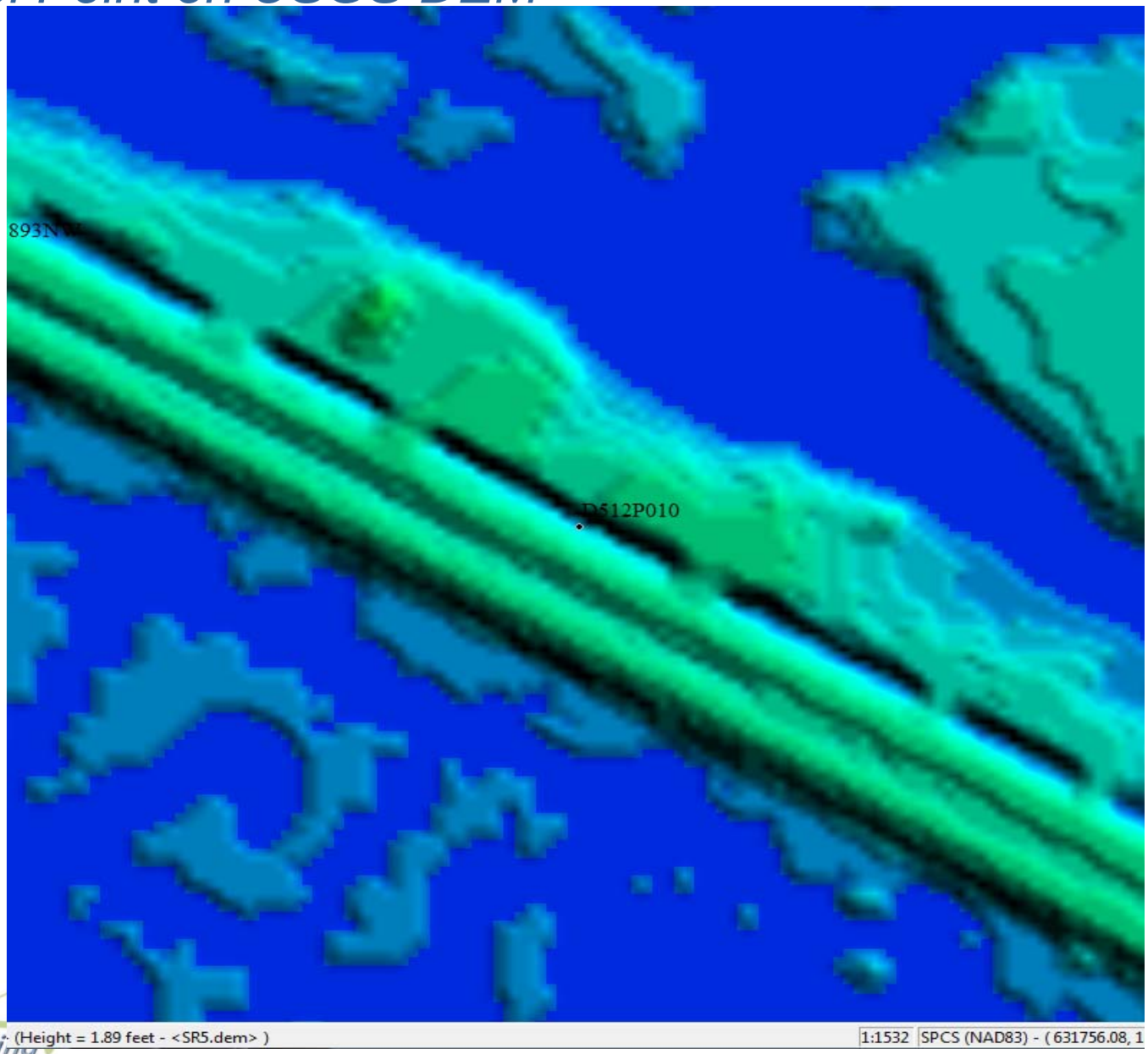
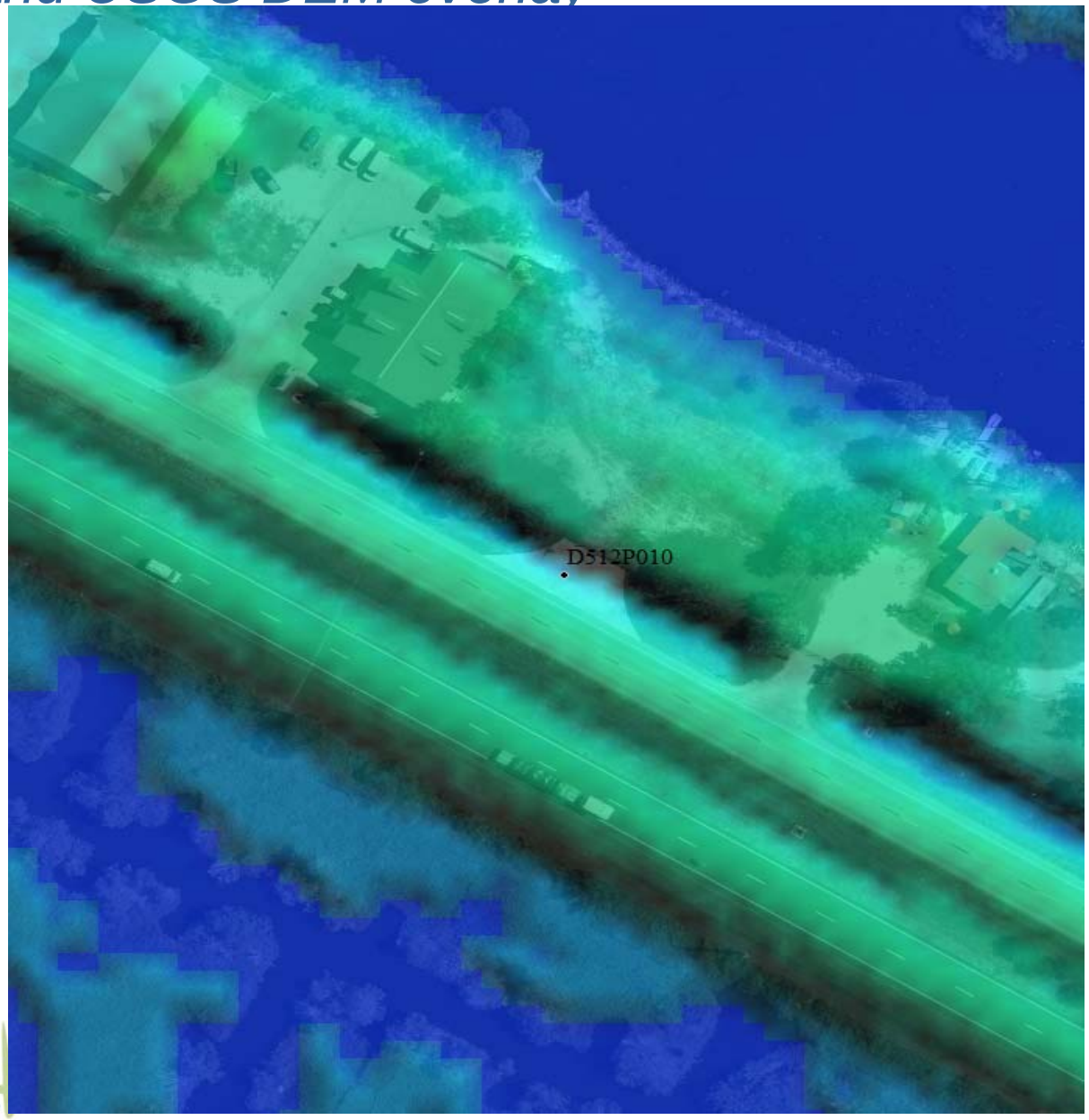


Image and USGS DEM overlay



Google Earth Image 1995

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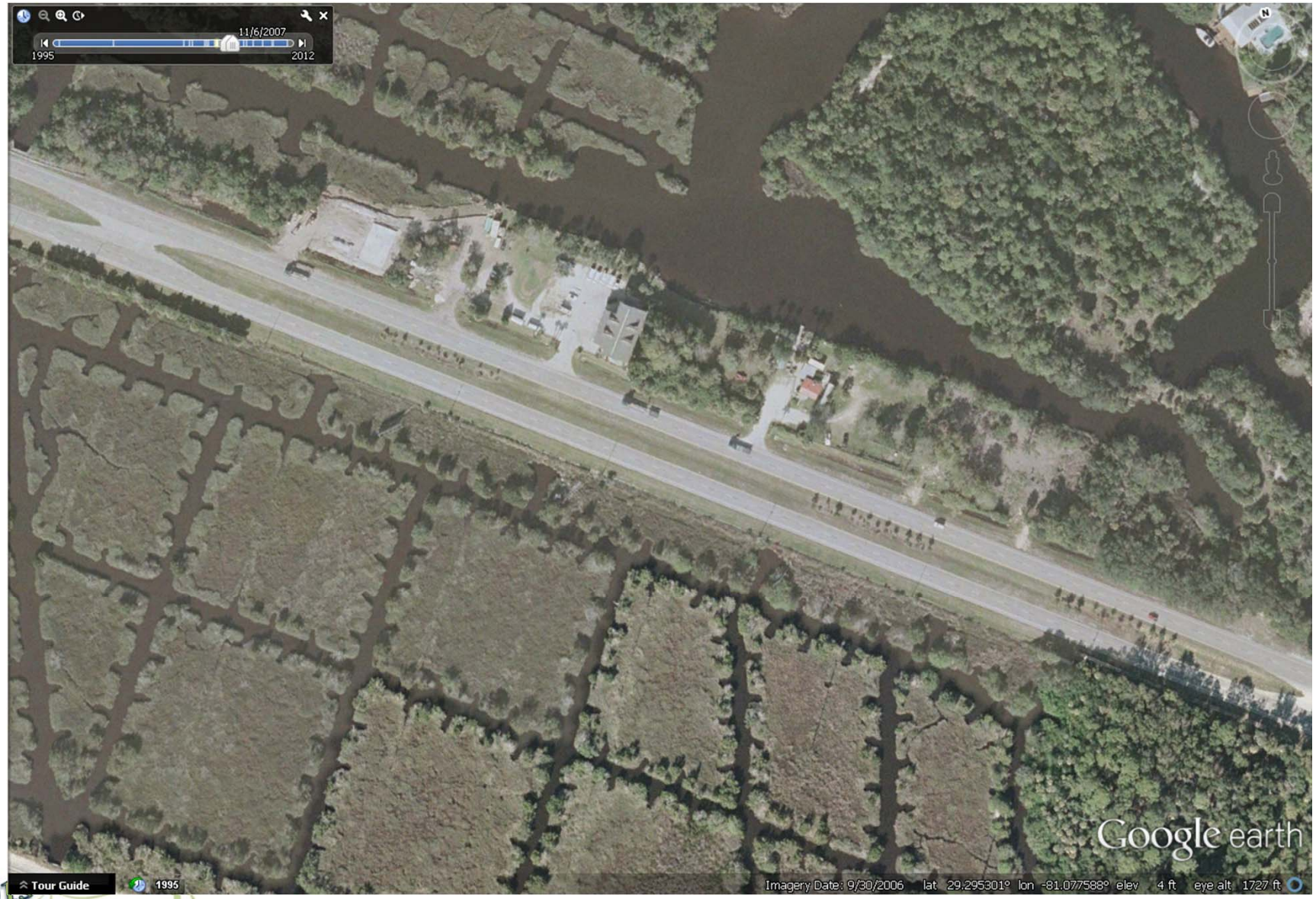
Google Earth Image 11-6-2007



Google Earth Image 12-2-2007

Utilize Point Cloud data derived from Auto-Correlation methods.

Digital Surface Models (DSM) derived from stereo imagery can expedite the process of creating or improving large area surface models.

Advantages: Point Clouds of large areas; Quick Turn-Around

Disadvantages: Accuracy dependent on aerial triangulation solution; image resolution; obscured areas due to vegetation and shadows.

Bridge RGB LAS

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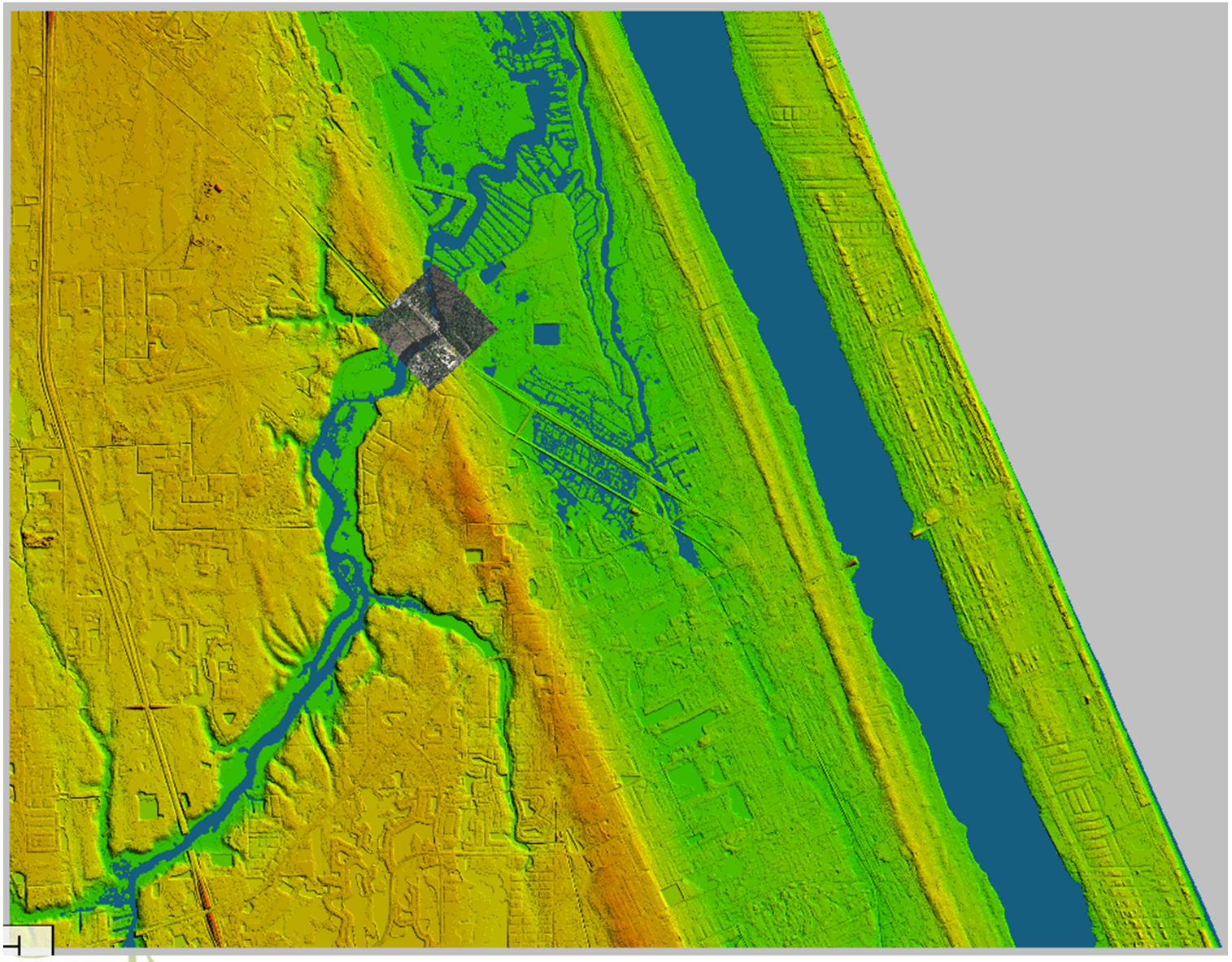
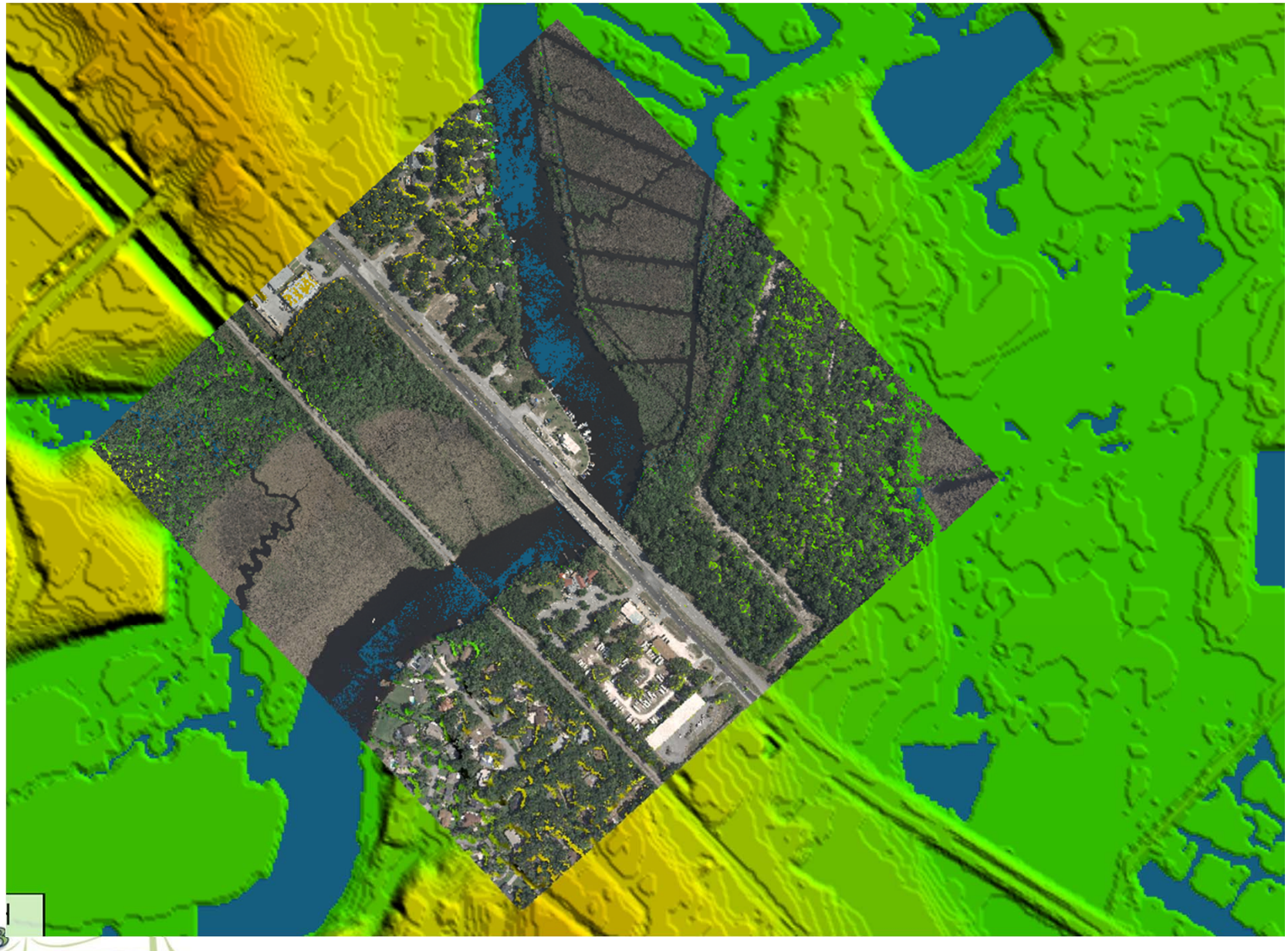
Bridge

Auto-Correlation_3D perspective

USGS 1/9th arc DEM merged with Auto-Correlated Point Cloud





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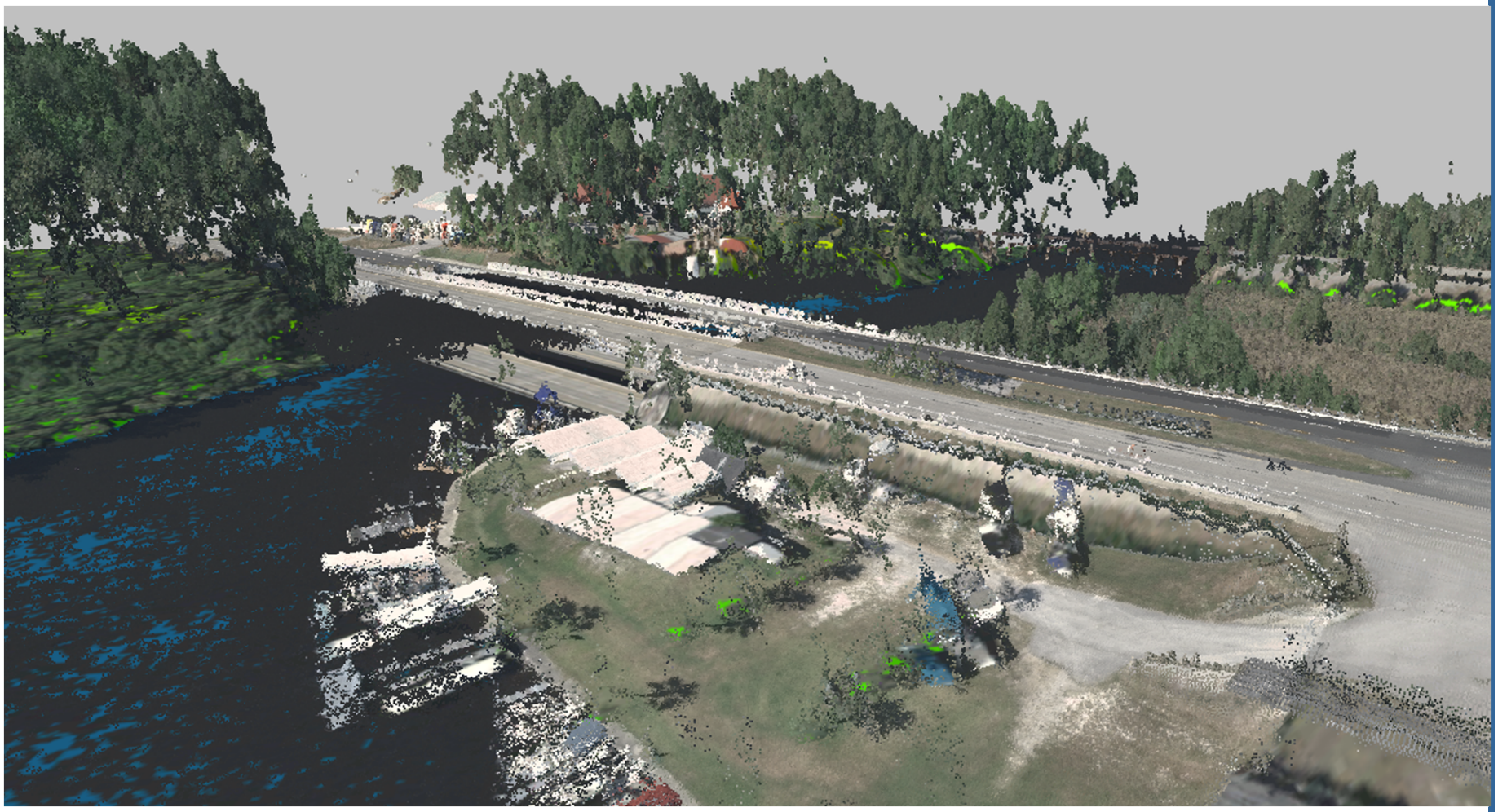

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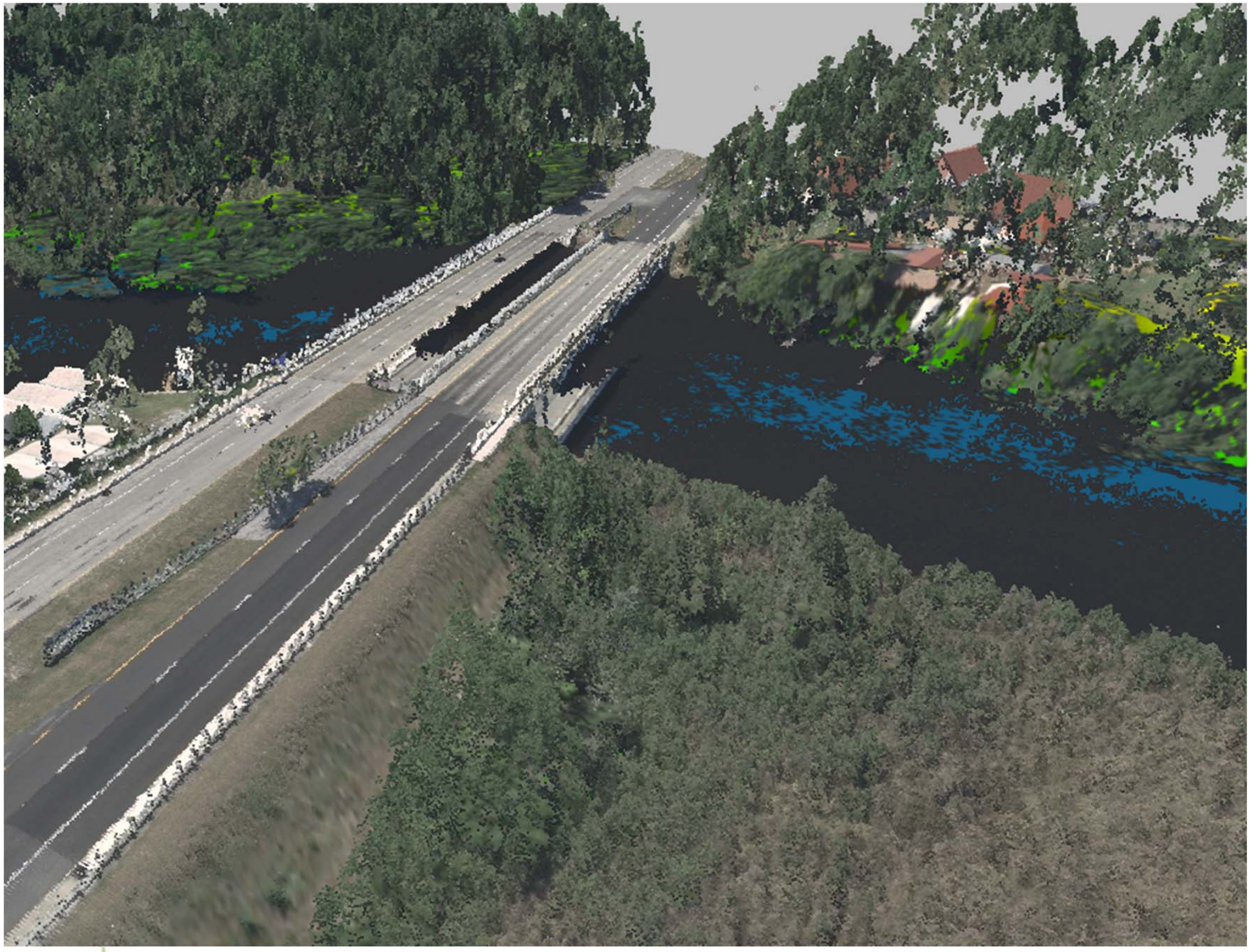

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