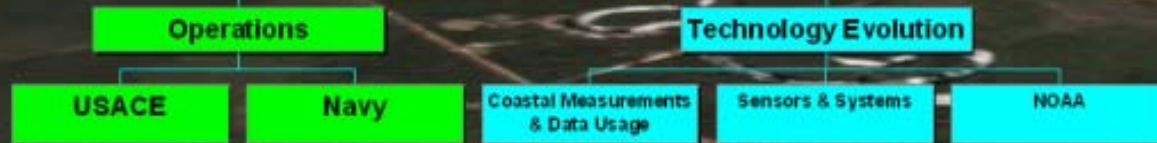
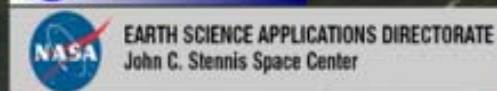
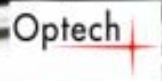




Overview of CHARTS: Principles and Capabilities

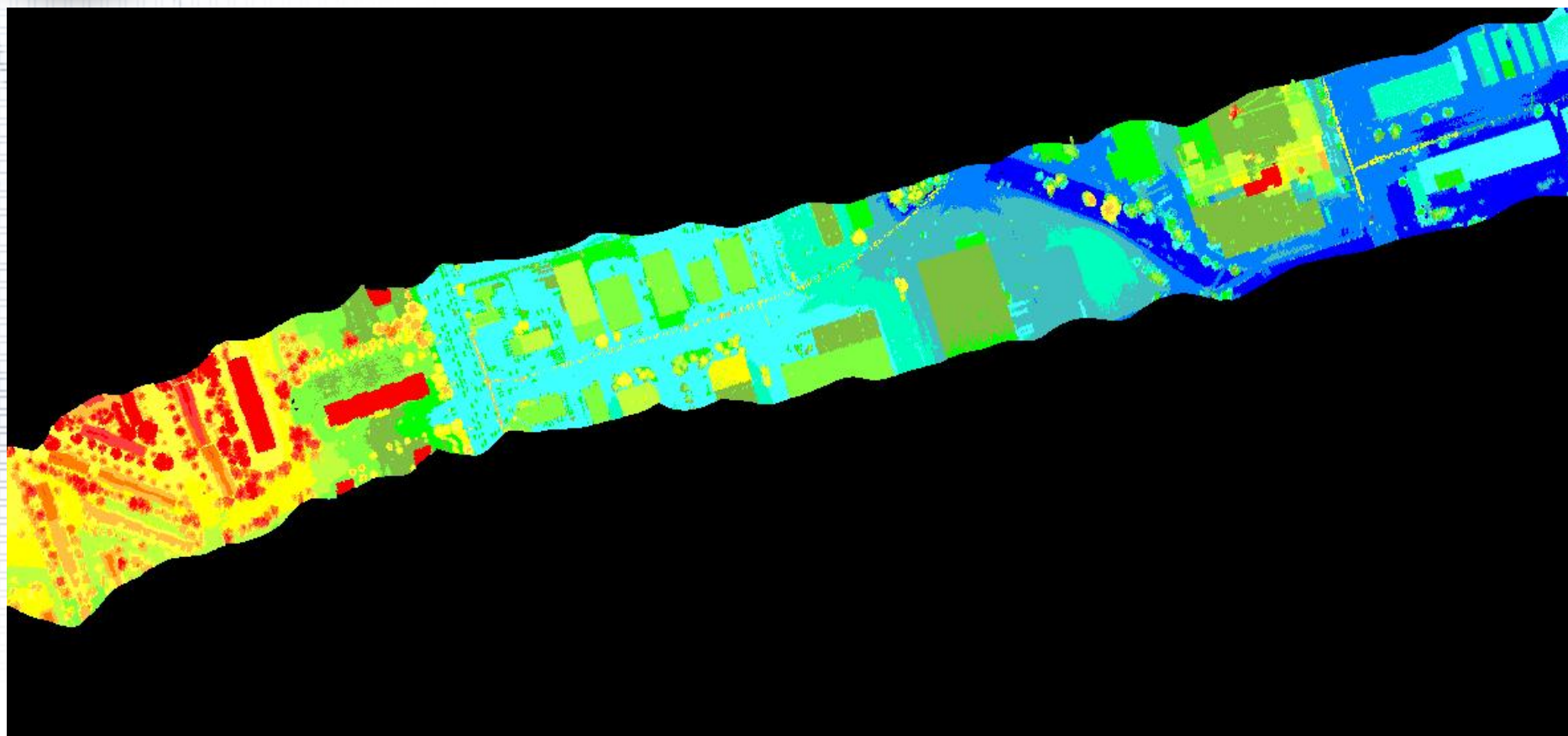
**Eddie Wiggins
6/20/07**

Joint Airborne Lidar Bathymetry Technical Center of Expertise





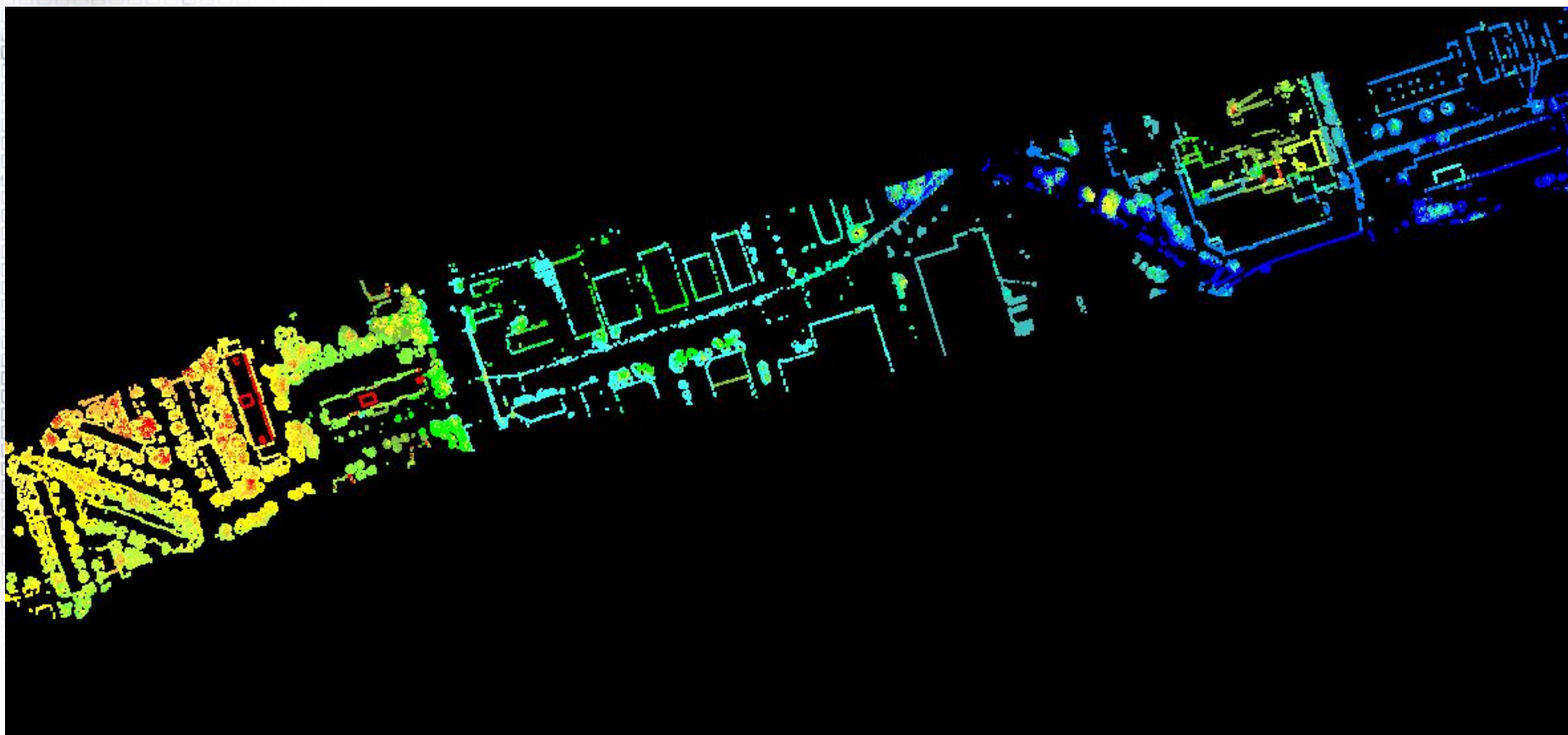
First Return - All Data



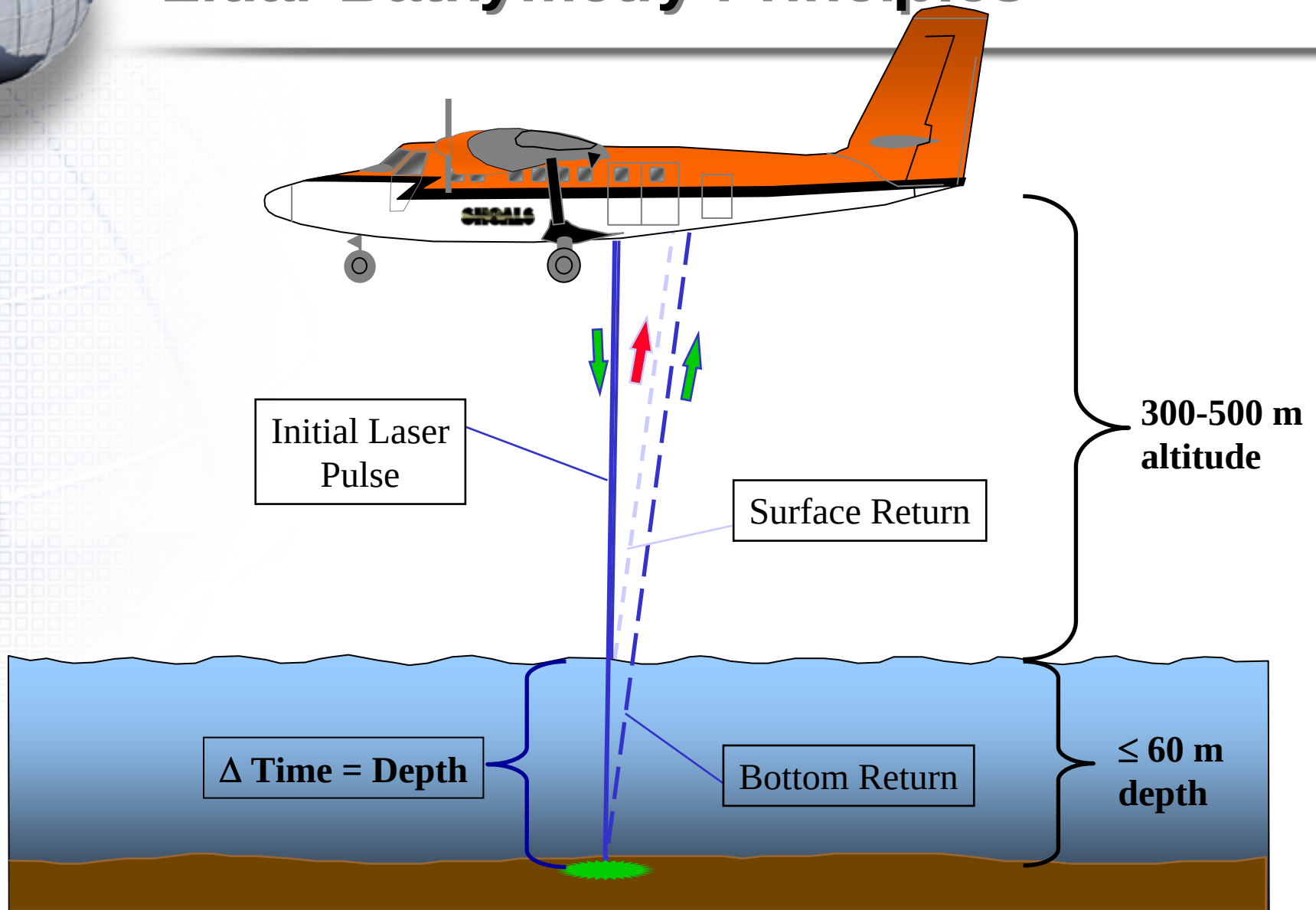


Second Return

Building outline, trees & wires

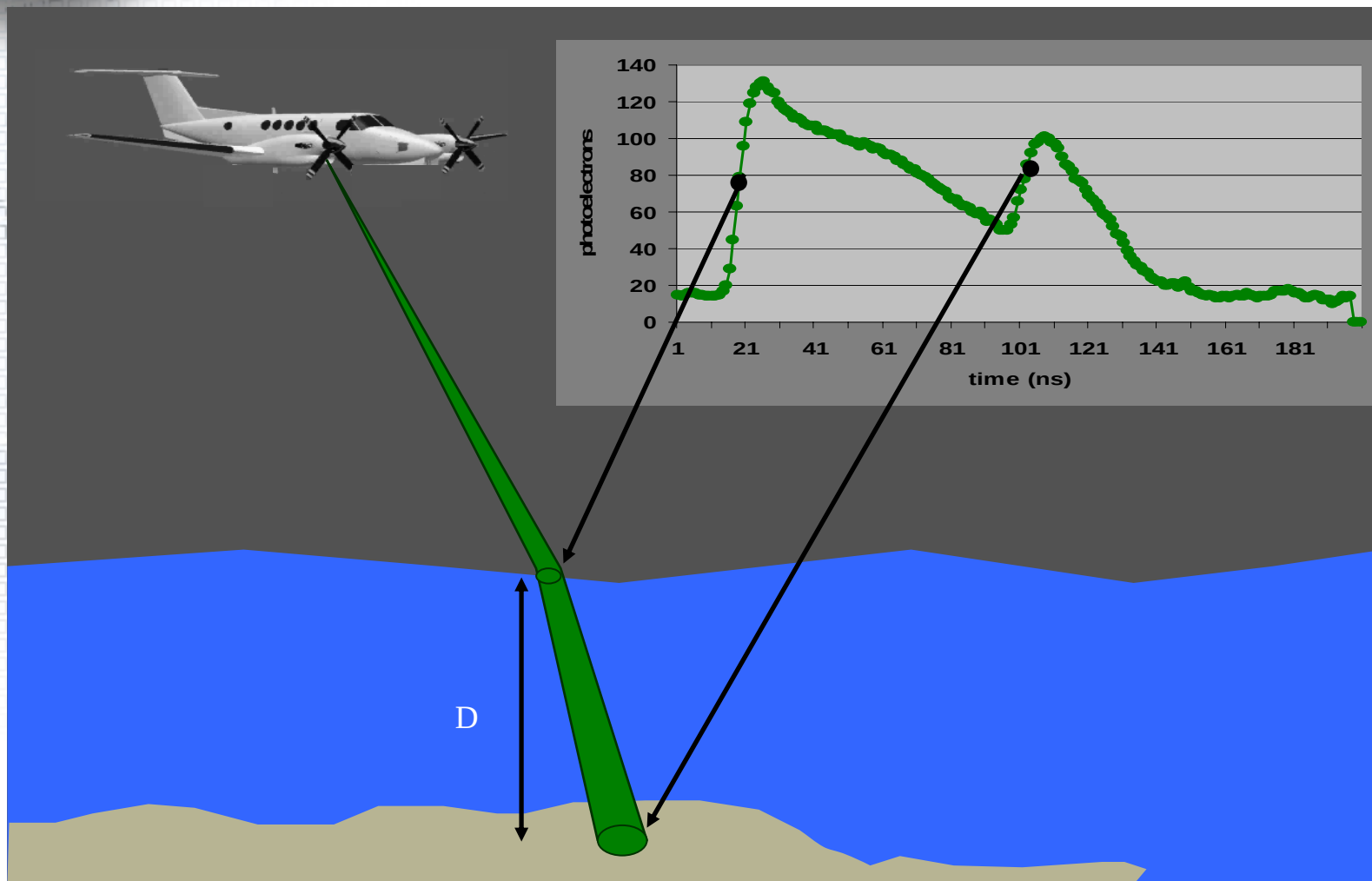


Lidar Bathymetry Principles



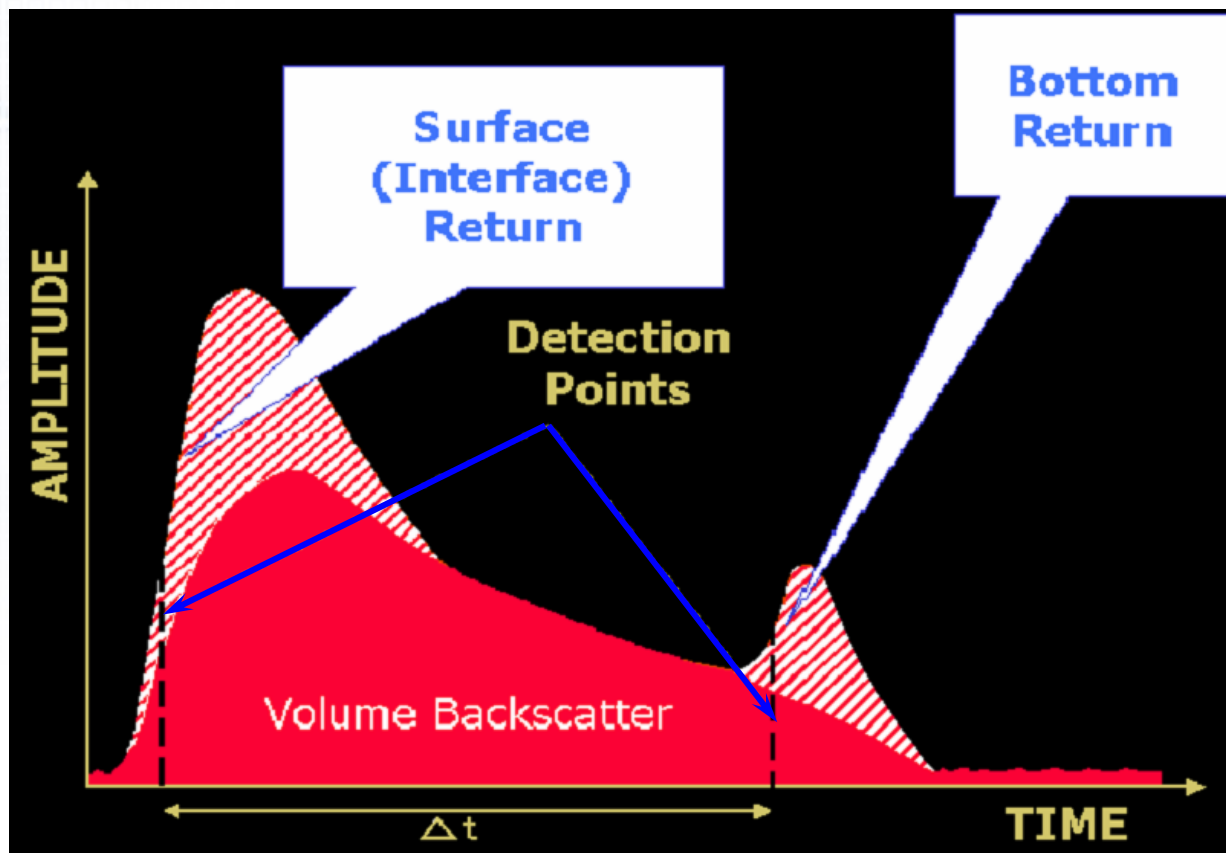


Bathy Lidar Return Signal





Surface and Bottom Detection





Lidar Program History



SHOALS 200
Bell 212
Jan 94 – Nov 98



SHOALS 400
DHC6 Twin Otter
Nov 98 – Sep 2003



CHARTS 1,000T10
King Air 200
Sep 2003 – Mar 2005





The CHARTS System



Integrated Laser System

Digital Camera

CASI-1500
Hyperspectral Imager

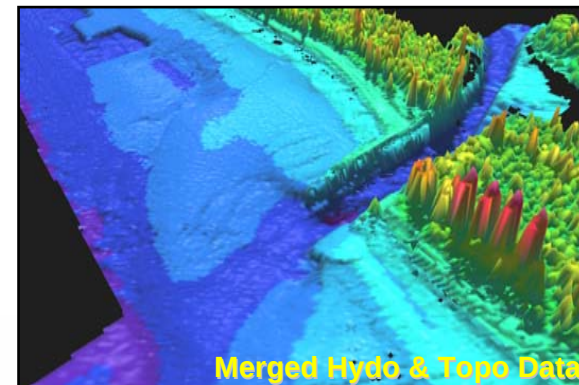


Bottom Aircraft Port



System Specifications

- ☐ 3,000 Hz Pulse Rate (hydro)
- ☐ 20,000 Hz Pulse Rate (topo)
- ☐ 1 Hz Digital camera (~20 cm pixel)
- ☐ CASI-1500 Hyperspectral Imager
 - 1500 pixels
 - 380 – 1500 nm wavelength
 - 288 possible bands
- ☐ IHO Order 1 Surveys capable
- ☐ 2x2 – 4x4 meter spot density
- ☐ 125 - 240 kts aircraft speed
- ☐ Portable ground processing system



Merged Hydro & Topo Data

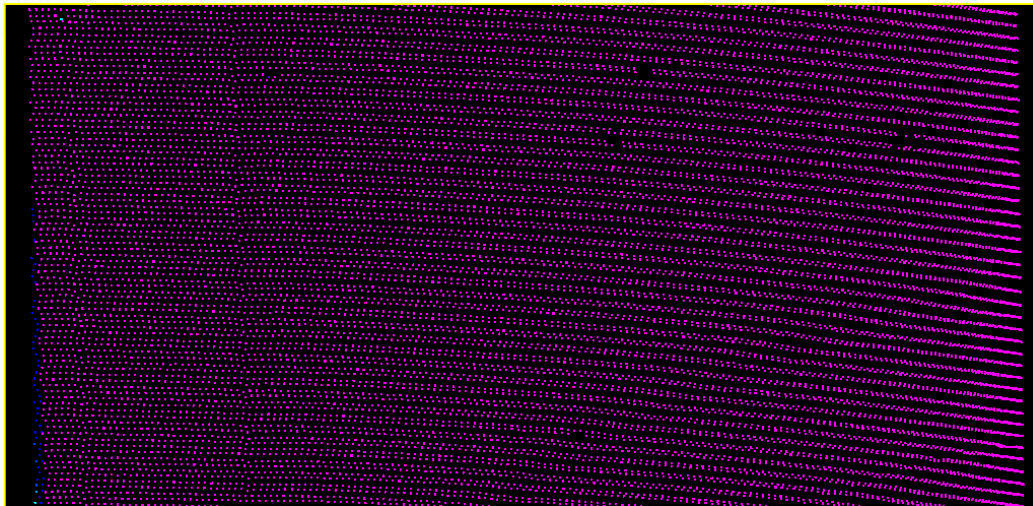


Digital Image



Topographic Survey Parameters

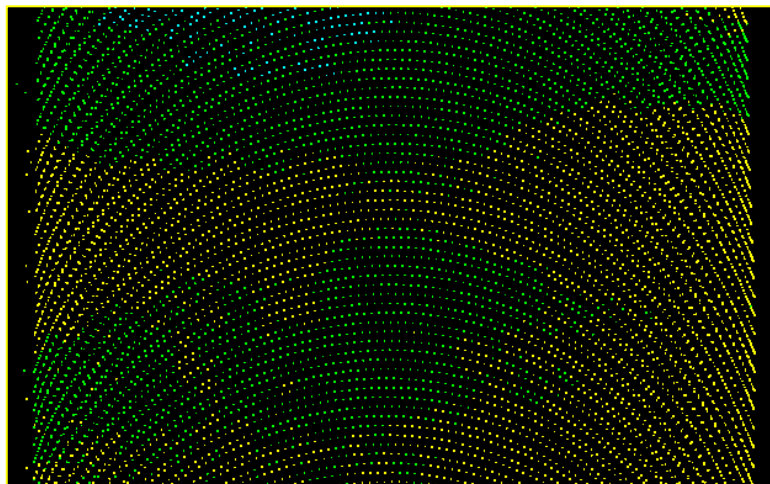
Altitude (m)	Swath (m)	Spacing (m,lateral)	Spacing (m,forward)	Speed (kn)	Scanner Frequency (Hz)	Coverage (km2/hr)
300	195	0.4	1.9	125	17	45
400	260	0.5	1.9	125	17	60
500	310	0.6	1.9	125	17	73
600	390	0.8	1.9	125	17	91
700	285	0.9	1.2	128	27.5	67
800	325	1	1.2	128	27.5	77
900	365	1.2	1.2	128	27.5	87
1000	405	1.3	1.3	139	27.5	104
1100	445	1.4	1.4	150	27.5	125
1200	485	1.5	1.5	164	27.5	148



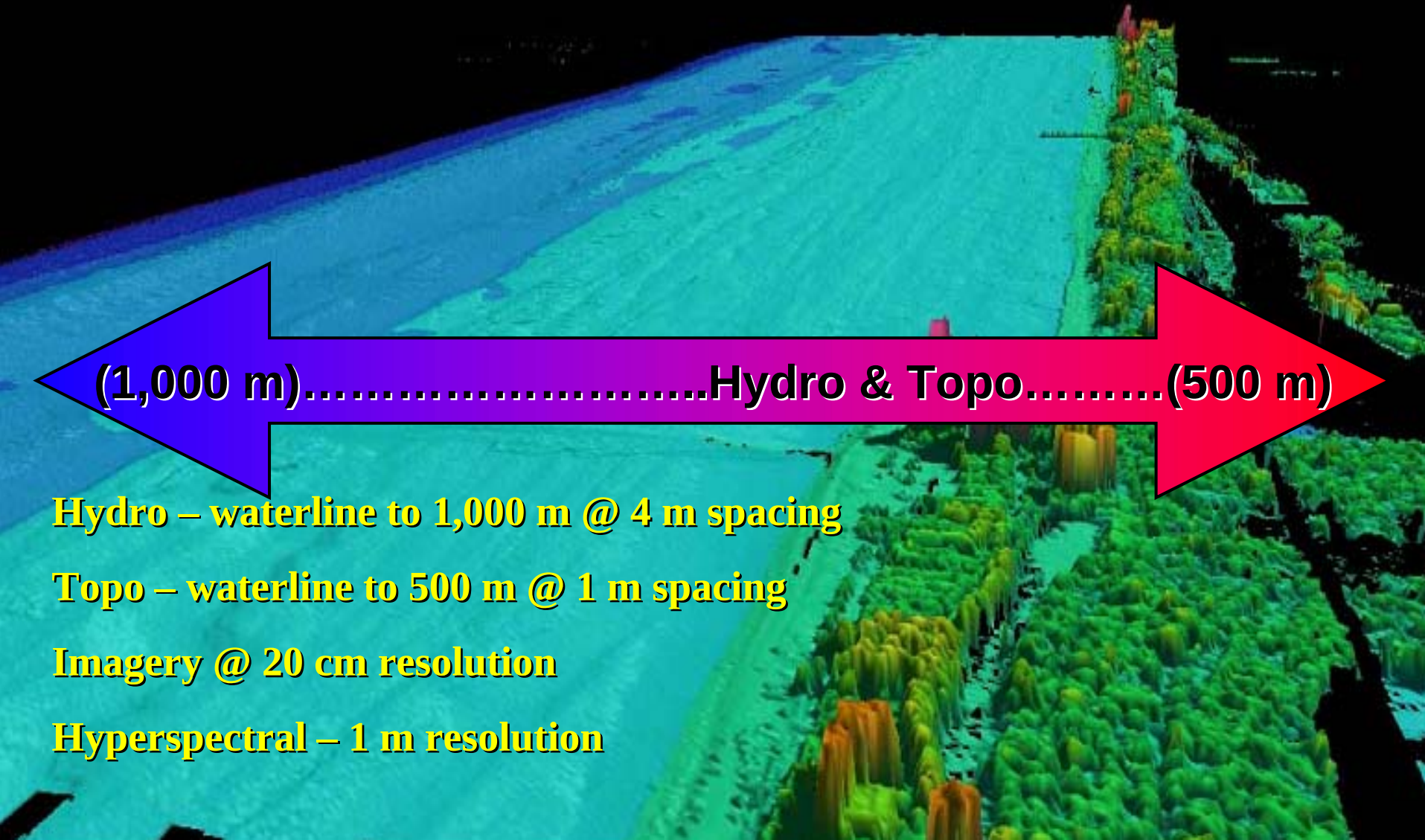


Hydrographic Survey Parameters

Nominal Spacing (m)(Nadir)	Altitude (m)	Swath (m)	Spacing (m,lateral)	Spacing (m,forward)	Speed (kn)	Scanner Frequency(Hz)	Coverage (km2/hr)
2 x 2 (20°)	400	161	2	2	125	16.2	37
	300	149	2	2	130	16.8	36
3 x 3 (22°)	400	303	3	3	125	10.7	70
	300	226	3	3	164	14.1	69
4 x 4 (22°)	400	301	4	4	219	14.1	122
	300	225	3.5	4	254	16.4	106
5 x 5 (22°)	400	297	4.5	4.2	262	16.1	144



USACE Coastal Mapping



(1,000 m).....Hydro & Topo.....(500 m)

Hydro – waterline to 1,000 m @ 4 m spacing

Topo – waterline to 500 m @ 1 m spacing

Imagery @ 20 cm resolution

Hyperspectral – 1 m resolution



2004 – 2007 NCMP Efforts

- > 5,500 km surveyed to date
- Topo/Bathy/Ortho/Spectral
- 2005
 - > 6.5 Billion LIDAR Shots
 - > 3 Terabytes of products

Legend

- 2004
- 2005
- 2006
- 2007





Data & Products

- Elevations, XYZ ASCII files & LAS
 - Land @ 1m x 1m 200%
 - Hydro @ 4m x 4m
- Ortho RGB Imagery
- 1-m Grid for GIS (Raster GIS)
- 5-m KML coverage file
- Shoreline vector (“0” NAVD88)
- Building footprint
- Bare Earth
- Bottom Reflectance
- Hyperspectral Based Products

Emphasis on GIS-ready products to support end users.

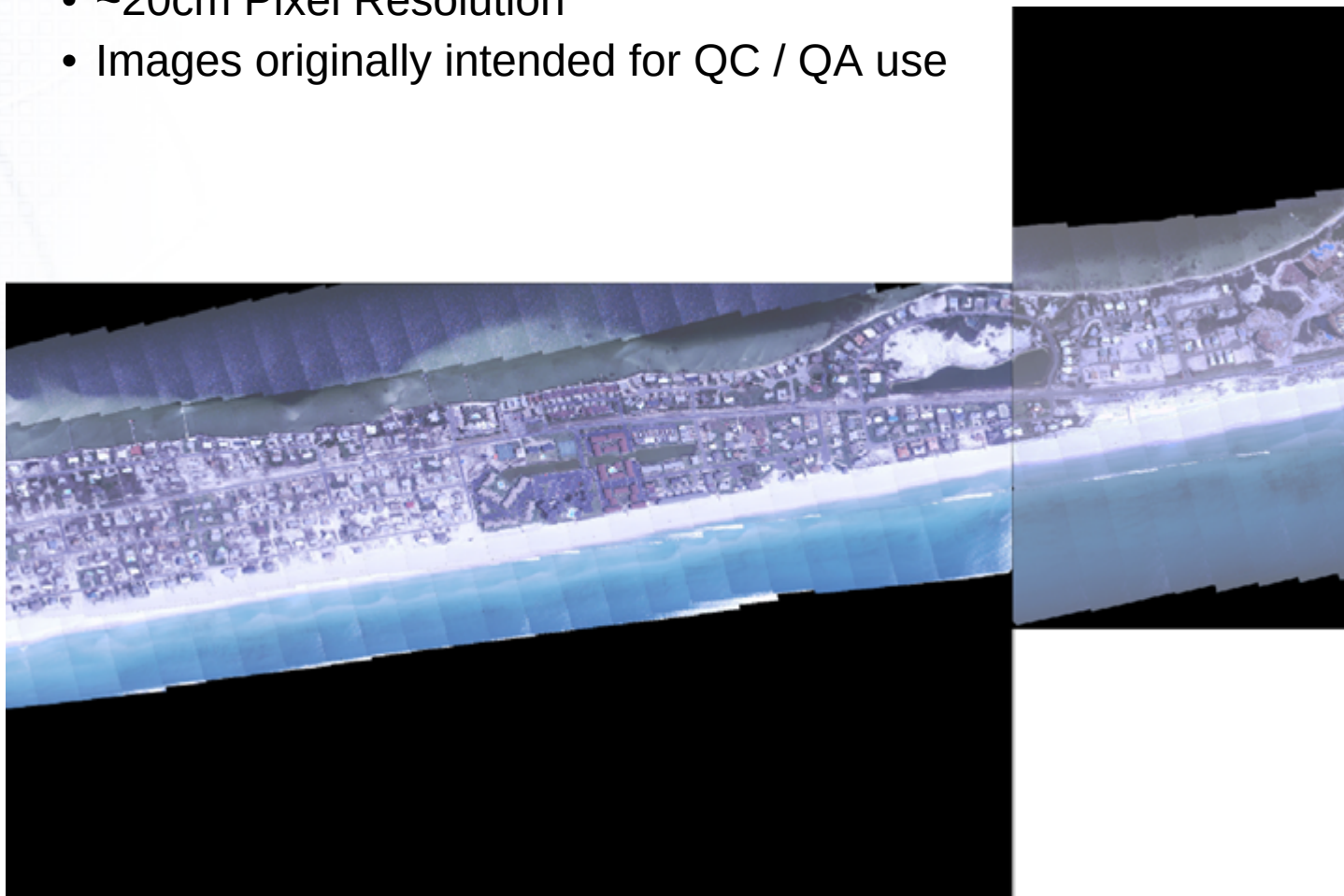
In 2007, delivery of point data to migrate totally to binary format.

Research in progress to establish spectral products.



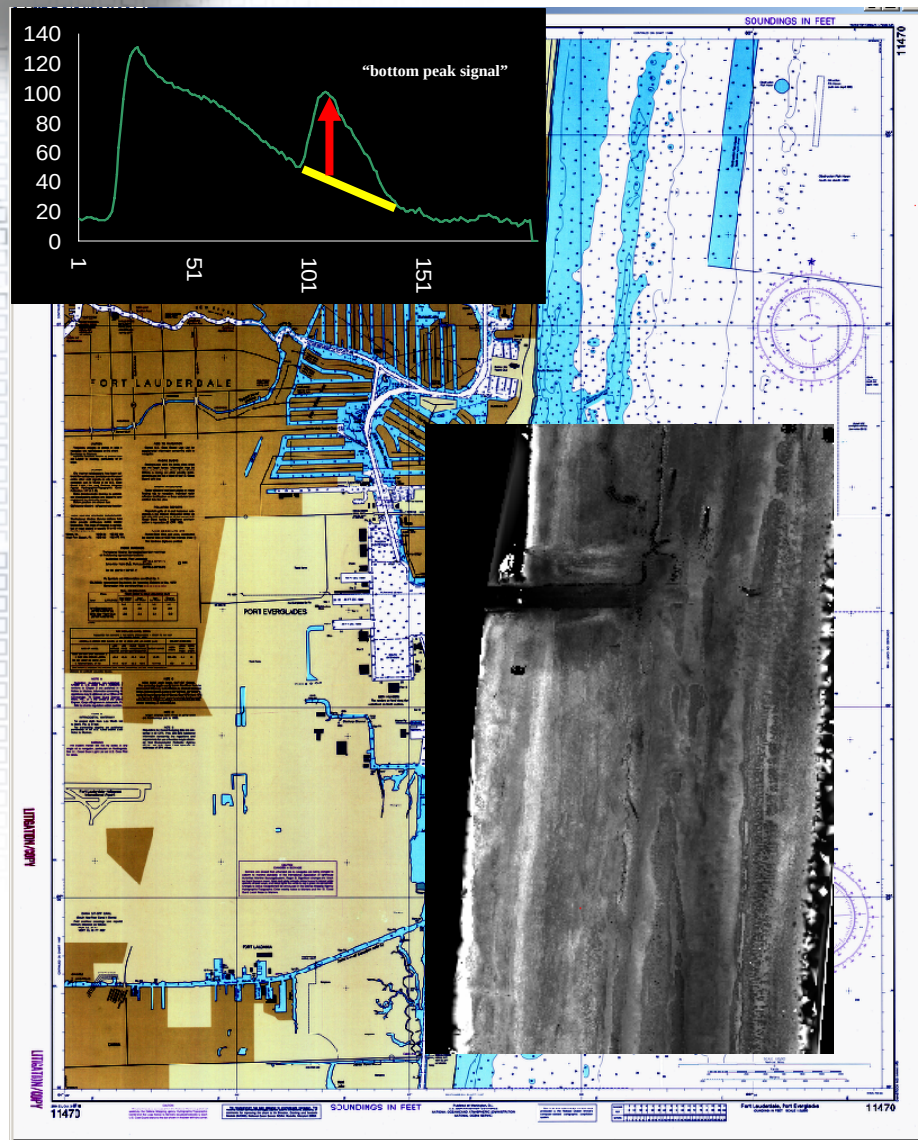
RGB Ortho-Mosaic

- ~20cm Pixel Resolution
- Images originally intended for QC / QA use





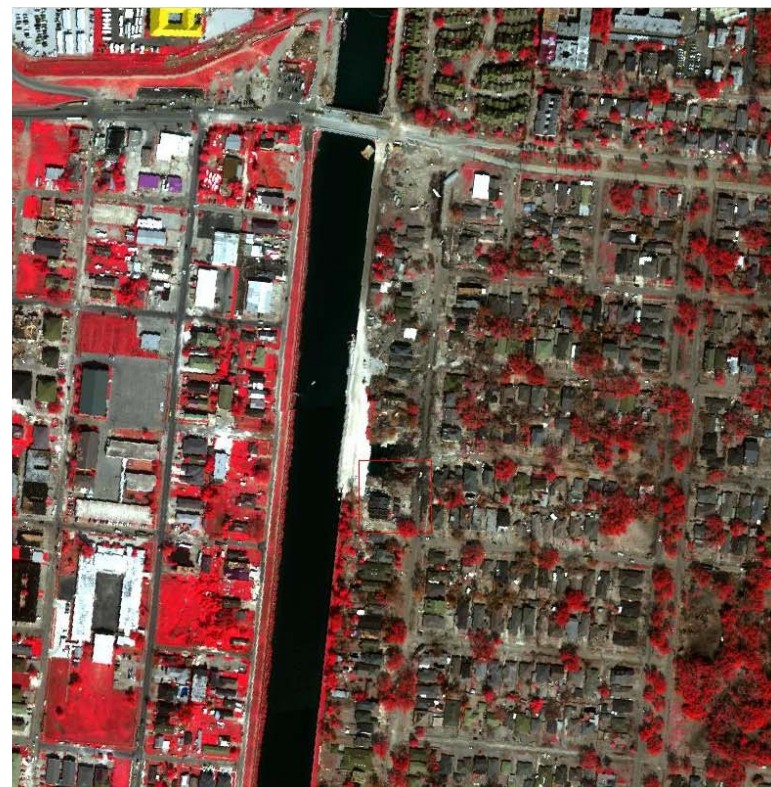
Reflectance





Hyperspectral Imagery

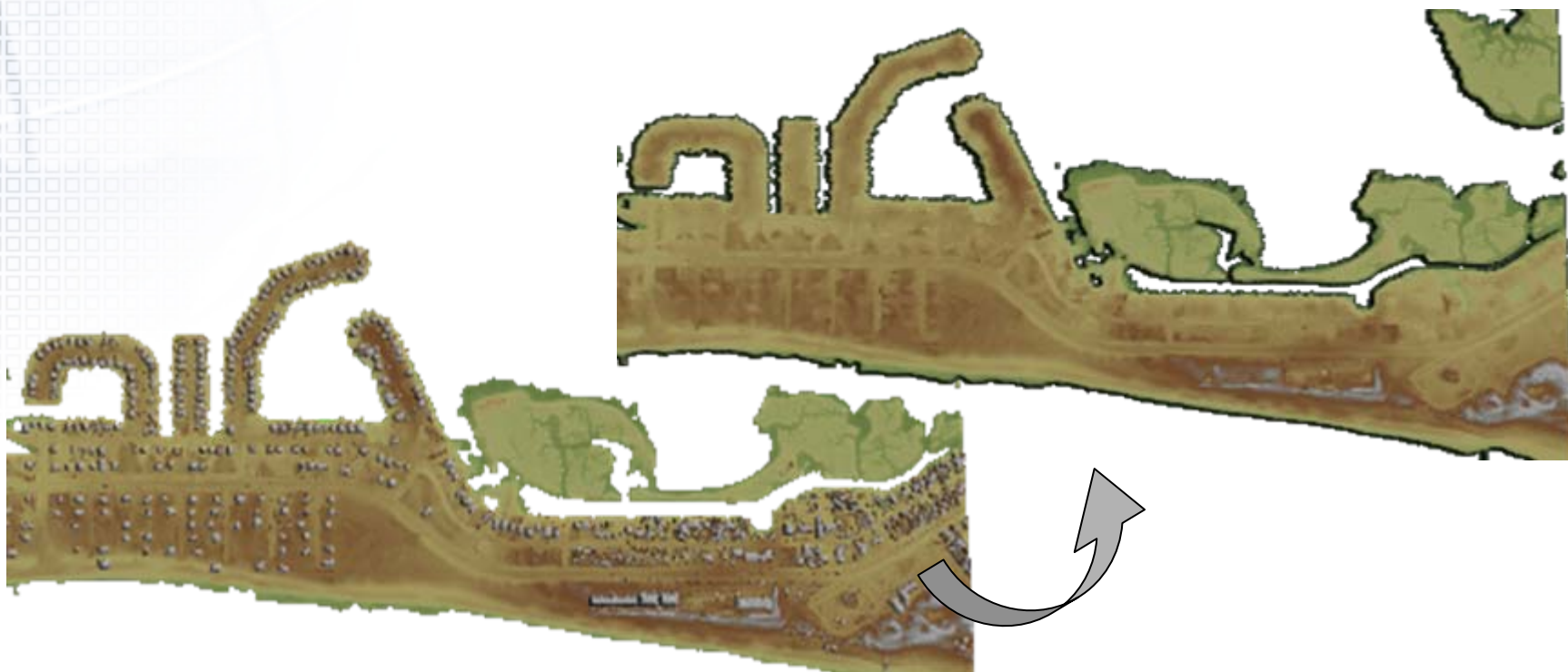
- 1m Pixel Resolution
- 36 Bands – 375nm to 1050nm
- Based on CASI 1500 Data





Bare Earth Model

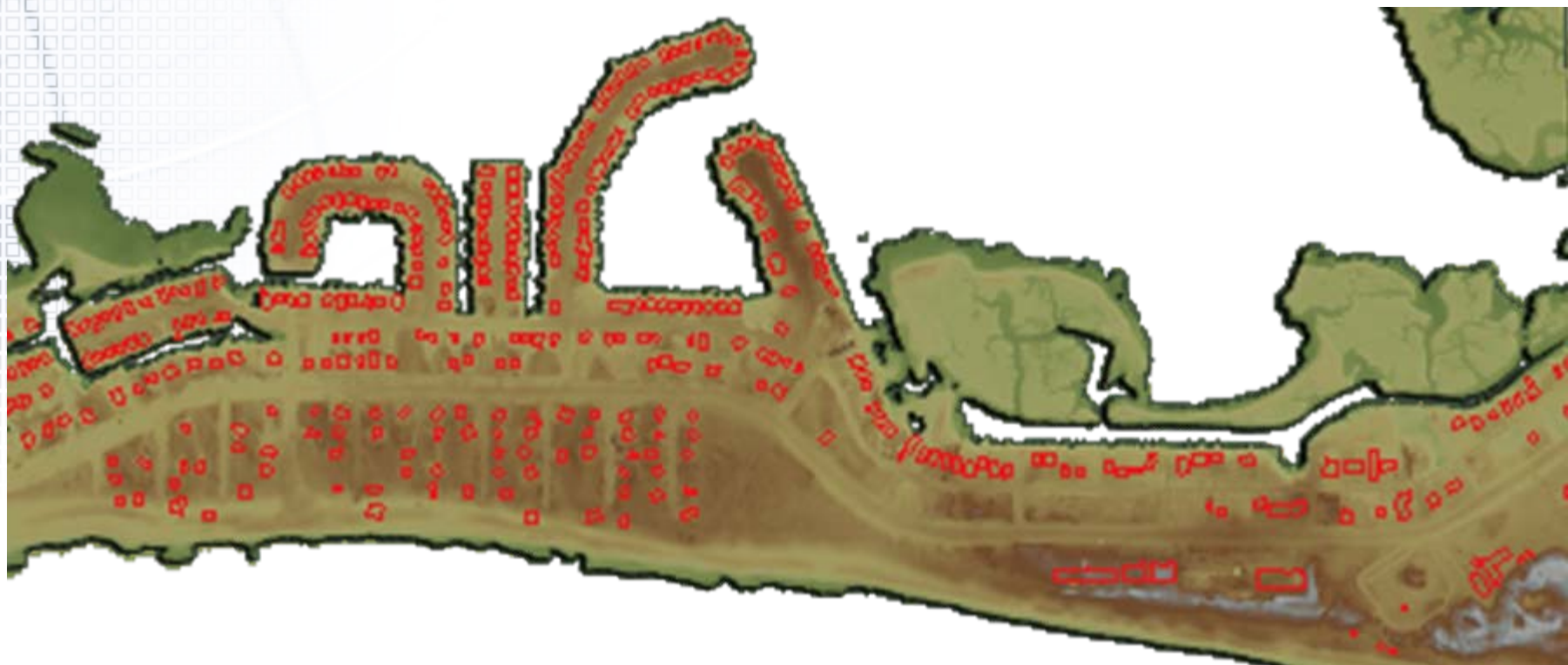
- Computed from first and last return data using LIDAR Analyst®
- Based on LAS or raster input





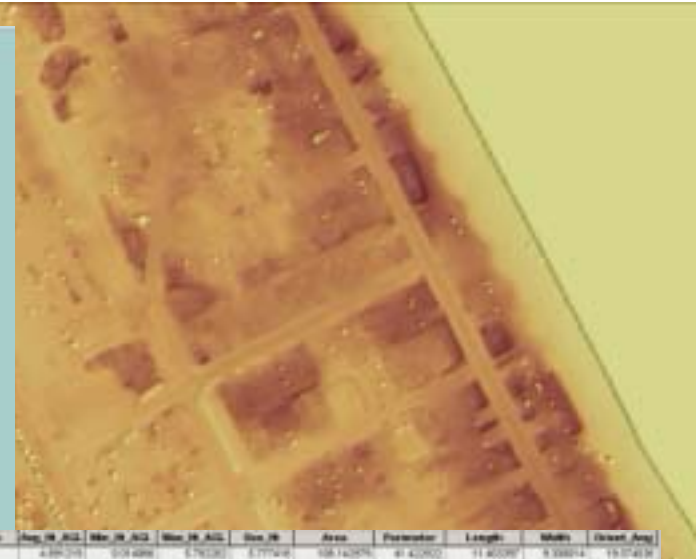
Building Footprints

- 1-m DEM of last return lidar data





Building Footprint & Bare Earth



Attributes of buildings_square_metrics

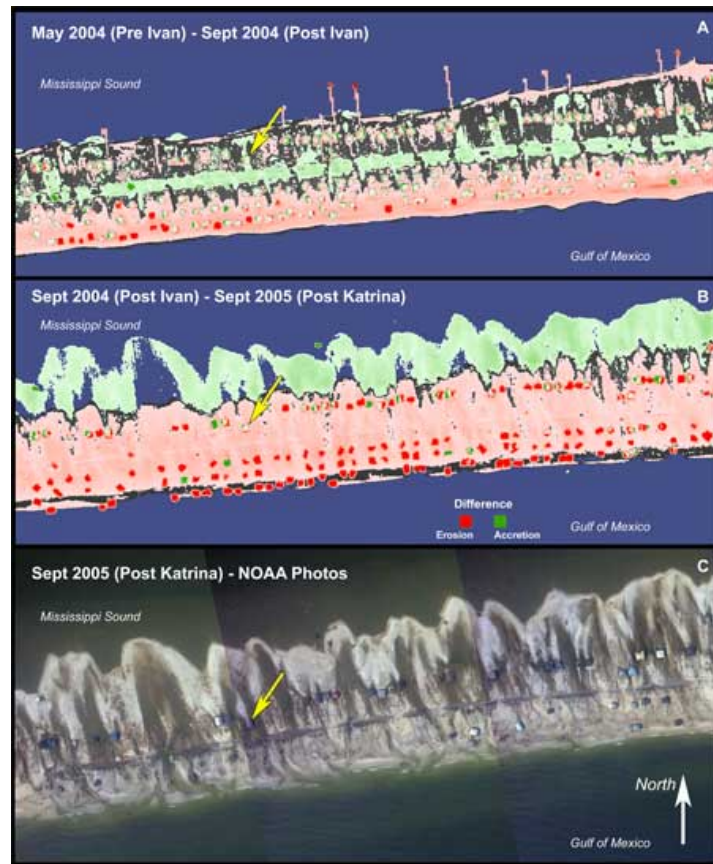
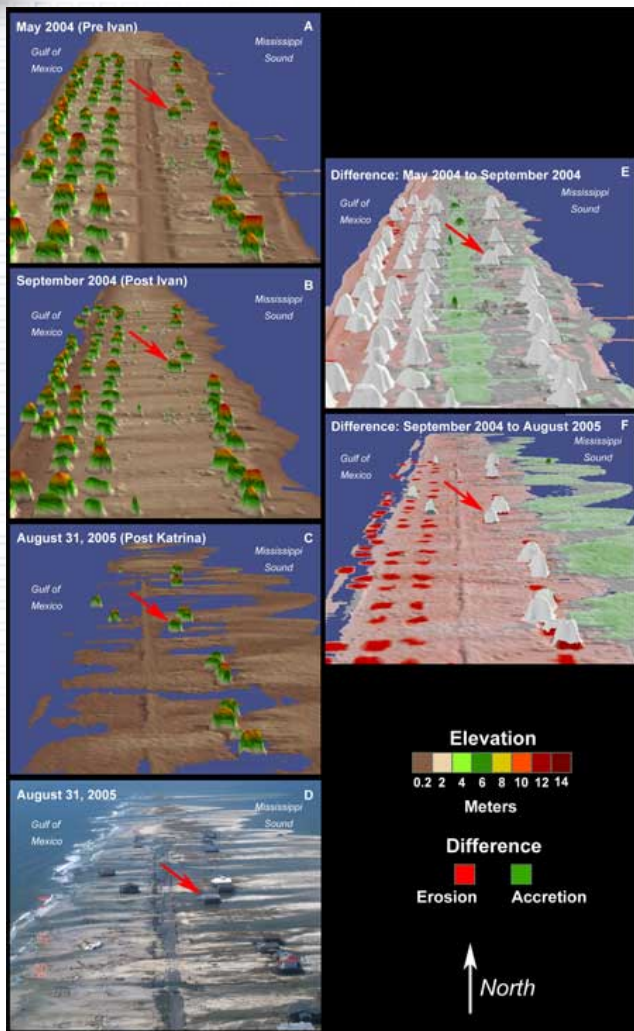
Avg_Hght	Area	Perimeter
10.352632	204.971516	23.445339
11.035743	962.413688	57.278261
9.984605	780.693249	47.176182
10.935997	2492.237058	93.500564
10.975225	559.429394	40.428492
11.244528	1144.077117	81.773165
13.952607	127.257536	19.616046
10.405354	426.279524	36.641368
9.941748	174.688730	24.175114
10.350836	1112.156084	56.537365
10.781099	551.281420	49.114621
10.750887	518.095231	40.117865
10.352426	1027.754835	58.539909
13.060701	619.616064	40.595760

Record: 11 0 11 Show: All Selected Records (0 out of 11)

ID	Shape	Group	Alt	Roof_Type	Avg_Ht_Alt	Min_Ht_Alt	Max_Ht_Alt	Area	Perimeter	Length	Width	Count_Avg
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13	Polygon	26	34	Complex	5.449481	0.728102	6.401010	12.181320	234.484426	80.800406	24.128138	16.101210
14	Polygon	26	35	Pkltree	4.412914	0.000000	5.708410	6.066411	117.280361	34.119889	8.501746	20.004471
16	Polygon	26	36	Pkltree	5.015882	0.108880	6.870882	8.132071	122.284884	33.702281	16.202780	16.077540
17	Polygon	26	37	Pkltree	4.210288	0.007034	6.809134	6.876769	284.321389	62.489078	10.669075	19.074038
18	Polygon	26	38	Pkltree	7.075940	0.087078	10.164880	10.181180	110.287710	43.081078	11.223600	8.724101
19	Polygon	26	39	Pkltree	4.078084	0.046811	7.440889	7.487930	210.872787	39.073811	10.021841	10.021841
20	Polygon	26	40	Pkltree	5.038117	0.087220	6.940880	8.313882	154.348211	32.272782	17.088078	8.028720
21	Polygon	26	41	Pkltree	6.154261	0.200000	6.877634	6.822107	141.863686	40.888889	14.217902	8.888889
22	Polygon	26	42	Pkltree	5.038835	4.202188	10.200784	9.888430	110.718784	40.028440	10.078880	7.948484
23	Polygon	26	43	Pkltree	4.888889	0.108880	7.088884	12.000714	171.268237	33.220709	16.718101	10.801880
24	Polygon	26	44	Pkltree	4.701887	0.107140	6.717134	6.024207	140.000000	44.201880	14.077028	8.701220
25	Polygon	26	45	Pkltree	7.401275	0.278884	10.084880	8.708482	126.221207	44.848428	11.041167	10.021841
26	Polygon	26	46	Pkltree	7.240881	0.048108	10.000740	10.711489	111.818784	41.284484	11.277020	8.888889
27	Polygon	26	47	Pkltree	6.888482	1.100000	8.374880	7.181841	120.188480	40.172000	14.000000	8.888889
28	Polygon	26	48	Pkltree	7.444780	0.448480	10.084880	8.718300	88.888480	38.888128	11.448176	8.778174
29	Polygon	26	49	Pkltree	6.070720	0.041227	10.284880	10.400811	101.187827	41.242001	10.711884	8.444444
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35	Polygon	26	55	Multi-Level Flat	4.777880	0.001781	6.788480	6.001841	1078.888780	288.274880	76.120780	49.371880
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37	Polygon	26	57	Pkltree	6.084880	0.000000	10.108880	10.108880	41.400780	10.000000	8.000000	8.000000
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46	Polygon	26	66	Pkltree	6.084880	0.000000	10.108880	10.108880	41.400780	10.000000	8.000000	8.000000
47	Polygon	26	67	Pkltree	6.084880	0.000000	10.108880	10.108880	41.400780	10.000000	8.000000	8.000000
48	Polygon	26	68	Pkltree	6.084880	0.000000	10.108880	10.108880	41.400780	10.000000	8.000000	8.000000
49	Polygon	26	69	Pkltree	6.084880	0.000000	10.108880	10.108880	41.400780	10.000000	8.000000	8.000000
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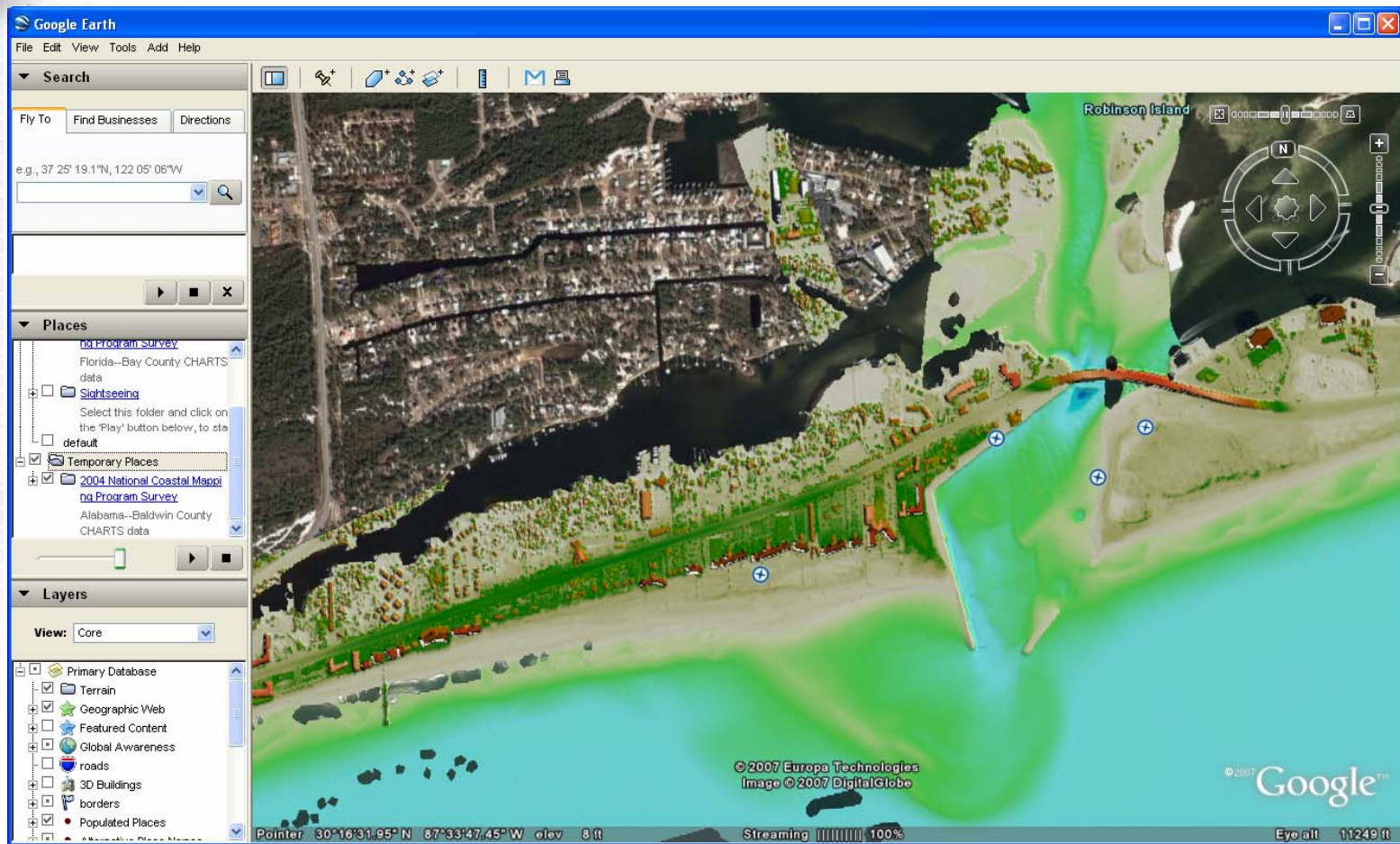


Topo & Hydro Elevations





KML Files





Summary

- CHARTS integrates topographic and bathymetric lidar, along with RGB and hyperspectral imagers, into one system
- JALBTCX uses CHARTS to conduct the NCMP for USACE
- JALBTCX generates GIS-ready products
- Repetitive surveys support change detection work