Spatial Differences in Seagrass Mapping by Different Photo Interpreters

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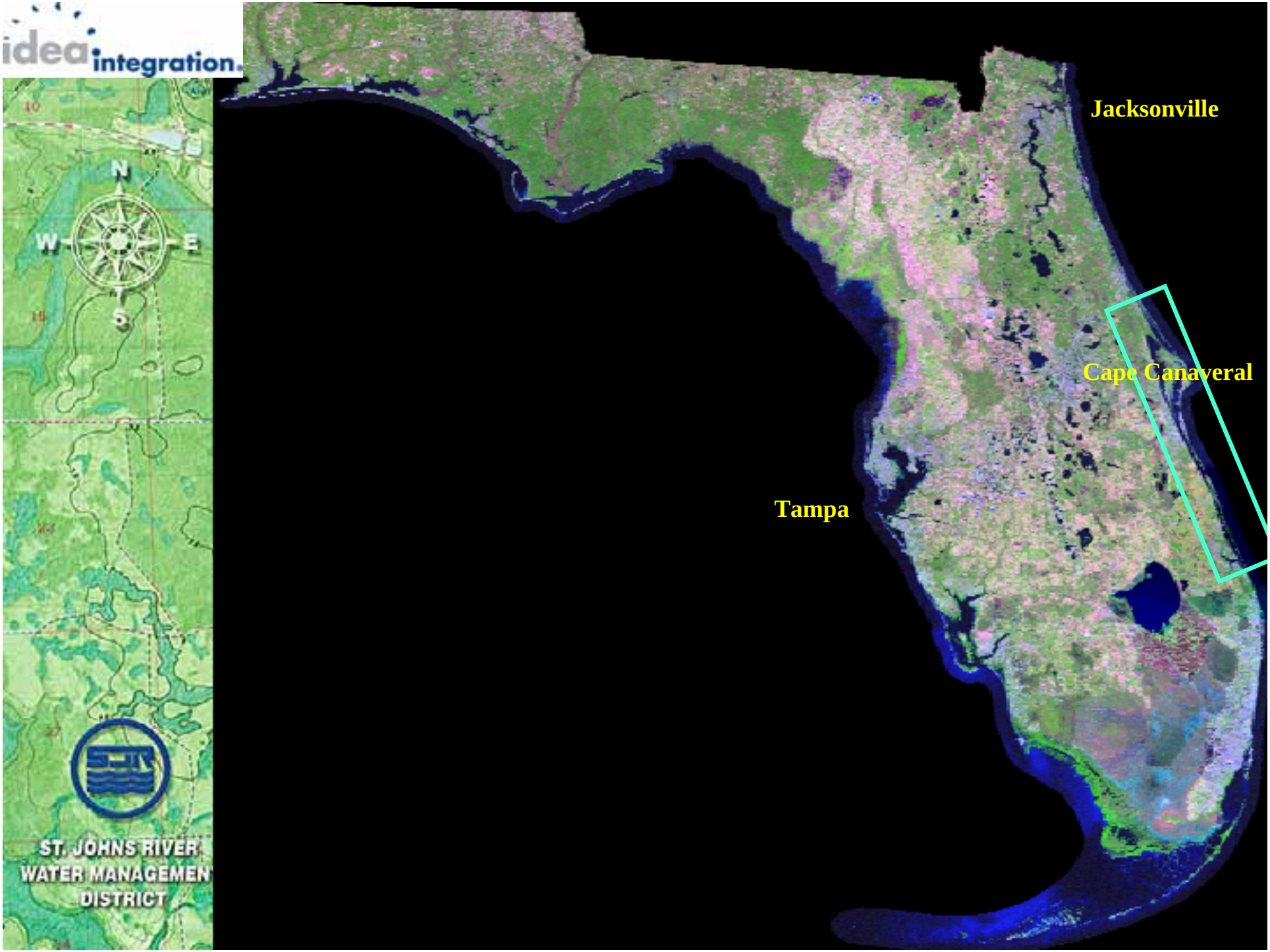
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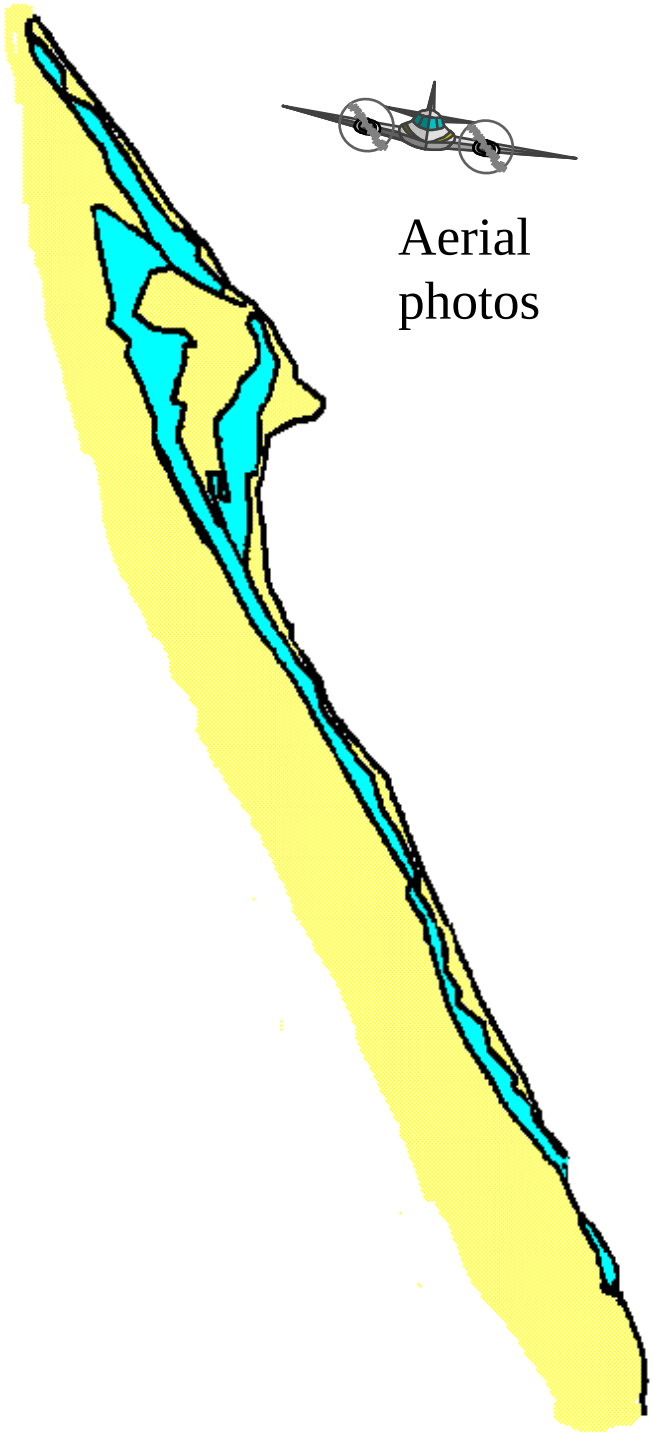
WATER MANAGEMEN
DISTRICT
Jacksonville
Cape Canaveral
Tampa

Importance of Seagrasses

- A primary objective of the Indian River Lagoon (IRL) Surface Water Improvement and Management (SWIM) Plan is to protect and restore seagrasses, a key resource.
- Seagrasses are a good indicator of the overall health of the lagoon ecosystem.
- Seagrass coverage statewide has generally declined since 1943.
- The IRL SWIM Plan directs the South Florida and St. Johns River Water Management Districts to map seagrasses in the Indian River Lagoon at 2-3 year intervals.

'Setting Seagrass Depth, Coverage, and Light Targets for the Indian River Lagoon System, Florida' Estuaries Vol. 28, No. 6, 9. 923-935 December 2005



Aerial photos

Ground-truthing

Photo Interpreting

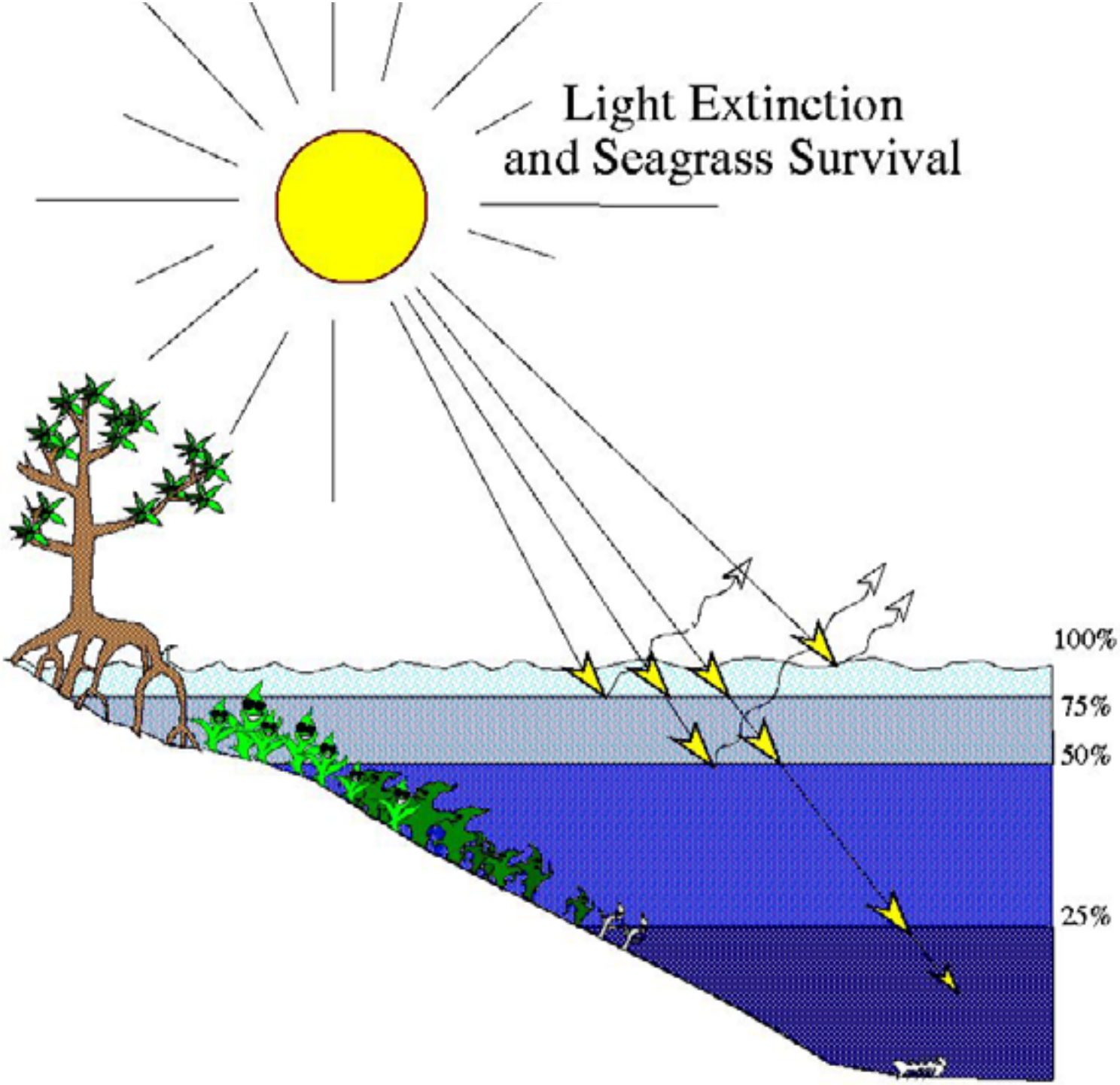
Digitizing

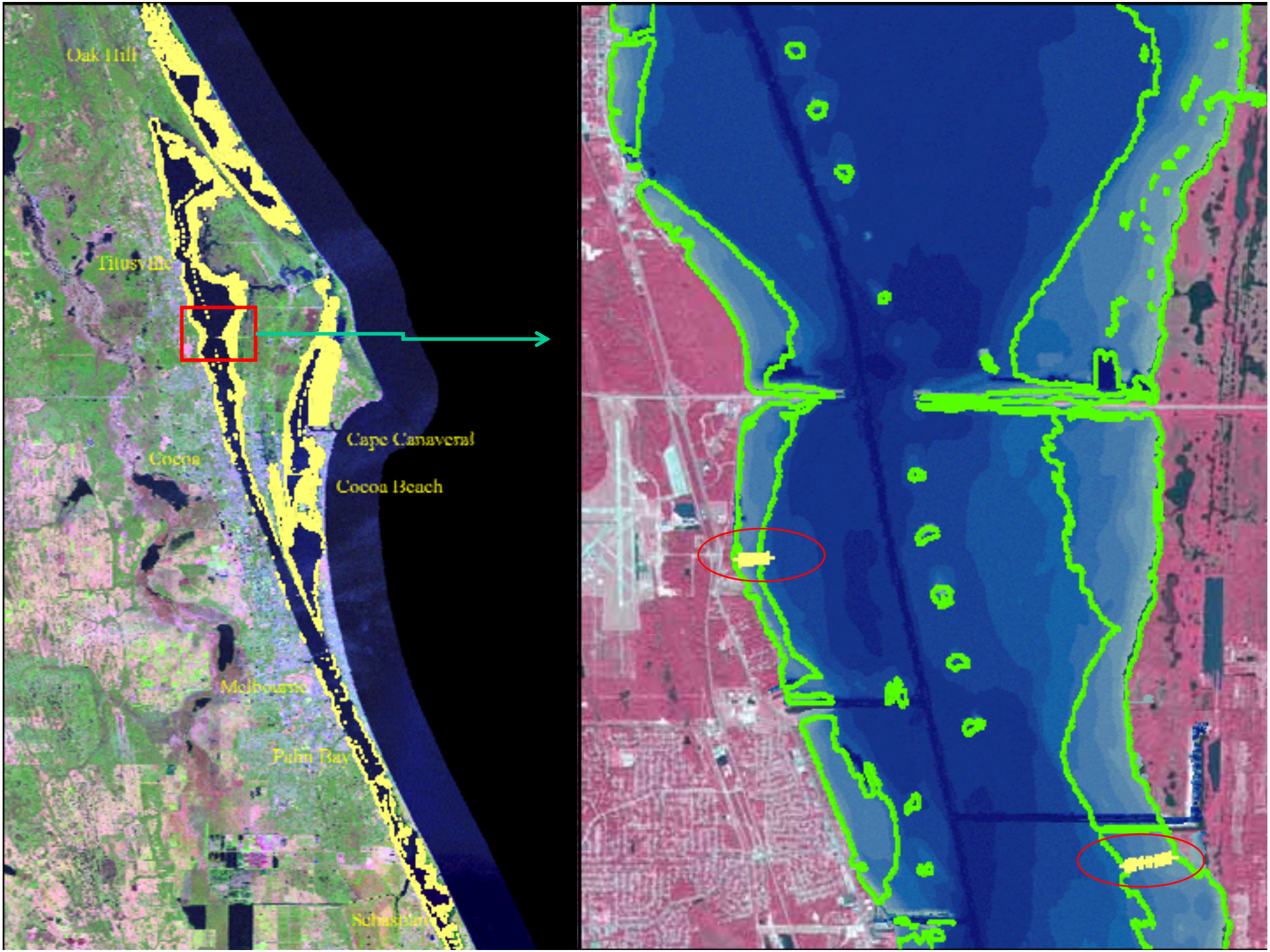
Why Measure the Deep Edge?

- Expansion of seagrass into deeper water indicates improvement in water quality & clarity.
- Light limitation is commonly the principal factor limiting the depth distribution of seagrasses.
- Seagrass depth and light targets are the basis for developing water quality criteria
- Deep edge of seagrass beds are measured bi-annually by some 90 well distributed transects. Each transect starts from shore and advances by 10 meter increments towards the middle of the lagoon till there is no seagrass.
- More extensively deep edge is measured from GIS maps. This is where the power of GIS analysis comes into play.

idea integration.

Light Extinction and Seagrass Survival

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Cocoa
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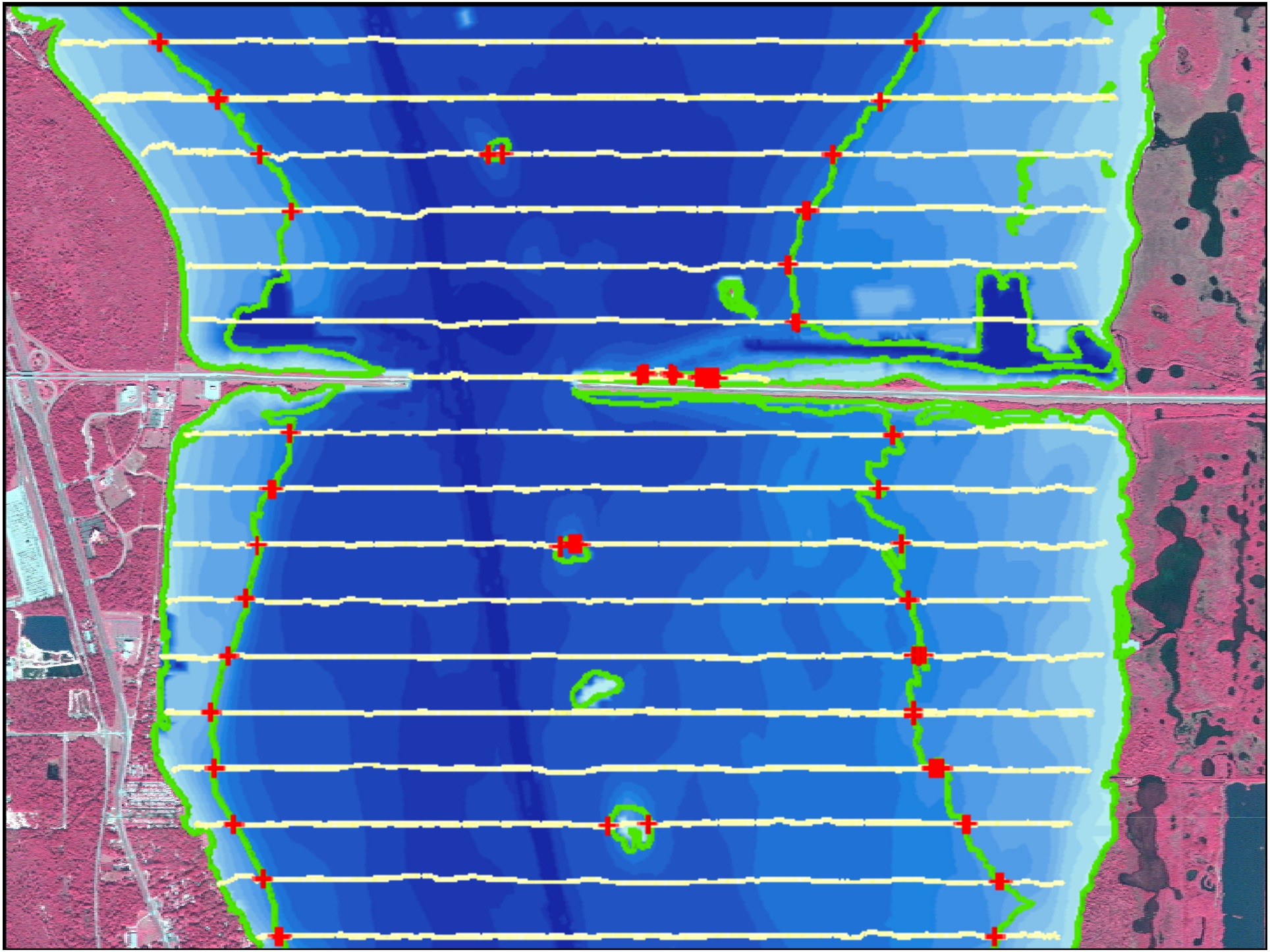
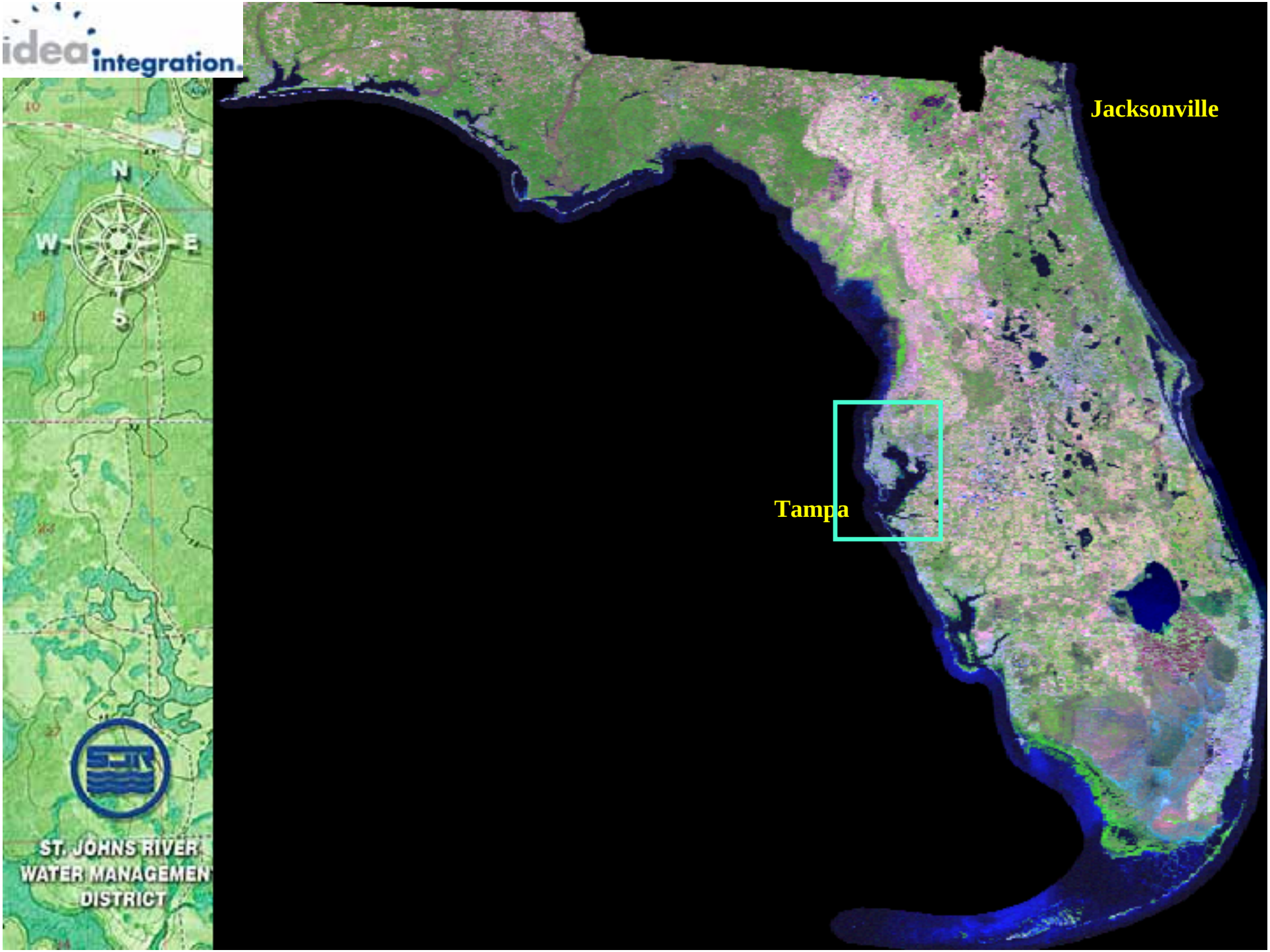
Melbourne
Palm Bay



The SWFWMD Exercise

- In 2006, 2 photo-interpreters (PI) A & B, each interpreted and digitized seagrass polygons from 5 aerial photographs 3 different times.
- The imagery was captured by Digital Mapping Camera (DMC) for St. Joseph Sound / Clearwater Harbor, Tampa Bay area.
- This exercise was managed by Kristen Kaufman. SWFWMD's primary objective was to measure the differences in acreage between PIs.
- Although PIs can duplicate with a fair amount of accuracy the area of a seagrass beds, the spatial placement of those boundary lines, especially the deep edge can vary. Reason: depth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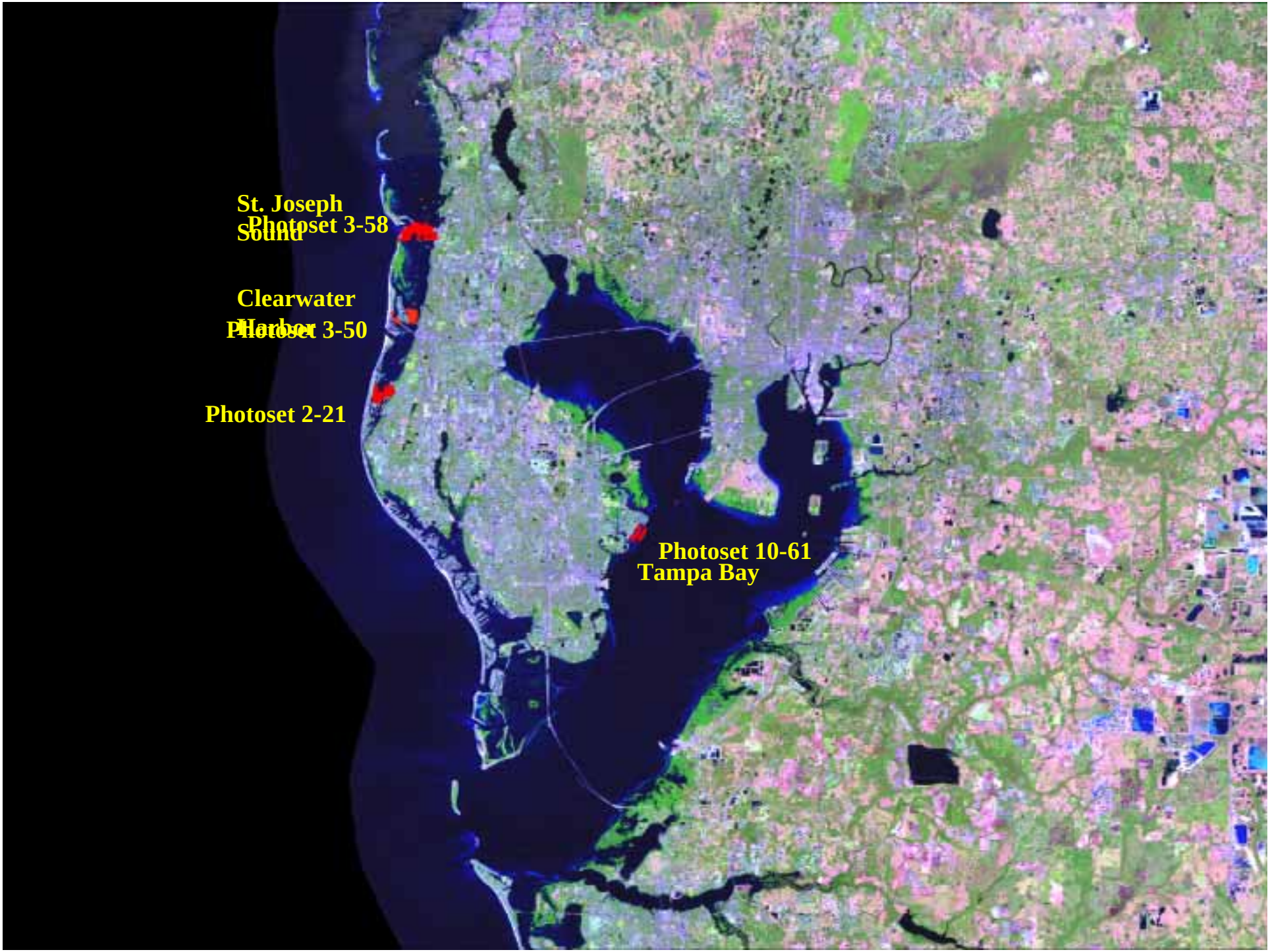

St. Joseph Sound
Photoset 3-58
Clearwater Harbor
Photoset 3-50
Photoset 2-21
Photoset 10-61
Tampa Bay

Variance in Area calculations

Photo Set	PI B	PI A
3-58	seagrass acreage	seagrass acreage
set 1	536.18	513.63
set 2	537.59	516.75
set 3	512.43	511.43
Overall Variance:		**4.53%**

Photo Set	PI B	PI A
3-50	seagrass acreage	seagrass acreage
set 1	176.93	174.55
set 2	174.02	179.52
set 3	176.8	171.11
Overall Variance:		**1.48%**

Photo Set	PI B	PI A
2-21	seagrass acreage	seagrass acreage
set 1	224.78	224.34
set 2	225.86	230.05
set 3	229.17	218.14
Overall Variance:		**2.34%**

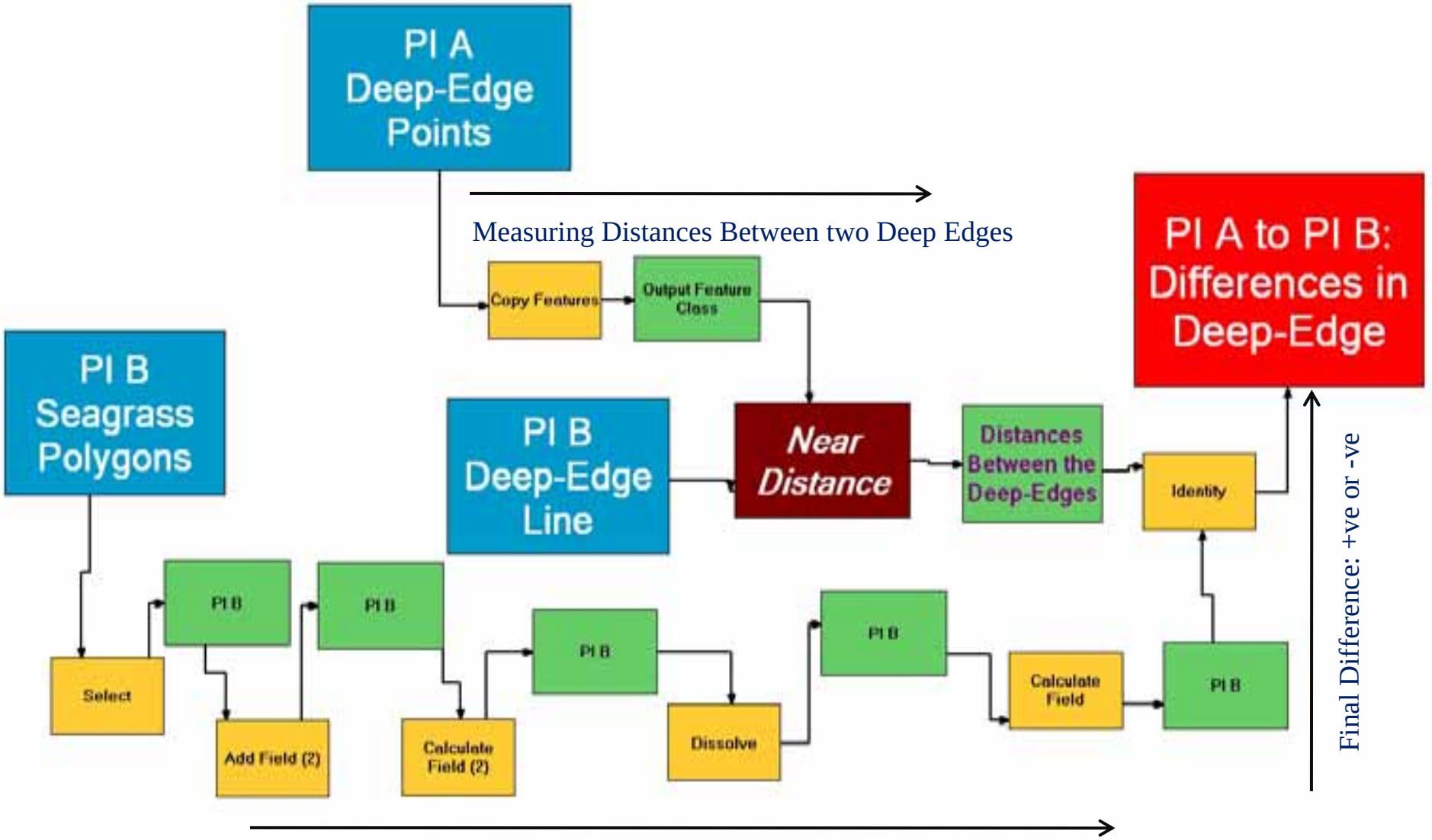
Photo Set	PI B	PI A
10-66	seagrass acreage	seagrass acreage
set 1	96.46	101.71
set 2	95.75	112.31
set 3	95.39	106.99
Overall Variance:		**16.68%**

GIS Methods Utilized:

- ArcMap, ArcEdit, ArcCatalog (Tools & Spatial Model/s)
- X-Tools (to Convert Deep Edge Lines to Equidistant Points)
- Would be Extremely Time Consuming and Tedious to do so by Other Means with Very Low Accuracy.
- Although the Average of the Differences is a good Indicator of Accuracy, the +ve (Gains: Deeper) and –ve (Losses; Shallower) Values lend the data to Statistical Analysis


Measuring Deep Edge for PI A


Minor Differences
Major Differences
Measuring Differnces in Deep Edge
Between PI A <-> PI B



Assigning +ve Values if the Difference is Towards the Deep End and –ve Vice versa

Average Differences in Meters

PI ↓ Photo Sets →	10-66	2-21	3-50	3-58
PI A: 1st to 2nd Mapping	8.02	5.33	6.44	6.9
PI A: 2nd to 3rd Mapping	6.62	7.98	6.52	11.58
PI A: 1st to 3rd Mapping	10.2	7.44	8.51	10.93
PI B: 1st to 2nd Mapping	5.29	4.57	4.81	4.87
PI B: 2nd to 3rd Mapping	4.72	6.62	7.23	11.16
PI B: 1st to 3rd Mapping	3.62	7.36	7.32	9.95
PI A <-> PI B: 1st to 1st Mapping	7.37	7.22	6.83	12.21
PI A <-> PI B: 2nd to 2nd Mapping	6.19	7.79	6.48	11.38
PI A <-> PI B: 3rd to 3rd Mapping	5.31	10.12	8.23	12.32

Statistical Analysis

- The **Sign Test** was employed to determine if differences within and between the PIs were significant

- ***HO***: the median value of the distribution is *m* (generally *m* = 0), values larger (+) and smaller (-) than the median are equally likely.
  - When matched pairs are used, the probability of observing (**A,B**) is equal to that of observing (**B,A**) and the value of **A-B** has median value of **0**.

- P value < **0.05** reject null hypothesis

Sign Test *(* Significant Difference)*

Set 3_58	P Value for Pair 1 to 2	P value for Pair 2 to 3	P value for Pair 1 to 3	Set 3_50	P Value for Pair 1 to 2	P value for Pair 2 to 3	P value for Pair 1 to 3
Photo Interpreter A	0.462	0.003 *	0.001 *	Photo Interpreter A	0.400	0.000 *	0.000 *
Photo Interpreter B	0.100	0.004 *	0.003 *	Photo Interpreter B	0.003 *	0.918	0.185
Set 3_58	**P Value for Pair 1 to 1**	**P value for Pair 2 to 2**	**P Value for Pair 3 to 3**	**Set 3_50**	**P Value for Pair 1 to 1**	**P value for Pair 2 to 2**	**P Value for Pair 3 to 3**
Photo Interpreter A & B	0.000 *	0.012 *	0.024 *	Photo Interpreter A & B	0.642	0.006	0.002 *

Set 10_66	P Value for Pair 1 to 2	P value for Pair 2 to 3	P value for Pair 1 to 3	Set 2_21	P Value for Pair 1 to 2	P value for Pair 2 to 3	P value for Pair 1 to 3
Photo Interpreter A	0.567	0.670	0.012 *	Photo Interpreter A	0.818	0.084	0.003 *
Photo Interpreter B	0.333	0.128	0.674	Photo Interpreter B	0.05	0.507	0.131
Set 10_66	**P Value for Pair 1 to 1**	**P value for Pair 2 to 2**	**P Value for Pair 3 to 3**	**Set 2_21**	**P Value for Pair 1 to 1**	**P value for Pair 2 to 2**	**P Value for Pair 3 to 3**
Photo Interpreter A & B	0.000 *	0.000 *	0.000 *	Photo Interpreter A & B	0.875	0.839	0.091

Conclusion/s

- Seagrass acreages do not differ much between the PIs. Gains & losses cancel each other while drawing the seagrass polygon boundaries. That is OK for SWFWMD where the biomass estimates are important.

- This exercise does not measure the accuracy of deep edge line placement, but only the bias between the PIs as well as the bias when repeated by the same PI.

- Deep Edge: average differences for photo sets ranged from 3.62 meters to 12.32 meters.

- Statistical tests show that there are significant difference between & within PIs for the deep edge line placement.

Recommendations

- If the slope is gentle, few meters difference in deep edge should not matter. If the slope is steep: even small changes can impact the estimates of % light reaching the bottom.

- Suggestion:
  - Conduct an exercise to field verify entire polygons using GPS during the time period when imagery is obtained. Then measure the error.
  - Try to avoid multiple PIs.

- IRL: no new mapping is done each time. Only change polygons are delineated. When changing or drawing a new deep edge employ meticulous use of signatures as well as ground truth.

Acknowledgements

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idea integration.

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Questions/Comments/Suggestions
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