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WorldView-2 Applications: methodological testing and capability in relation to vegetation monitoring in the Everglades

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WorldView-2 Applications: methodological testing and capability in relation to vegetation monitoring in the Everglades

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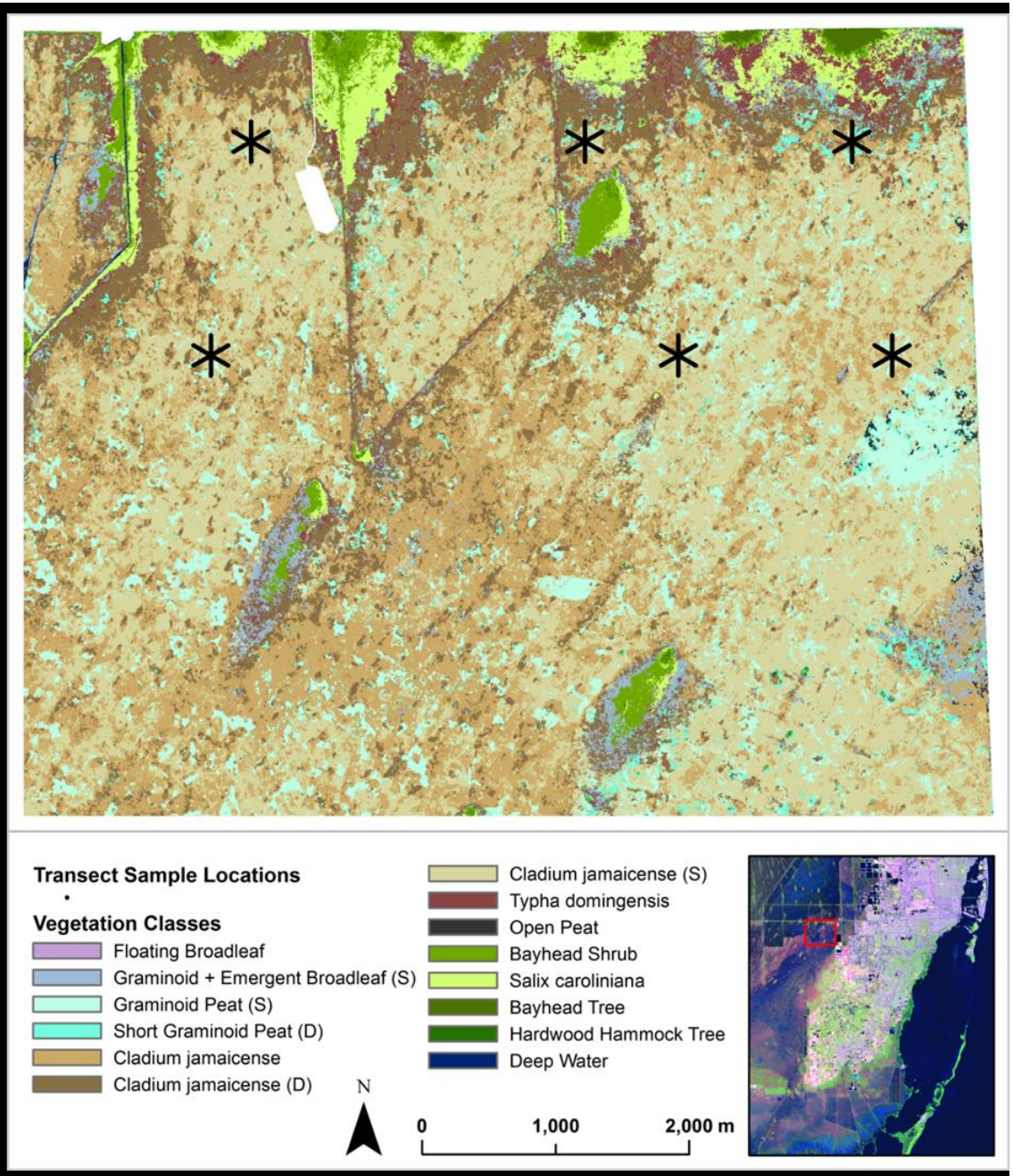
FIU GIS Center
FLORIDA INTERNATIONAL UNIVERSITY

Department of Biological Sciences
SCHOOL OF ENVIRONMENT, ARTS AND SOCIETY

- Remote sensing to map and monitor vegetation trends in the Everglades

Why RS?

- exhaustive coverage of large extents
- permanent record (data archive)
- algorithm - repeatable, consistent, modifiable
- spectral and textural information
- quantitative class definitions
- accuracy and confidence
  - overall (map)



Vegetation map of NESRS derived from bi-seasonal WV2 data; November 2010 & May 2013

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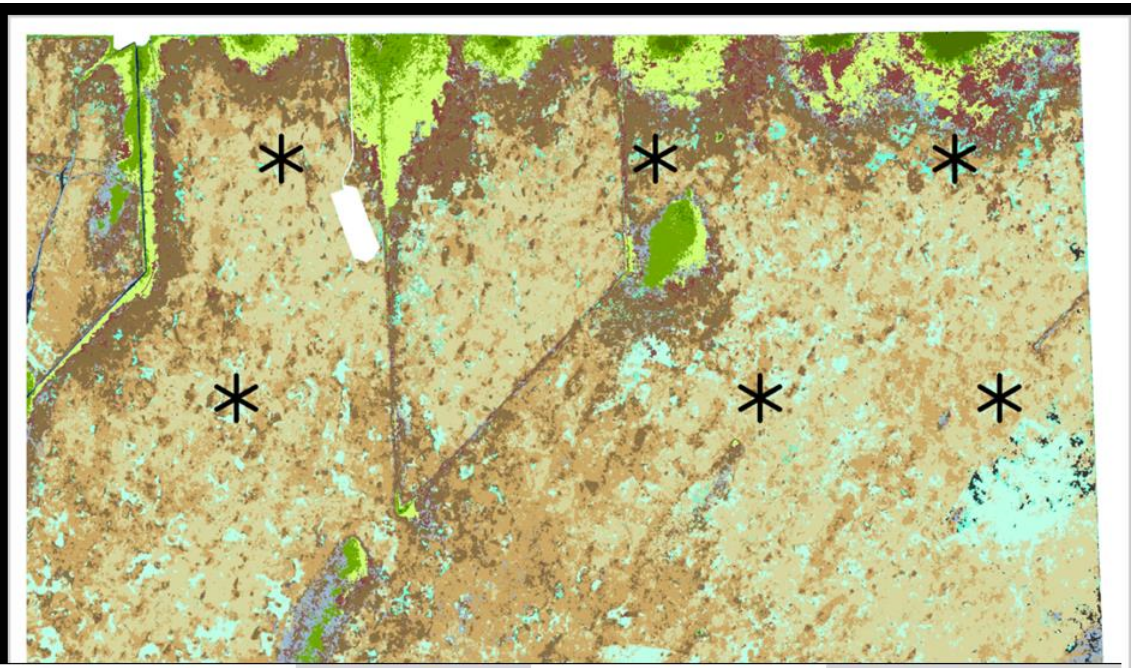
- spectral and textural information
- quantitative class definitions
- accuracy and confidence
  - overall (map)
  - class-specific

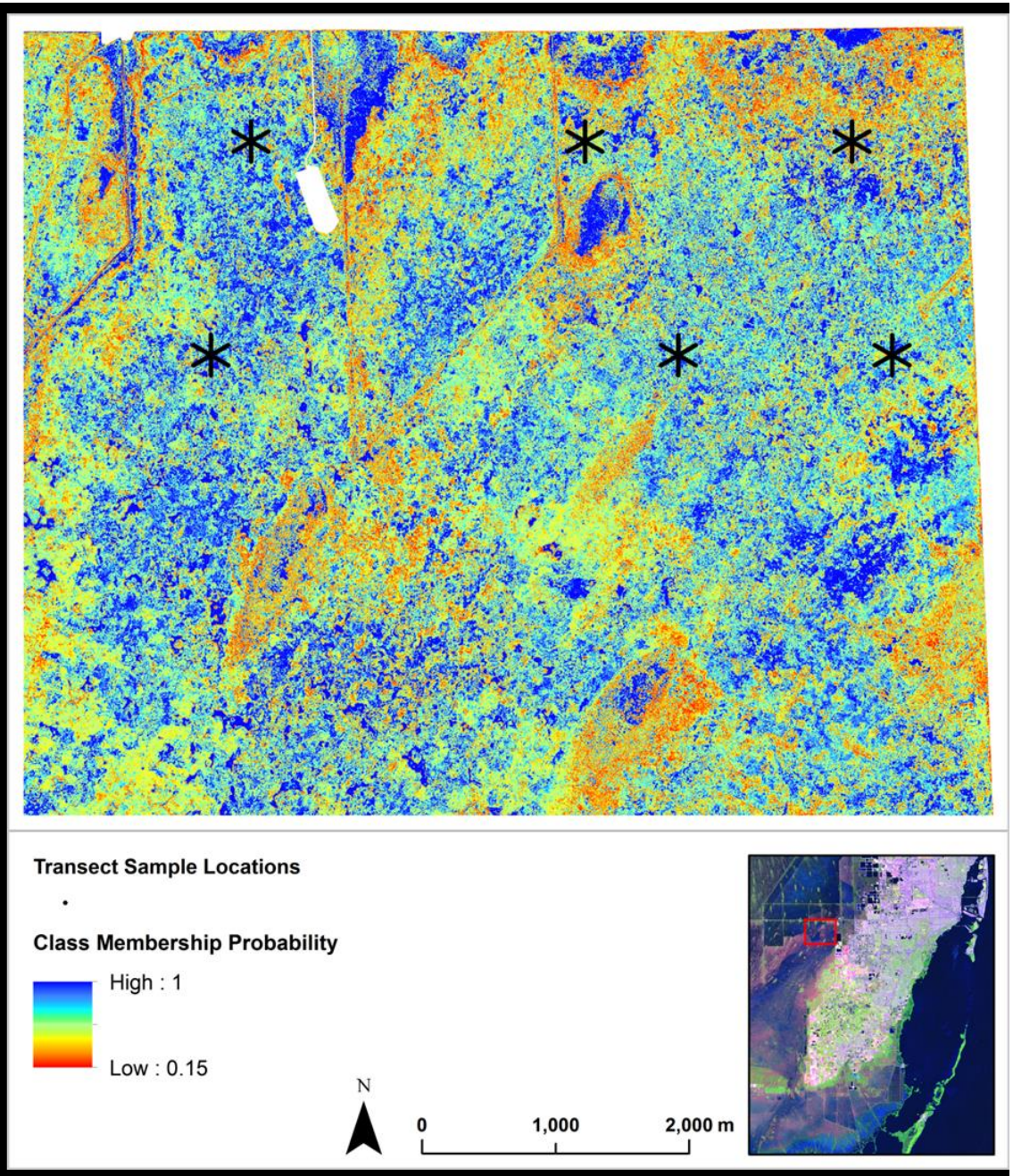


Vegetation Class Name	Floating Broadleaf	Graminoid + Emergent Broadleaf (S)	Graminoid Peat (S)	Short Graminoid Peat (D)	*Cladium jamaicense*	*Cladium jamaicense (D)*	*Cladium jamaicense (S)*	*Typha domingensis*	*Salix caroliniana*	Bayhead Shrub	Bayhead Tree	Hardwood Hammock Tree	Open Peat	Deep Water
Floating Broadleaf	95.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Graminoid + Emergent Broadleaf (S)	0.0	61.9	0.6	1.8	1.5	0.8	0.0	2.3	6.2	0.0	0.0	0.0	0.0	0.0
Graminoid Peat (S)	0.0	5.5	83.3	1.8	0.6	0.5	7.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Short Graminoid Peat (D)	0.0	5.8	3.7	78.3	3.2	3.9	1.8	3.3	0.0	3.0	0.0	0.0	0.0	0.0
Cladium jamaicense	0.0	2.3	1.0	3.9	74.9	8.0	8.1	2.5	0.0	0.0	0.0	0.0	0.0	0.0
Cladium jamaicense (D)	0.0	7.7	0.8	5.7	11.3	83.0	0.4	13.1	0.0	1.1	0.0	0.0	0.0	0.0
Cladium jamaicense (S)	0.0	6.8	9.5	4.1	7.1	1.5	81.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Typha domingensis	4.9	5.8	1.2	2.6	0.9	2.3	0.1	77.1	3.1	1.9	0.0	0.0	0.0	0.0
Salix caroliniana	0.0	2.9	0.0	0.2	0.4	0.0	0.0	0.4	86.3	0.0	0.0	0.0	0.0	0.0
Bayhead Shrub	0.0	1.3	0.0	1.2	0.0	0.0	0.0	0.4	4.3	93.7	0.0	5.9	0.0	0.0
Bayhead Tree	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
Hardwood Hammock Tree	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	94.1	0.0	0.0
Open Peat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.7	0.0
Deep Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	100

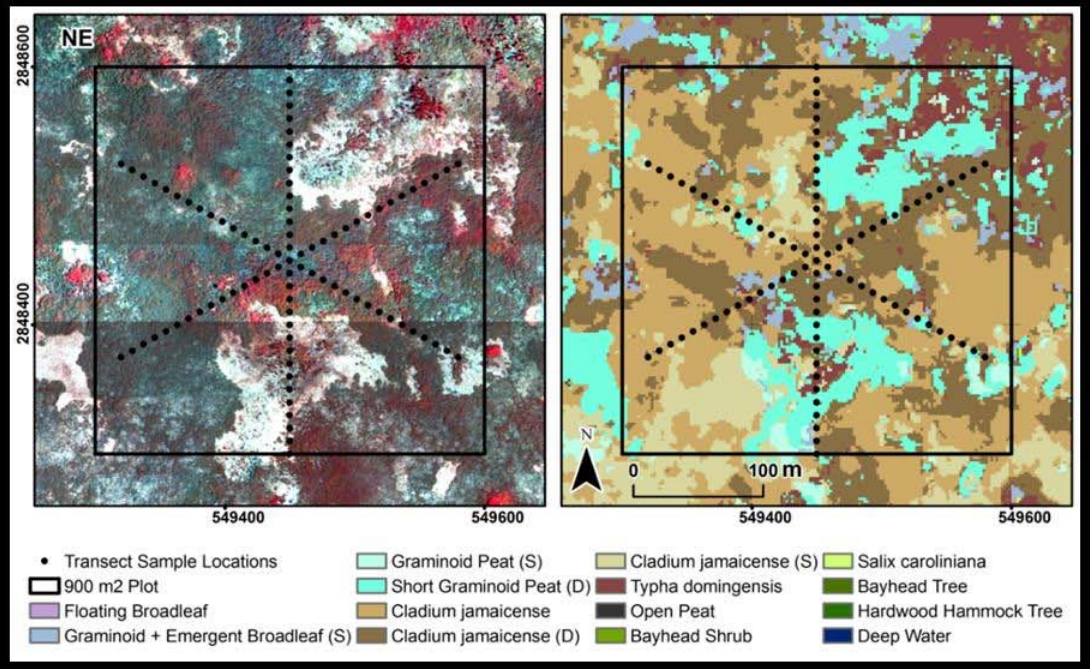
- Remote sensing to map and monitor vegetation trends in the Everglades

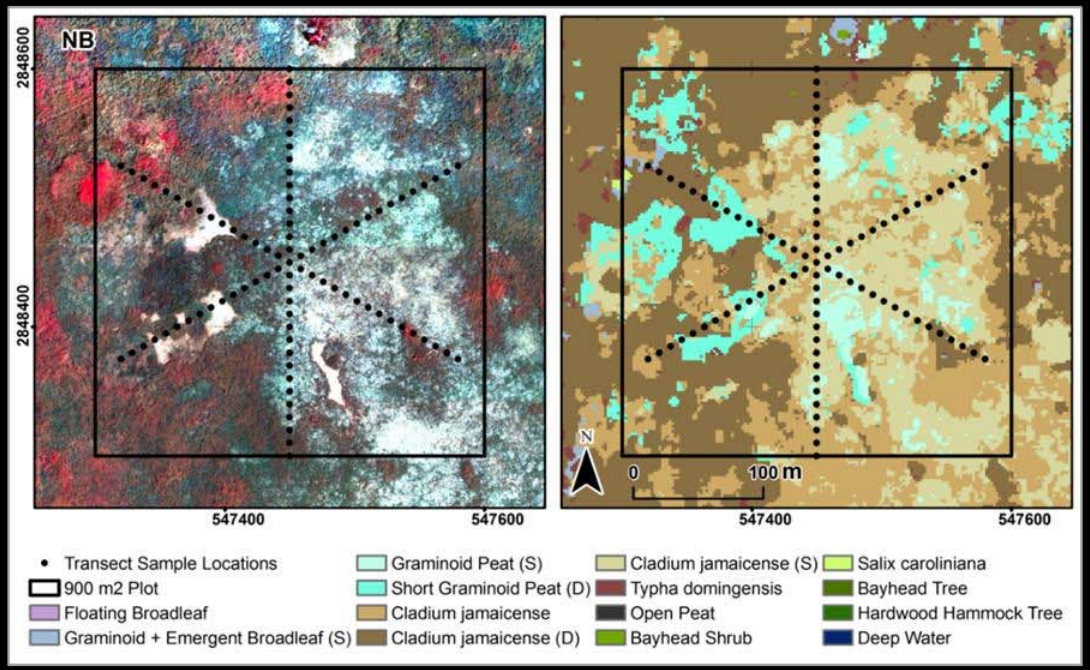
Why RS?

- exhaustive coverage of large extents
- permanent record (data archive)
- algorithm - repeatable, consistent, modifiable
- spectral and textural information
- quantitative class definitions
- accuracy and confidence
  - overall (map)
  - class-specific
  - location-specific (probability of class membership)



Abundance estimates at high spatial precision

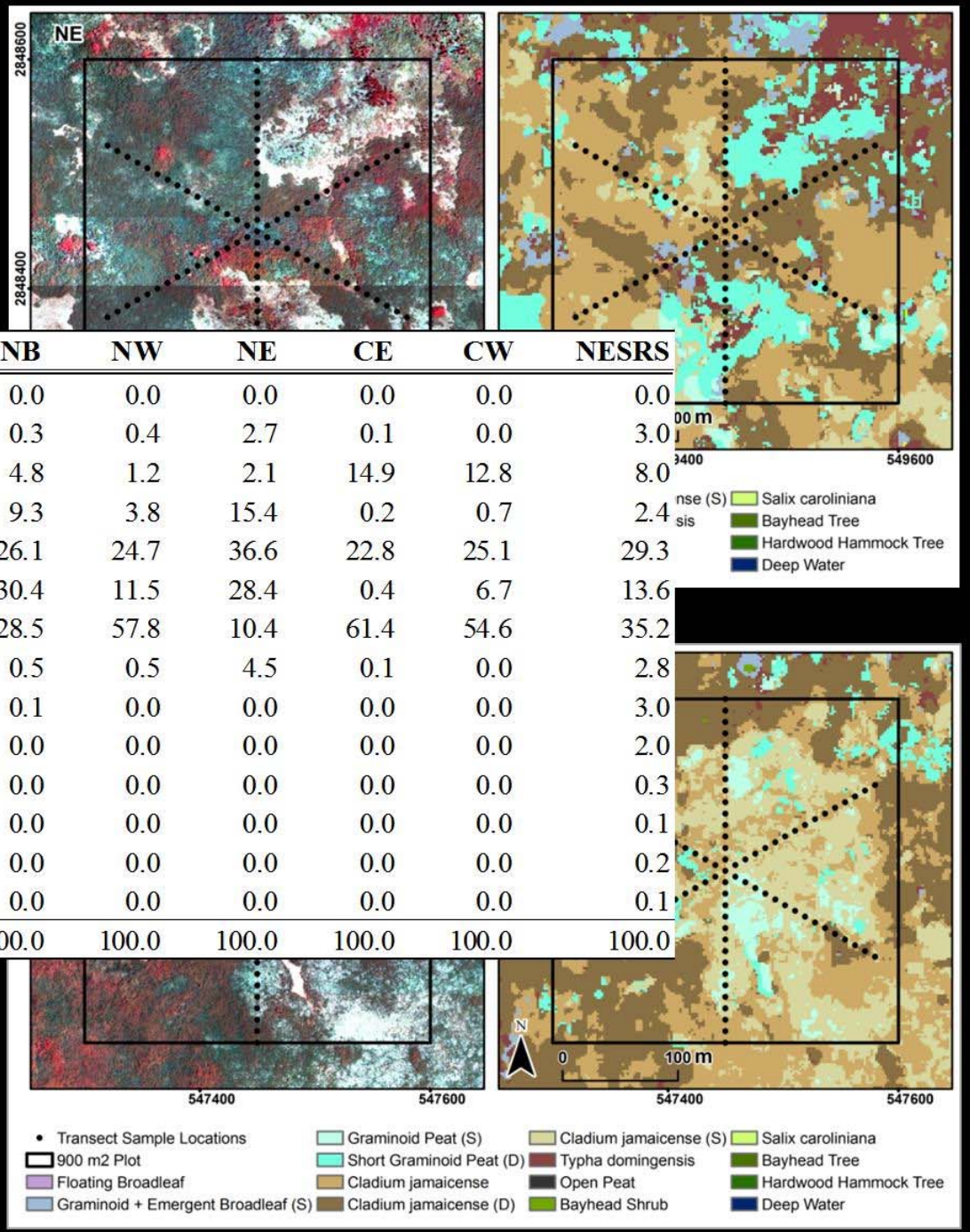




Abundance estimates at high spatial precision

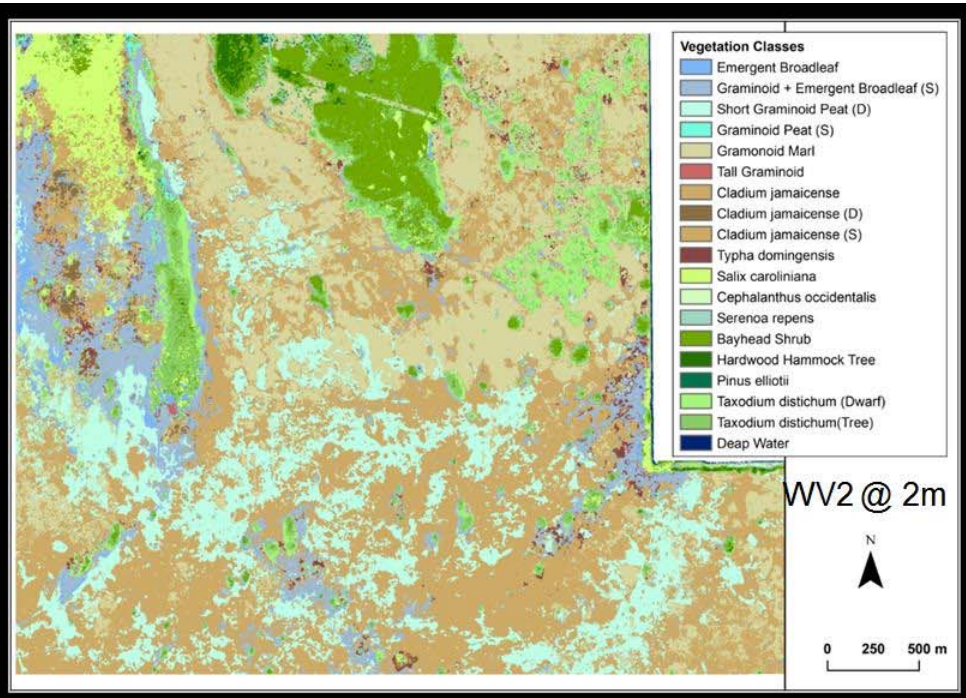
Vegetation Class Name	CB	NB	NW	NE	CE	CW	NESRS
Floating Broadleaf	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Graminoid + Emergent Broadleaf (S)	0.0	0.3	0.4	2.7	0.1	0.0	3.0
Graminoid Peat (S)	14.7	4.8	1.2	2.1	14.9	12.8	8.0
Short Graminoid Peat (D)	0.2	9.3	3.8	15.4	0.2	0.7	2.4
Cladium jamaicense	24.2	26.1	24.7	36.6	22.8	25.1	29.3
***Cladium jamaicense* (D)**	4.8	30.4	11.5	28.4	0.4	6.7	13.6
***Cladium jamaicense* (S)**	55.9	28.5	57.8	10.4	61.4	54.6	35.2
Typha domingensis	0.1	0.5	0.5	4.5	0.1	0.0	2.8
Salix caroliniana	0.0	0.1	0.0	0.0	0.0	0.0	3.0
Bayhead Shrub	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Bayhead Tree	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Hardwood Hammock Tree	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Open Peat	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Deep Water	0.0	0.0	0.0	0.0	0.0	0.0	0.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2 Abundance of vegetation and non-vegetative classes used for mapping in northeast Shark River Slough (NESRS) study area. Data are percent mapped. D = dense; S = sparse. Locations: NW = northwest; NB = north bridge; NE = north east; CW = central west; CB = central bridge; CE = central east



Thematic Precision

- Class definitions
  - monotypic and mixes



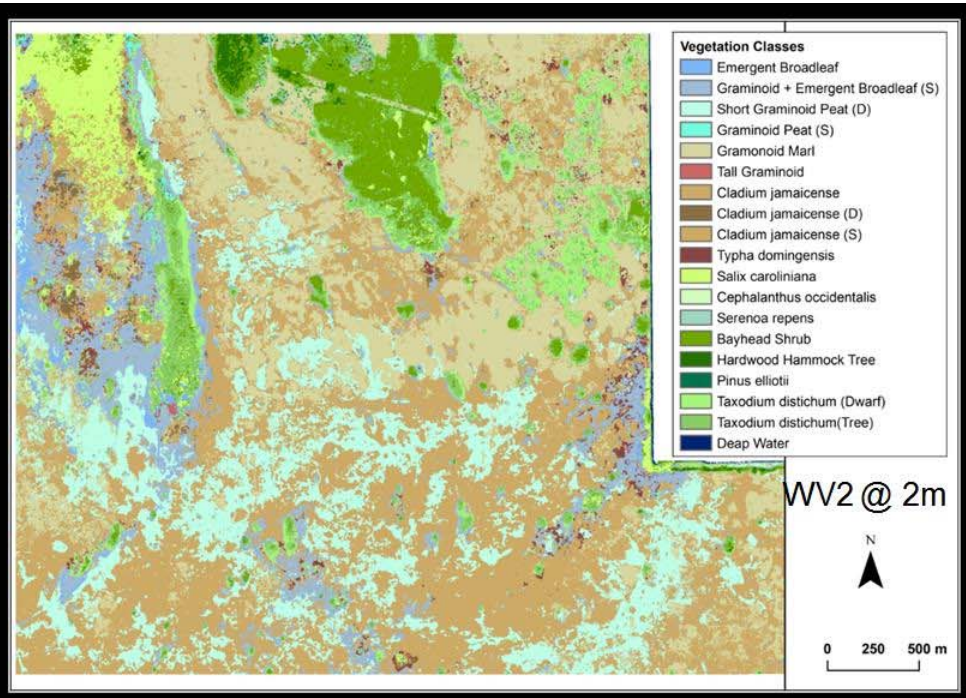
Vegetation map, southern Taylor Slough

Thematic Precision

- Class definitions
  - monotypic and mixes

Spectral Resolution

- Number of bands
- Bandwidth + distribution



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Thematic Precision

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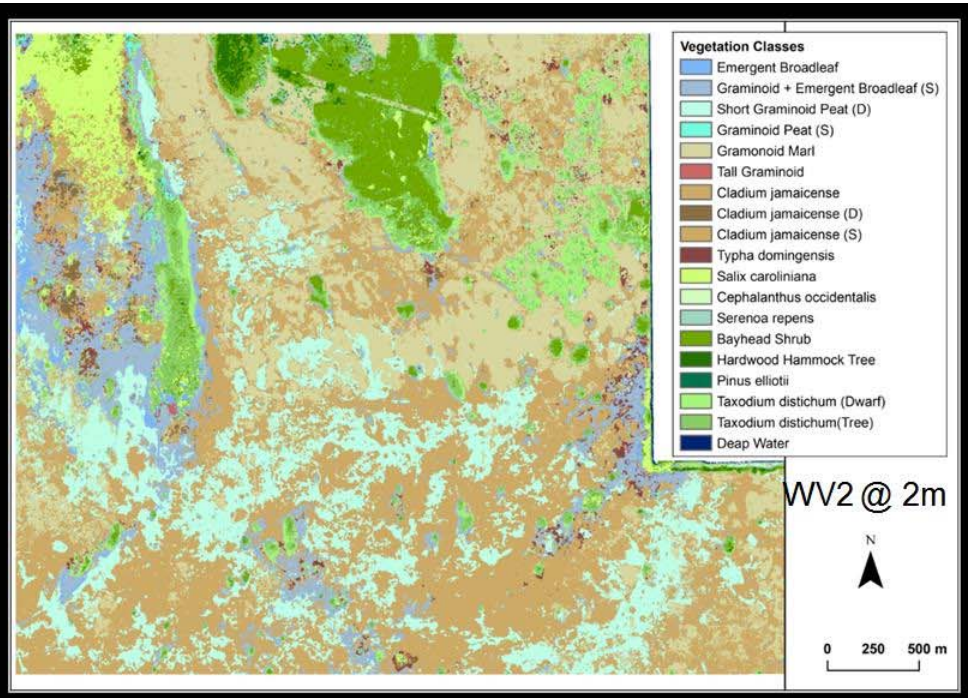
Spectral Resolution

- Number of bands
- Bandwidth + distribution

Radiometric Resolution

- Quantization in bits
  - number of grey levels
  - data precision



Vegetation map, southern Taylor Slough

Thematic Precision

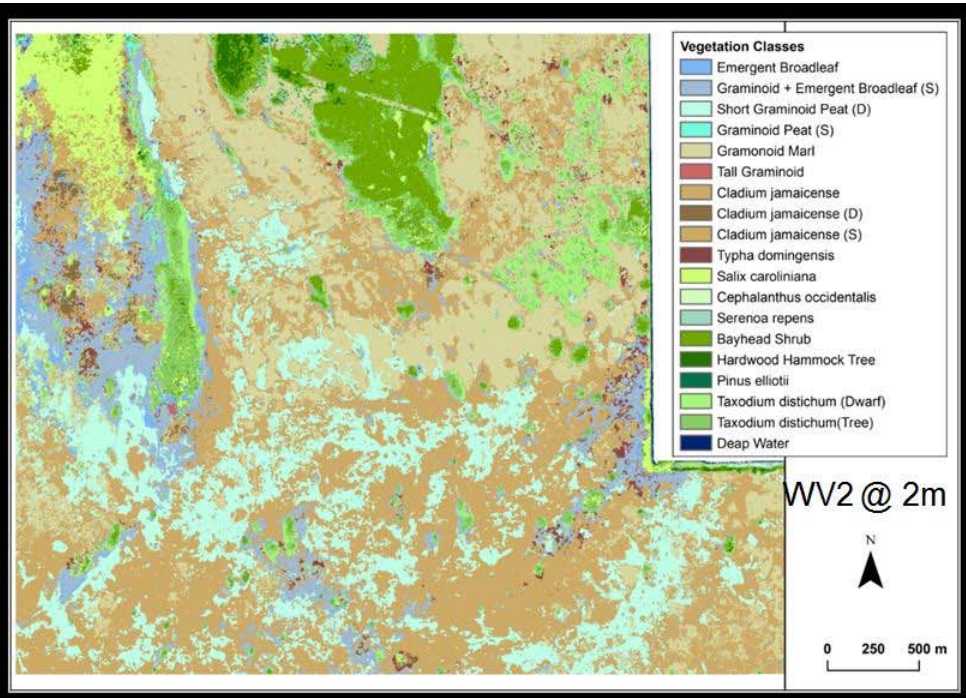
- Class definitions
  - monotypic and mixes
- At what spatial scale?

Spectral Resolution

- Number of bands
- Bandwidth + distribution

Radiometric Resolution

- Quantization in bits
  - number of grey levels
  - data precision



Vegetation map, southern Taylor Slough

Thematic Precision

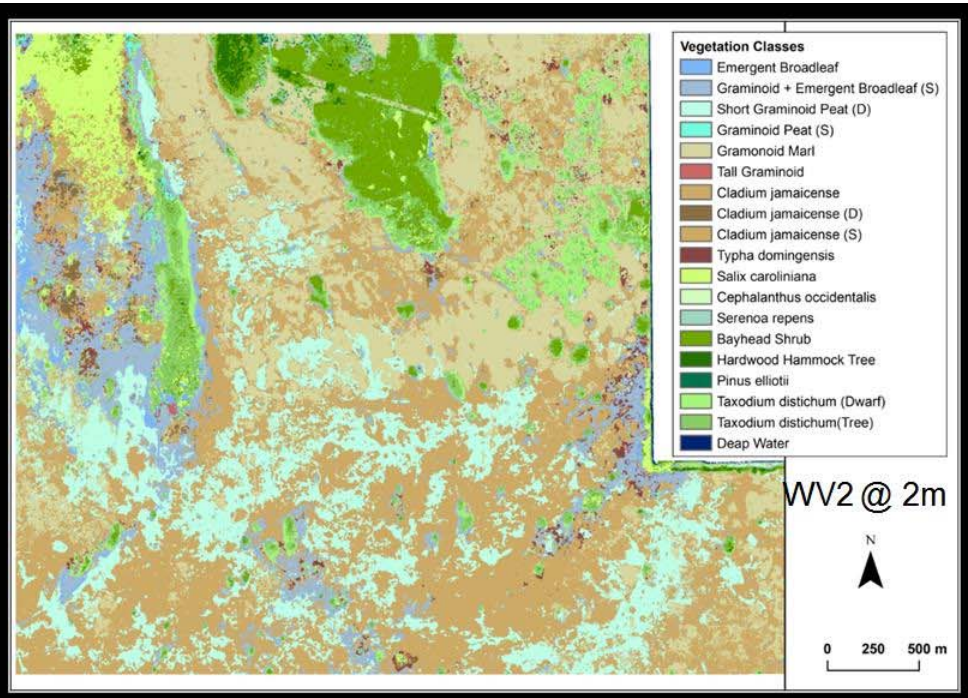
- Class definitions
  - monotypic and mixes
- At what spatial scale?
  - patch size of interest
  - vegetation heterogeneity

Spectral Resolution

- Number of bands
- Bandwidth + distribution

Radiometric Resolution

- Quantization in bits
  - number of grey levels
  - data precision



Vegetation map, southern Taylor Slough

Thematic Precision

- Class definitions
  - monotypic and mixes
- At what spatial scale?
  - patch size of interest
  - vegetation heterogeneity

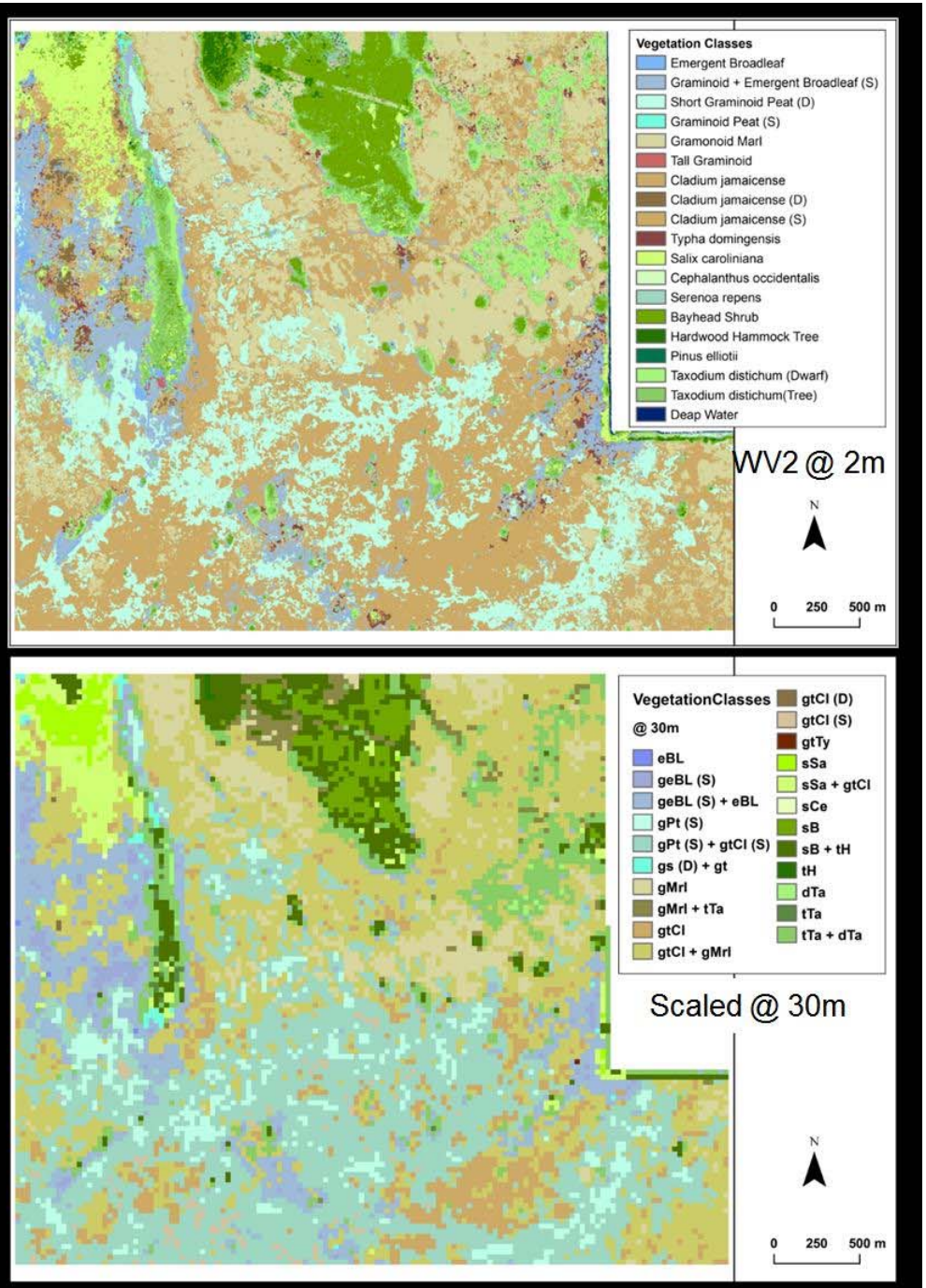
Spectral Resolution

- Number of bands
- Bandwidth + distribution

Radiometric Resolution

- Quantization in bits
  - number of grey levels
  - data precision

Spatial Resolution



Vegetation maps, southern Taylor Slough

Thematic Precision

- Class definitions
  - monotypic and mixes
- At what spatial scale?
  - patch size of interest
  - vegetation heterogeneity
- Change definitions
- At what temporal scale?
  - change vs. natural variability

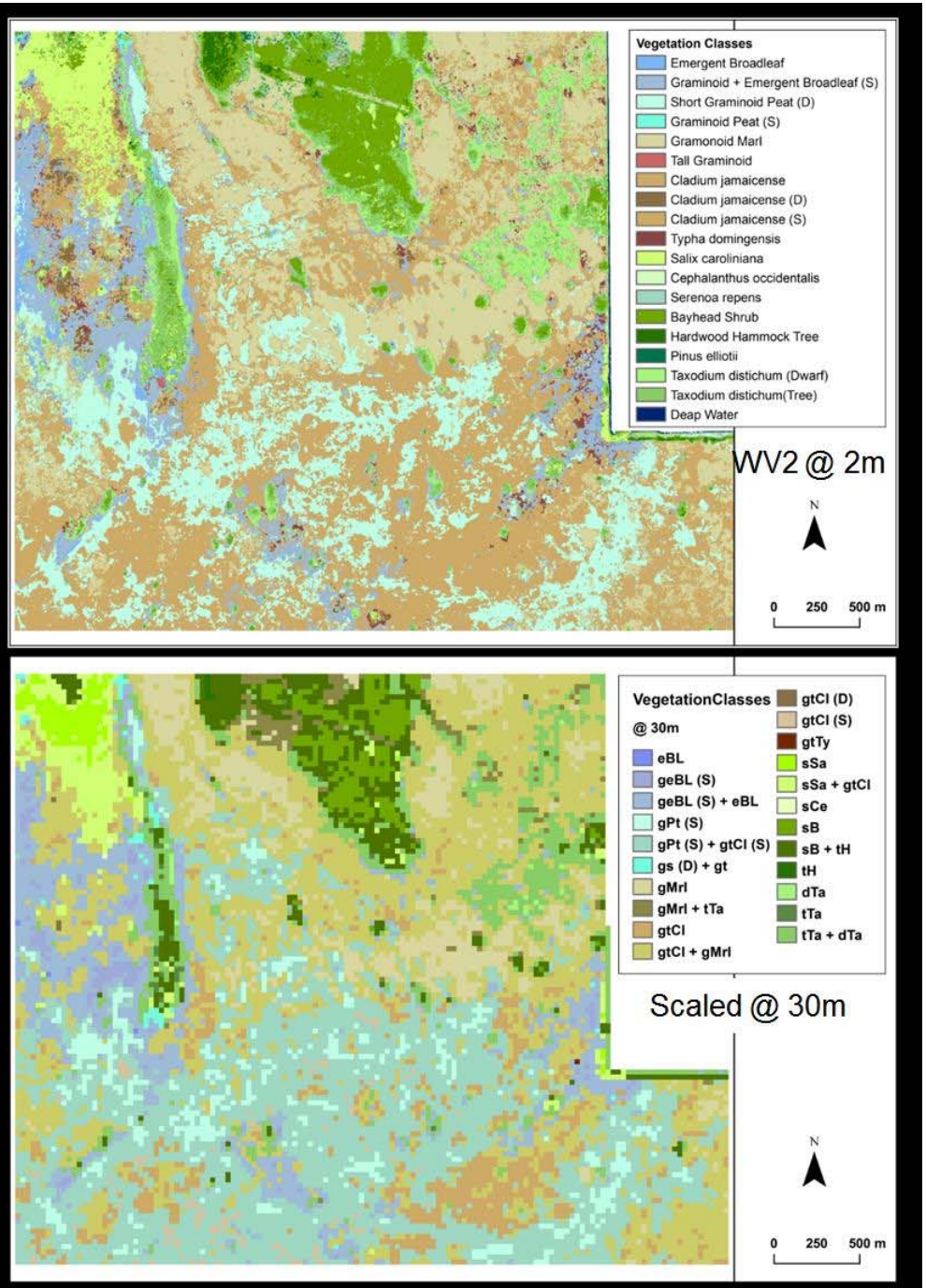
Spectral Resolution

- Number of bands
- Bandwidth + distribution

Radiometric Resolution

- Quantization in bits
  - number of grey levels
  - data precision

Spatial Resolution



Vegetation maps, southern Taylor Slough

Thematic Precision

- Class definitions
  - monotypic and mixes
- At what spatial scale?
  - patch size of interest
  - vegetation heterogeneity
- Change definitions
- At what temporal scale?
  - change vs. natural variability

Spectral Resolution

- Number of bands
- Bandwidth + distribution

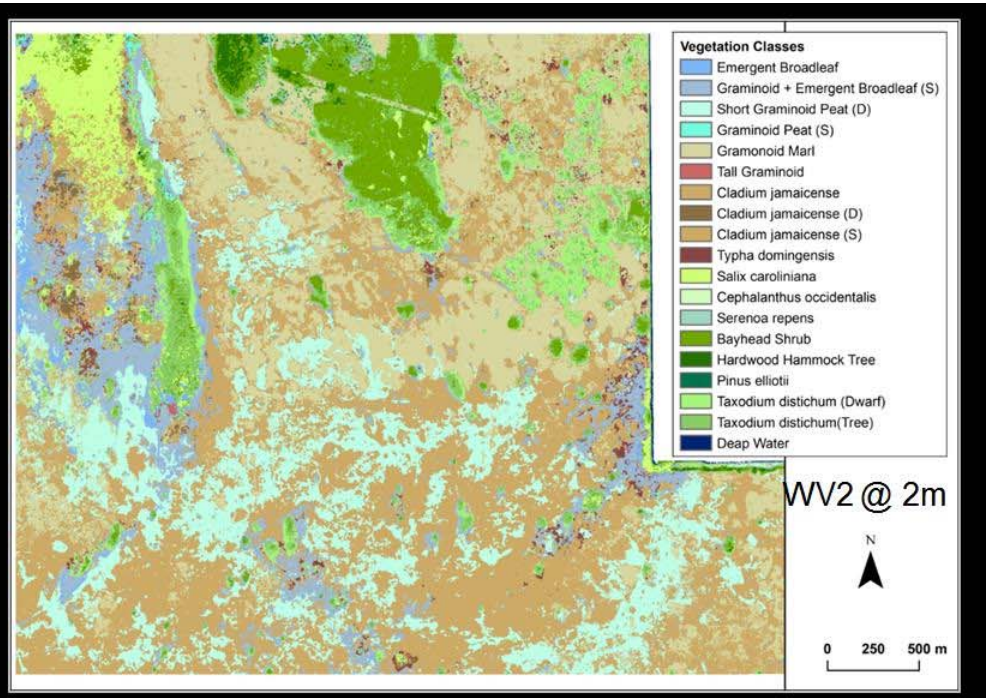
Radiometric Resolution

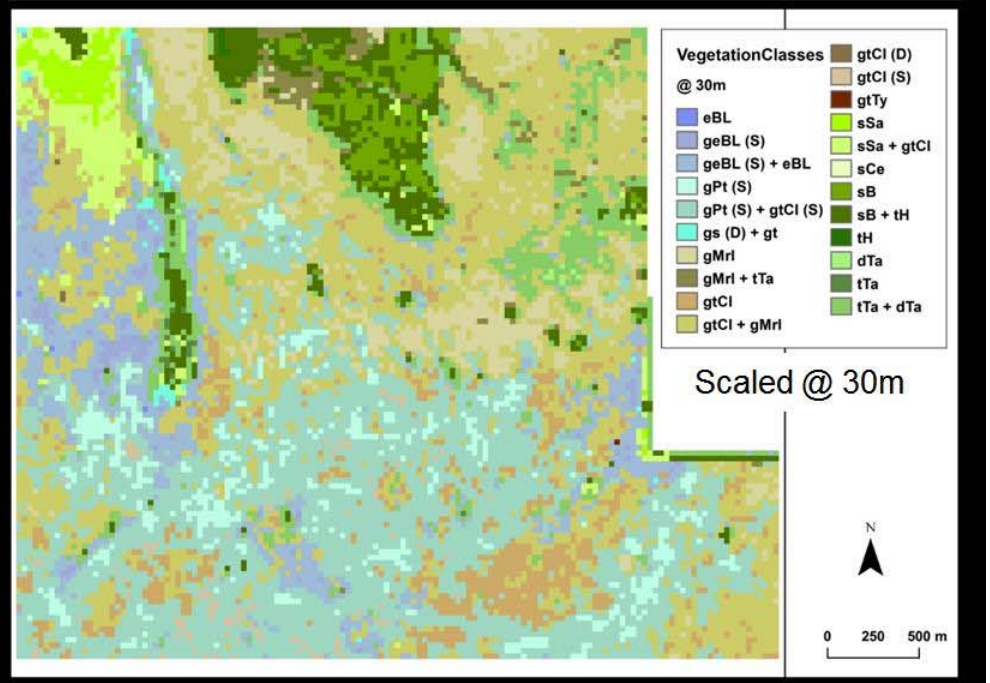
- Quantization in bits
  - number of grey levels
  - data precision

Spatial Resolution

Temporal Resolution

- Frequency to capture persistence of change





Vegetation maps, southern Taylor Slough

Remote Sensing Data Source Available at No Cost to ENP

Satellite	Sensor	Type	Spectral	Wavelength Range (nm)	Spatial (m)	Radiometric (bit)	Product (bit)	Temporal (days)	KB/km2	GB/ENP	Total Size (GB)
Landsat 5	Thematic Mapper - TM	MS	6	450 - 2,350	30	8	8	16	6.67	0.04	0.04
		TH	1	10,400 - 12,500	120	8	8		0.07	0.00	
Landsat 7	Enhanced Thematic Mapper - ETM	PAN	1	520 - 900	15	8	8	16	4.44	0.03	0.07
		MS	6	450 - 2,350	30	8	8		6.67	0.04	
		TH	2	10,400 - 12,500	60	8	8		0.56	0.00	
Landsat 8	Operational Land Imager - OLI	PAN	1	500 - 680	15	12	16	16	8.89	0.05	0.17
		MS	8	430 - 1,380	30	12	16		17.78	0.11	
	Thermal Infrared Scanner - TIRS	TH	2	10,600 - 12,510	100	12	16		0.40	0.00	
World View 2		PAN	1	450 - 800	0.46	11	16	1.1 - 3.7	9,451.80	57.70	86.24
		MS	8	400 - 1,040	1.85	11	16		4,674.95	28.54	
World View 3		PAN	1	450 - 800	0.31	11	16	1 - 4.5	20,811.65	127.05	197.87
		MS	8	400 - 1,040	1.24	11	16		10,405.83	63.53	
		SWIR	8	1,195 - 2,365	3.7	14	16		1,168.74	7.13	
		CAVIS	12	405 - 2,245	30	11	16		26.67	0.16	

Reference Data Sources

Airborne	Sensor	Spectral	Wavelength Range (nm)	Spatial (m)
Aerial Photography	Digital Photography	3 to 4	CIR, RGB	~0.3
UAS	Digital Photography	3 to 4	CIR, RGB	~0.01
Google, Bing, etc.	Multiple	3	RGB	~0.3 -

Integrated multi-scale approach

- big data – co-registration of RS and reference data
- requires spatial scaling of vegetation class scheme
- high-performance computing (parallel processing)
- crowd-sourcing?