Mangrove Expansion Rates in the Apalachicola Bay region of Florida

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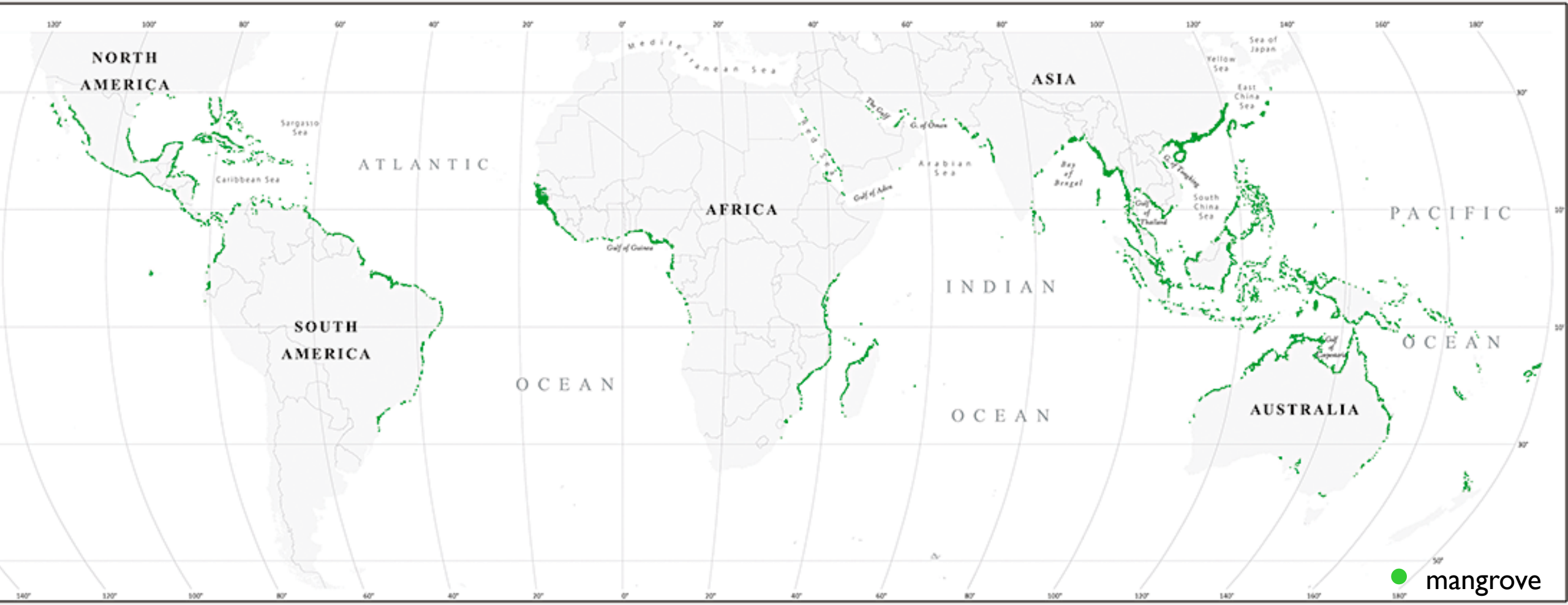
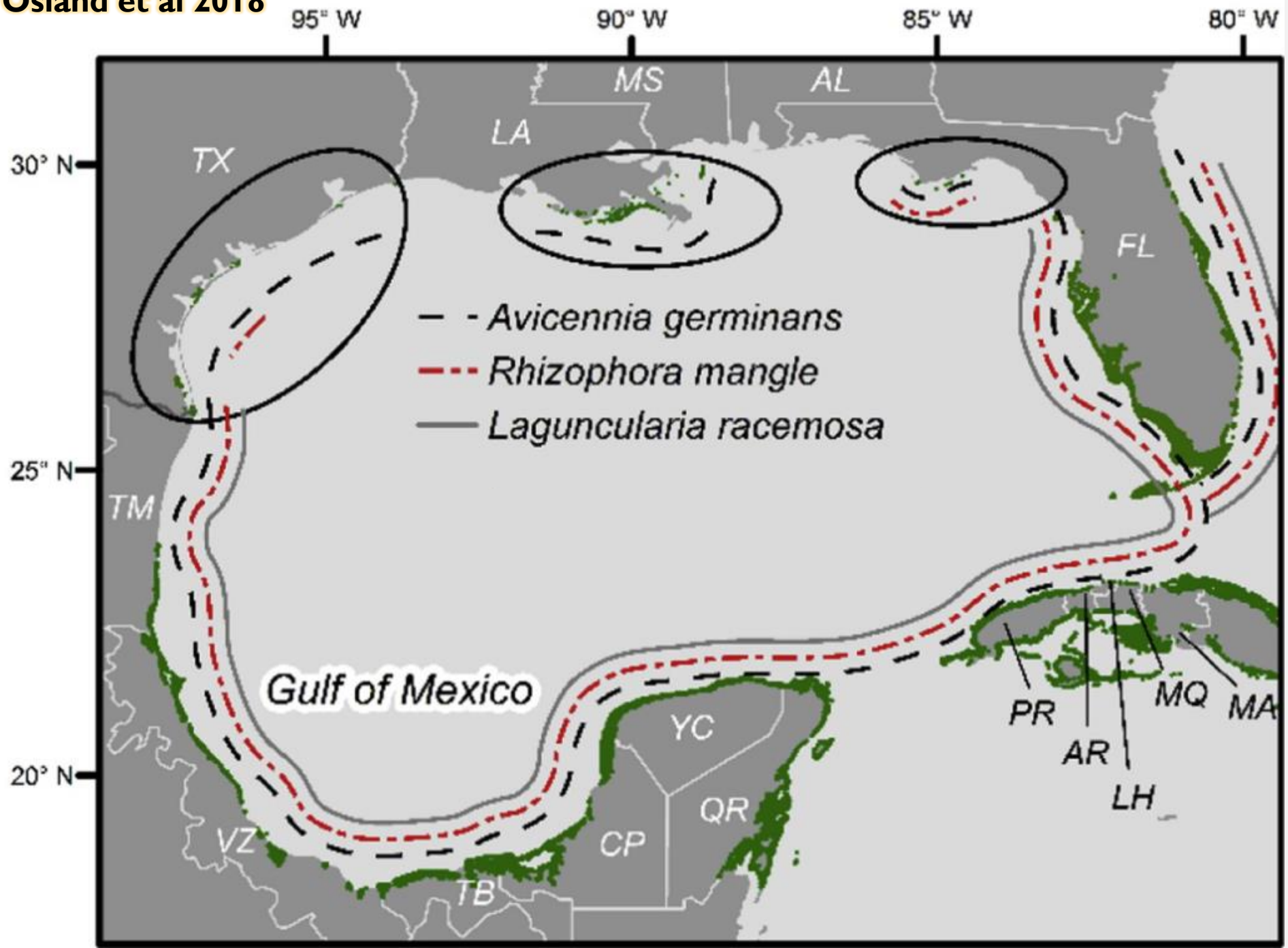
Jason Garwood, Research Director- Apalachicola National Estuarine Research Reserve

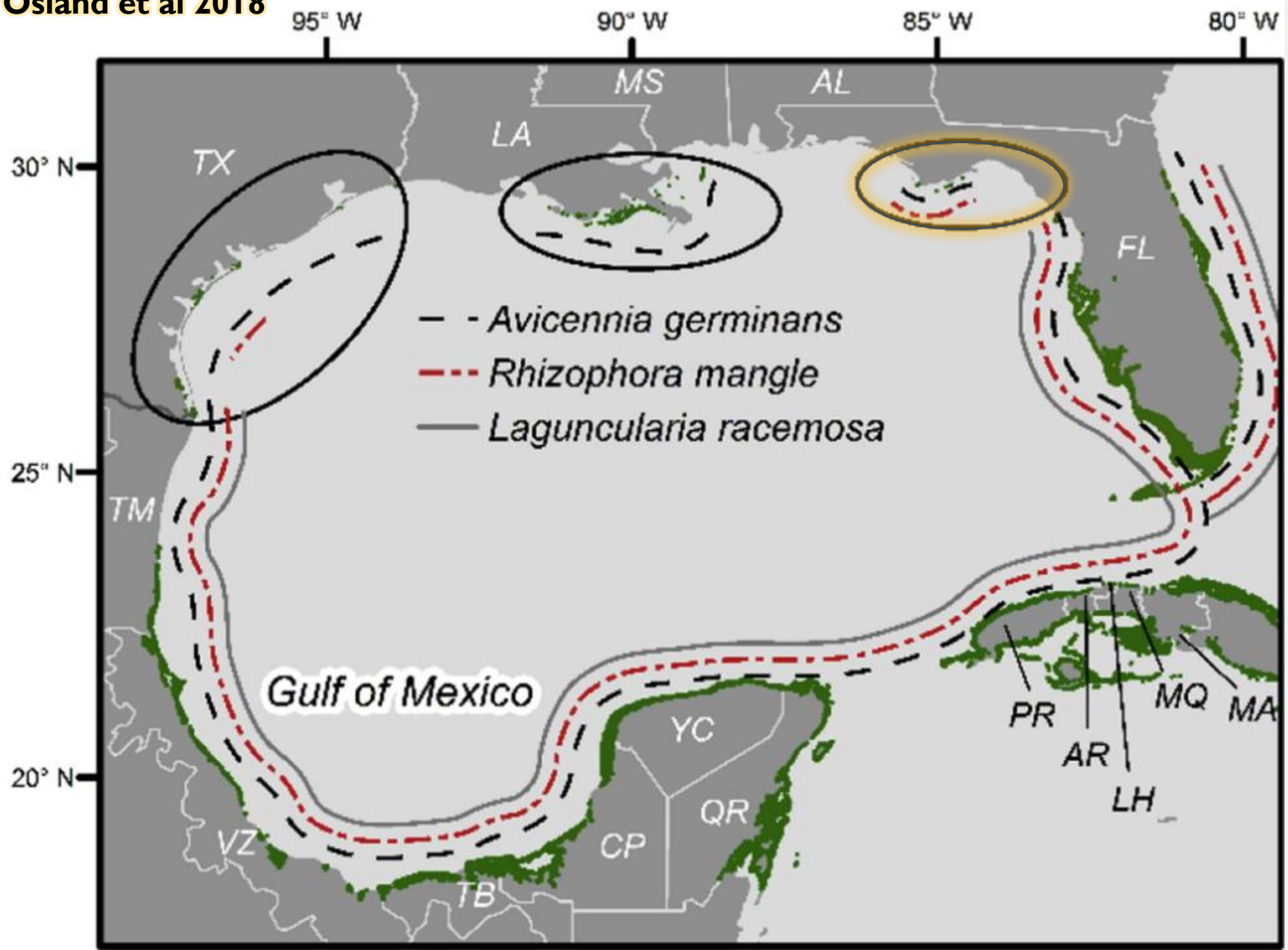
Giri et al 2011



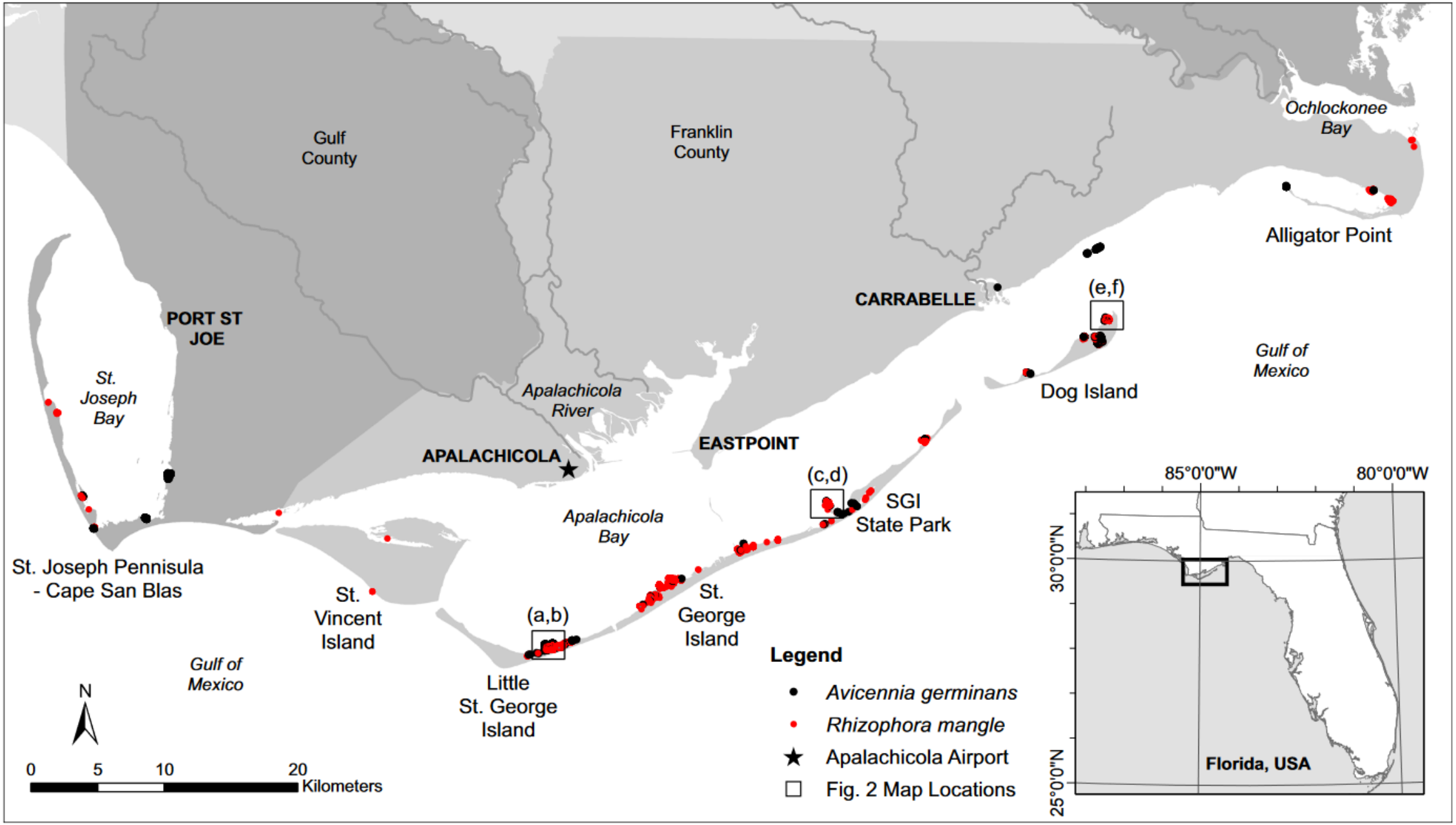
Osland et al 2018



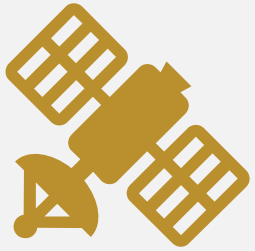
Osland et al 2018



Snyder et al 2021



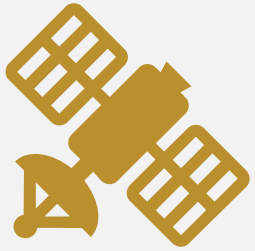
REMOTE SENSING



Platforms

Satellite
Aircraft
Drones
Ground-based platforms

REMOTE SENSING



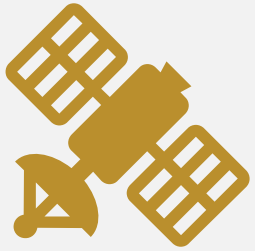
Platforms

Satellite
Aircraft
Drones
Ground-based platforms

Scale

Global
Regional
Local

REMOTE SENSING



Platforms

Satellite
Aircraft
Drones
Ground-based platforms

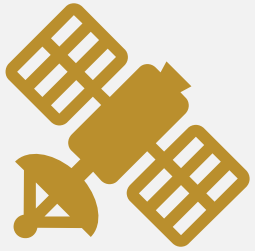
Scale

Global
Regional
Local

Sensors

Passive
Active

REMOTE SENSING



Platforms

Satellite
Aircraft
Drones
Ground-based platforms

Scale

Global
Regional
Local

Sensors

Passive
Active

Applications

Habitat inventory
Biomass estimation
Wetland health
Habitat changes

RATE OF MANGROVE EXPANSION IN APALACHICOLA BAY FLORIDA

Platforms

Satellite
Aircraft
Drones
Ground-based platforms

Scale

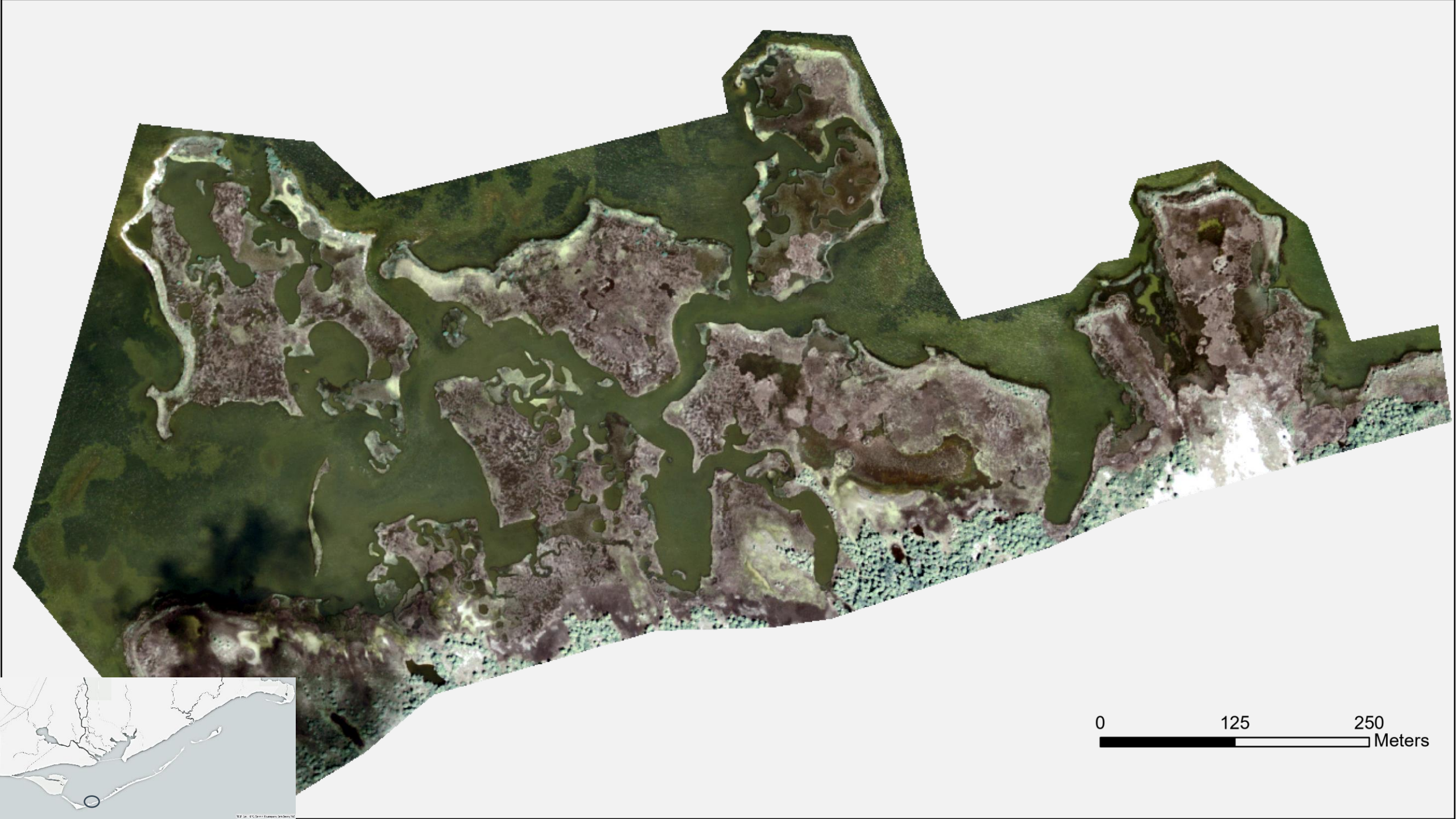
Global
Regional
Local

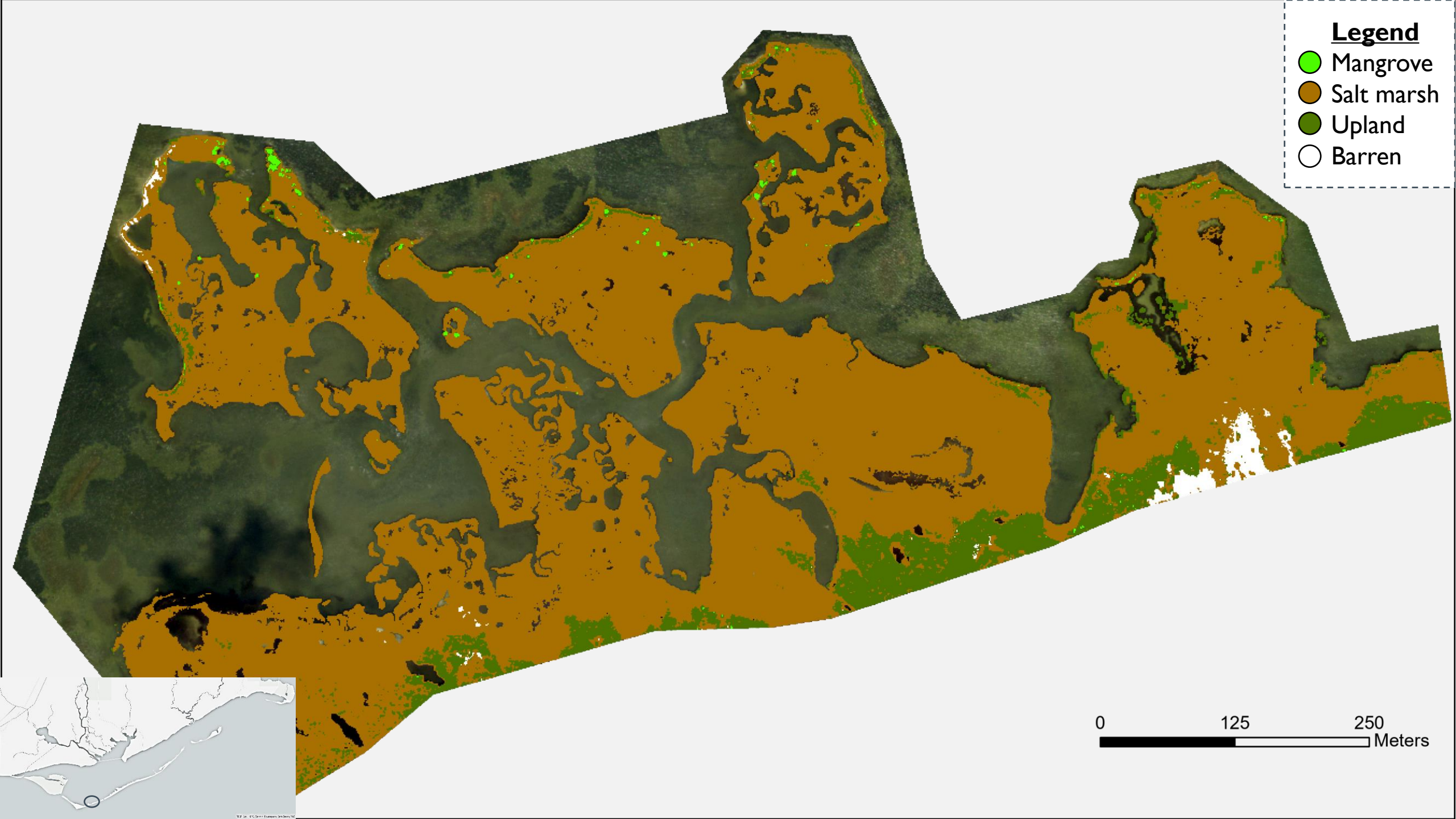
Sensors

Passive
Active

Applications

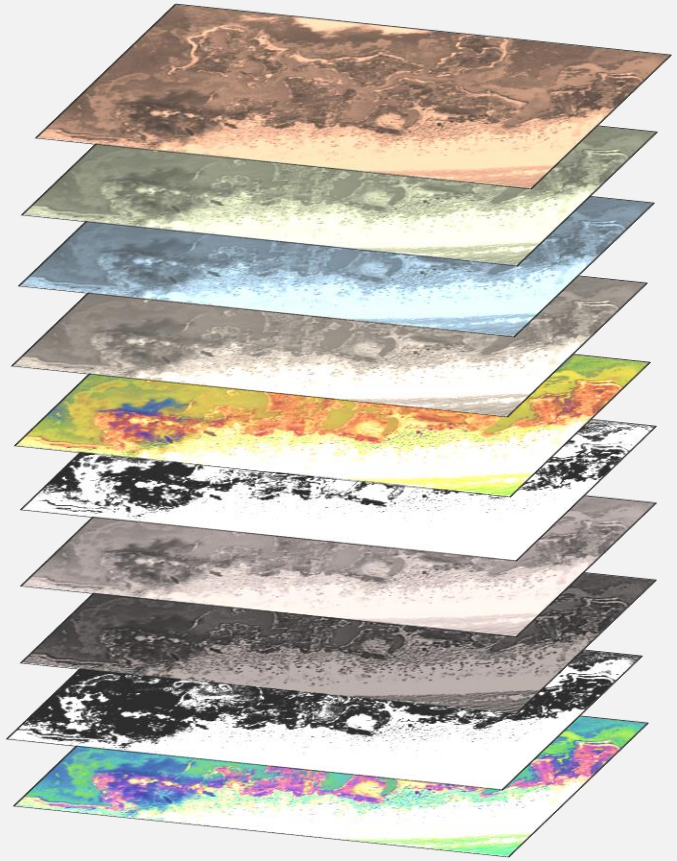
Habitat inventory
Biomass estimation
Wetland health
Habitat changes


0
125
250
Meters

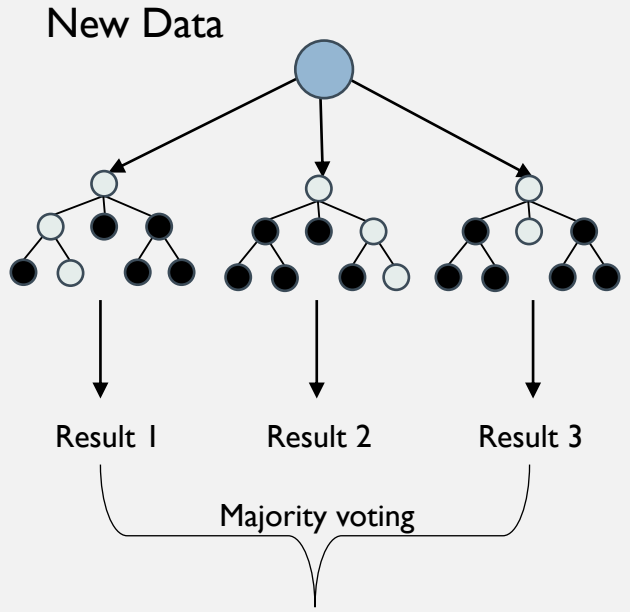

Legend
Mangrove
Salt marsh
Upland
Barren
0
125
250
Meters

Imagery → Layers → Samples → Classification

- NAIP aerial imagery



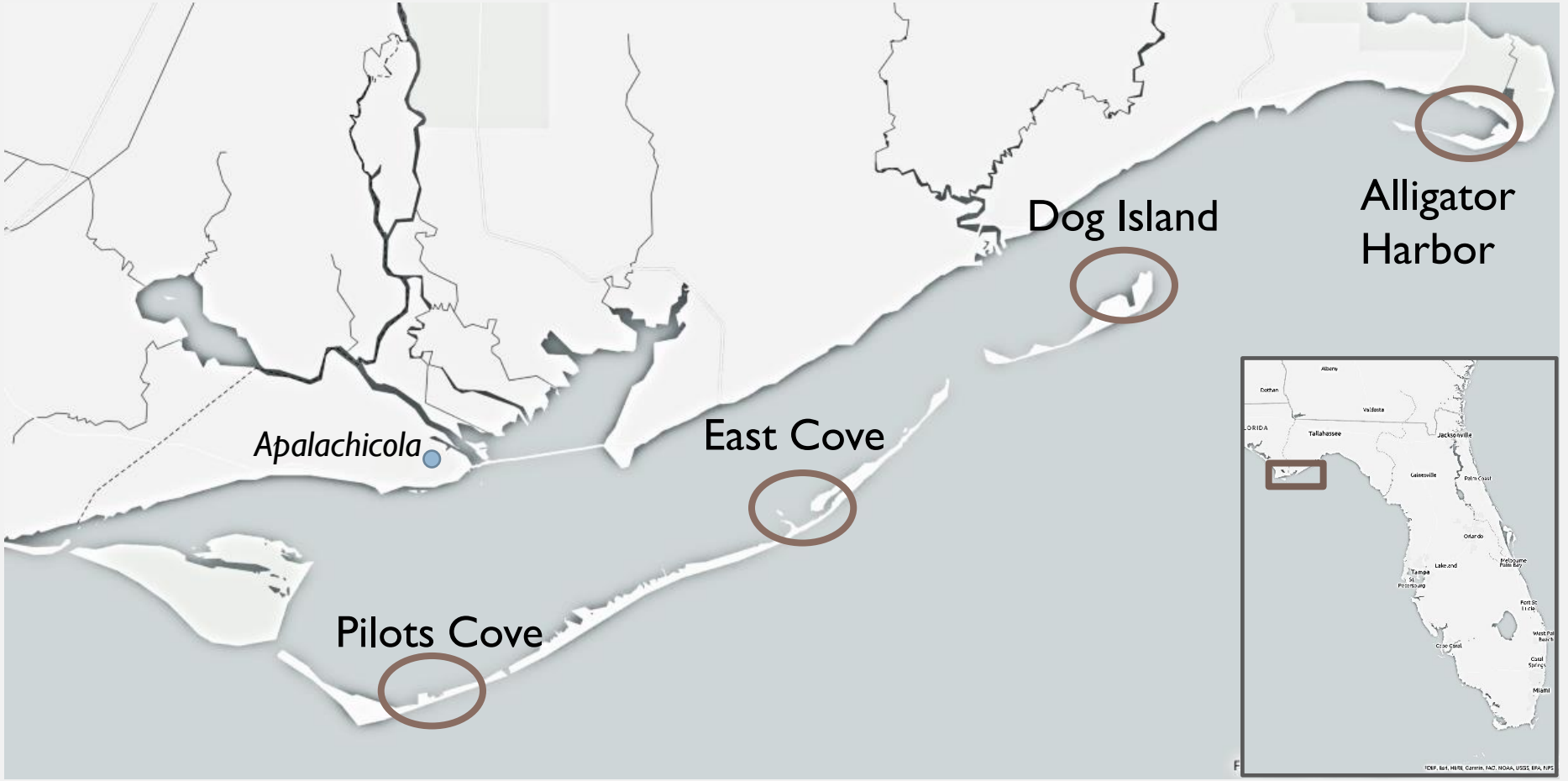
- Mangrove
- Salt marsh
- Upland
- Barren
- Water



Random forest prediction

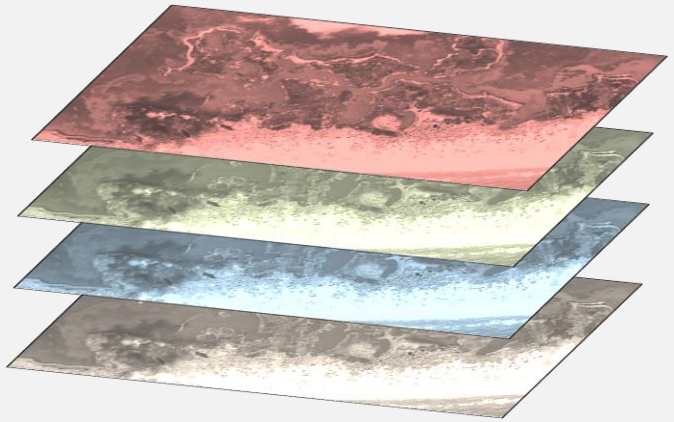
Imagery

- NAIP aerial imagery
  - 2010, 2013, 2015, 2017, 2019, 2022
  - 1-m resolution
  - 4 bands



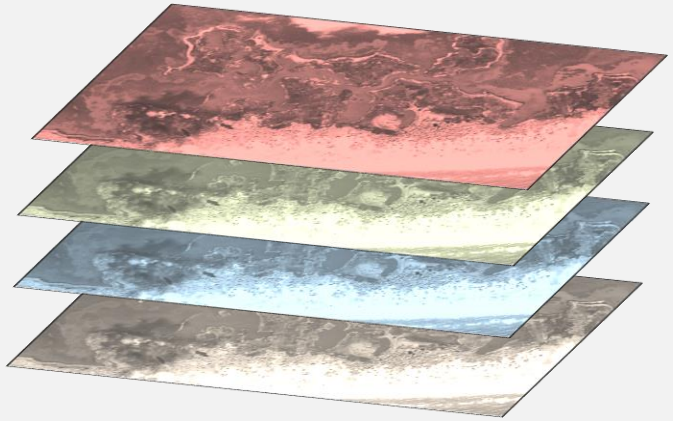
Layers

- R, G, B, IR
  - *High NIR reflectance*



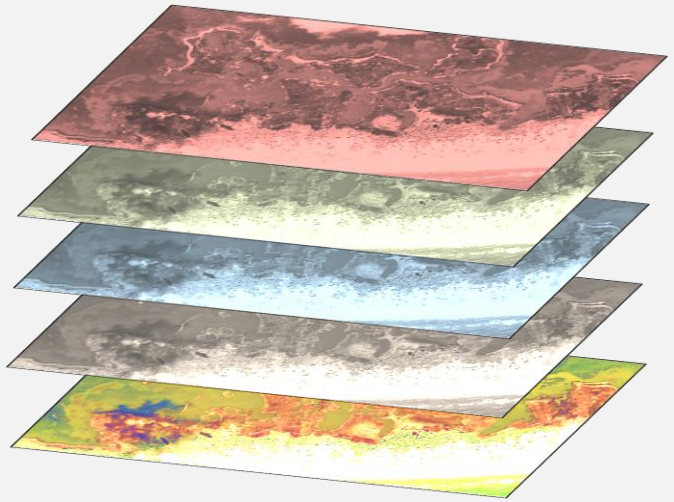
Layers

- R, G, B, IR
  - *High NIR reflectance*



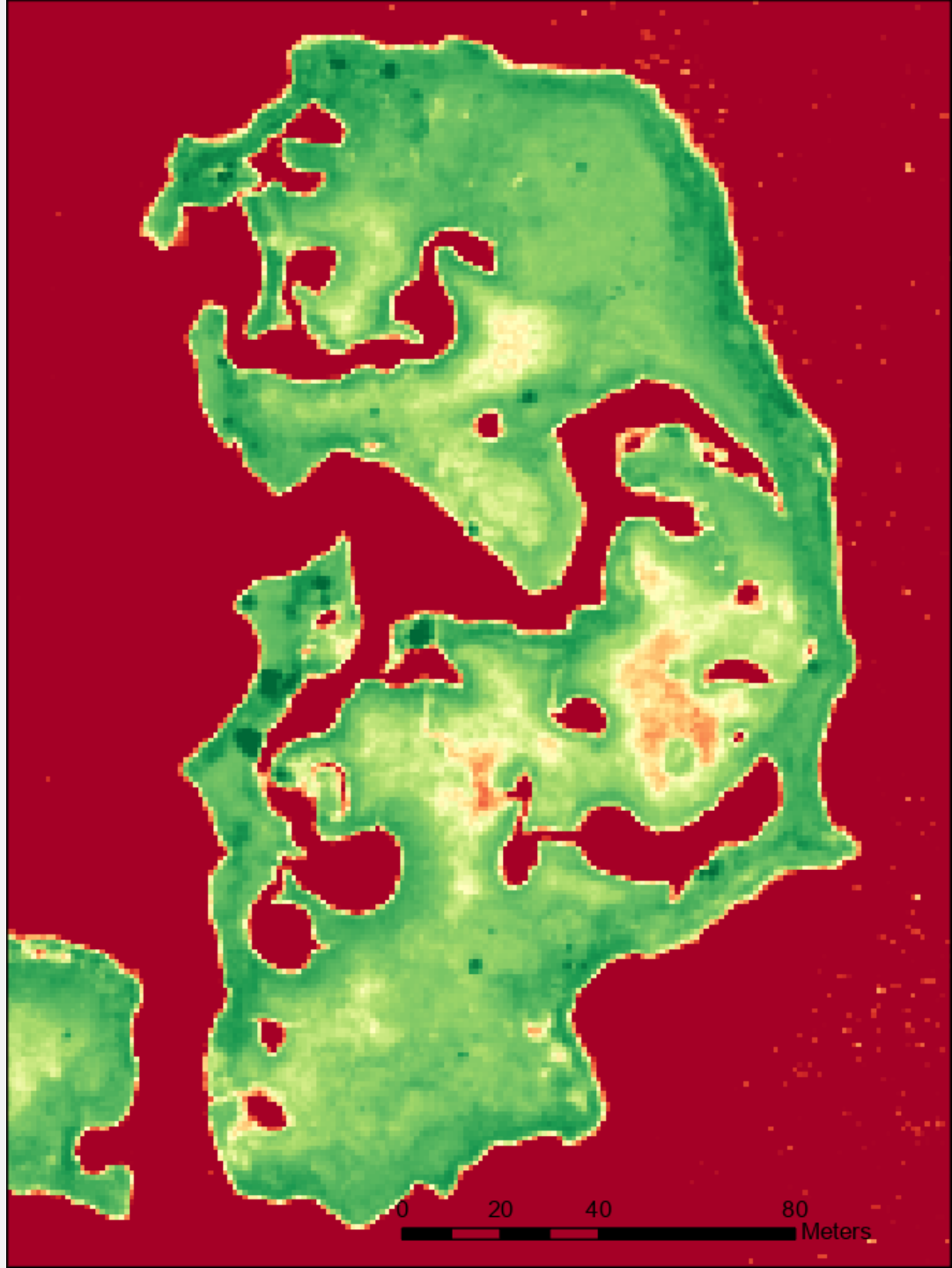
Layers

- R, G, B, IR
- NDVI



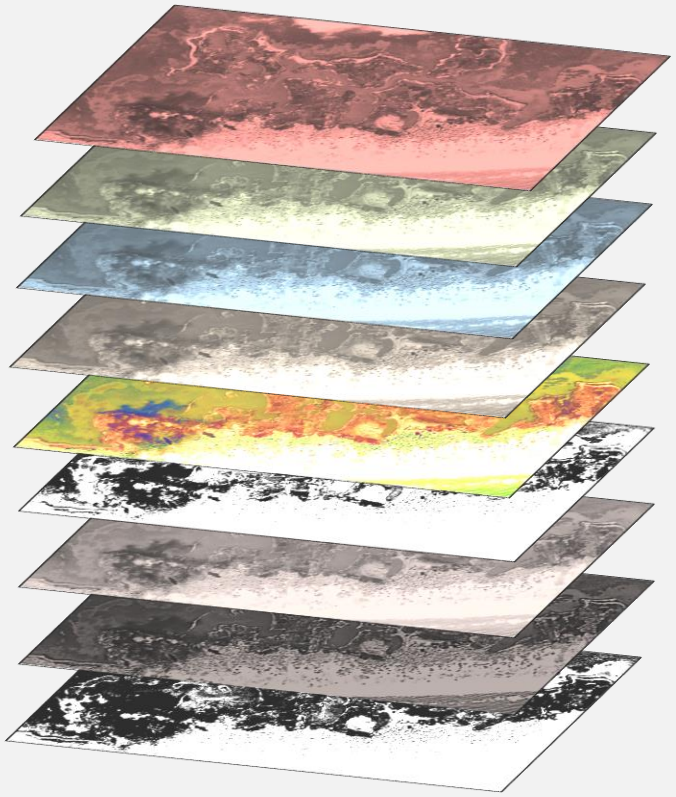
IR- RED

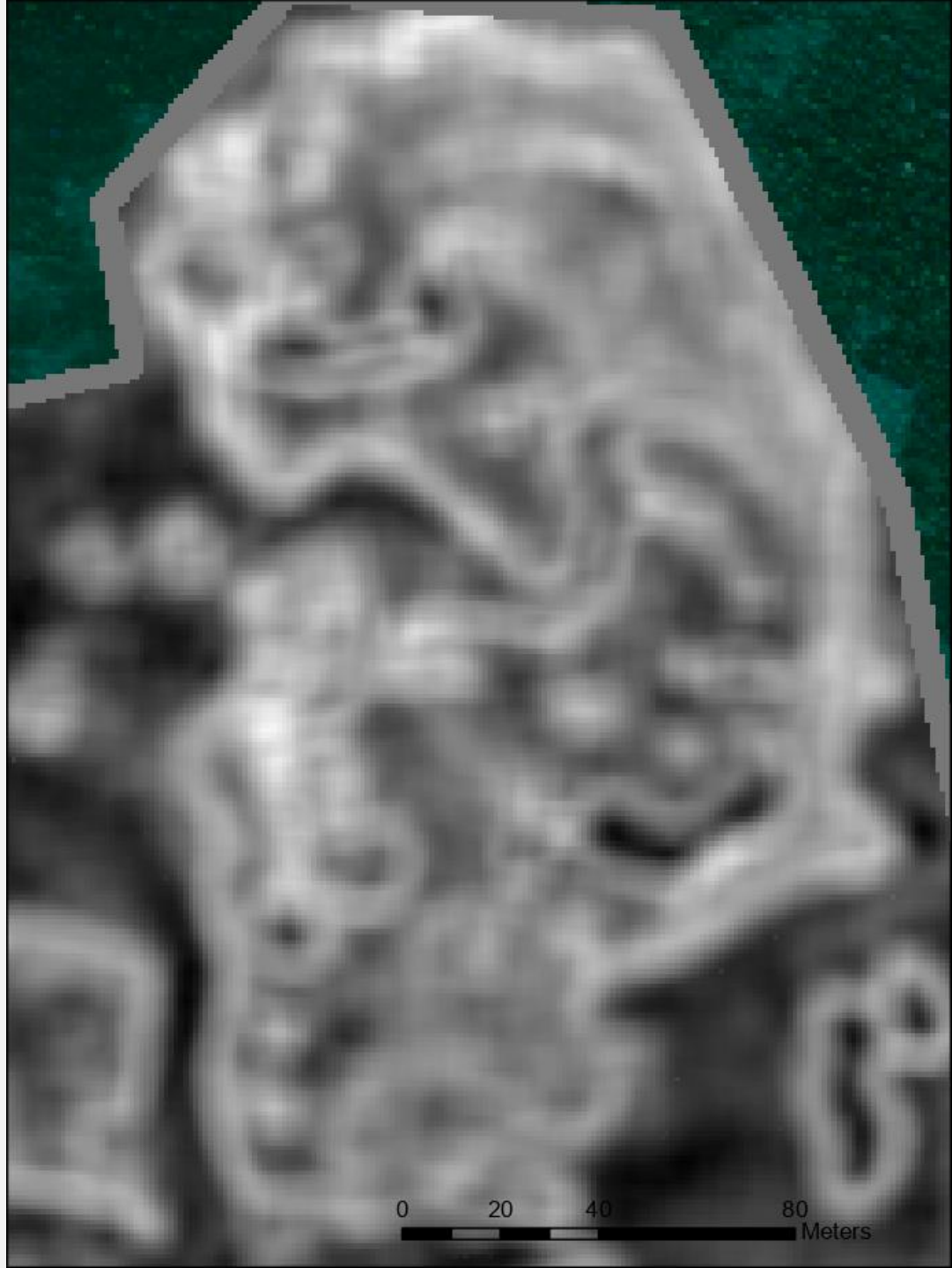
IR + RED



Layers

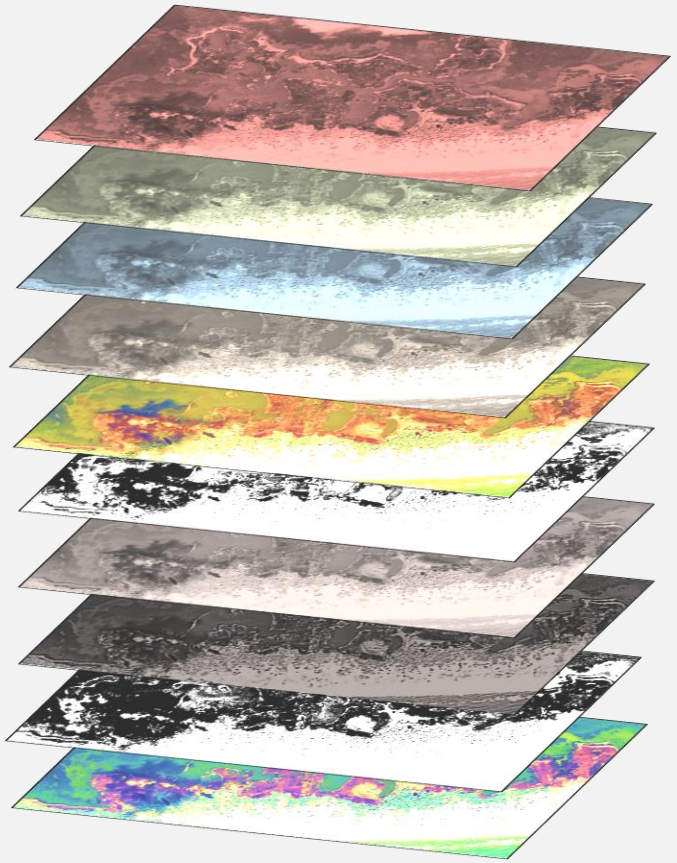
- R, G, B, IR
- NDVI
- Texture analysis

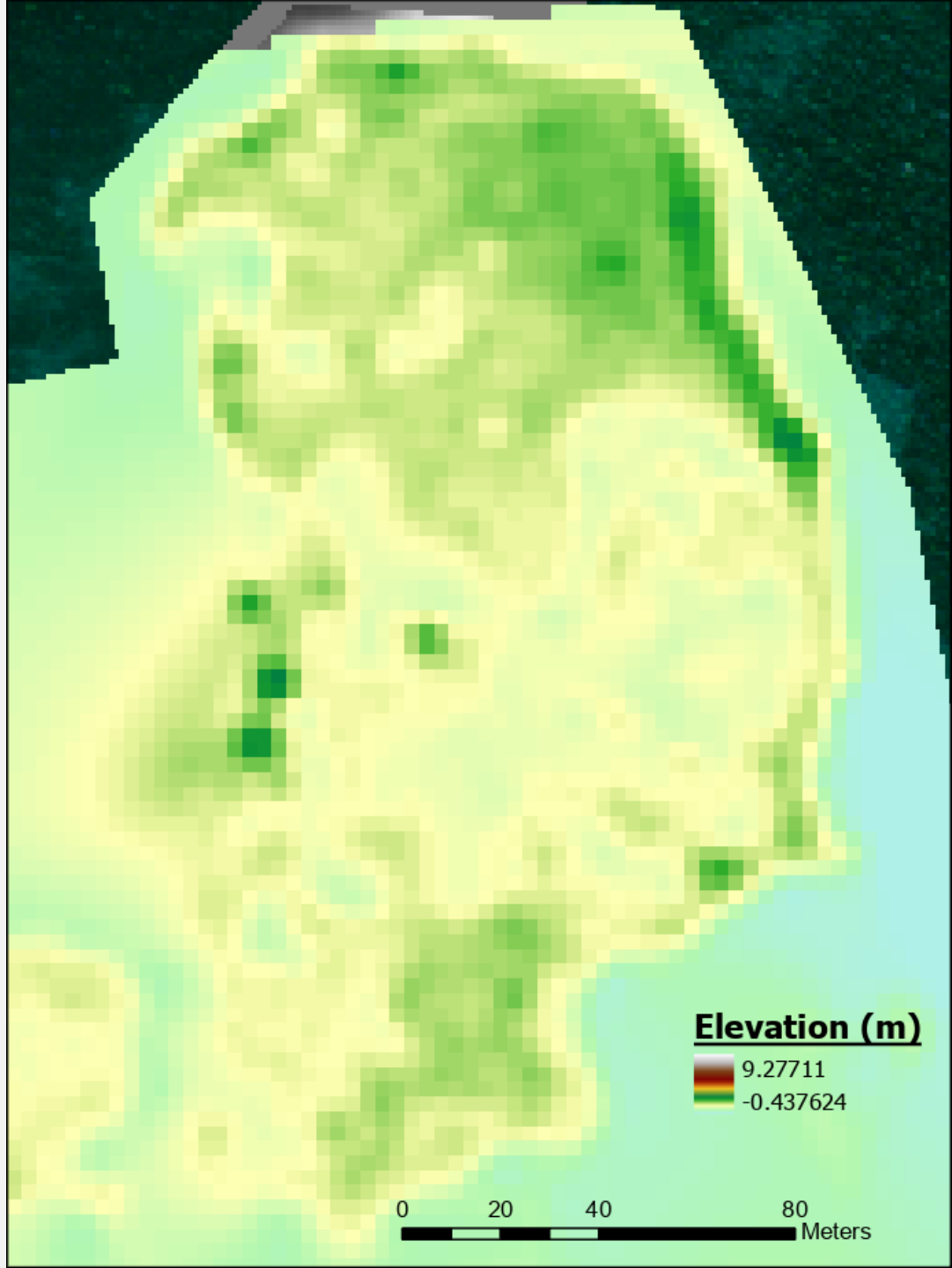




Layers

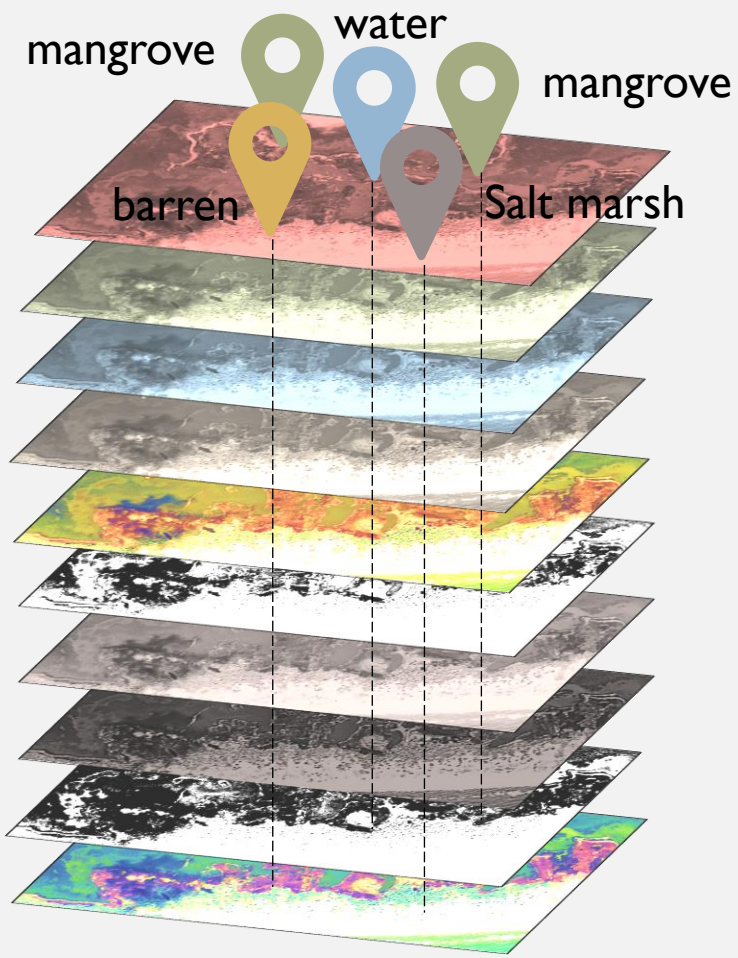
- R, G, B, IR
- NDVI
- Texture analysis
- DEM





Layers

- R, G, B, IR
- NDVI
- Texture analysis
- DEM



Samples

- Assign a class to pixels
- 5 classes:
  - Mangroves:
    1. *Red*
    2. *Black*

Samples

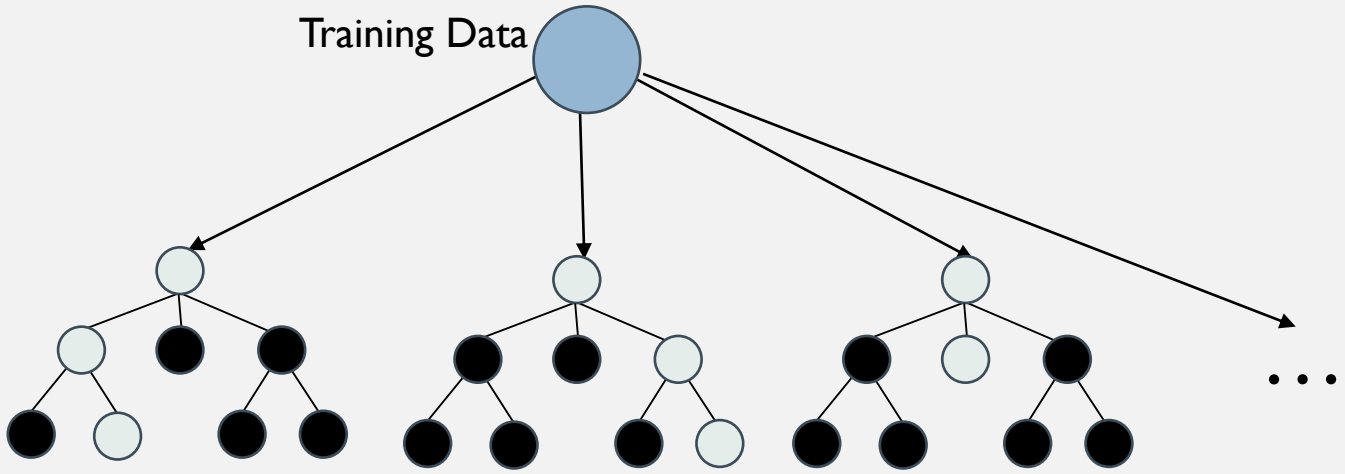
- Assign a class to pixels
- 5 classes:
  - Mangroves
  - Salt marsh vegetation:
    1. *Juncus roemerianus*
    2. *Spartina alterniflora*
    3. *Glasswort*
    4. *Saltwort*

Samples

- Assign a class to pixels
- 5 classes:
  - Mangroves
  - Salt marsh vegetation
  - Upland
  - Barren
  - Water
- 500 samples

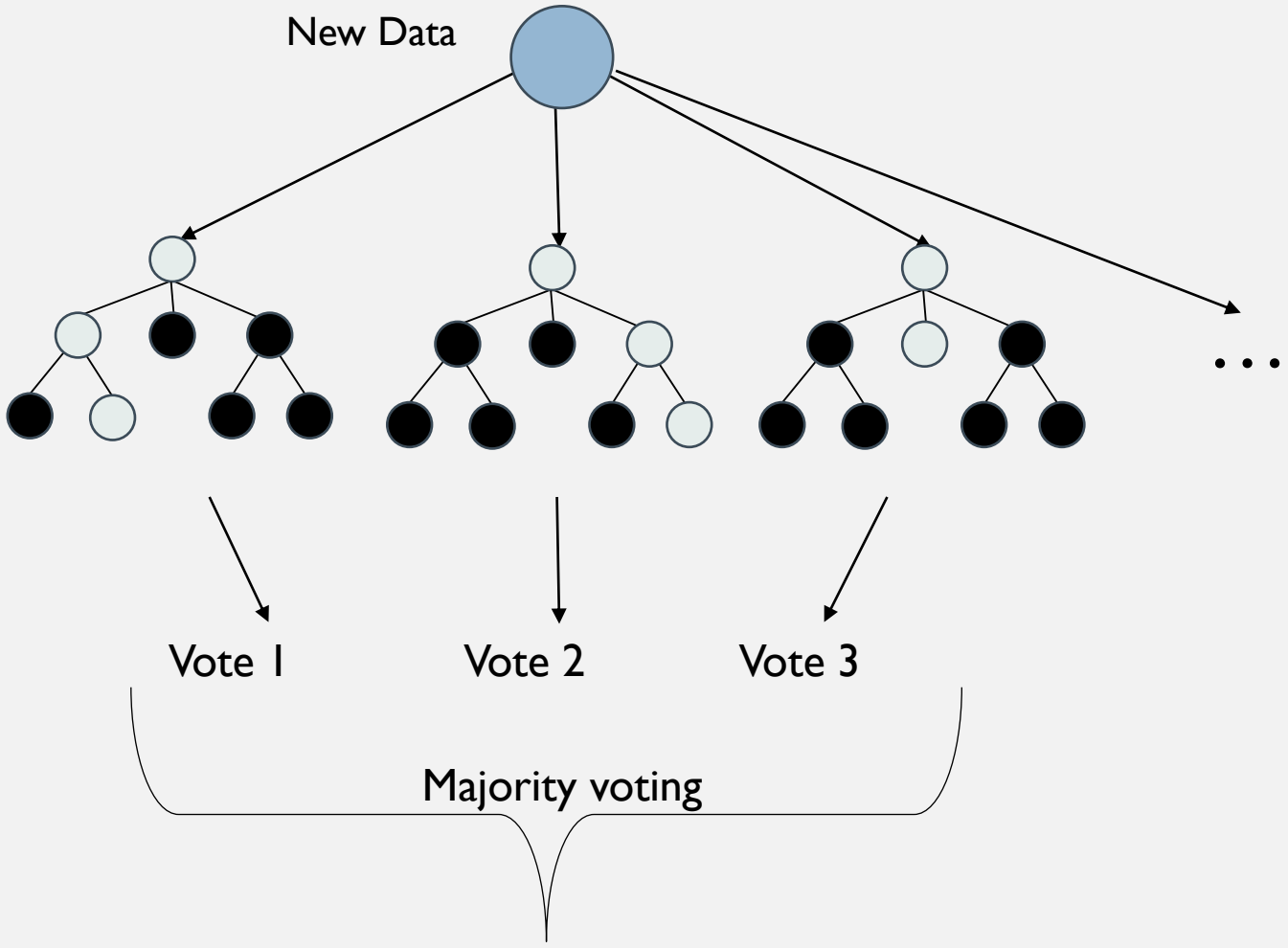
Classification

- Create random forest model
- Train using 80% of samples



Classification

- Create random forest model
- Train using 80% of samples
- Classify
- Test using 20% of samples
  - Total accuracy
  - Class accuracy

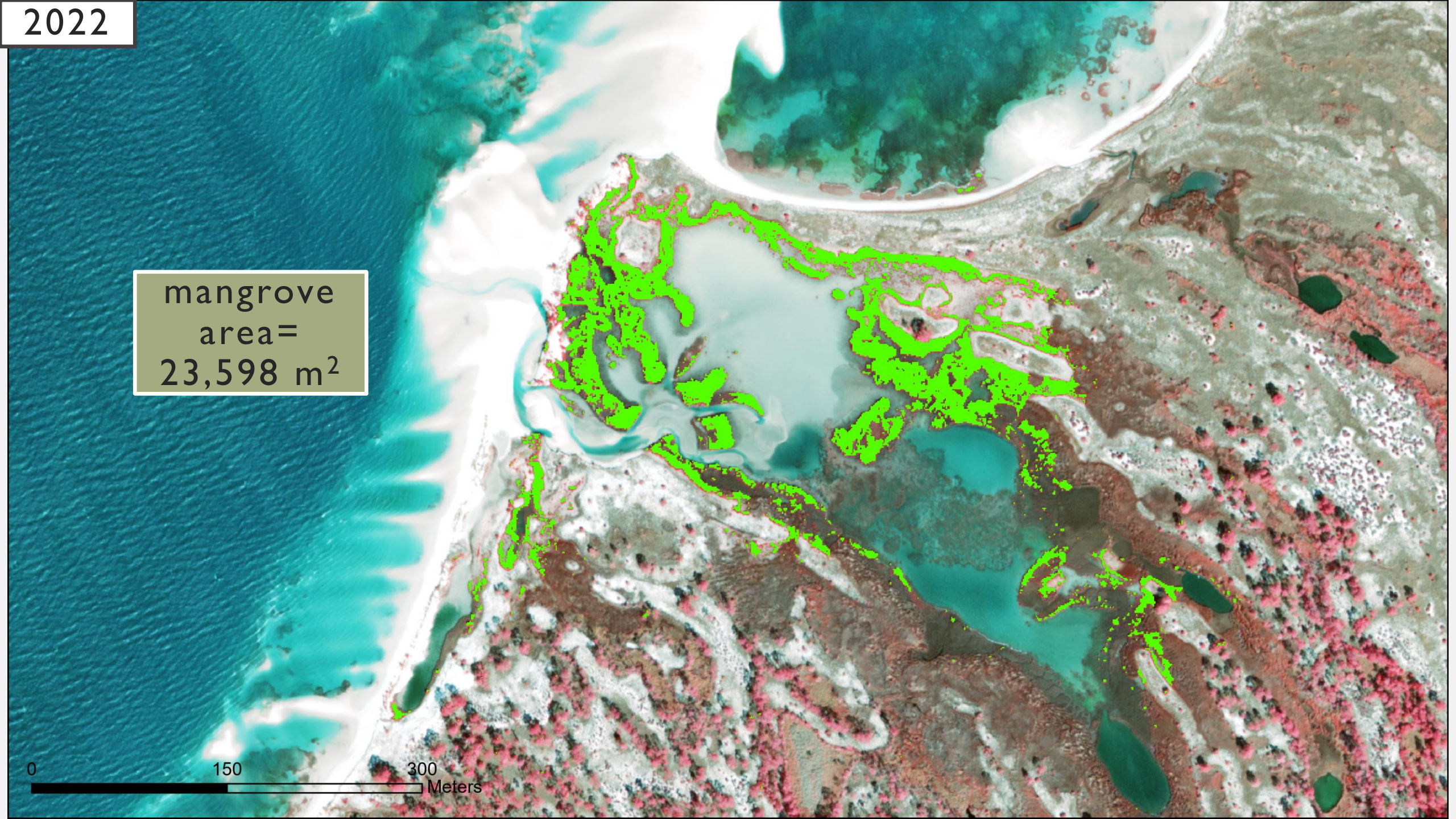


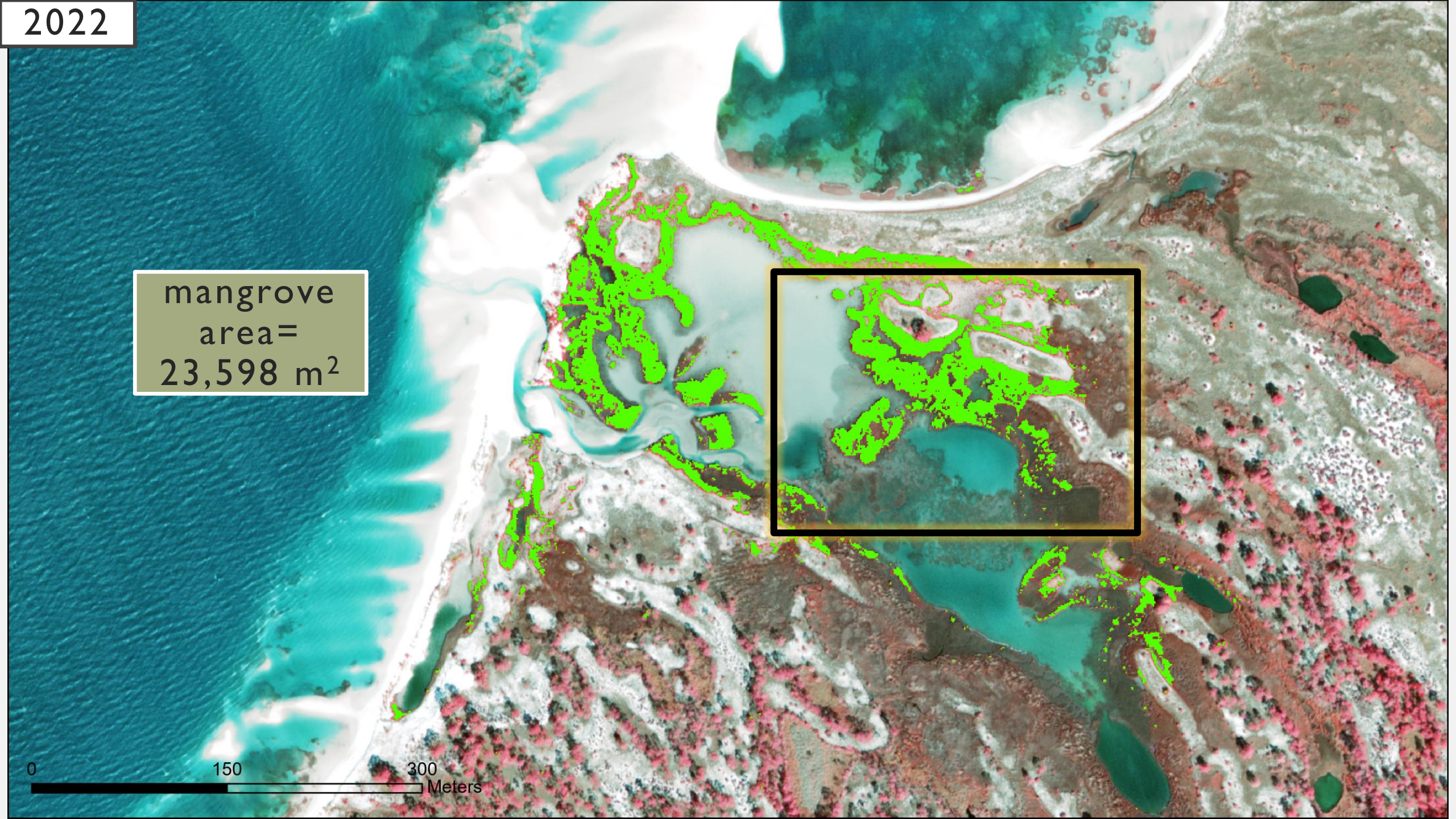
PRELIMINARY RESULTS

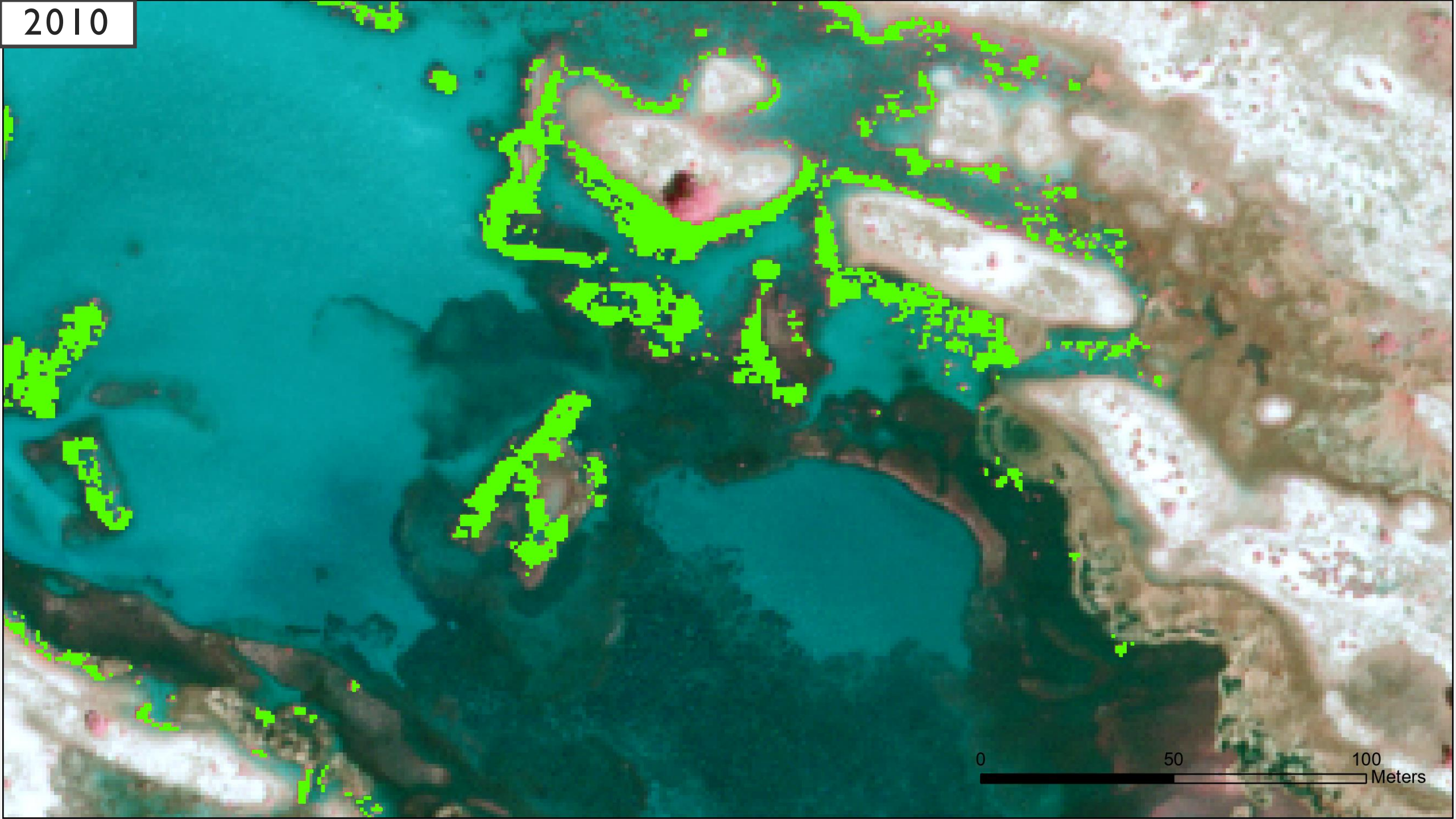

Alligator Harbor
Dog Island
Apalachicola
East Cove
Pilots Cove
Albany
Dothan
Valdosta
Tallahassee
Jacksonville
Gainesville
Palm Coast
Orlando
Lakeland
Tampa
St Petersburg
Melbourne
Palm Bay
Port St Lucie
Cape Coral
Coral Springs
Miami
FDEP, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS

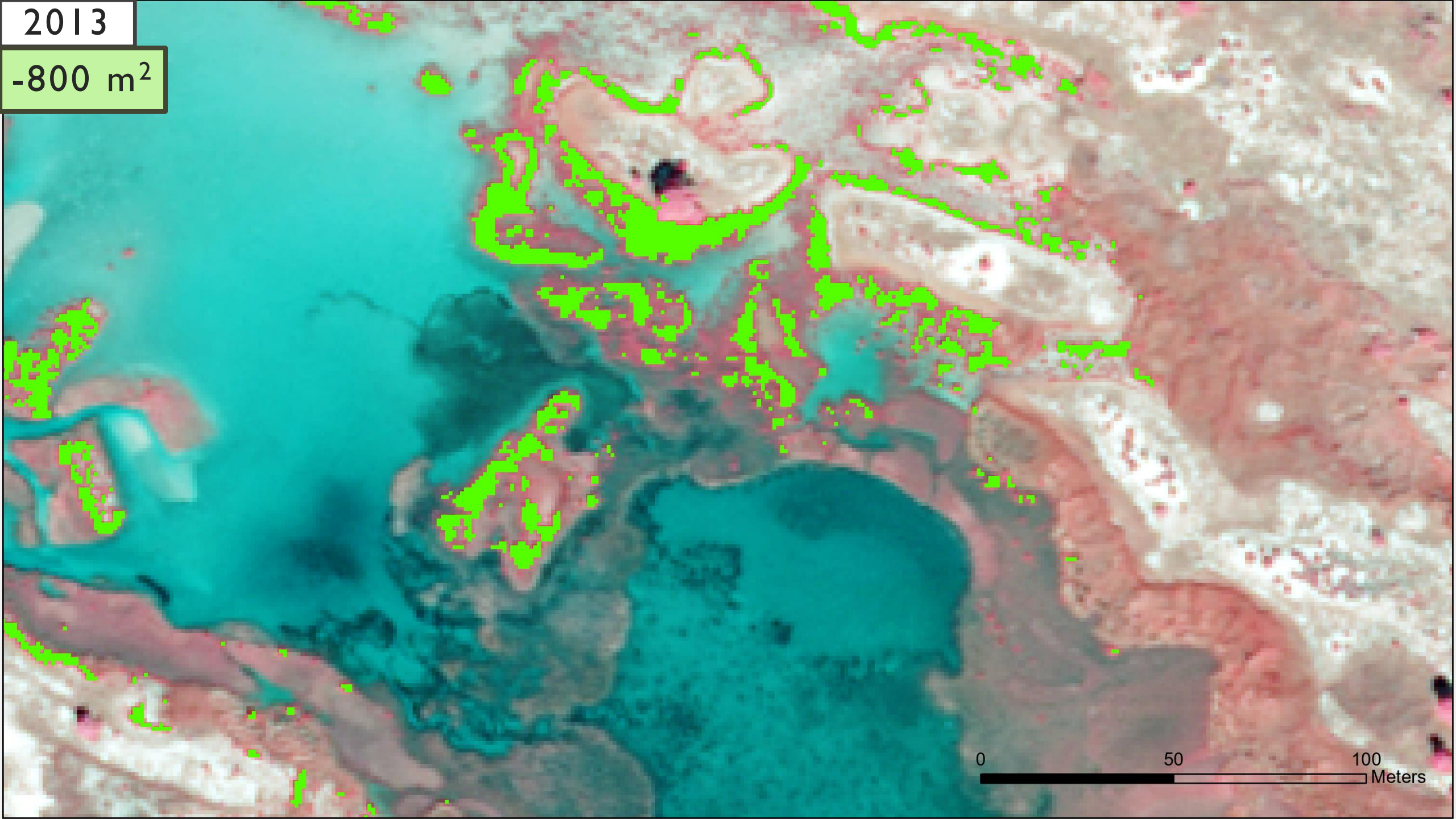

2010
0
150
300
Meters

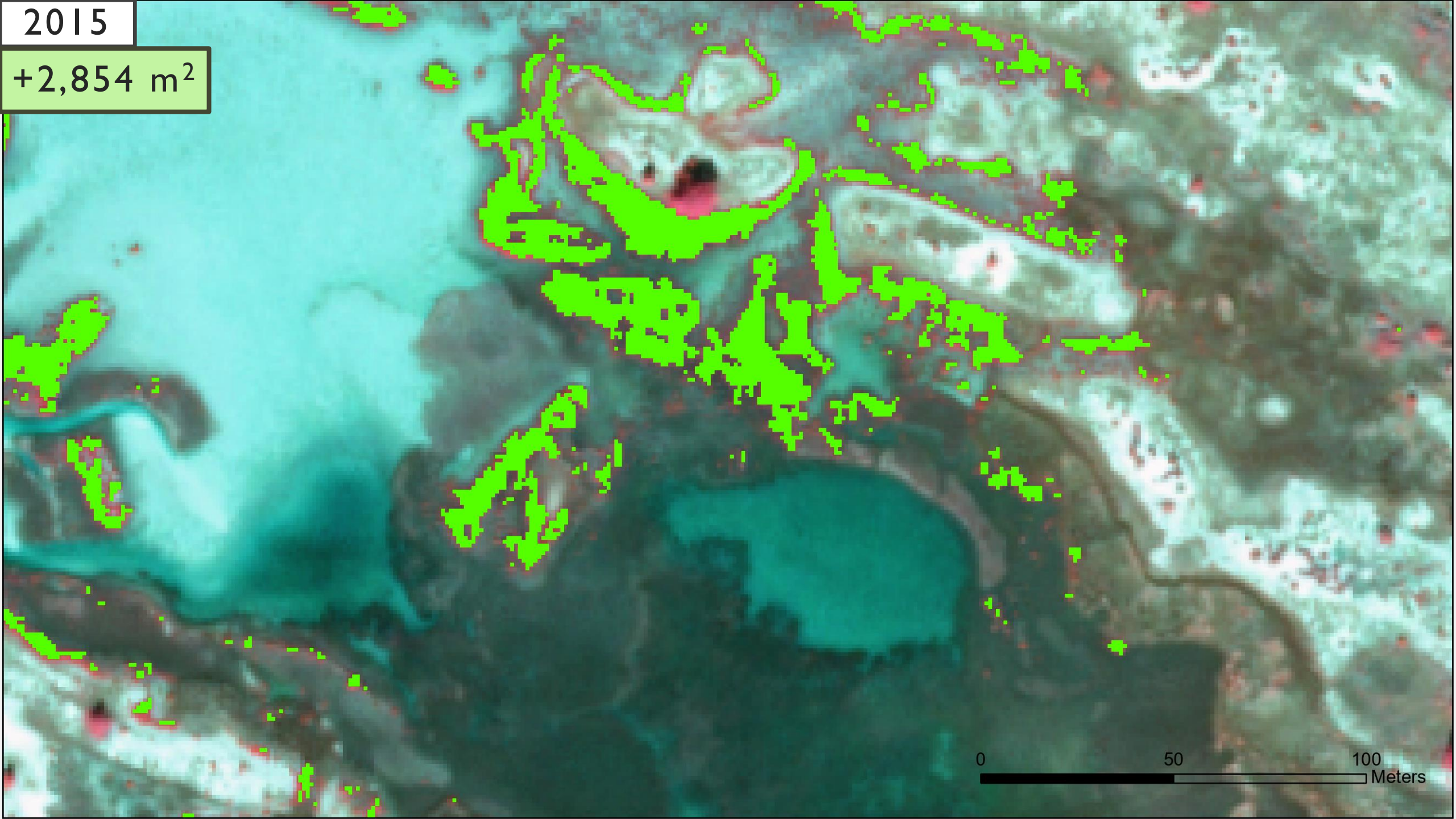

2010
mangrove area= 9,274 m²
0
150
300
Meters

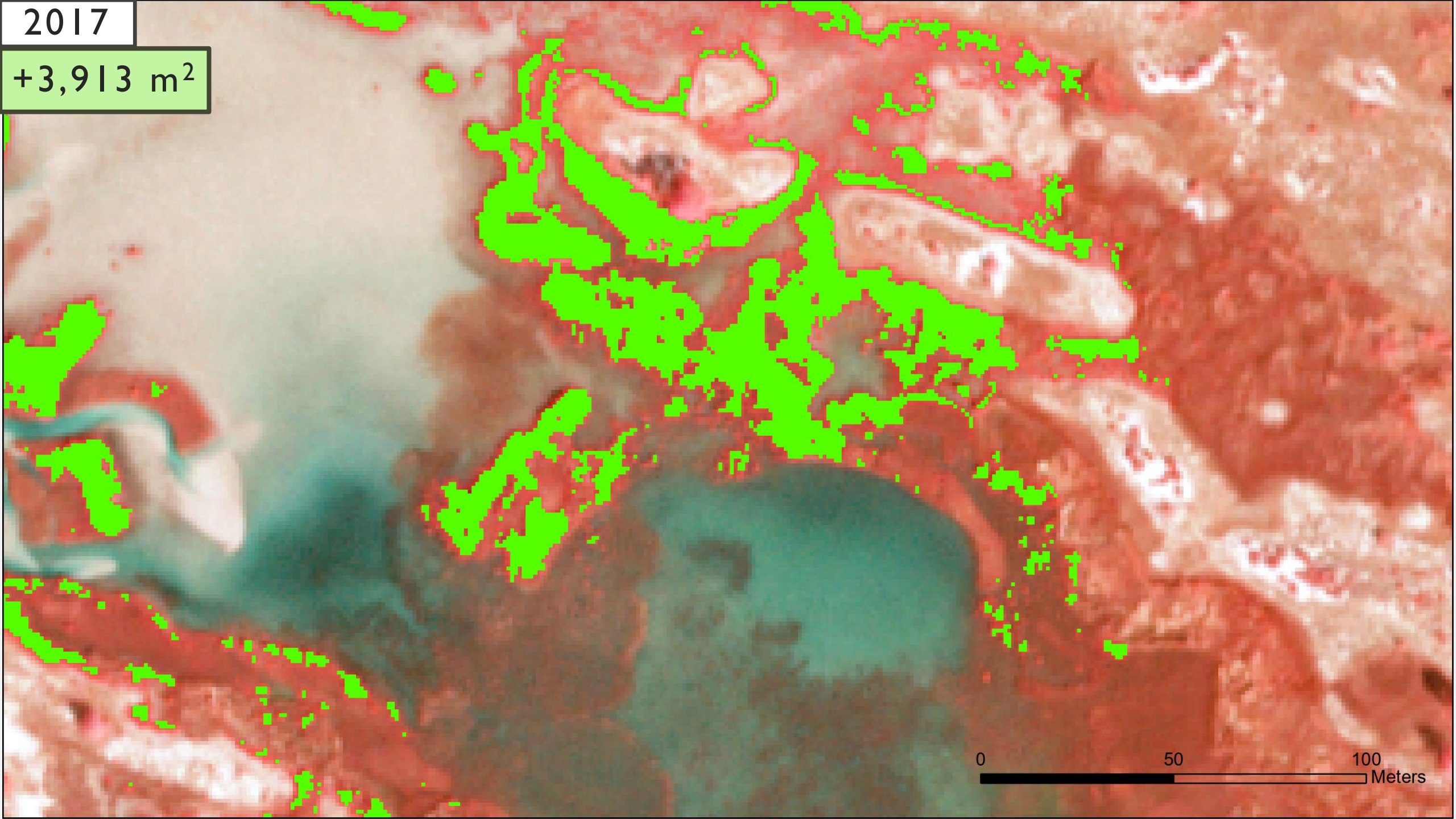

2022
mangrove area= 23,598 m²
0
150
300
Meters

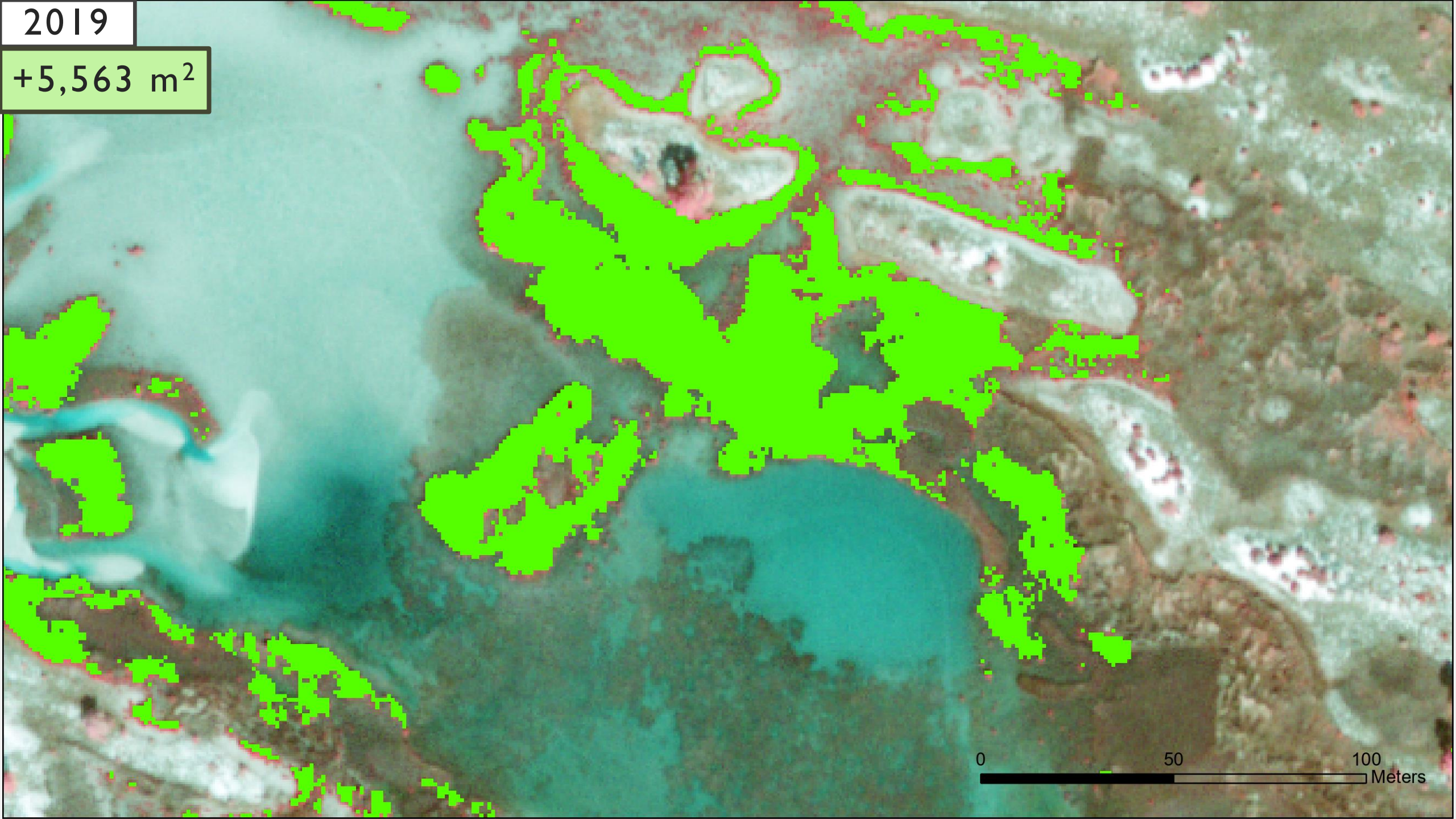

2022
mangrove area= 23,598 m²
0
150
300
Meters

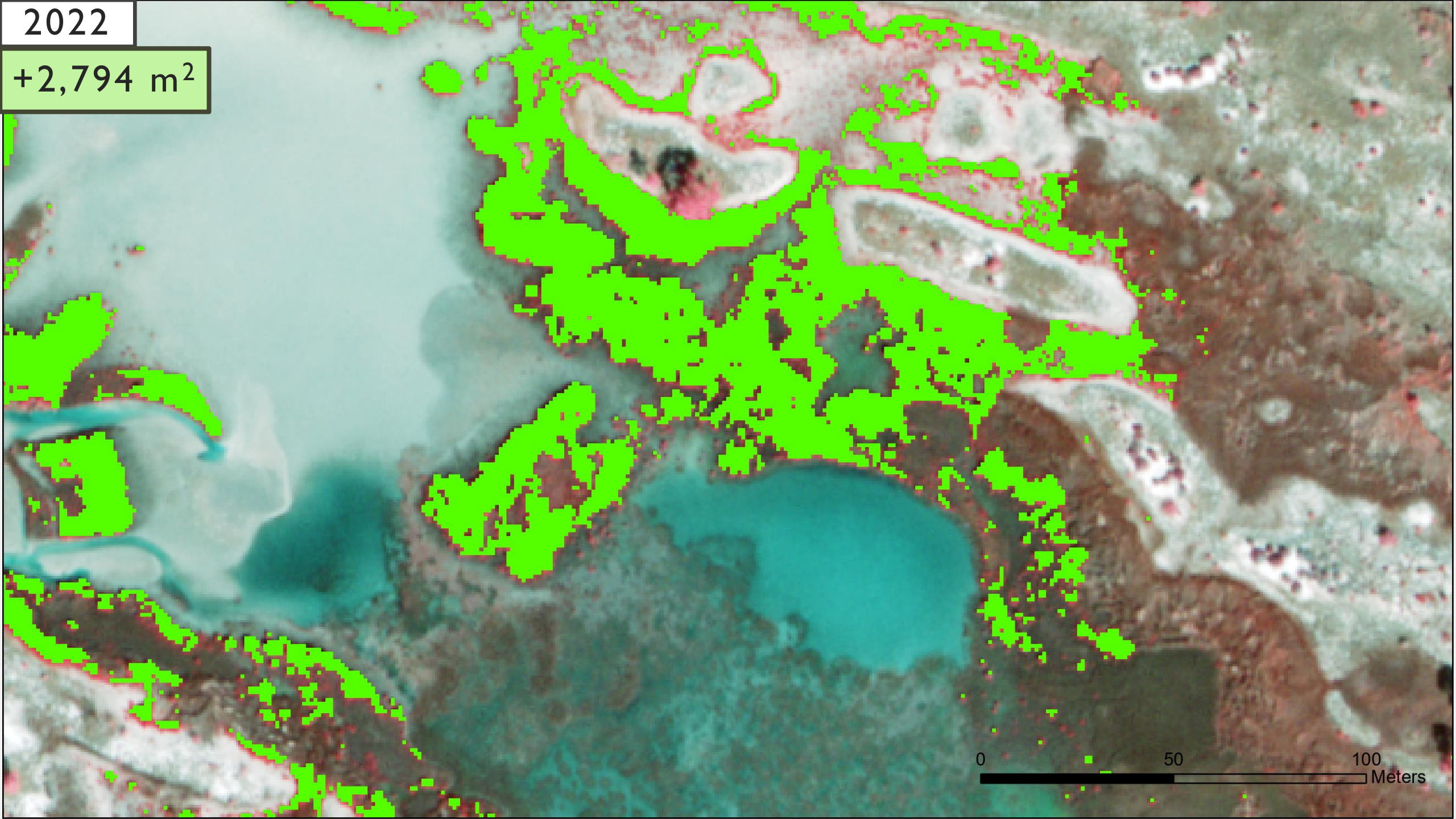

2010
0
50
100
Meters

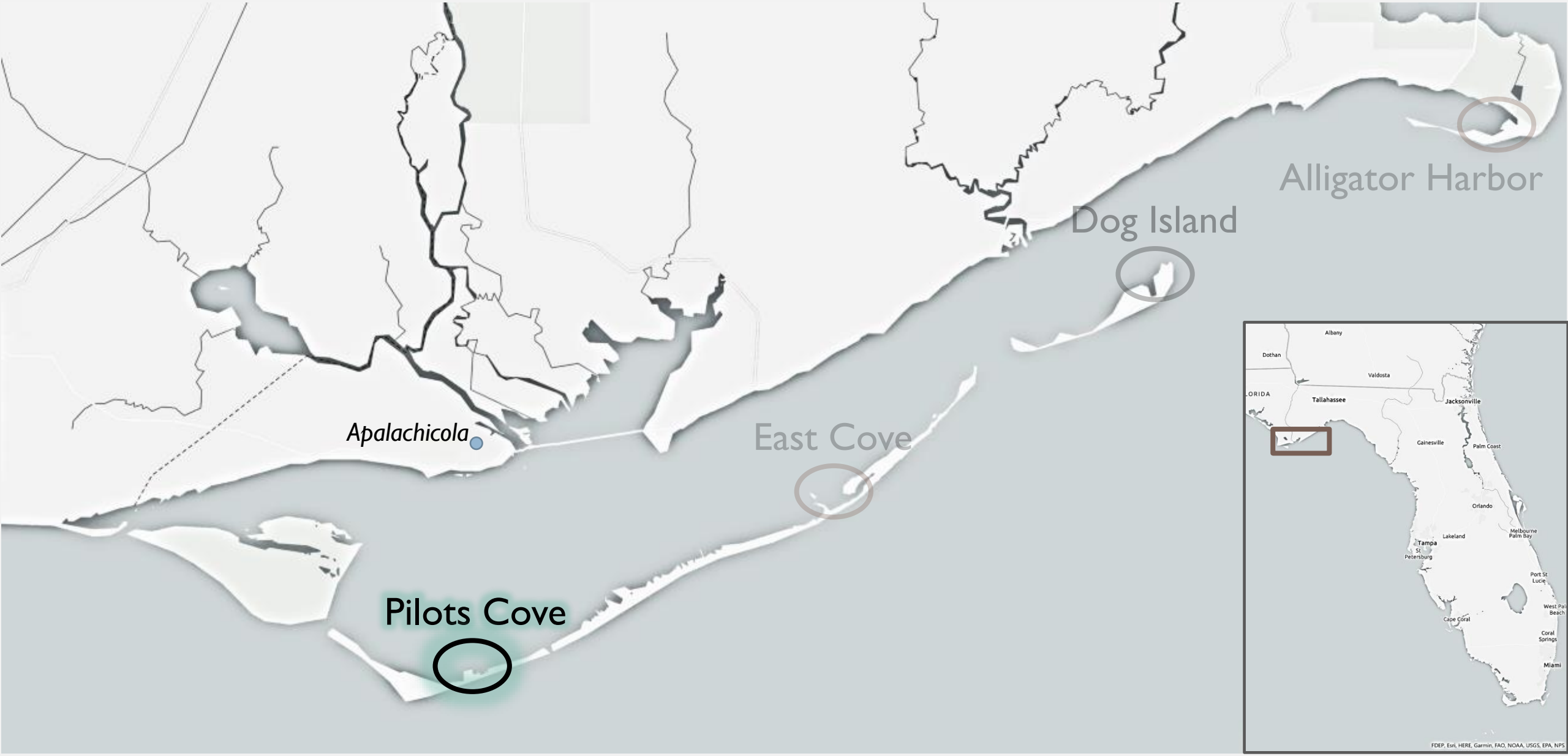

2013
-800 m²
0
50
100
Meters


2015
+2,854 m²
0
50
100
Meters


2017
+3,913 m²
0
50
100
Meters

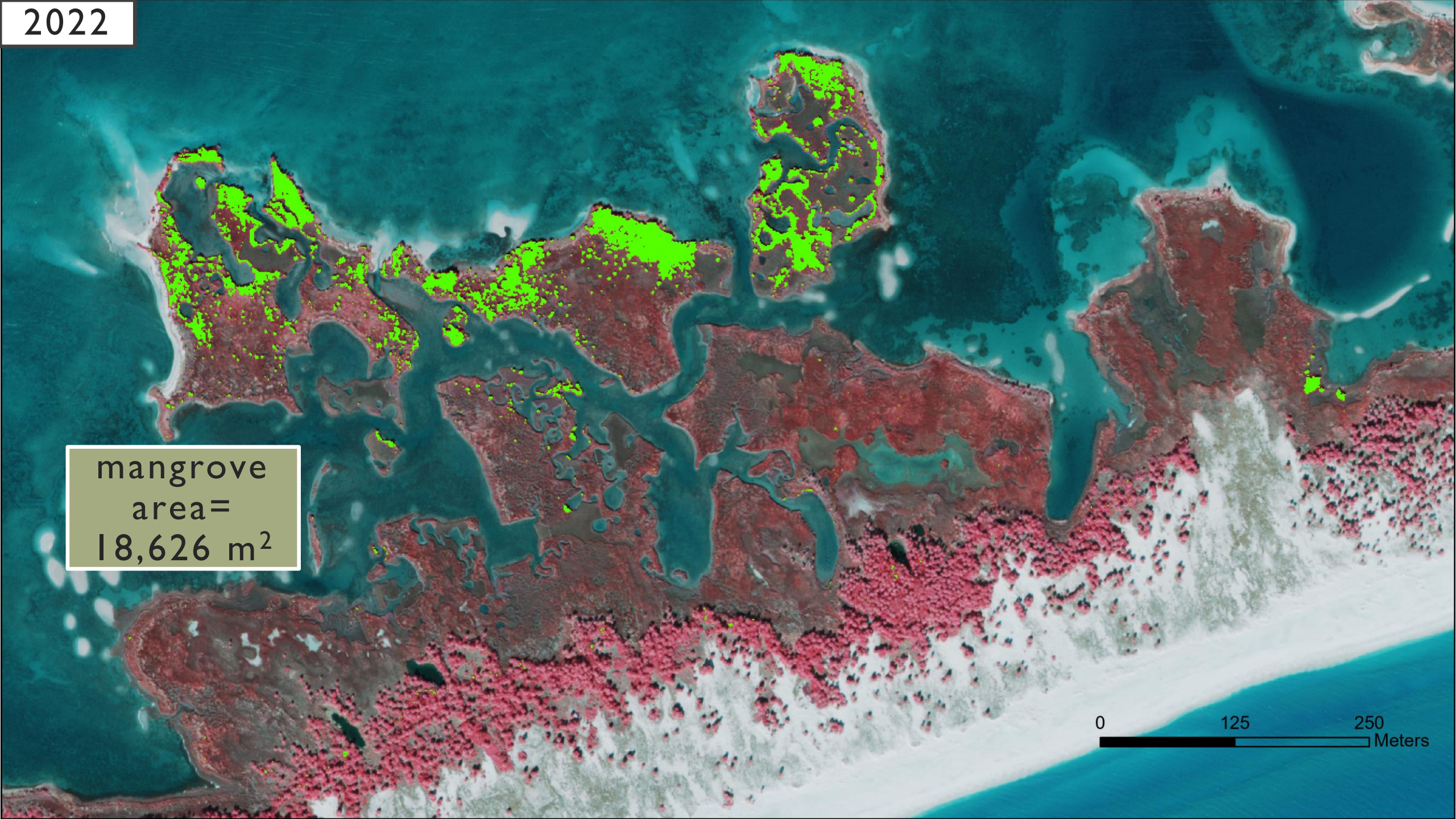

2019
+5,563 m²
0
50
100
Meters

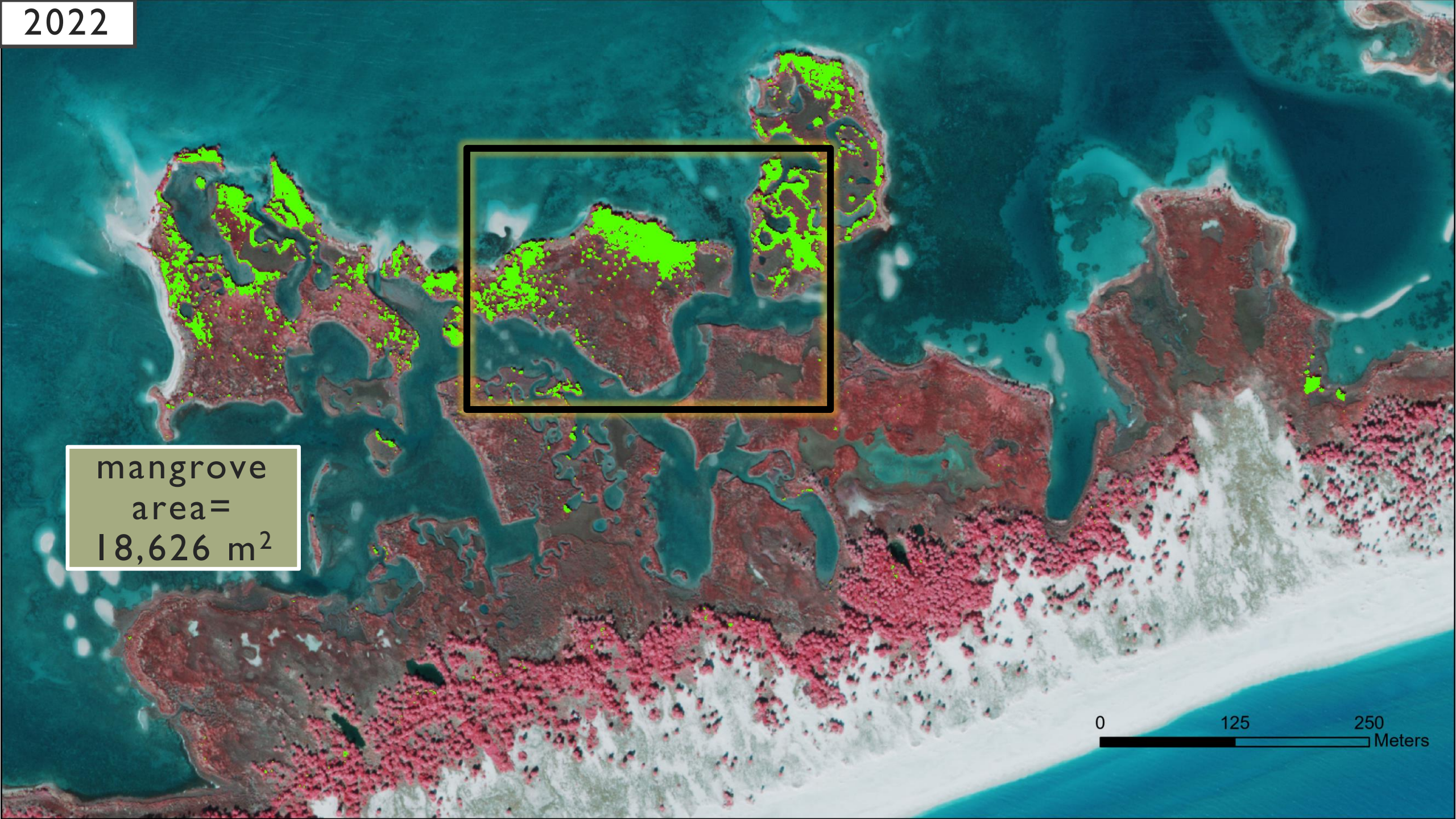

2022
+2,794 m²
0
50
100
Meters


Alligator Harbor
Dog Island
Apalachicola
East Cove
Pilots Cove
Albany
Dothan
Valdosta
Tallahassee
Jacksonville
Gainesville
Palm Coast
Orlando
Lakeland
Tampa
St Petersburg
Melbourne
Palm Bay
Port St Lucie
Cape Coral
Coral Springs
Miami
FDEP, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS


2010
0
125
250
Meters

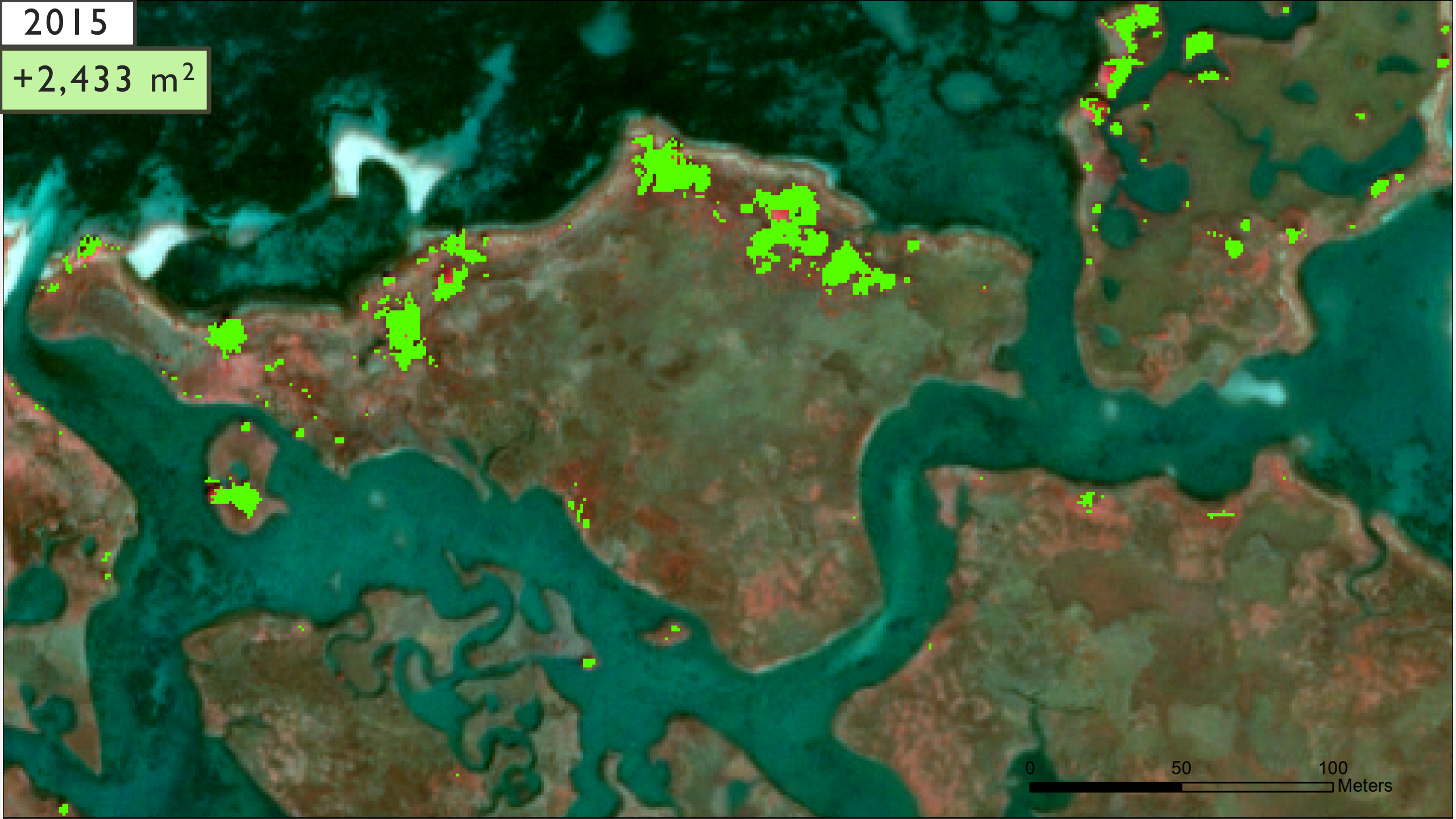

2010
mangrove area= 1,946 m²
0
125
250
Meters

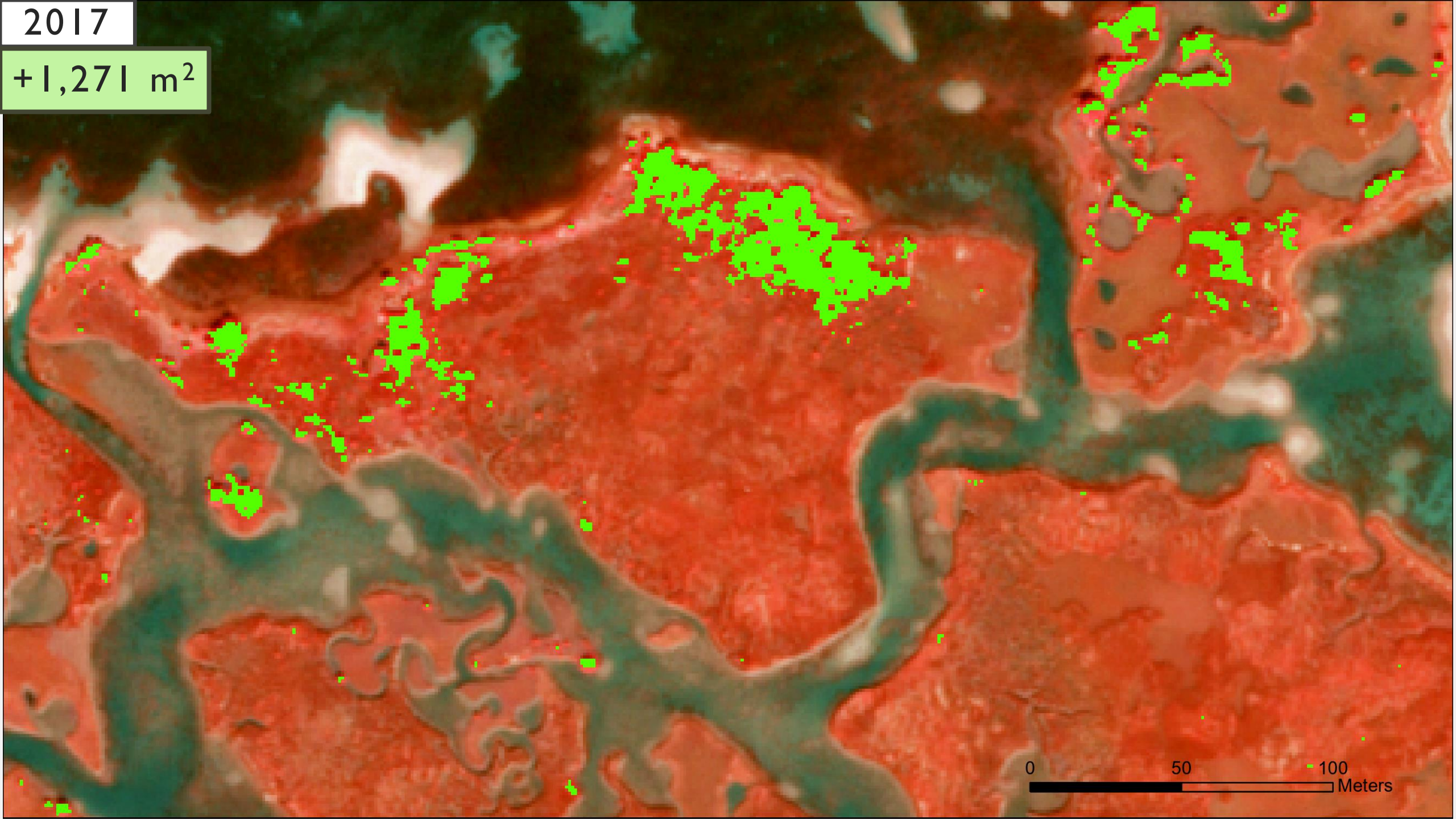

2022
mangrove area= 18,626 m²
0
125
250
Meters

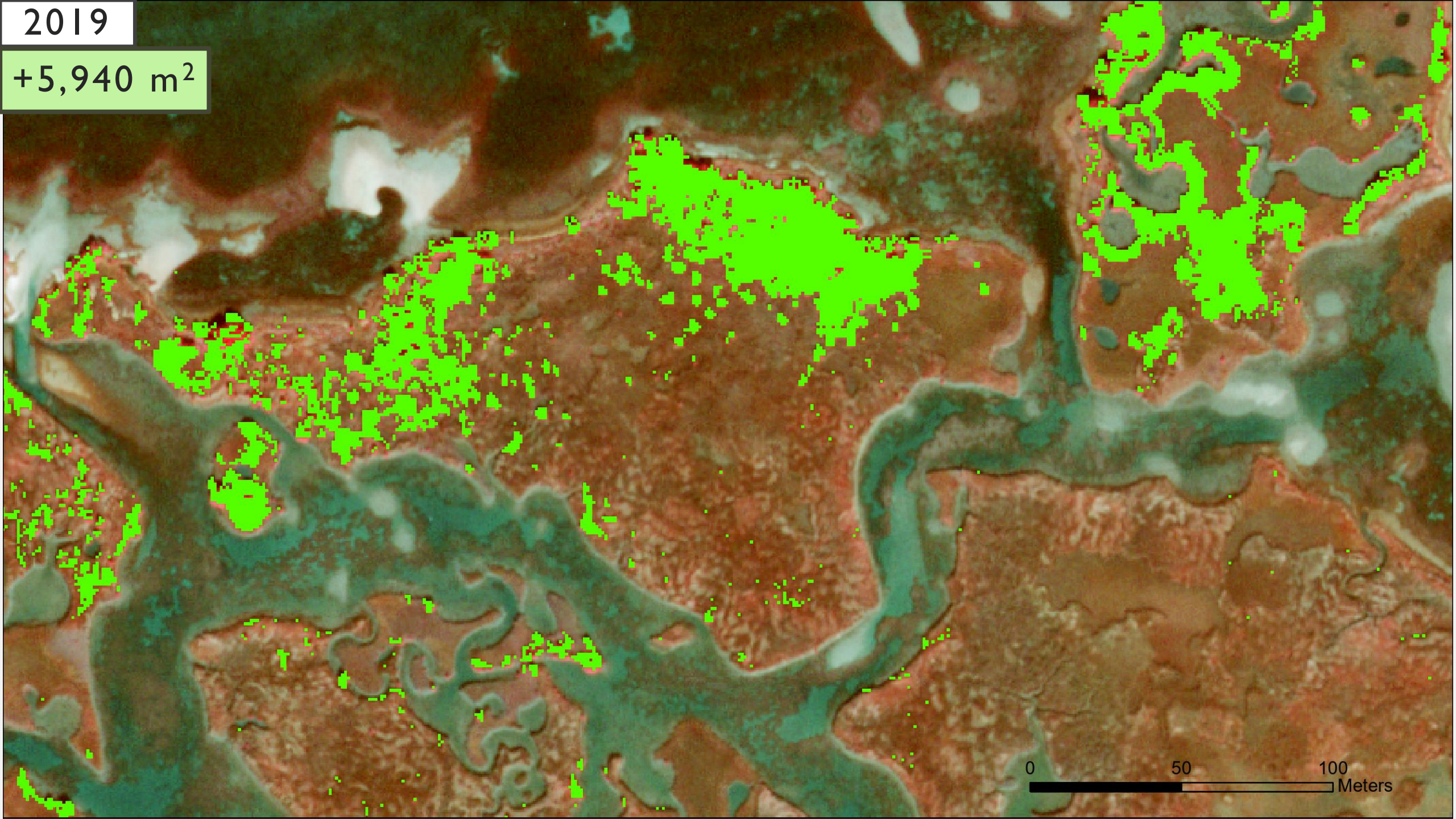

2022
mangrove area= 18,626 m²
0
125
250
Meters

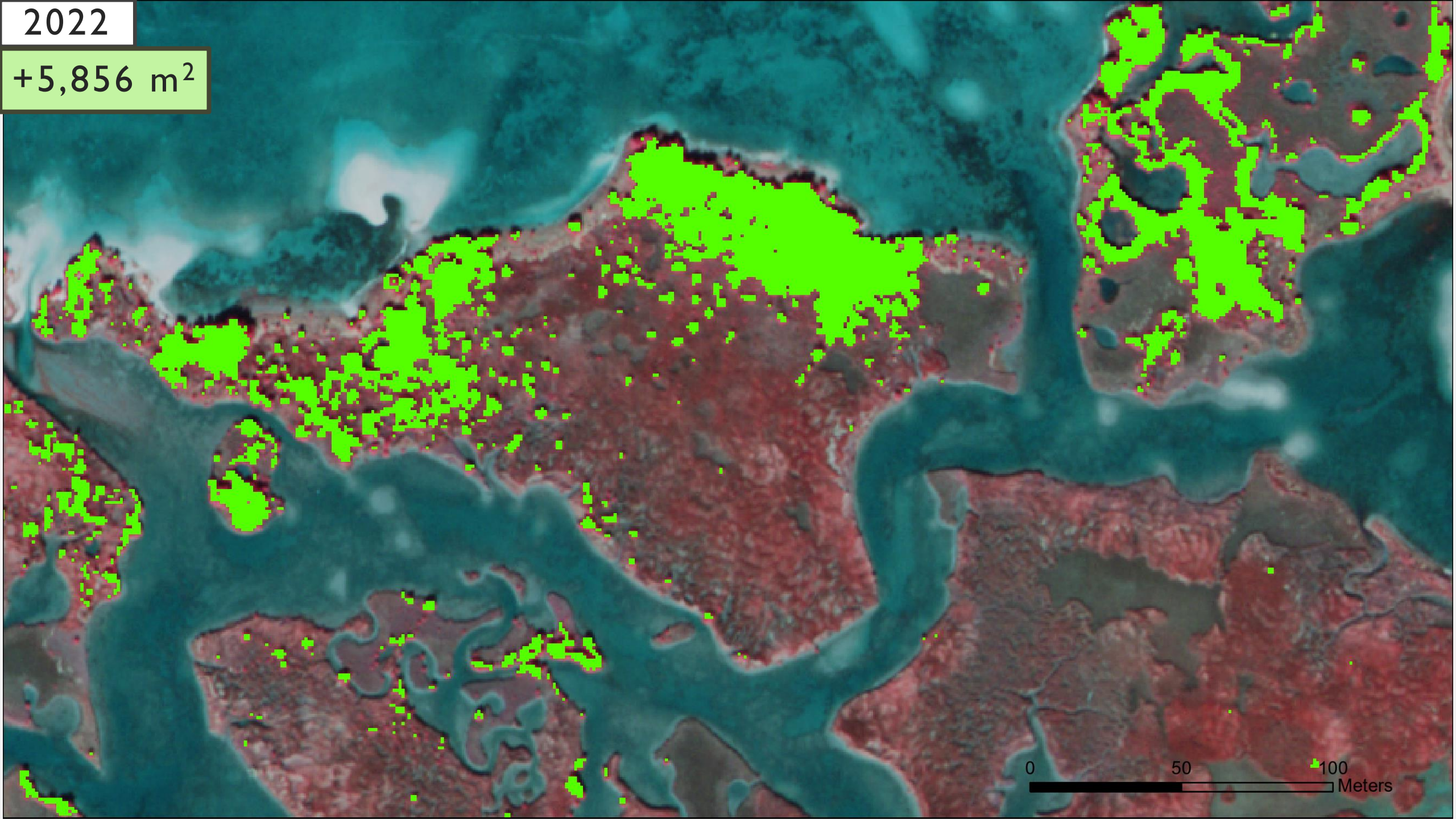

2010
0
50
100
Meters


2013
+1,180 m²
0
50
100
Meters


2015
+2,433 m²
0
50
100
Meters

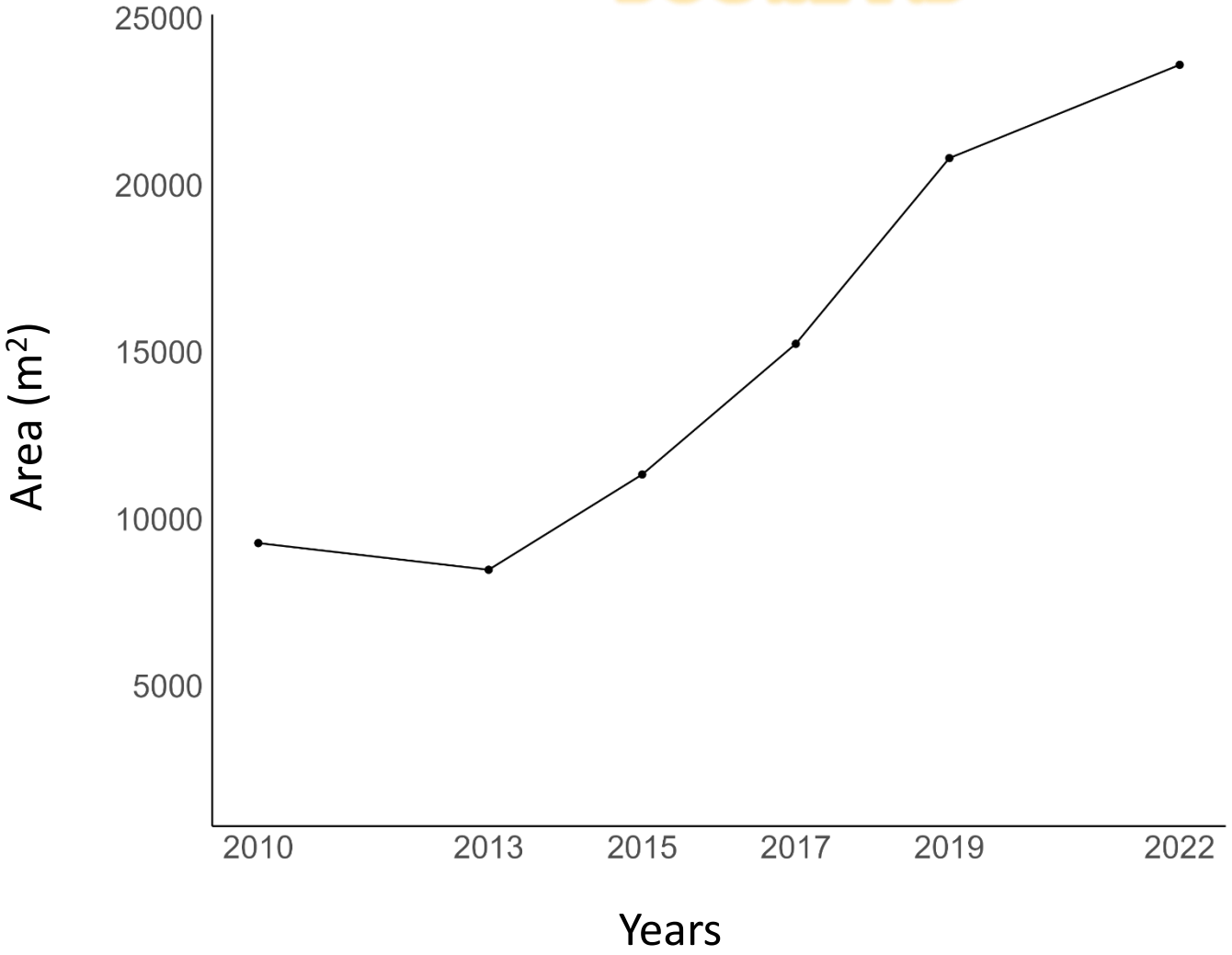

2017
+1,271 m²
0
50
100
Meters


2019
+5,940 m²
0
50
100
Meters


2022
+5,856 m²
0
50
100
Meters

PRELIMINARY RESULTS

DOG ISLAND

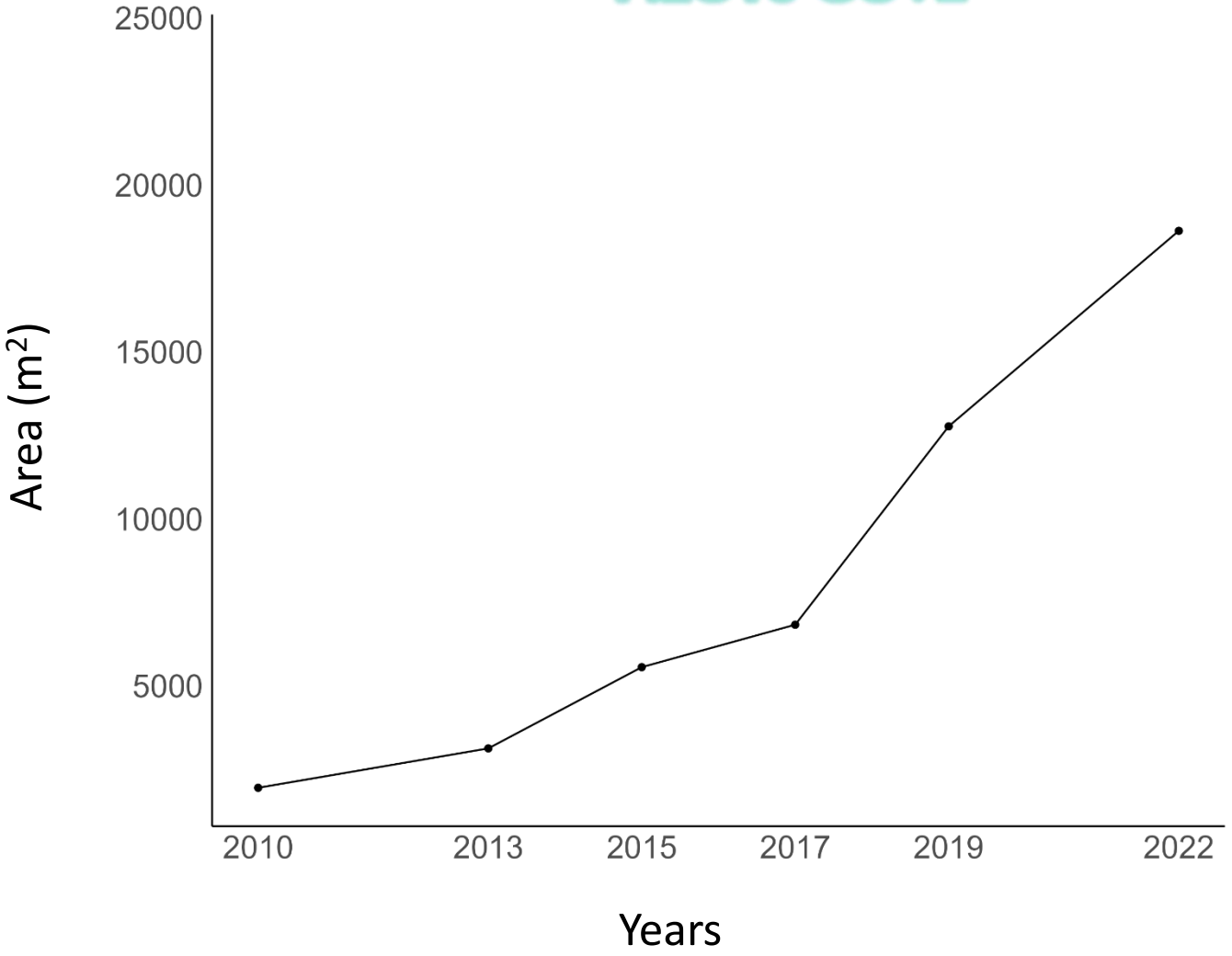


Net Rate of change=
1,193 m^2/year

Time Period	Rate of Change (m^2/year)
2010-2013	-267
2013-2015	1,427
2015-2017	1,956
2017-2019	2,787
2019-2022	931

PRELIMINARY RESULTS

PILOTS COVE

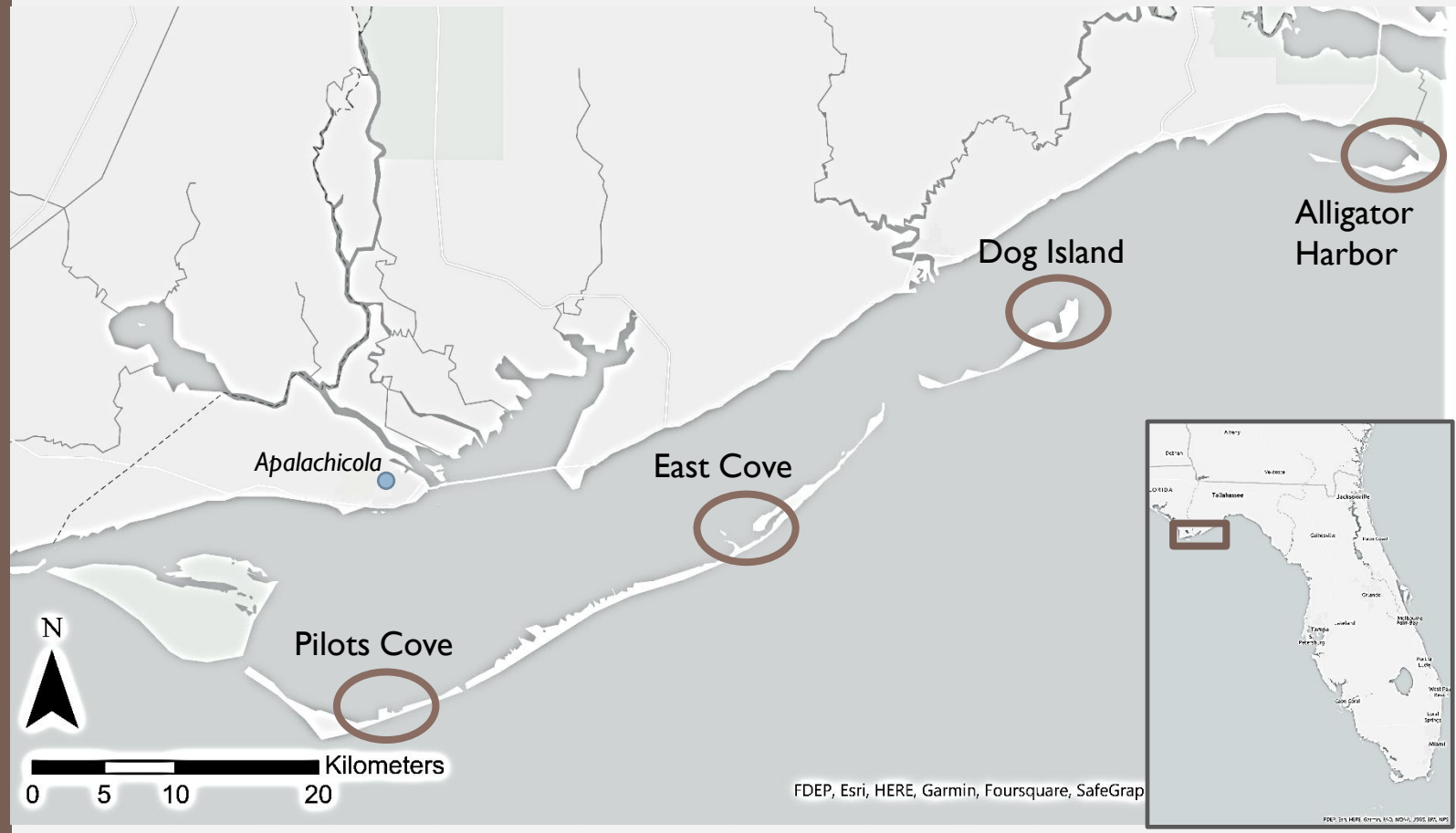


Net Rate of change=
1,390 m^2/year

Time Period	Rate of Change (m^2/year)
2010-2013	393
2013-2015	1,216
2015-2017	635
2017-2019	2,970
2019-2022	1,952

NEXT STEPS

- Including uncertainty in the area calculated
- Continued work:
  - 2 more sites w/ current low mangrove density:
    - East Cove
    - Alligator Harbor



RELEVANCE

- Habitat loss
- Predict loss
- Conservation

RELEVANCE

- Habitat loss
- Predict loss
- Conservation
- Cost-effective way to continue monitoring mangroves

RELEVANCE

- Habitat loss
- Predict loss
- Conservation
- Cost-effective way to continue monitoring mangroves
- Other Gulf states

REFERENCES

- Giri, C., Ochieng, E., Tieszen, L. L., Zhu, Z., Singh, A., Loveland, T., Masek, J., & Duke, N. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data: Status and distributions of global mangroves. *Global Ecology and Biogeography*, *20*(1), 154–159. https://doi.org/10.1111/j.1466-8238.2010.00584.x
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THANK YOU!

Questions?

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Dr. Sarah Lester + Rasster Lab members
Dr. Josh Breithaupt + Breithaupt Lab members
Ryan Slapikas
Kevin Engelbert
Jason Garwood