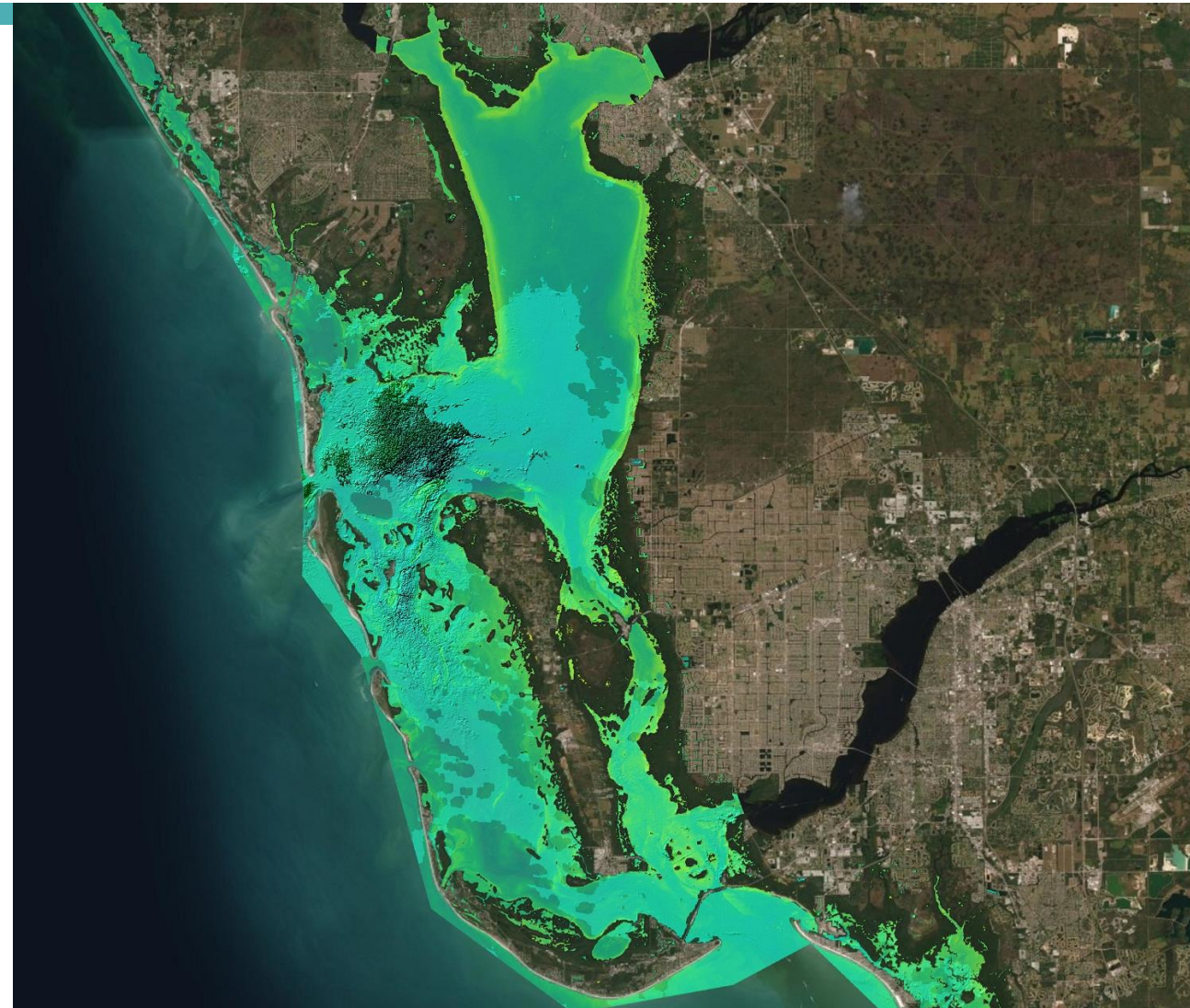




Florida Water Resources

Assessing Coastal Resiliency Across Florida's
Aquatic Preserves Response To Hurricane
Forces

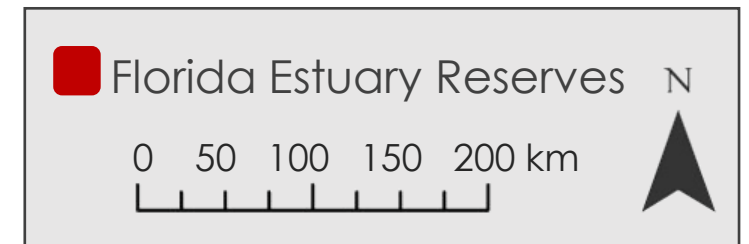
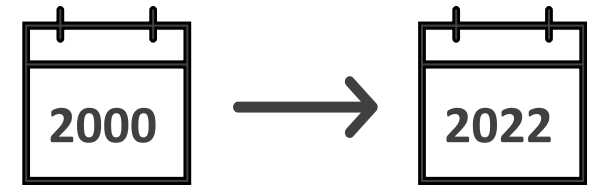
Samuel Perrello (Team Lead)
Emily Heltzel
Kyle Stark
Koya Oki



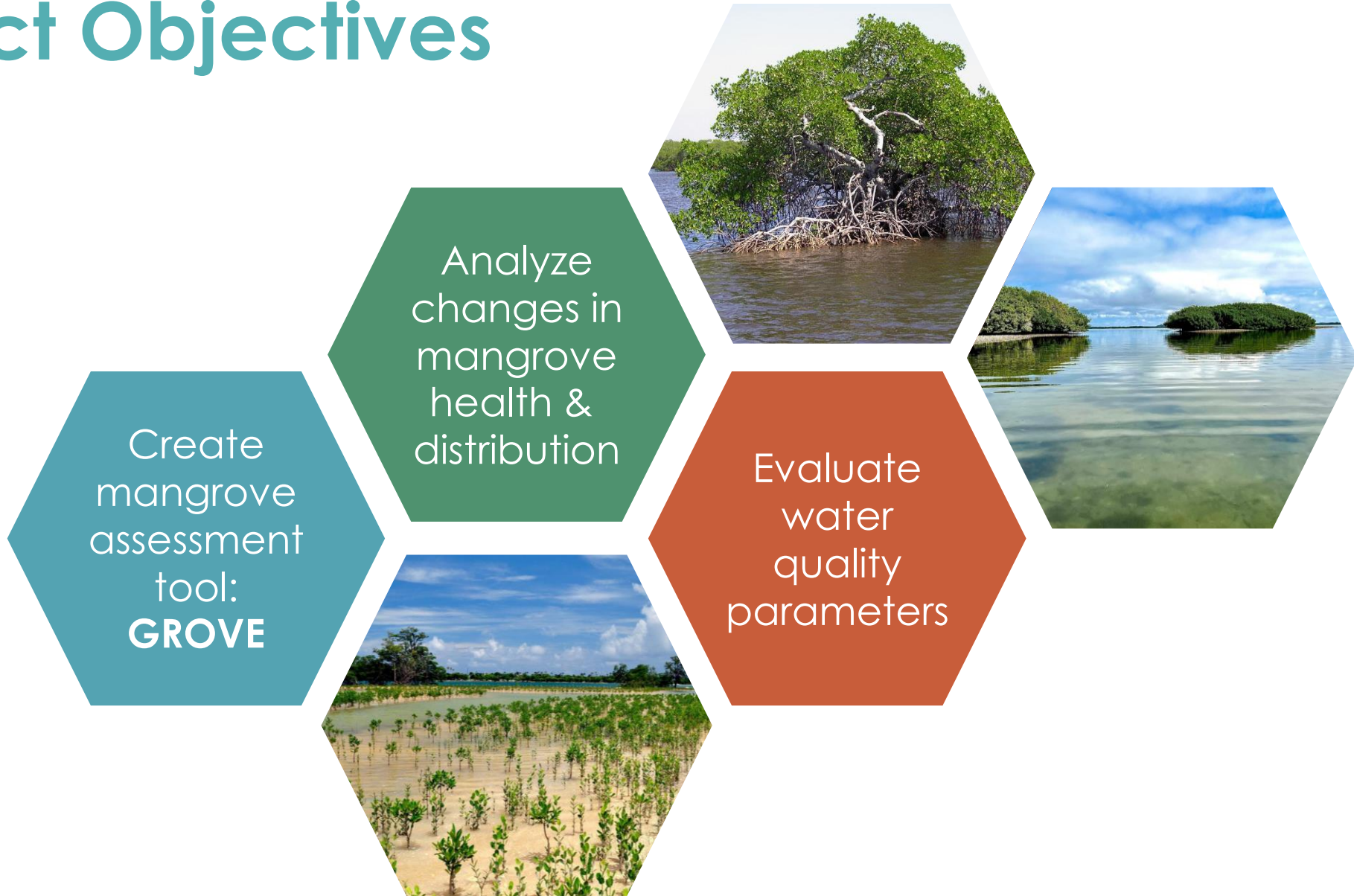
Study Area: Florida Aquatic Preserves



Study Period



Project Objectives



Project Partners



**Florida Department of
Environmental
Protection (DEP) –
Office of Resilience
and Coastal
Protection**



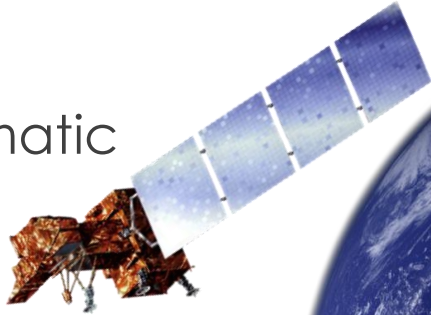
Community Concerns

- ▶ Florida is in a high-risk zone for hurricanes which threaten human safety and cause environmental destruction
- ▶ Anthropogenic expansion in mangrove habitat areas
- ▶ Lack of research within the area for mangrove health and extent
- ▶ Mangrove forest degradation leads to increased risk of erosion during storm events

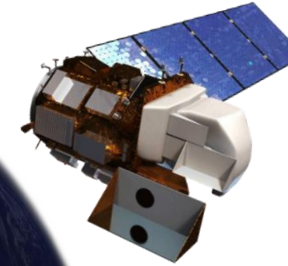


NASA Satellites and Sensors

Landsat 7
Enhanced Thematic
Mapper (ETM+)



Landsat 8
Operational
Land Imager
(OLI)



Shuttle Radar
Topography
Mission (SRTM)



Landsat 9
Operational Land
Imager 2 (OLI-2)



Sentinel-2
Multispectral
Instrument (MSI)



Methodology: Mangrove Extent

Satellites

- Landsat 7 ETM+
- Landsat 8 OLI
- Landsat 9 OLI-2
- Topography Mission (SRTM)

GEE

- Cloud masking
- Elevation mask
- NDWI
- MNDWI
- Thresholding

GEE

- Random Forest classification
- Extent calculations

Hurricane time period extent analysis

Overall change from 2000 – 2021



In situ data

Florida DEP

- Download mangrove extent data

GEE

- Perform Accuracy Assessment



Methodology: Model Accuracy

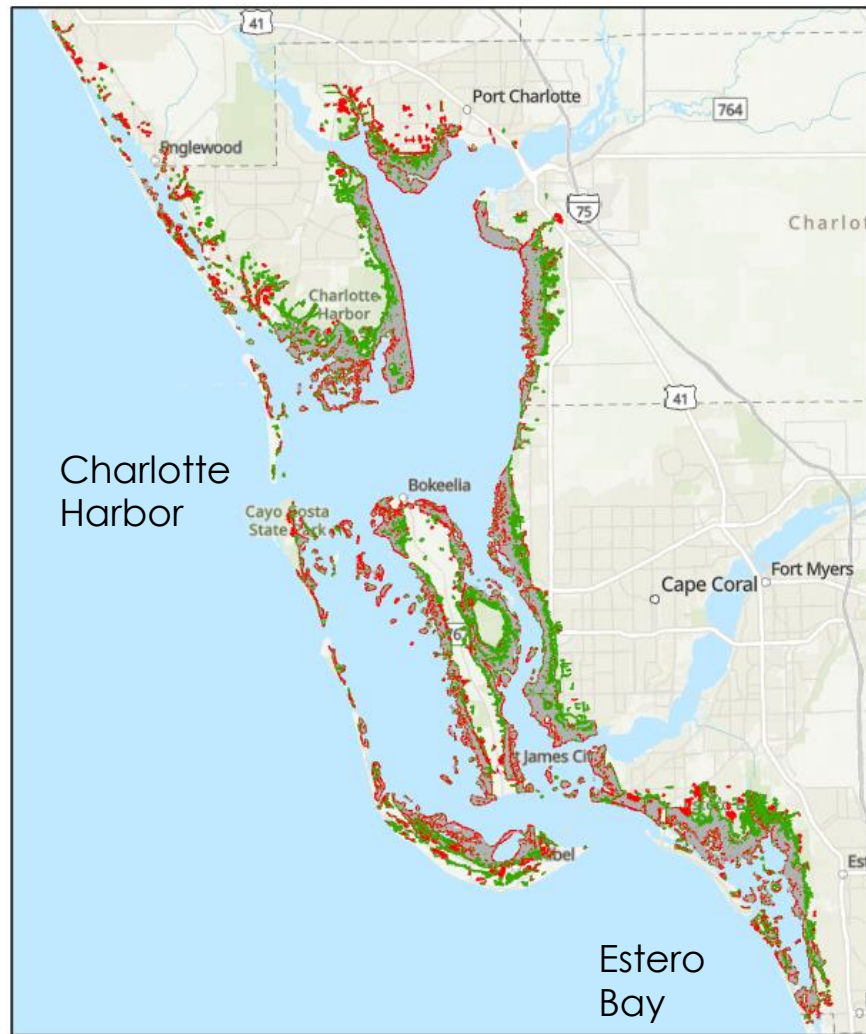
- ▶ **Only one** mangrove training datapoint was **incorrectly identified** across all aquatic preserves
- ▶ **Extremely positive results:** suggest that a model, trained with data from 2021 could perform well in previous years

2021 Test Data

	Non-vegetation	Other Vegetation	Mangrove
Non-vegetation	10	1	0
Other Vegetation	2	2	1
Mangrove	1	0	15



Results: Mangrove Extent - Charlotte Harbor & Estero Bay



Mangrove Extent Changes 2000 – 2021

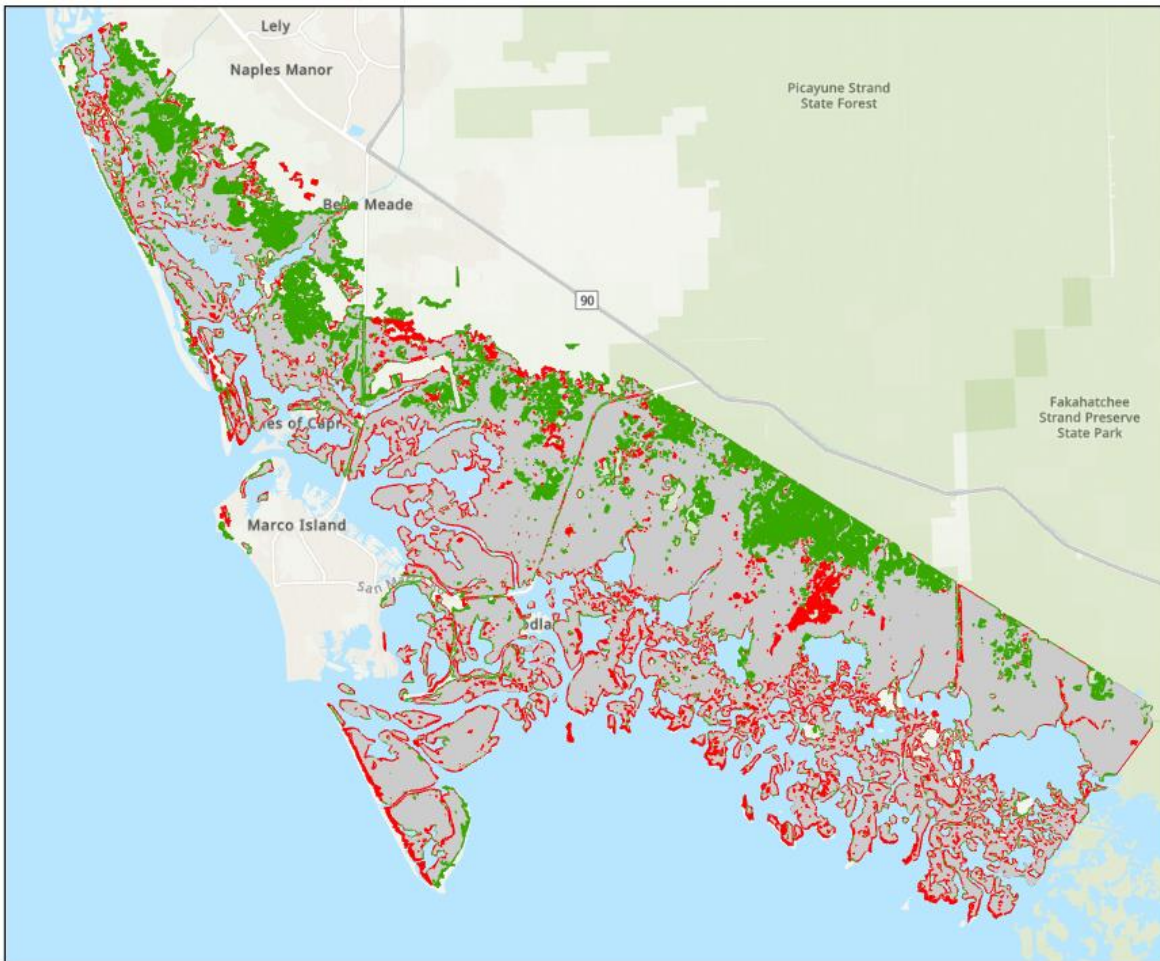
- Losses
- Gains
- Constant

0 5 10 15 20 km

- ▶ Approximate mangrove area change 2000 – 2021:
 - ▶ **Gain** = 5,570 ha
 - ▶ **Loss** = 1,680 ha
- ▶ Overall trends:
 - ▶ **Gain** away from the ocean/further from coastline
 - ▶ **Loss** exterior of forest

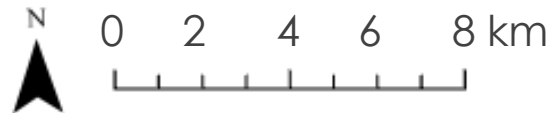


Results: Mangrove Extent – Rookery Bay



Mangrove Extent Changes 2000 – 2021

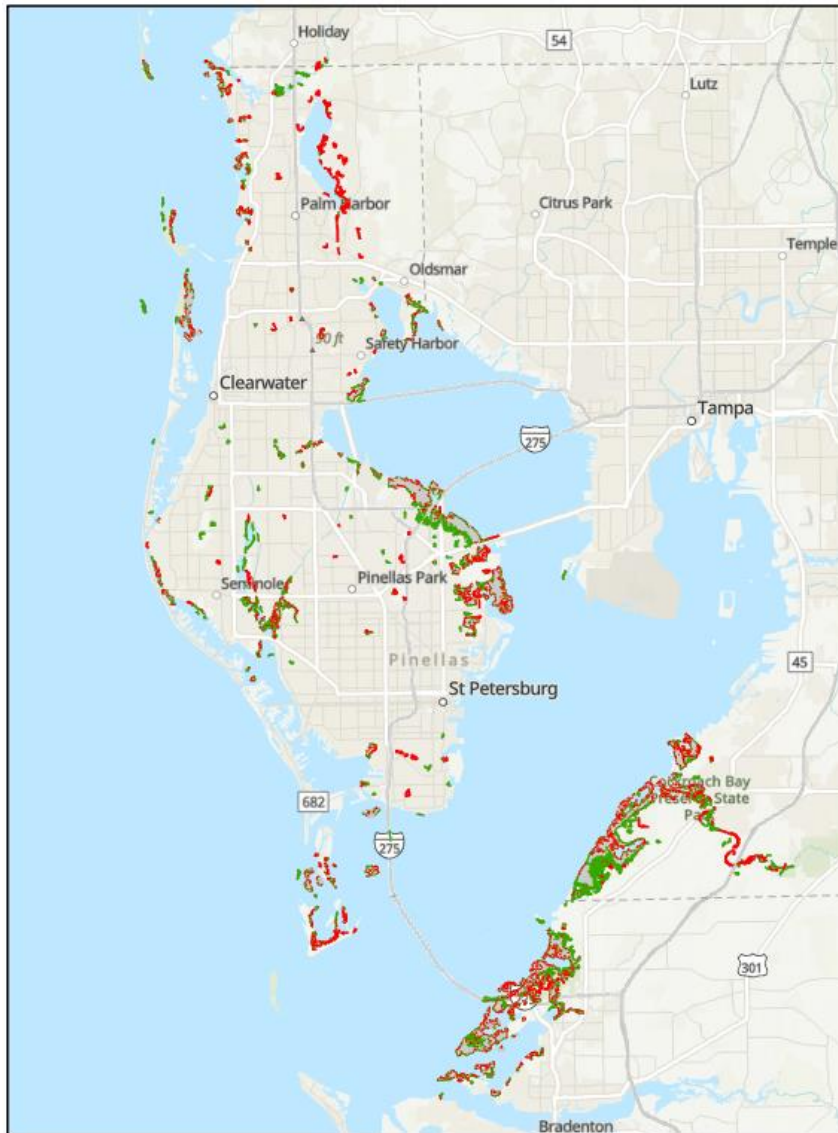
- Losses
- Gains
- Constant



- ▶ Approximate mangrove area change 2000 – 2021:
 - ▶ **Gain** = 3,260 ha
 - ▶ **Loss** = 1,430 ha
- ▶ Overall trends:
 - ▶ **Gain** concentrated inland; appears moving away from water
 - ▶ **Loss** largely on the exterior or ocean edge of the forests



Results: Mangrove Extent – Pinellas County



Mangrove Extent Changes 2000 – 2021

- Losses
- Gains
- Constant

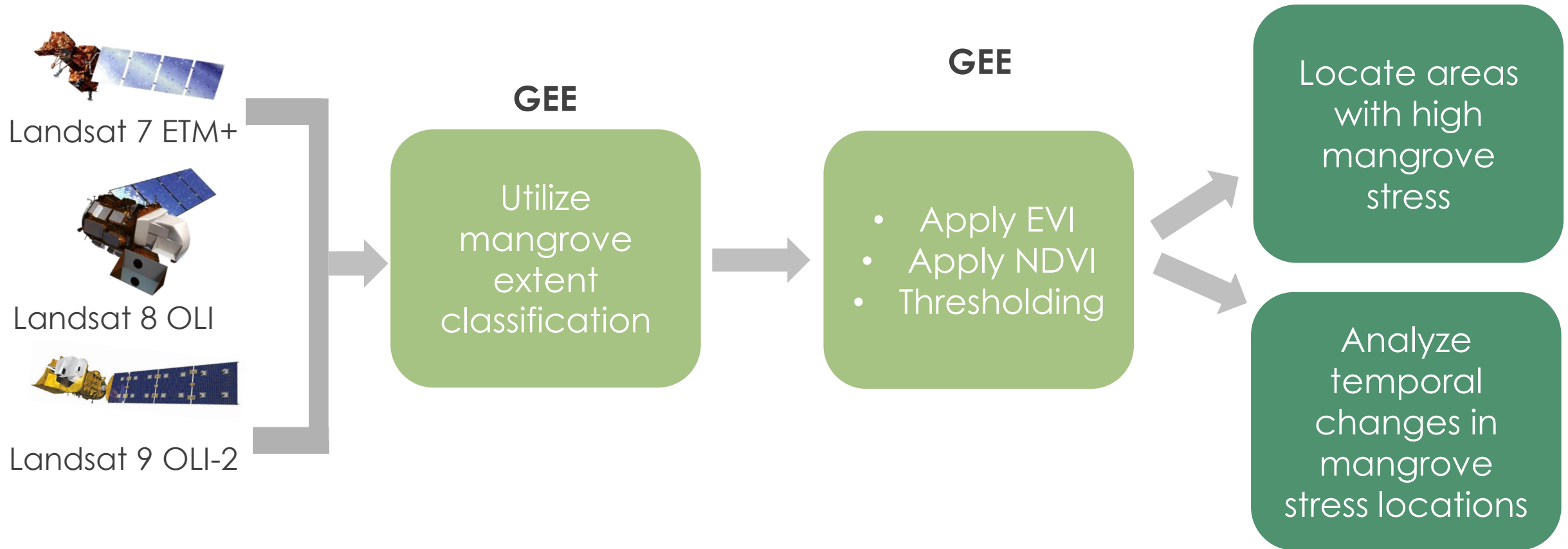


0 4 8 12 16 km

- ▶ Approximate mangrove area change 2000 – 2021:
 - ▶ **Gain** = 1,510 ha
 - ▶ **Loss** = 570 ha
- ▶ Overall trends:
 - ▶ **Gain** primarily around inland areas
 - ▶ **Loss** concentrated around exterior of forest, closest to ocean

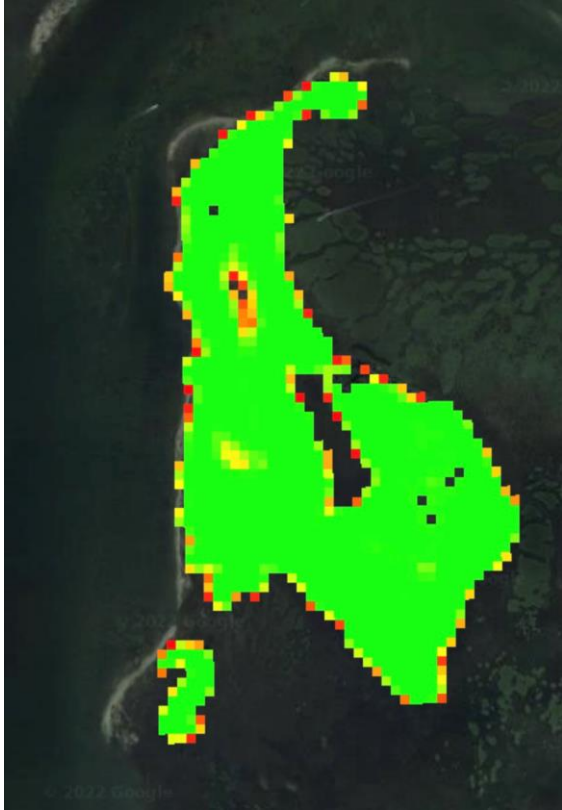


Methodology: Mangrove Health

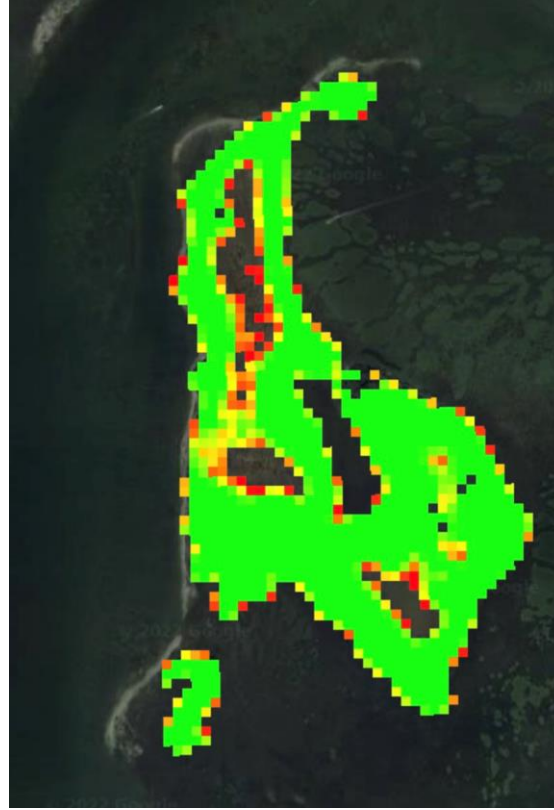


Results: Mangrove Health - Charlotte Harbor

2002



2021



- ▶ Areas highlighted in red have low NDVI values, these locations correspond to **high vegetation stress** and lower greenness
- ▶ Areas of specific interest are landlocked areas with low NDVI values
- ▶ Coastal edges proved to be difficult to classify due to their daily inundation and appearance of vegetation stress

Normalized Difference Vegetation Index (NDVI)

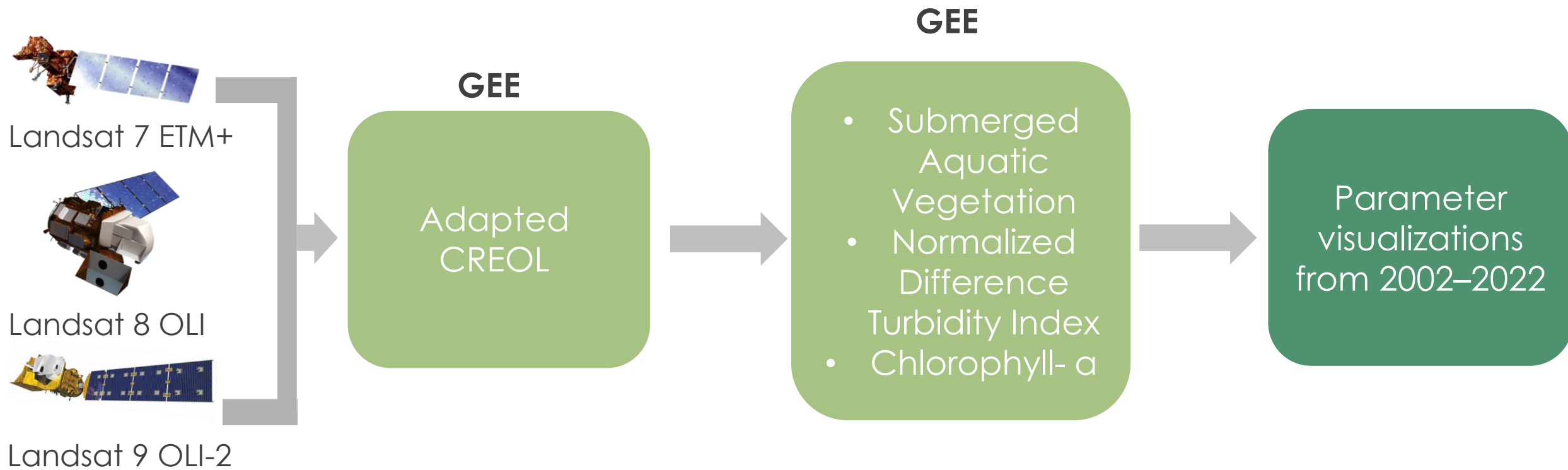


0.25

0.7



Methodology: Water Quality

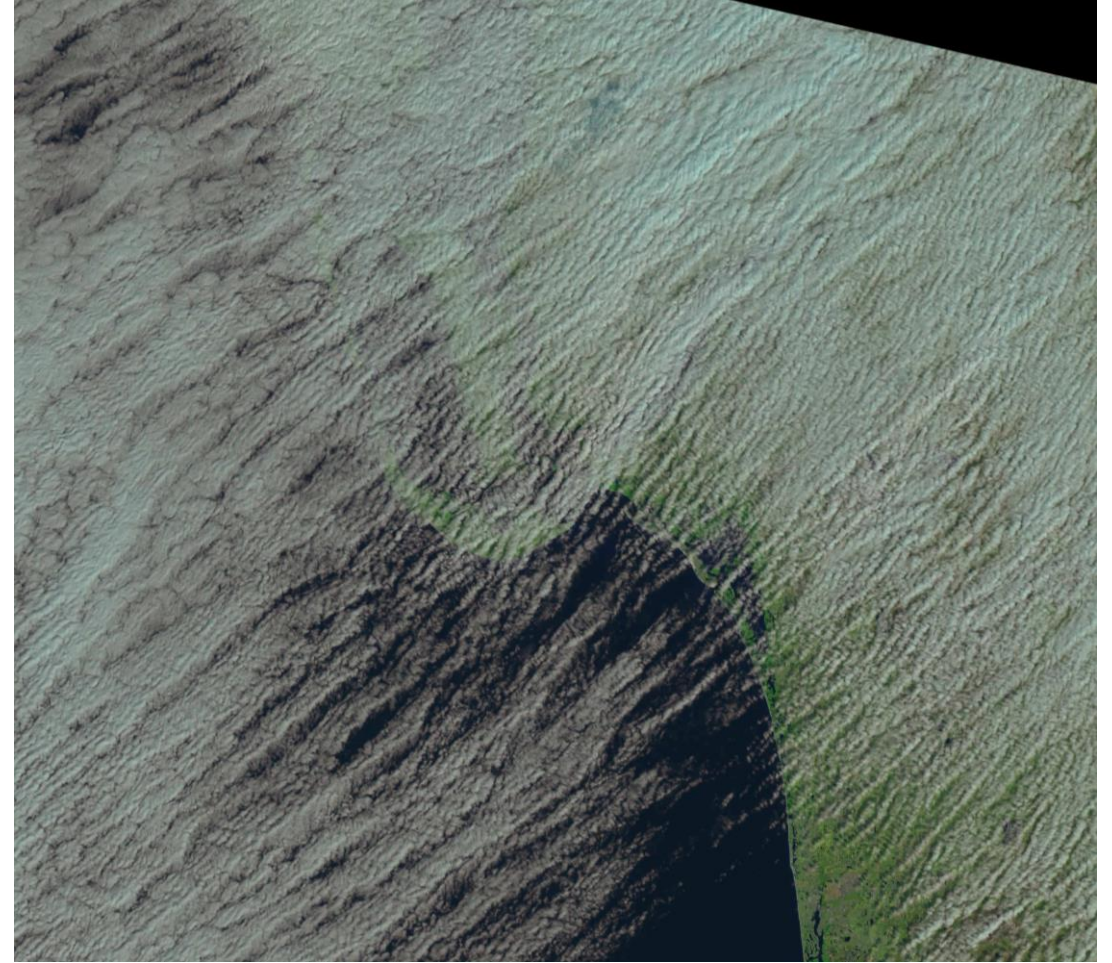


Limitations: Cloud Coverage

Single Image: Wet Season 2021

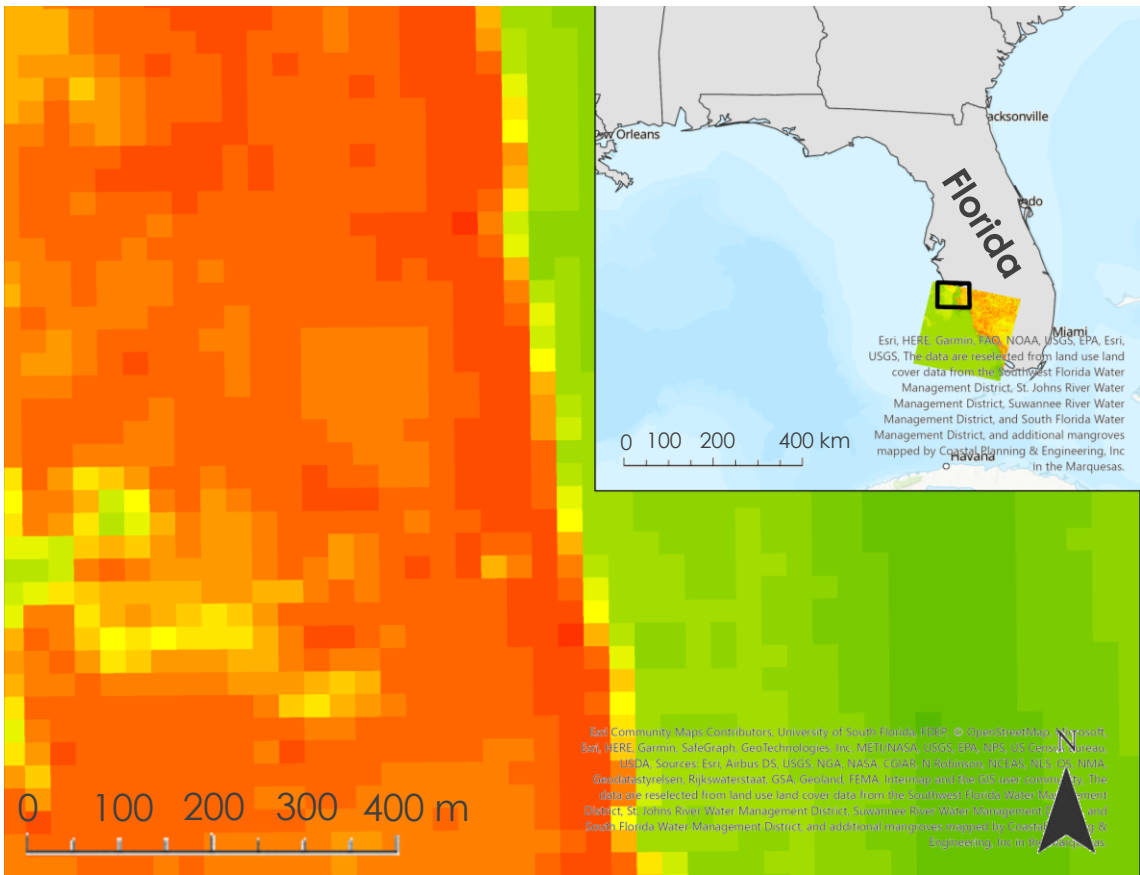


Single Image: Wet Season 2022



Limitations: Spatial & Temporal

Landsat 8 OLI Collection 2



30x30m geometry drawn in Charlotte Harbor Aquatic Preserve

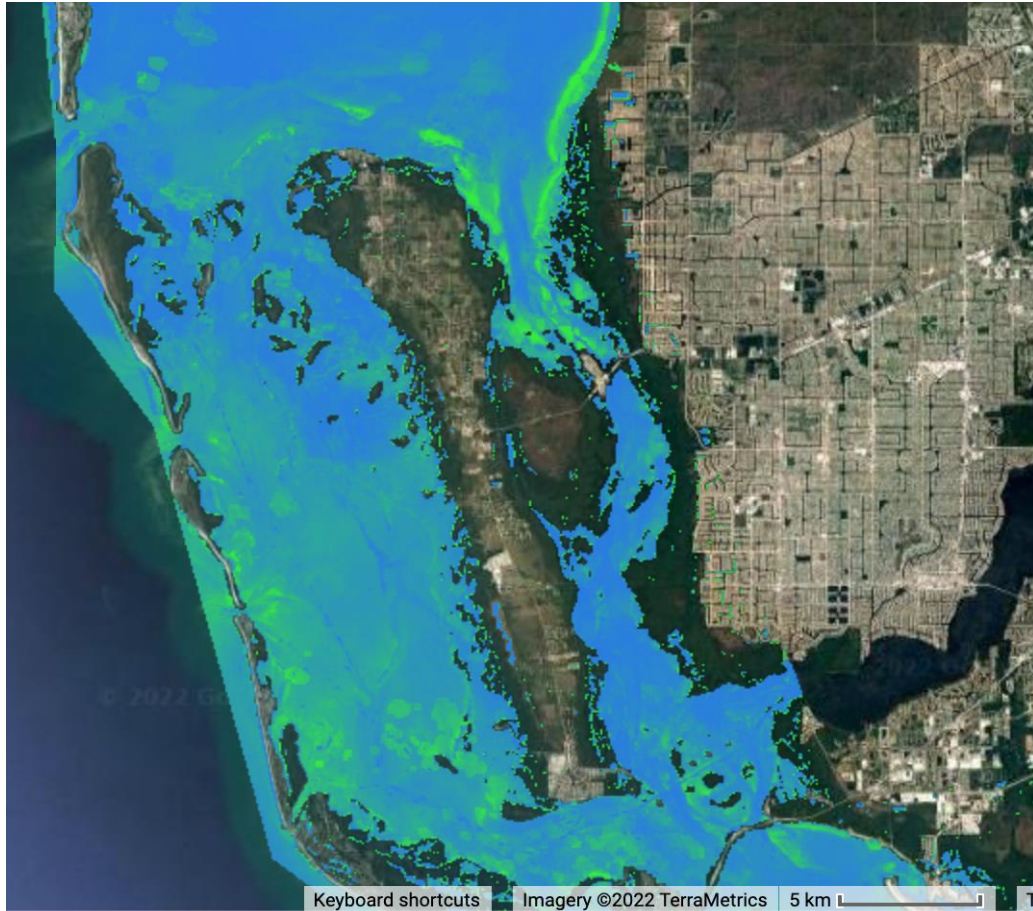
Landsat 8 OLI Collection Dates

Collection Level	Date	Row/Path
2	10/11/2021	16/42
2	10/27/2021	16/42
2	11/12/2021	16/42
2	11/28/2021	16/42
2	12/14/2021	16/42
2	12/30/2021	16/42
2	1/13/2022	16/42
2	1/29/2022	16/42

Same image path/collection collected every 16 days



Results: Water Quality - Charlotte Harbor

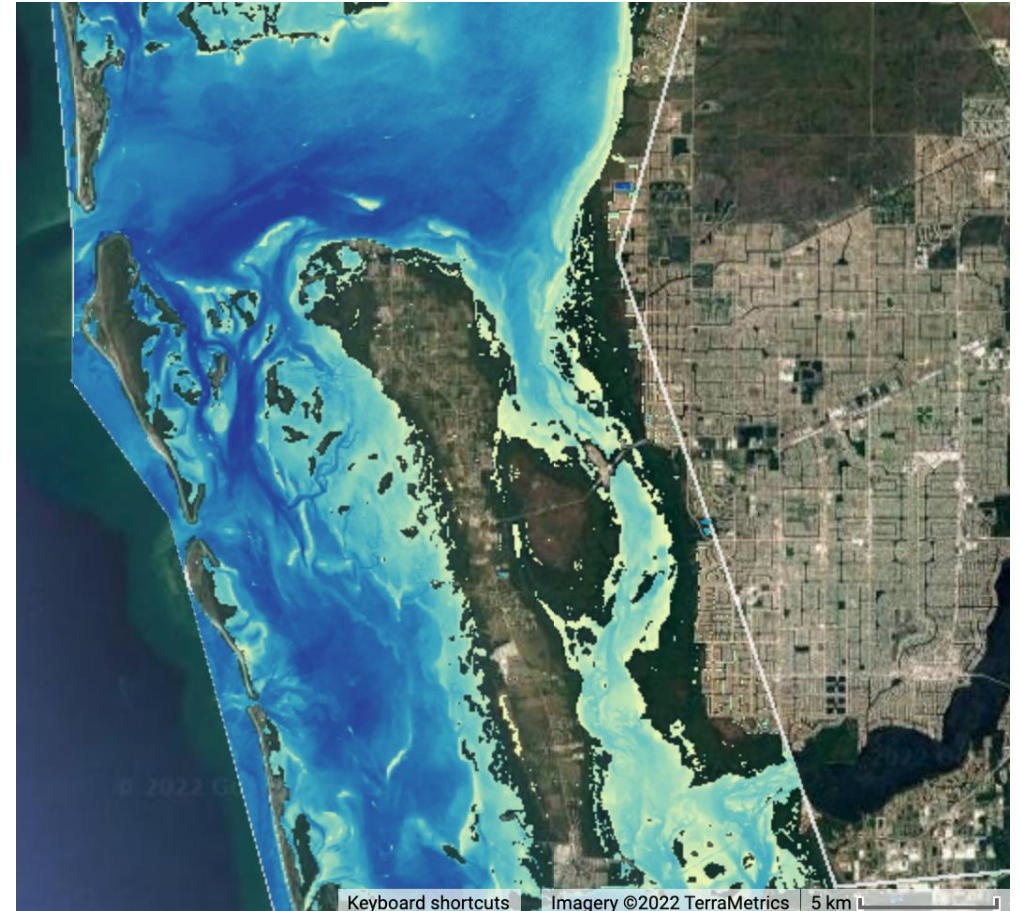


Chlorophyll-a (mg/m^3)



0

75



Normalized Difference Turbidity Index

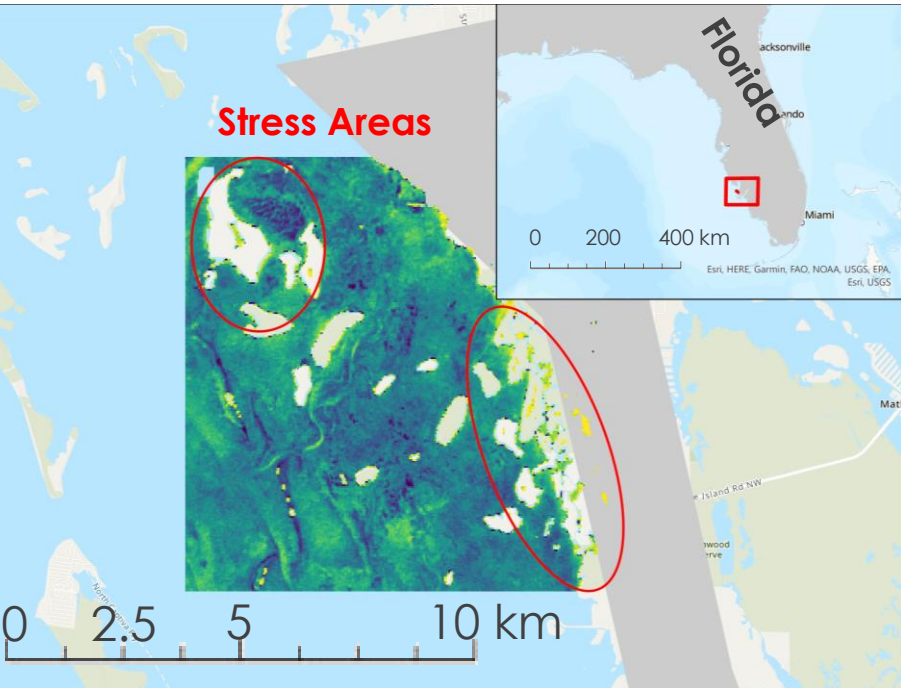


-0.5

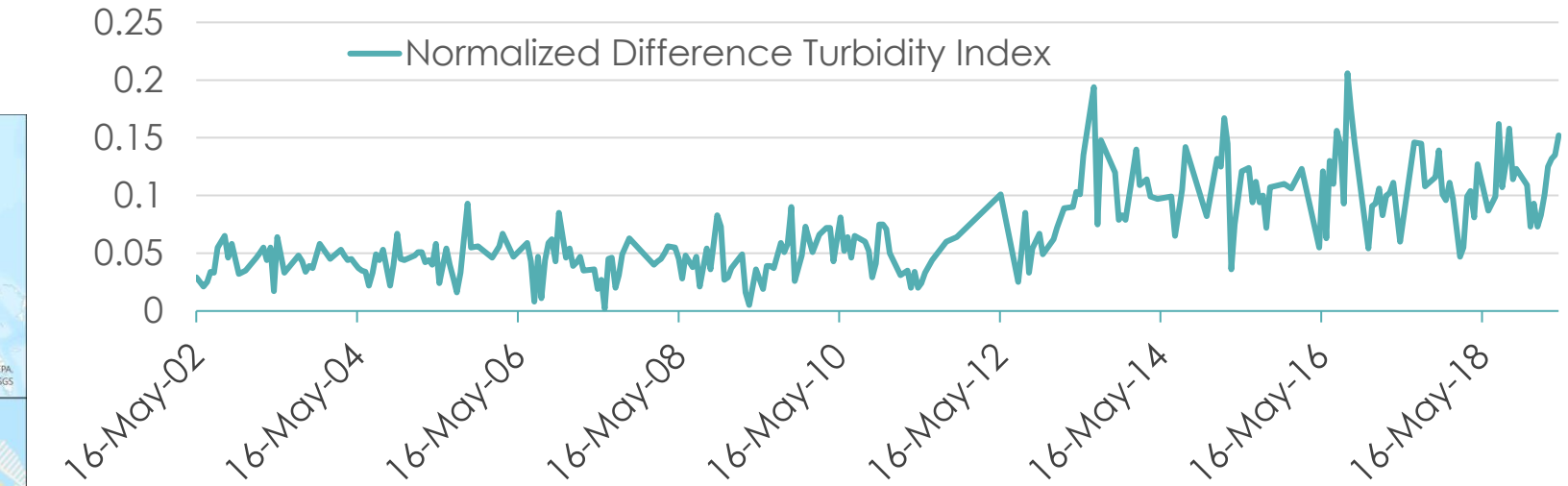
0



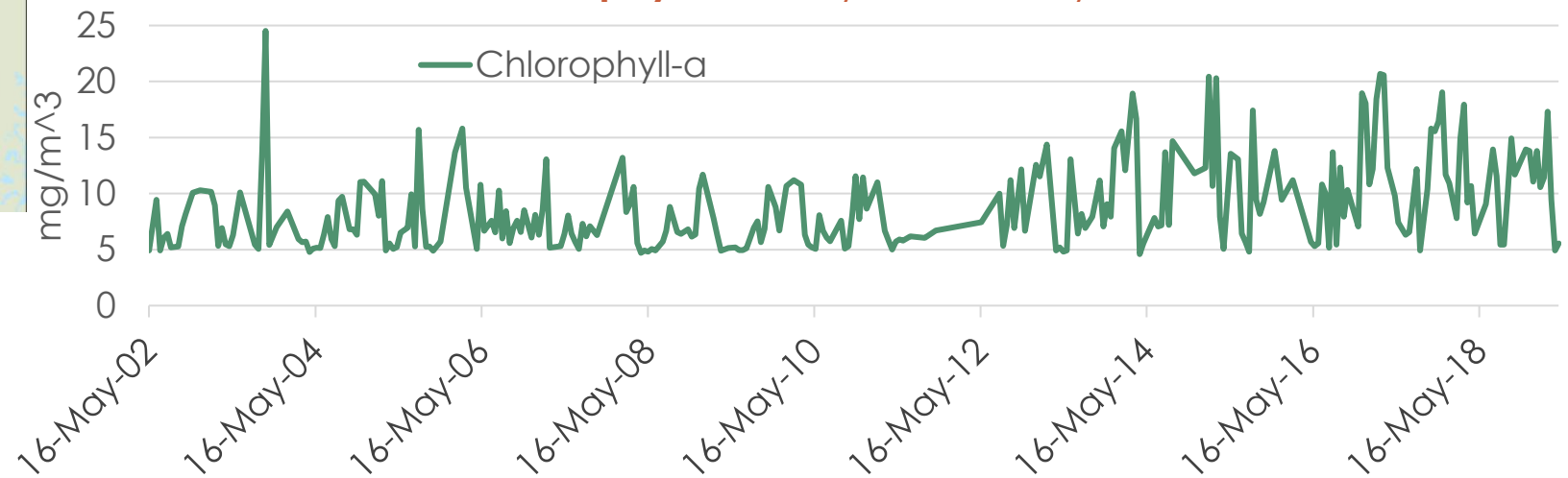
Results: Water Quality - Charlotte Harbor AP



Normalized Difference Turbidity Index: May 2002 – May 2019



Chlorophyll-a : May 2002 – May 2019





Conclusions

- ▶ **Mangrove Extent Change:** Vulnerable areas on transition zones
- ▶ **Water Quality:** Parameters are in a constant flux with different changes specific to regions and seasons
- ▶ **Mangrove Health:** Used as proxy for mangrove stress in future observations





Future Work

- ▶ **Improve accuracy of mangrove classification** through extensive in-situ data ground truthing
- ▶ **Improve water quality monitoring accuracy** through extensive in-situ data ground truthing
- ▶ **Predict mangrove stress areas** from water quality data
- ▶ **Analyze temporal erosion & shoreline movement**



Partners at Florida DEP, Office of Resilience & Coastal Protection

- ▶ **Melynda Brown** (Charlotte Harbor Aquatic Preserves, Manager)
- ▶ **Stephanie Erickson** (Estero Bay Aquatic Preserves, Manager)
- ▶ **Keith Laakkonen** (Regional Administrator)
- ▶ **Heather Stafford** (Southwest Florida Aquatic Preserves, Manager)
- ▶ **Arielle Taylor-Manges** (Research Specialist)

Science Advisors

- ▶ **Dr. Juan Torres-Pérez** (DEVELOP Science Advisor, NASA Ames Research Center)

Additional thanks to: **Britnay Beaudry** (DEVELOP Ames Fellow), **Hayley Pippin** (DEVELOP Ames Senior Geoinformatics Fellow)

This material contains modified Copernicus Sentinel data (2017-2021), processed by ESA.

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