

Utilizing NASA Earth Observations to Assess Sea Level Rise and Develop Optimal Green Infrastructure Plans to Restore Mangrove Habitat and Enhance Coastal Resiliency

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Community Concerns



- ▶ Shoreline **changes significantly** impact local **economies**
- ▶ **Extreme weather** is a major **threat** to coastal communities
- ▶ Implementation of **green infrastructure** as a **mitigation** technique
- ▶ **Increase** storm water **drainage capacity** and **pump stations**



Image Credit: Sevag Mehterian

Project Partner



City of Miami Beach, Public Works Department



Image Credit: Sevag Mehterian

Study Area & Period

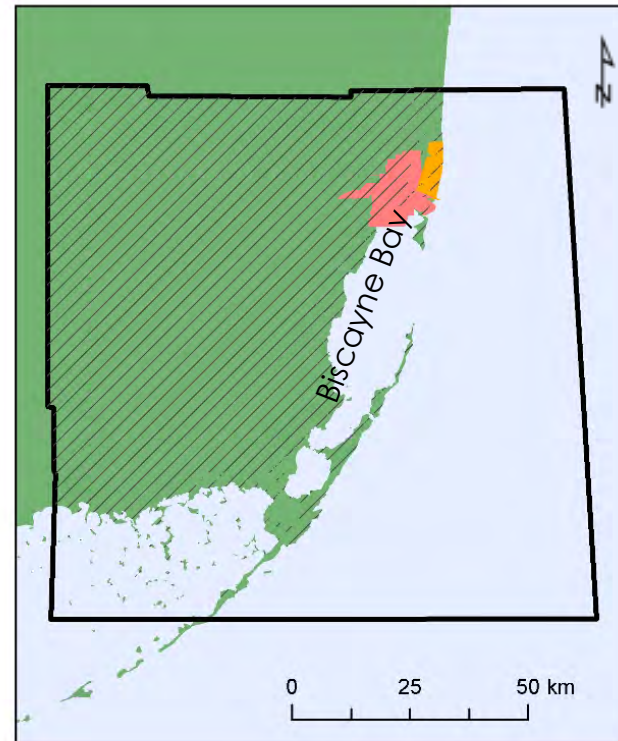


Image Credit: Sevag Mehterian

Miami-Dade County

- ▶ Biscayne Bay Area
- ▶ City of Miami Beach
- ▶ 1984-2017

Objectives



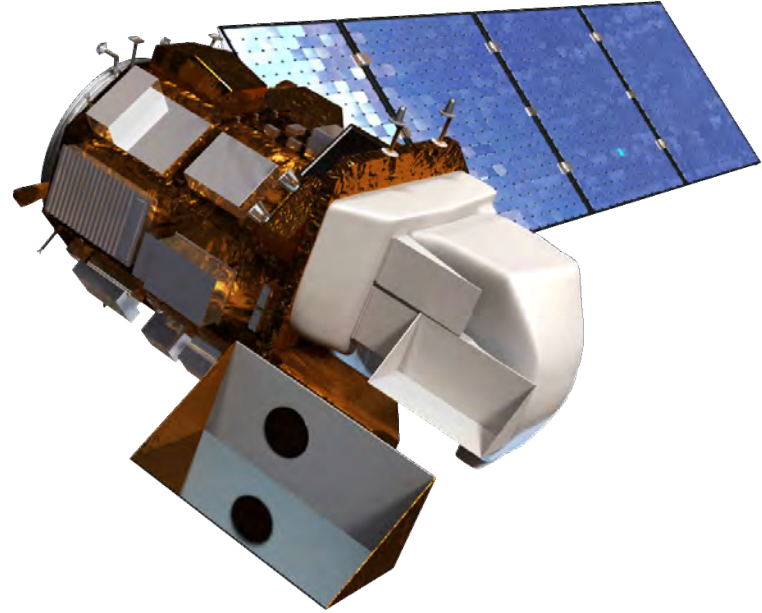
- ▶ **Examine coastal damage** in Miami Beach following **Hurricane Irma**
- ▶ **Map the distribution of historic urban vegetation** in Miami Beach
- ▶ **Assess the range and health of coastal wetlands** in **southeast Florida** using Landsat 5 TM, Landsat 8 OLI, and Terra MODIS data products



Image Credit: Sevag Mehterian



Landsat 5 TM



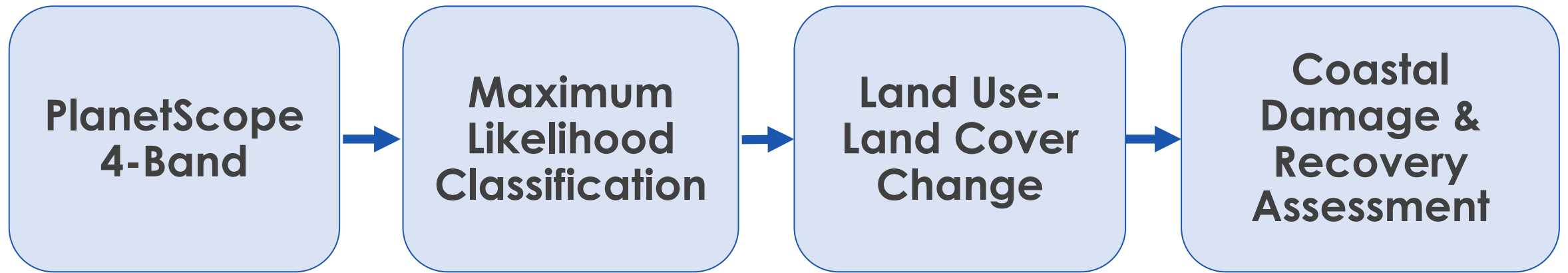
Landsat 8 OLI



Terra MODIS

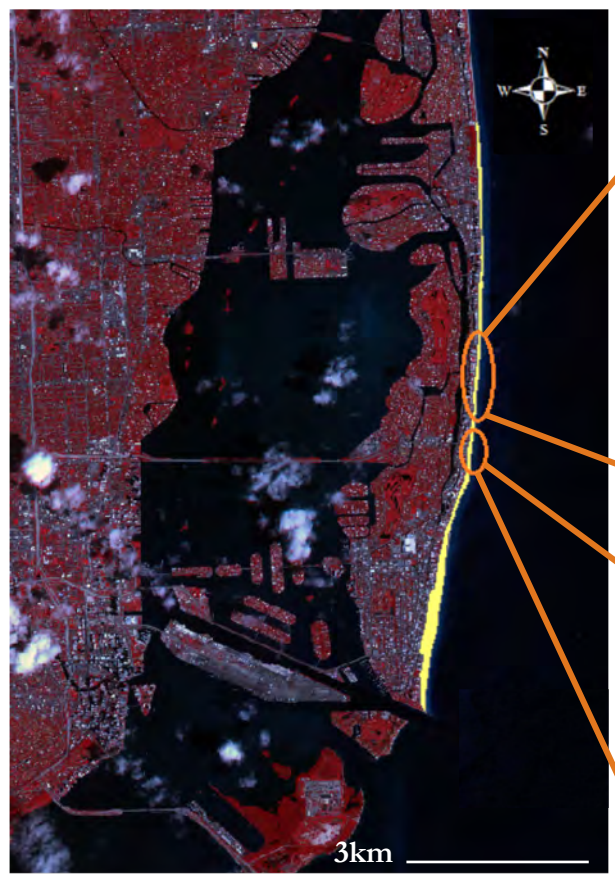


Methods – Coastal Damage



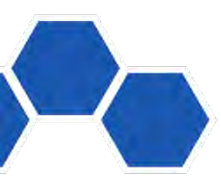


Results – Coastal Damage



		Sand
		Vegetation
		Water

Dates	Class	Area (km ²)
09/07 (3 days before Irma)	Sand	0.71
	Vegetation	0.48
09/12 (2 days after Irma)	Sand	0.92
	Vegetation	0.26
10/30 (40 days after Irma)	Sand	0.79
	Vegetation	0.39



Conclusions – Coastal Damage

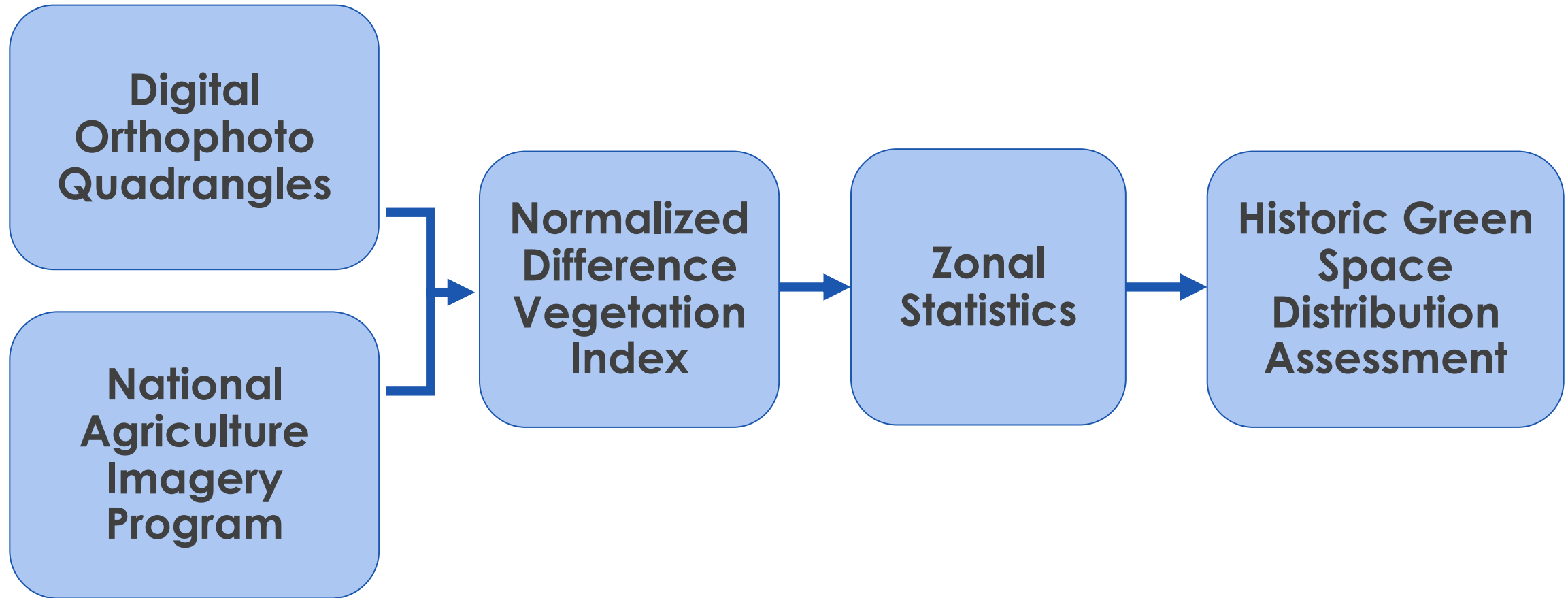
- ▶ Approximately **45%** of coastal vegetation along Miami Beach **was lost or damaged**
- ▶ An estimated **26%** of this **vegetation recovered** within 40 days of the storm's passing



Image Credit: Sevag Mehterian



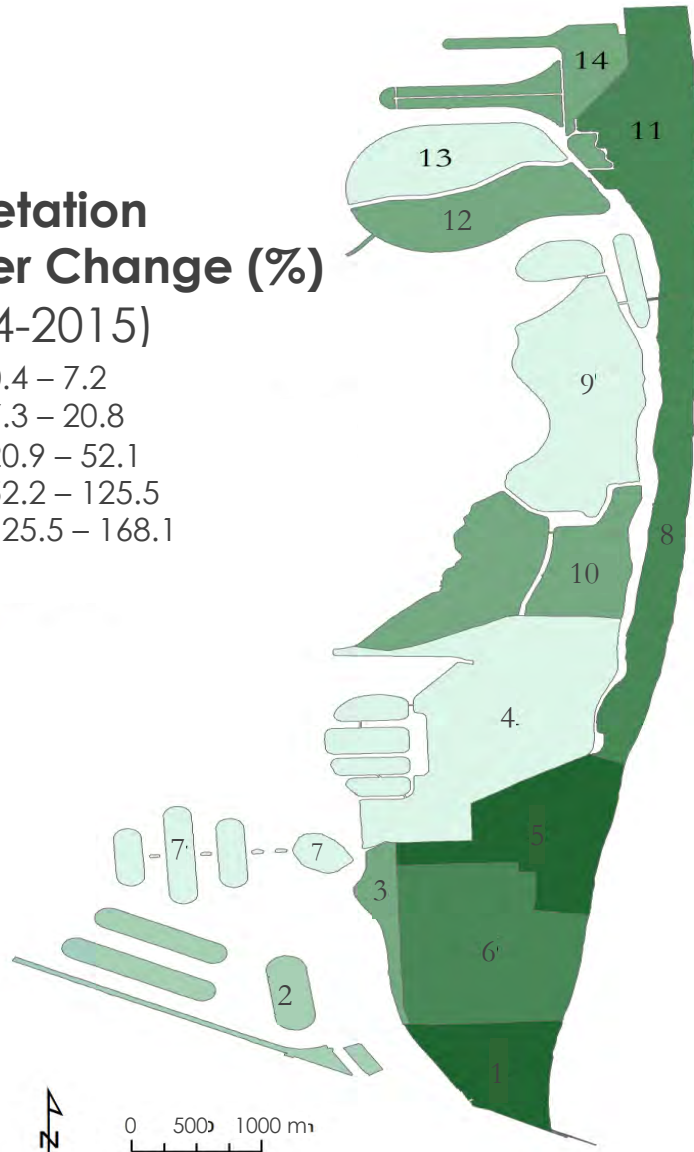
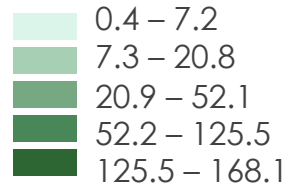
Methods – Urban Vegetation





Results – Urban Vegetation

Vegetation Cover Change (%) (1994-2015)



Neighborhoods

1. South Pointe
2. Star/Palm/Hibiscus
3. West Avenue & Bay Road
4. Bayshore
5. City Center
6. Flamingo/Lummus
7. South & Venetian Islands
8. Oceanfront
9. La Gorce
10. Nautilus
11. North Shore
12. Normandy Isles
13. Normandy Shores
14. Biscayne Point

Conclusions – Urban Vegetation



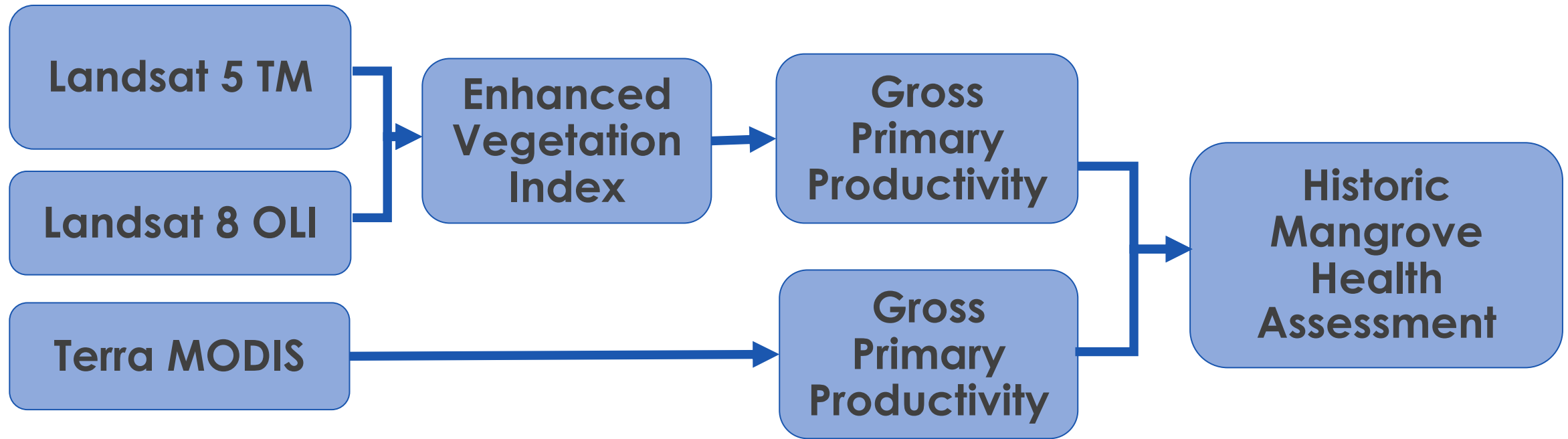
- ▶ The city of Miami Beach saw a **24% increase** in vegetation coverage between 1994 and 2015
- ▶ The city's plans to **implement and maintain green infrastructure** are having positive effects



Image Credit: Sevag Mehterian

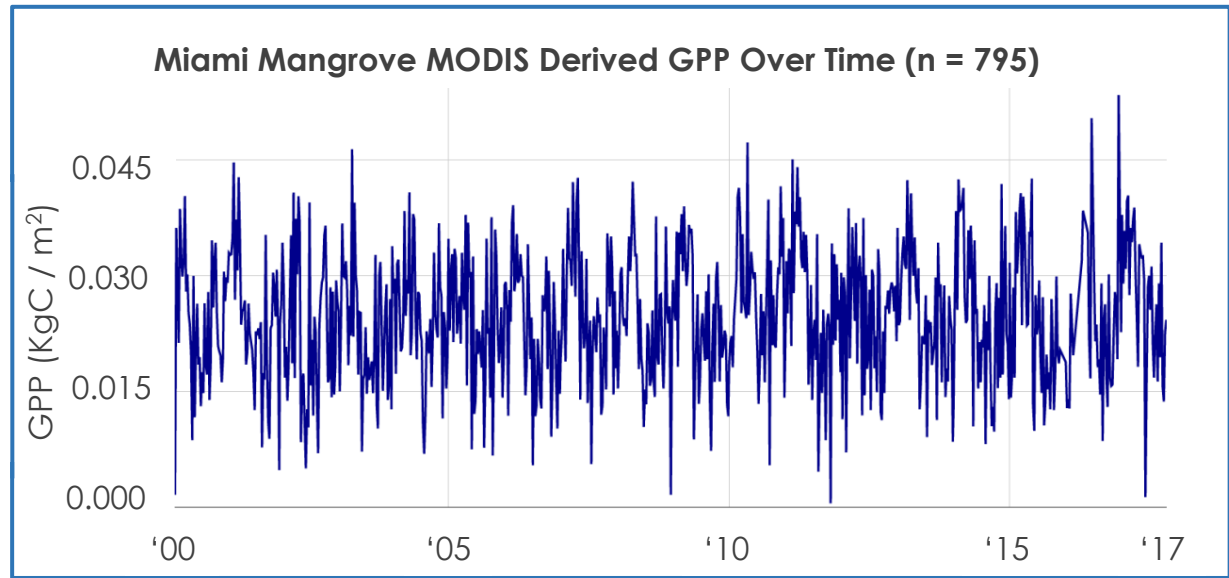
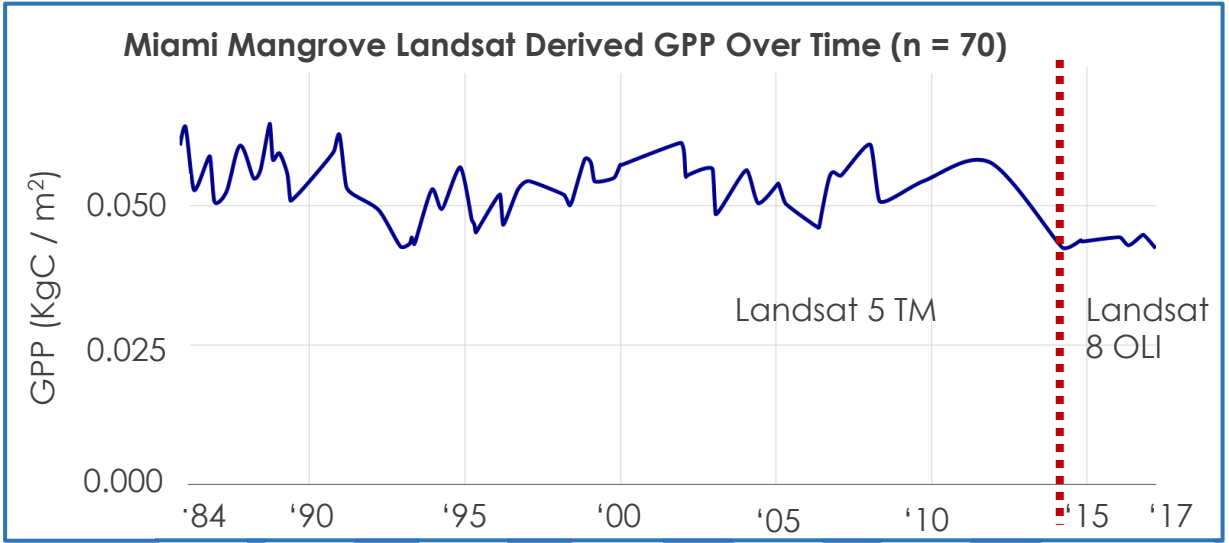
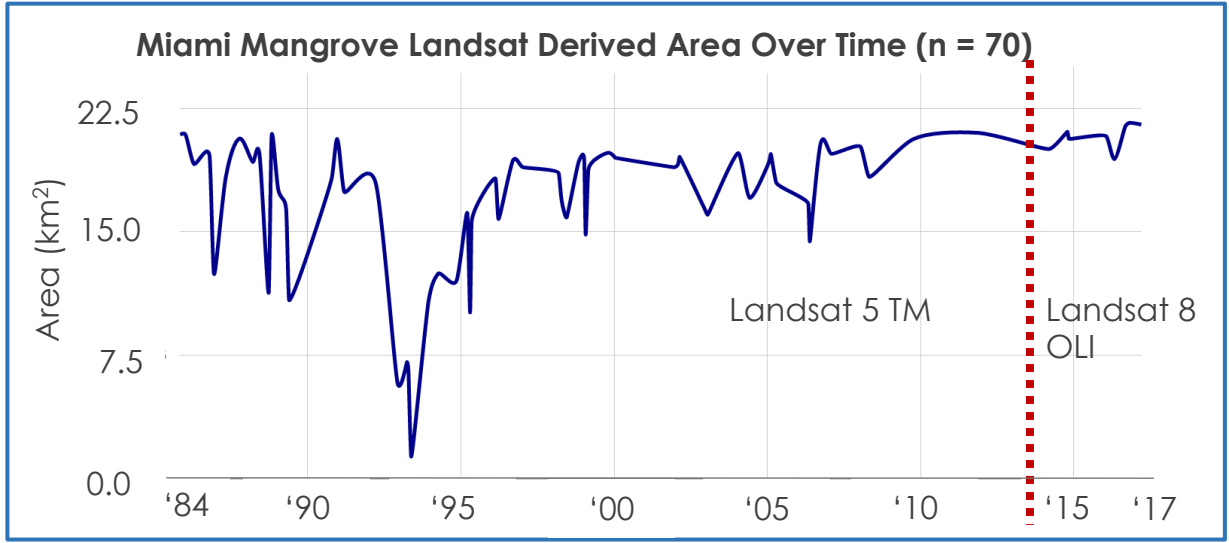


Methods – Mangrove Health





Results – Mangrove Health

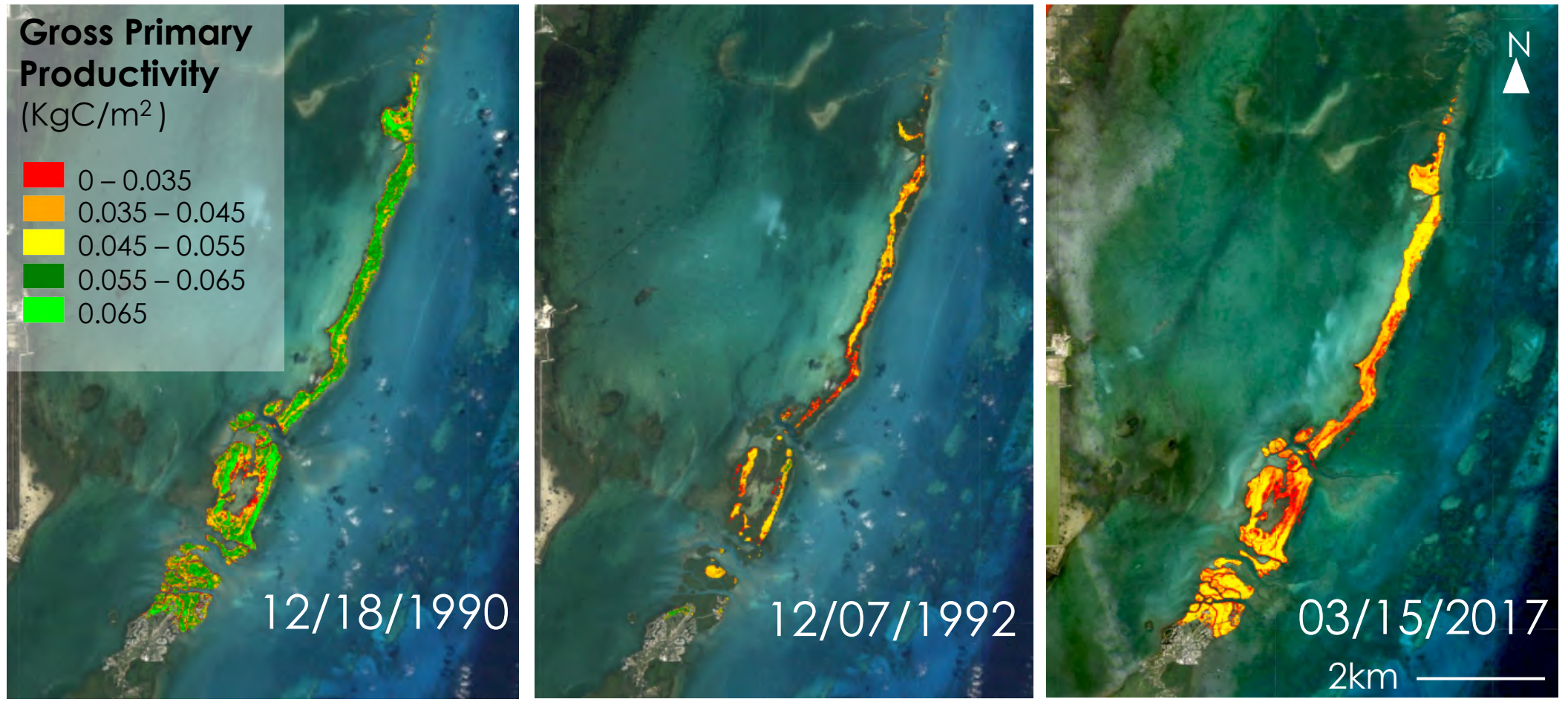


$$GPP = 0.096926 * EVI + 0.0003819$$

Where, $EVI = 2.5 [(NIR - Red) / (1 + NIR + 2.4 * Red)]$



Results – Mangrove Health





Conclusions – Mangrove Health



Image Credit: Sevag Mehterian

- ▶ **Mangrove forests** in Biscayne National Park represent **effective, self-sustaining green infrastructure**
- ▶ They exhibit **resiliency** in both hurricane and non-hurricane years

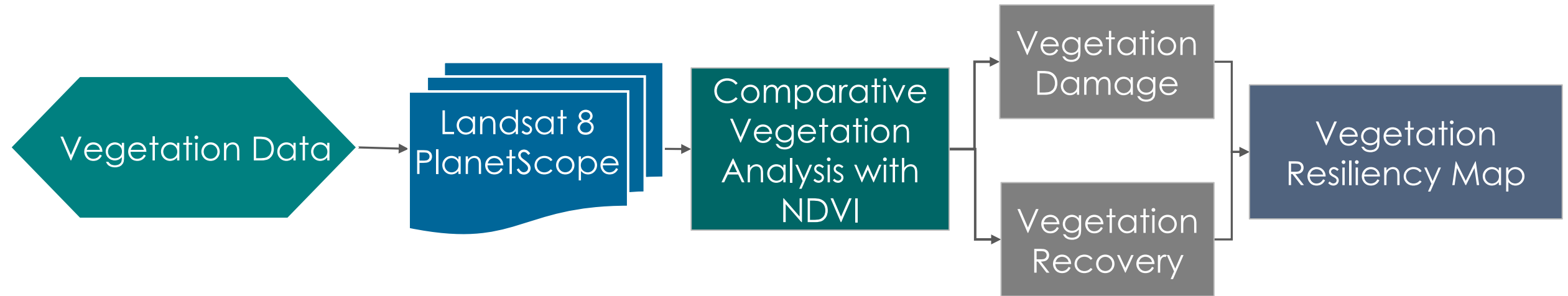


- ▶ How do the **observed recovery rates** compare with **previous** recovery rates?
- ▶ How do **storm impacts** affect **vegetation coverage**?
- ▶ What are the **most suitable** places for the **implementation** of **green infrastructure** in Miami Beach?



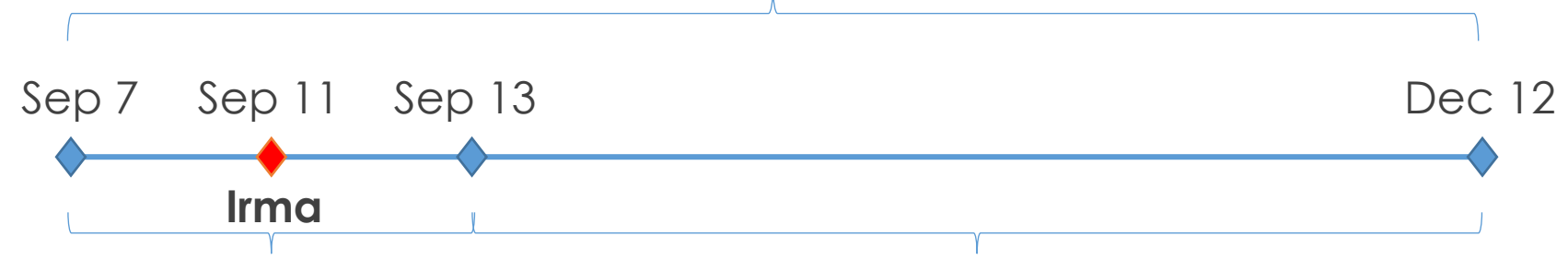


Vegetation Analysis Methods



Landsat 8 OLI

$$Damage = \frac{NDVI_{Sep\ 07} - NDVI_{Dec\ 12}}{NDVI_{Sep\ 07}}$$



Planet

$$Damage = \frac{NDVI_{Sep\ 07} - NDVI_{Sep\ 13}}{NDVI_{Sep\ 07}}$$

$$Recovery = \frac{NDVI_{Dec\ 12} - NDVI_{Sep\ 13}}{NDVI_{Sep\ 07} - NDVI_{Sep\ 13}}$$

Landsat 8 Results

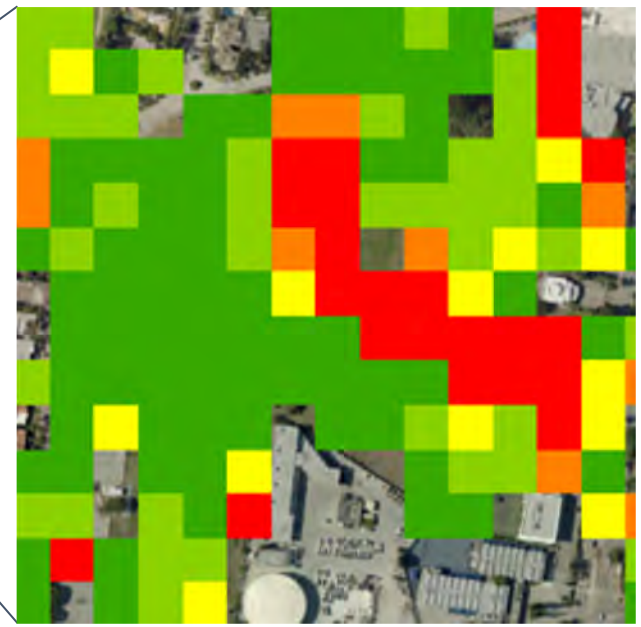
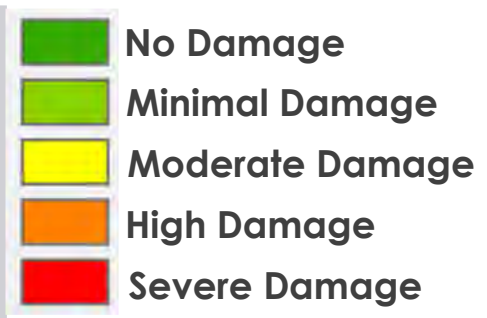
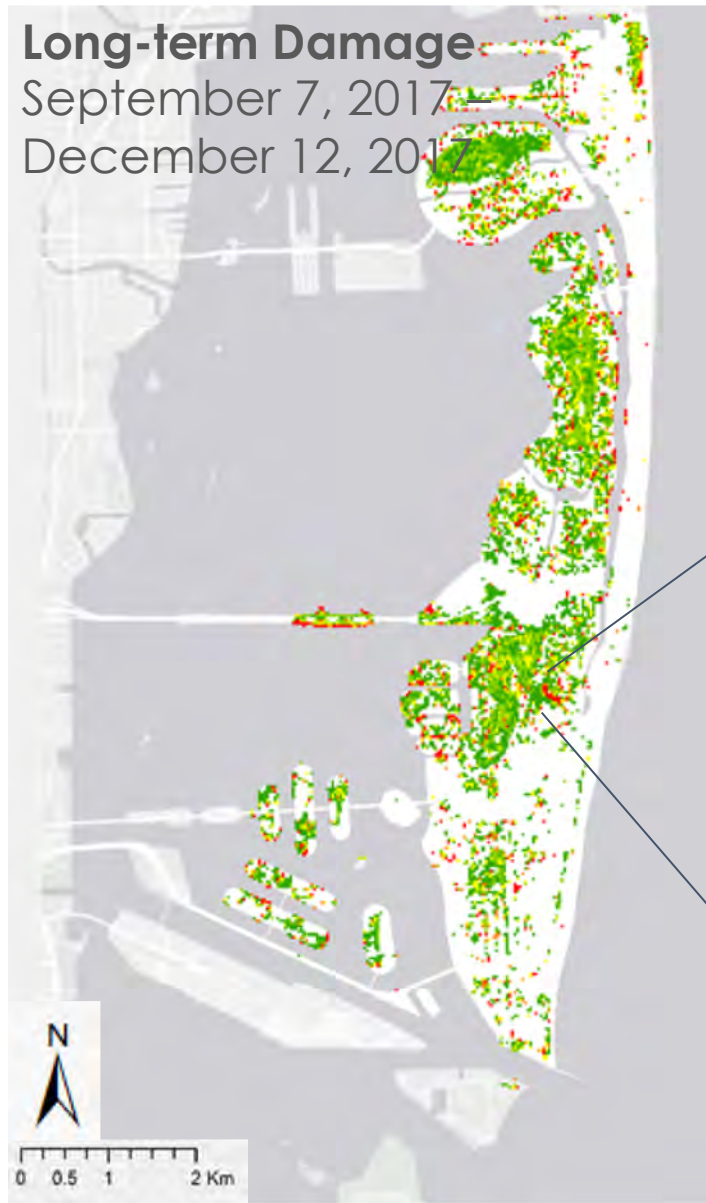
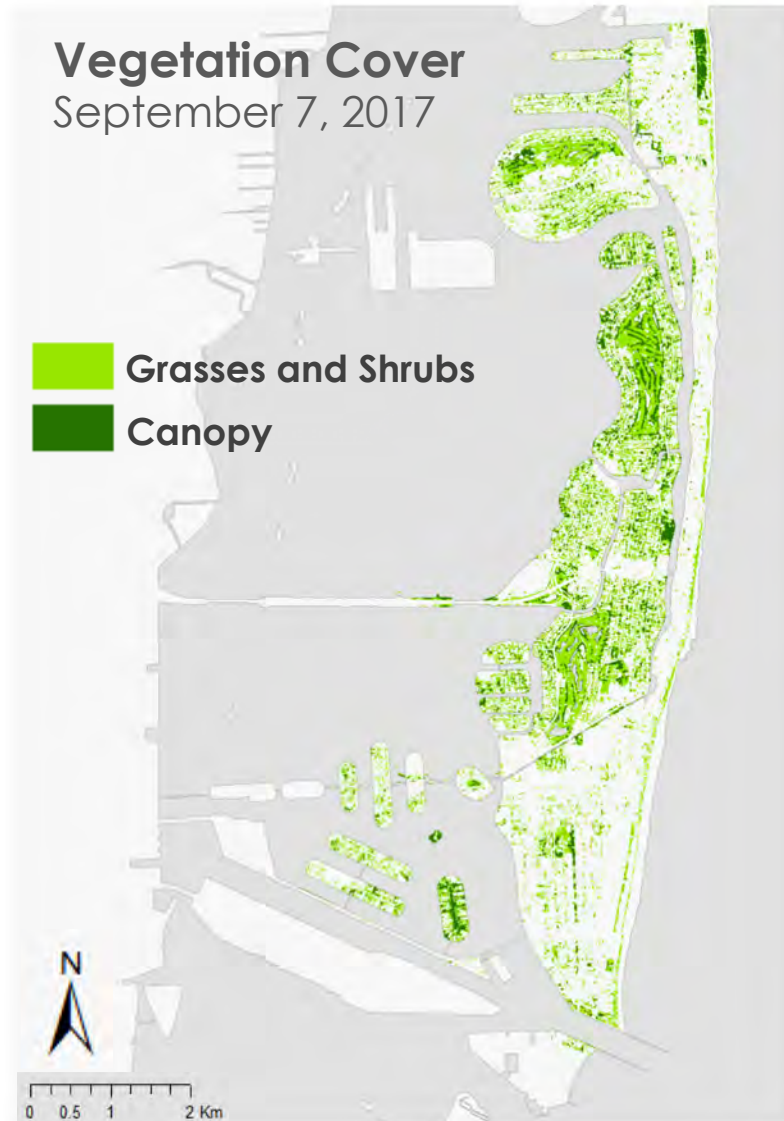
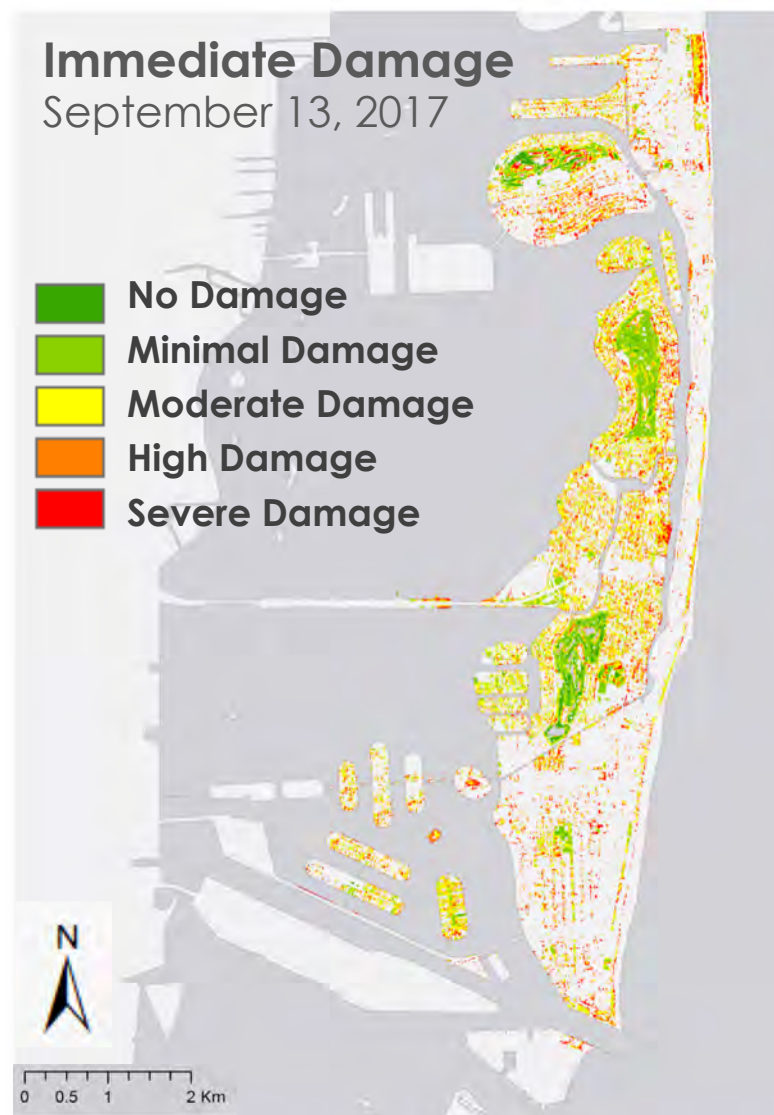


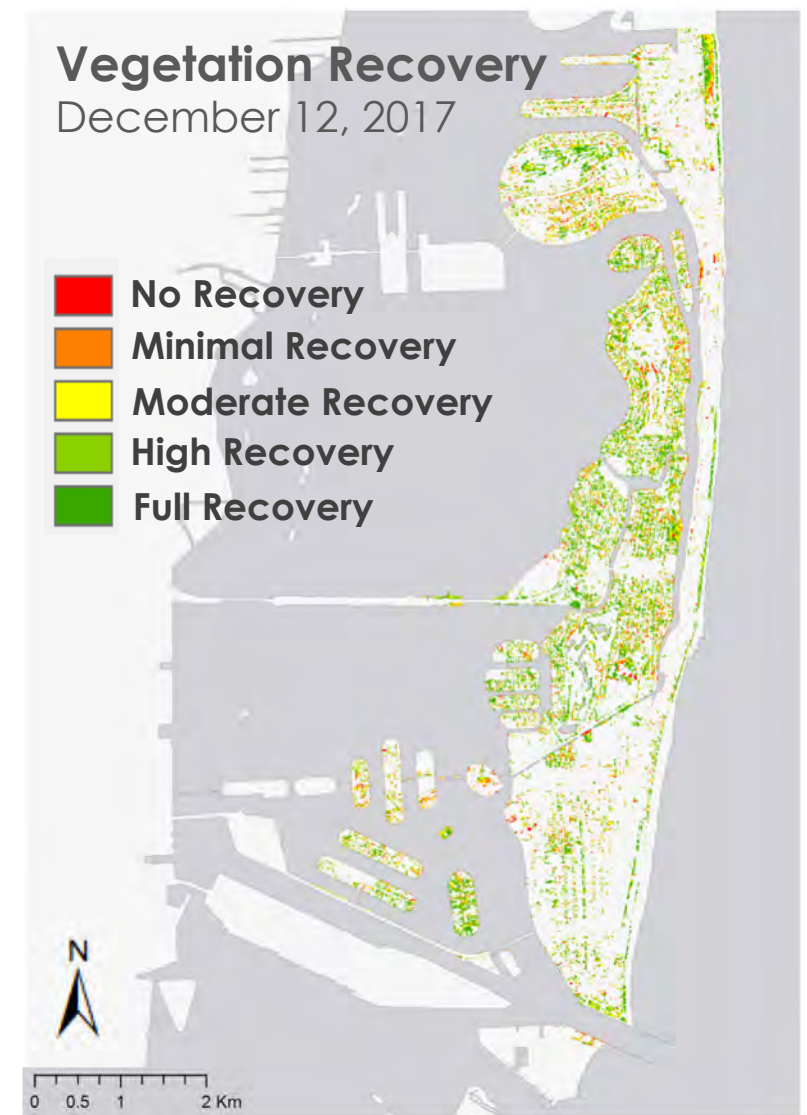
Image credit: Miami Beach Public Works Department



Vegetation cover makes up **30%** of the land



74% of vegetation experienced moderate to severe damage



80% of damage was more than **50% recovered**

Results



North Shore Park

March 1, 2016



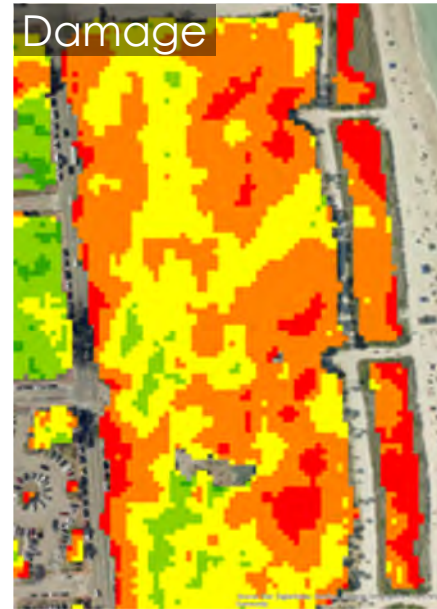
Image credit: Google Earth Pro

September 13, 2017



Image credit: Miami Beach Public Works Department

Damage



Still Water Park

March 1, 2016



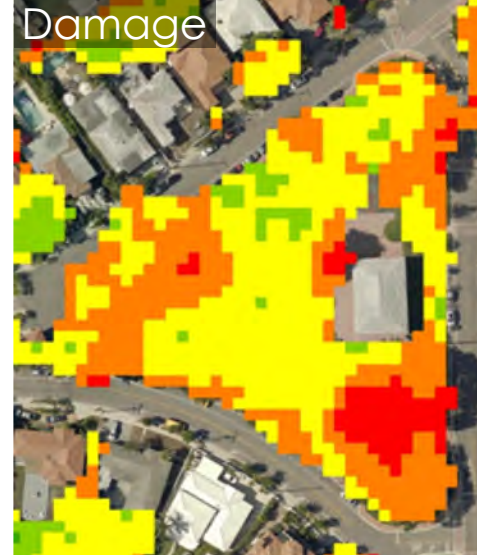
Image credit: Google Earth Pro

September 13, 2017



Image credit: Miami Beach Public Works Department

Damage



Conclusions – Vegetation Analysis



Image credit: Miami Beach Public Works Department

- ▶ Immediately following Hurricane Irma, our analysis showed that **vegetation experienced severe damage.**
- ▶ Our results will help our project partners to identify areas and species that demonstrated the **highest rate of resiliency.**



Acknowledgements

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Photographs Provided by

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Image Credit: Sevag Mehterian