# From Arboreal to Benthic Communities: The ABCs of land-to-ocean biodiversity observations

LOBO

Land to Ocean Biodiversity Observations

# From Arboreal to Benthic Communities:

# The ABCs of land-to-ocean biodiversity observations

Land to Ocean Biodiversity Observations


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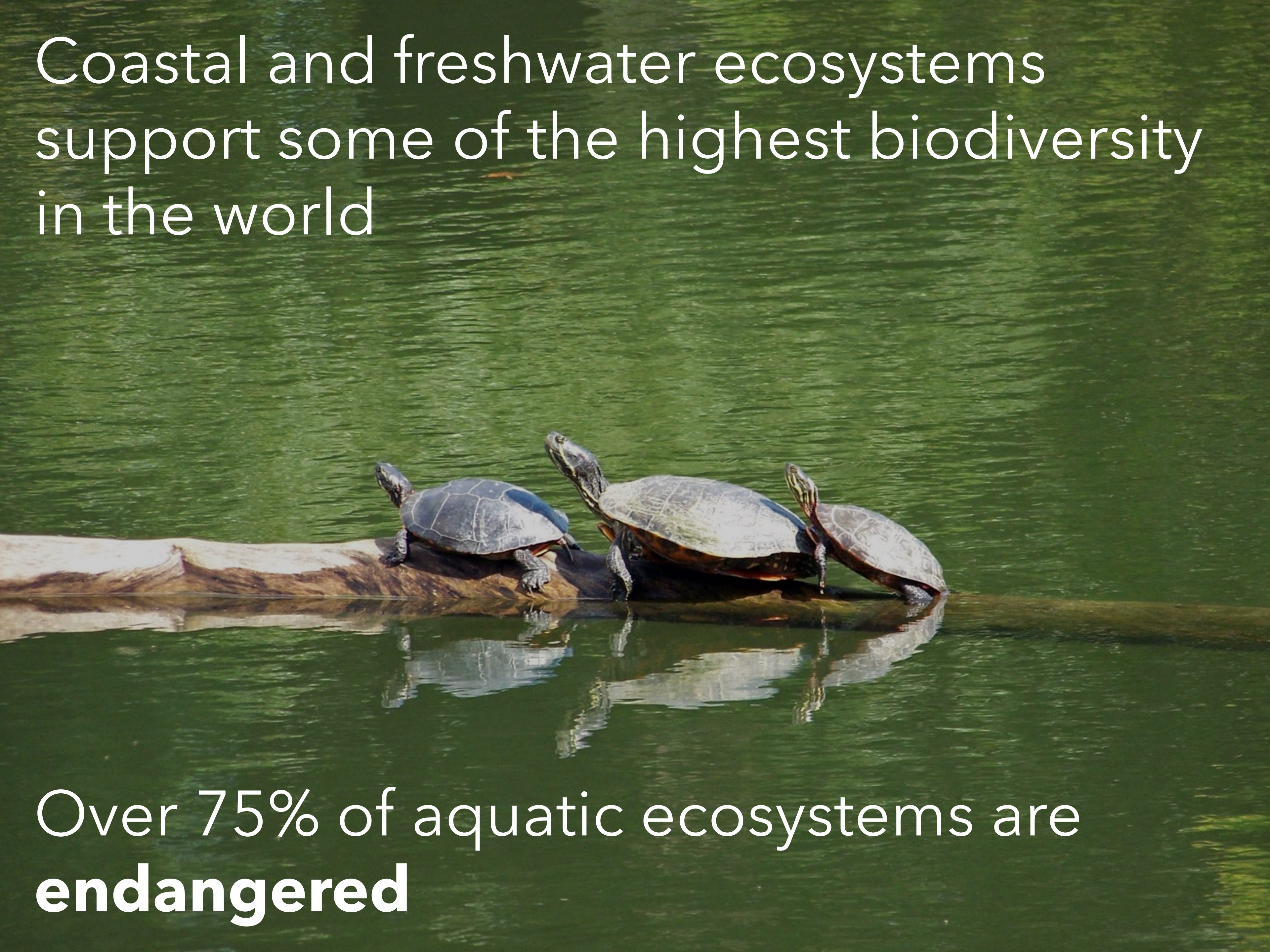

Coastal and freshwater ecosystems support some of the highest biodiversity in the world
Over 75% of aquatic ecosystems are **endangered**


Remote sensing enables us to consider land and adjacent marine ecosystems as part of a continuum
By National Park Service South Florida / Caribbean Network

# The ABCs of land-to-ocean biodiversity observations

Scoping study for land-to-ocean airborne campaign with ER-2

- AVIRIS-NG
- PRISM
- HyTES
- LVIS

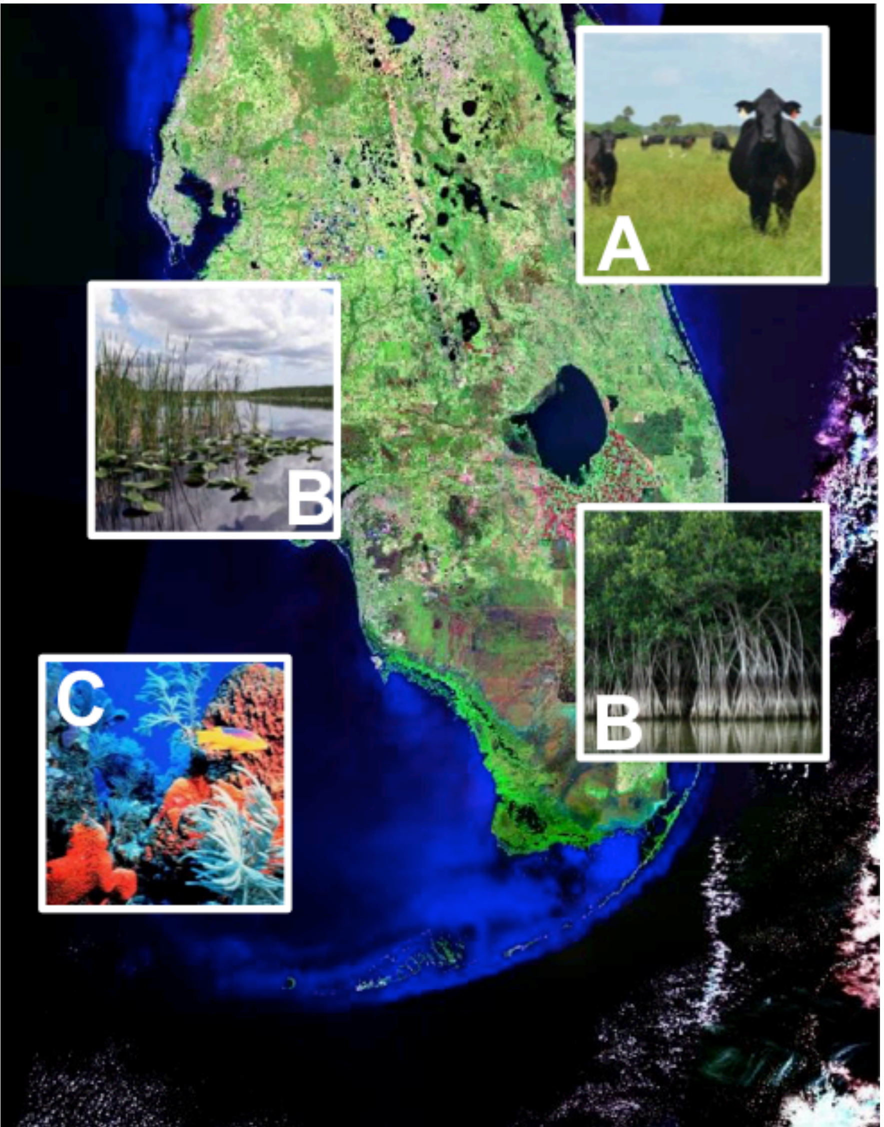
Airborne missions designed to explicitly address the needs of **linked** terrestrial, aquatic, and benthic ecological research

- Observations strategies
- Calibration correction & algorithm requirements
- Complementary field & satellite data, numerical models & simulations

# Overarching science questions

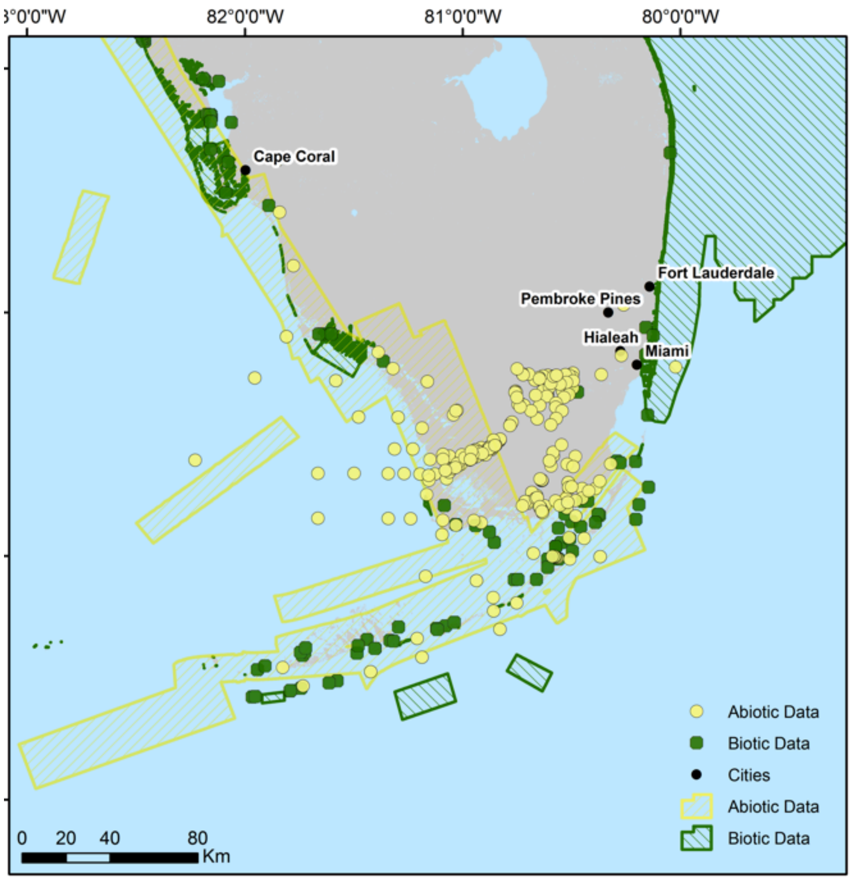
- What is the distribution and spatial configuration of coastal biodiversity at the scales of ecosystem, species, functional & phenological diversity?
- How does coastal biodiversity change due to tidal and event-driven flooding, with the seasons, and inter-annually?
- What specific remote sensing strategies are required to clearly identify these changes and processes?
  - From tree-top to sea-floor

# South Florida: A major sub-tropical Land-Ocean domain




- Substantial ecological, community, taxonomic and genetic diversity
  - 68 federally listed species
  - 422 state listed species
- Everglades National Park
  - 3rd largest wilderness area in US
- Florida Keys National Marine Sanctuary
  - Over 6,000 species
  - Only living barrier reef in N. America
- Complex social-ecological system

# Key partners and existing efforts




- FL Coastal Everglades LTER
  - Watershed focus
  - Social-ecological systems
- NOAA Atlantic Oceanographic & Met Lab
- FL Keys National Marine Sanctuary (FKNMS)
  - GCOOS & MBON

# High spatial resolution wetland mapping

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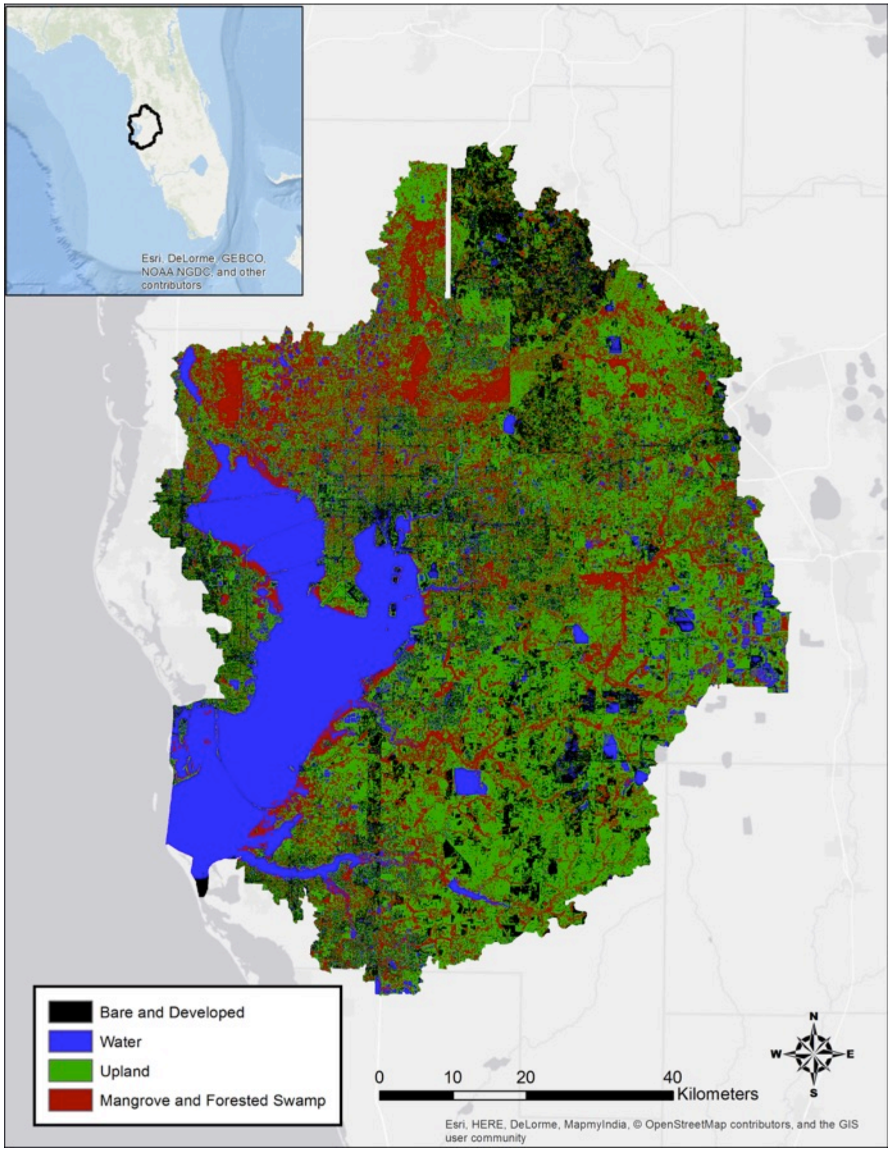


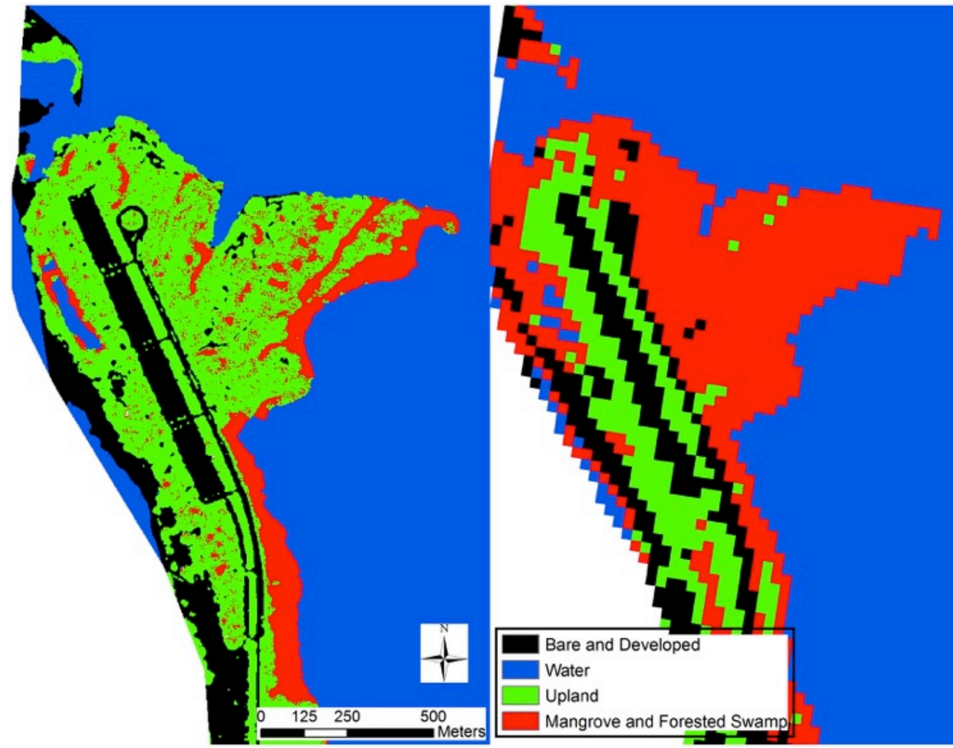


[From Frank Muller-Karger]

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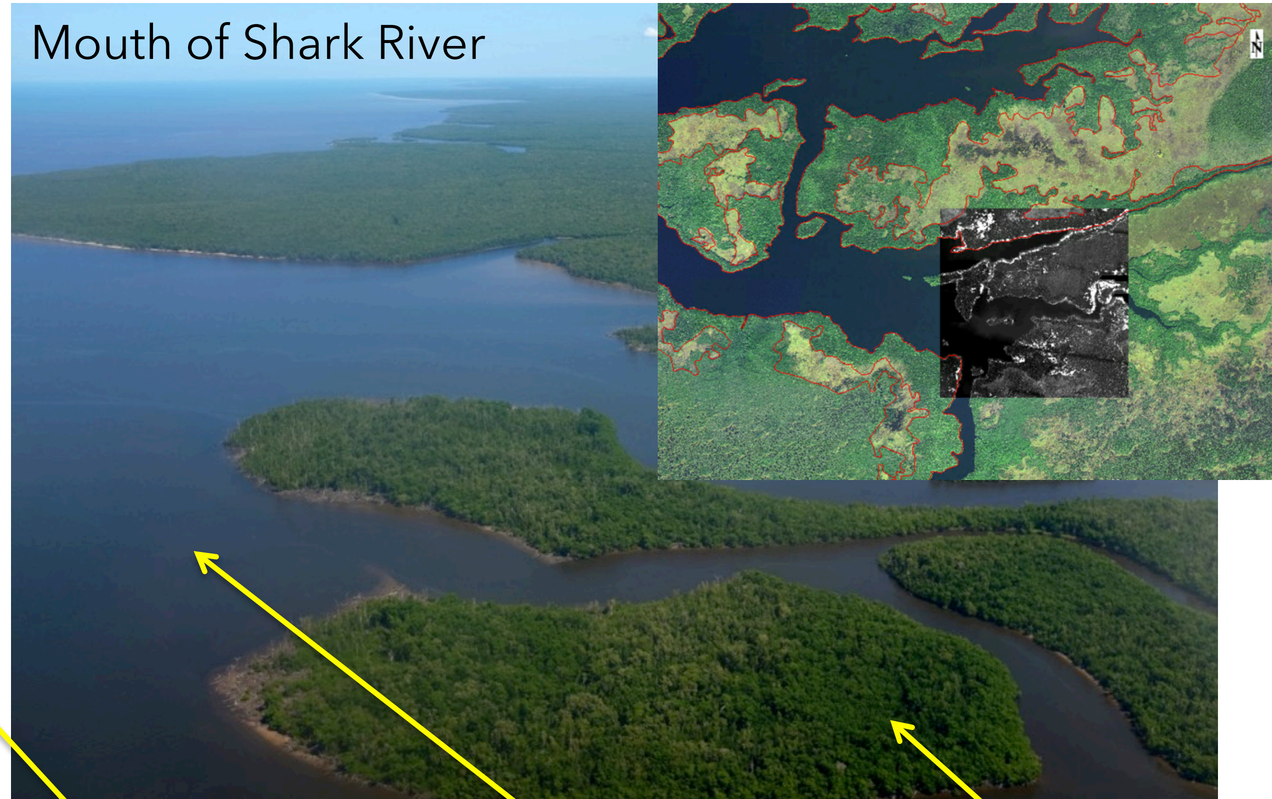
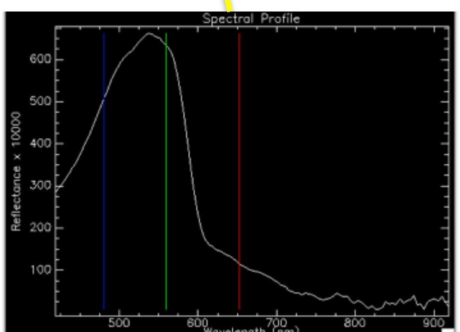
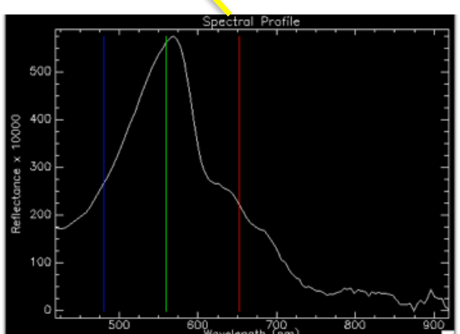
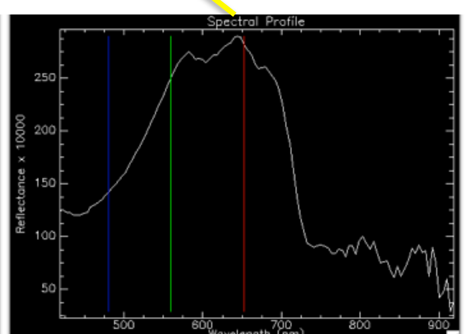
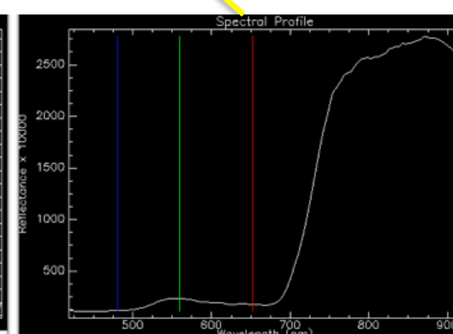
# G-LiHT as a proof of concept

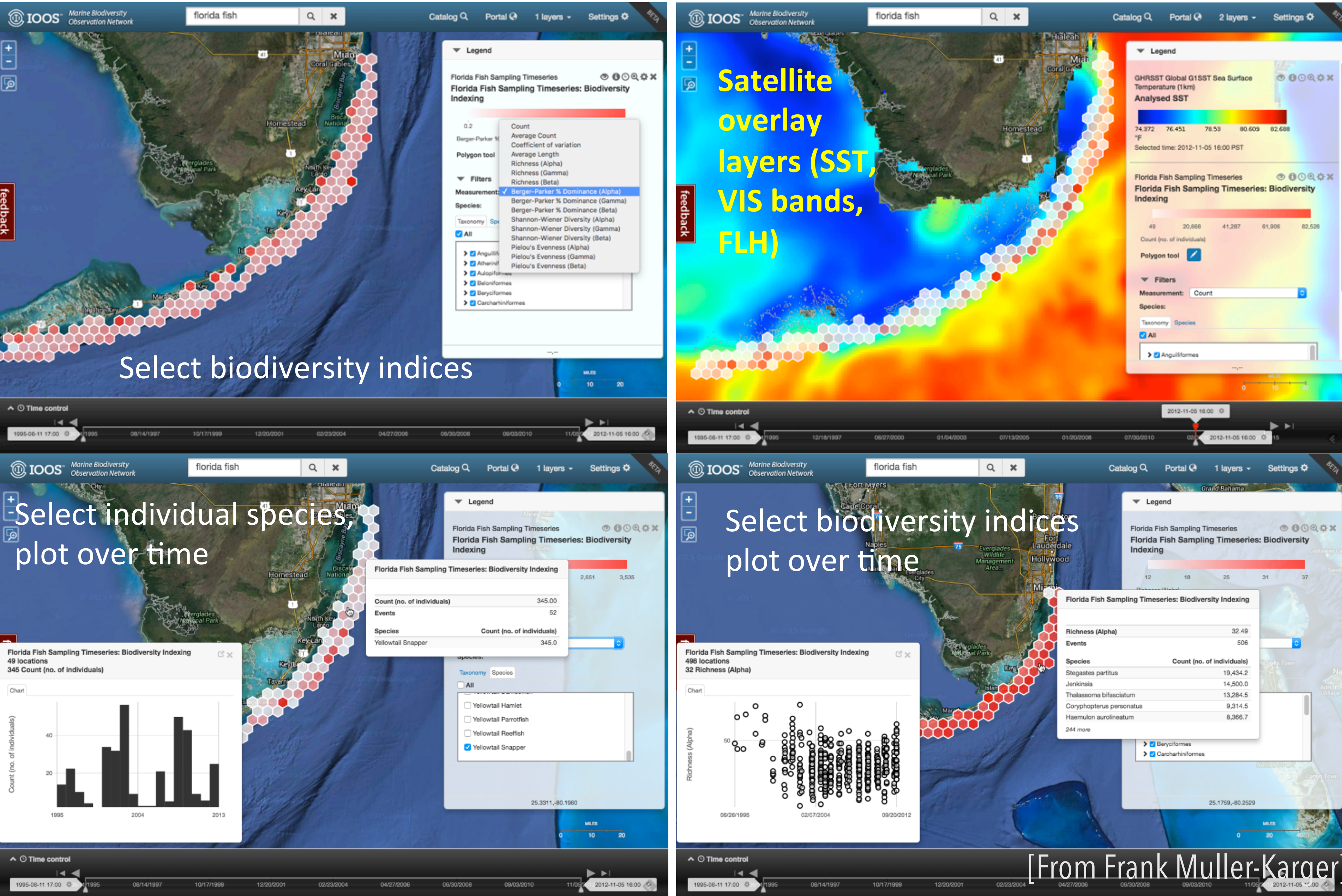




*VNIR At-Sensor Reflectance Spectra*

[From David Lagomasino]

# DMAC: Development of MBON Visualization




[From Frank Muller-Karger]

# Current capabilities and future opportunities

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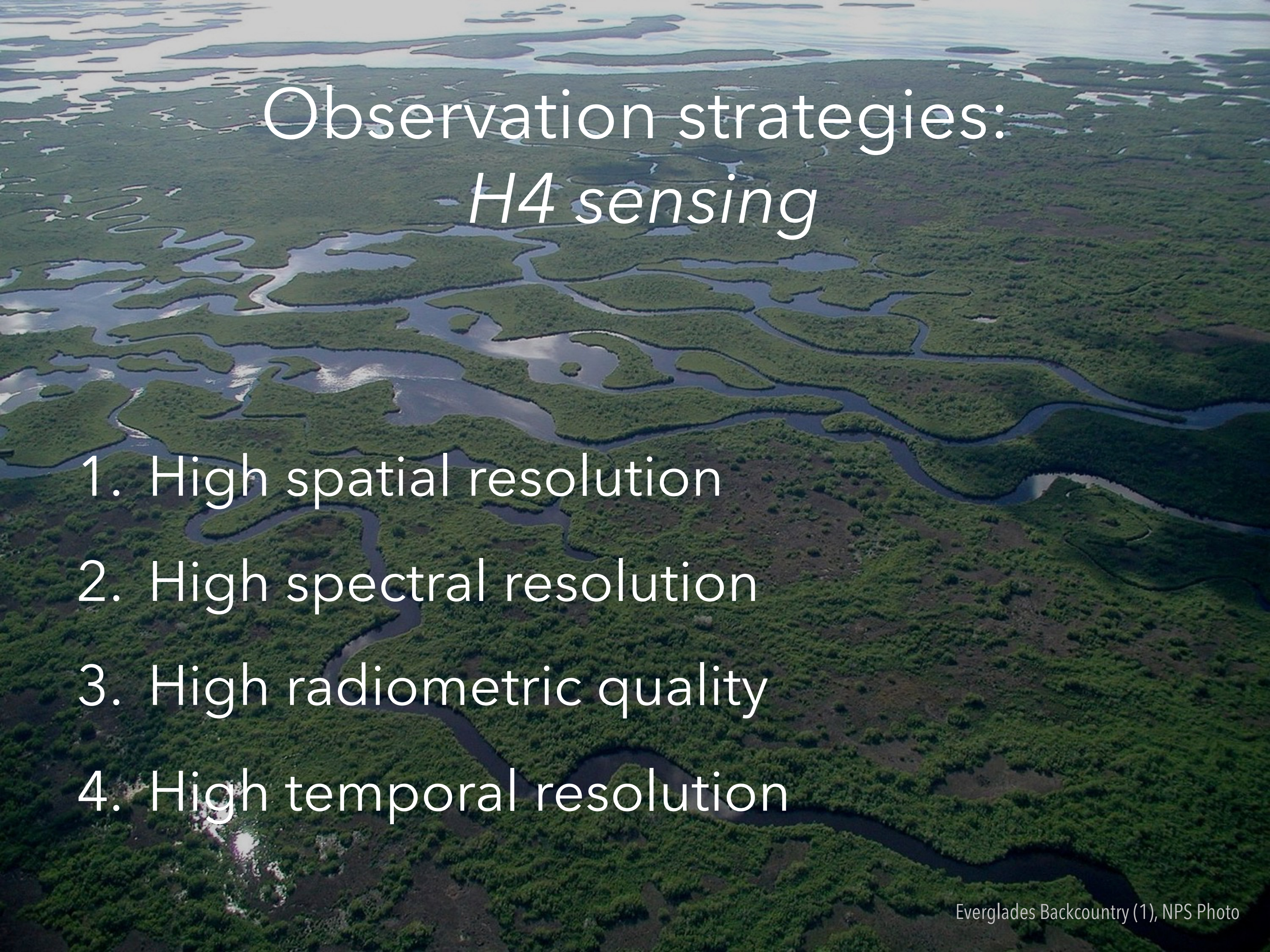
| Legend |
|---|
| Unproven |
| Demonstrated limited cases |
| In use |
| Habitat model required |

| EBV class | EBV | Habitat Type | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *Wetland Vegetation* | *Benthic Communities* | | | *Pelagic Organisms* | | | |
| | | Mangrove/ salt marsh | Seagrass | Macroalgae | Coral | Phytoplankton | HAB | Fish, Zoo-plankton | Apex predator |
| **Genetic composition** | Population genetic | | | | | | | | |
| **Species populations** | Distribution | | | | | IN USE FOR OPEN OCEAN | | | |
| | Abundance | | | | | | | | |
| | Size/vertical distribution | | | | | | | | |
| **Species traits** | Pigments | | | | | | | NA | NA |
| | Phenology | | | | | IN USE FOR OPEN OCEAN | | | |
| **Community composition** | Taxonomic diversity | | | | | | | | |
| **Ecosystem structure** | Functional type | | | | | | | | |
| | Fragmentation/ heterogeneity | | | | | IN USE FOR OPEN OCEAN | | | |
| **Ecosystem function** | Net primary production | | | | | | | NA | NA |
| | Net ecosystem production | | | | | | NA | NA | NA |

[Muller-Karger et al 2017]

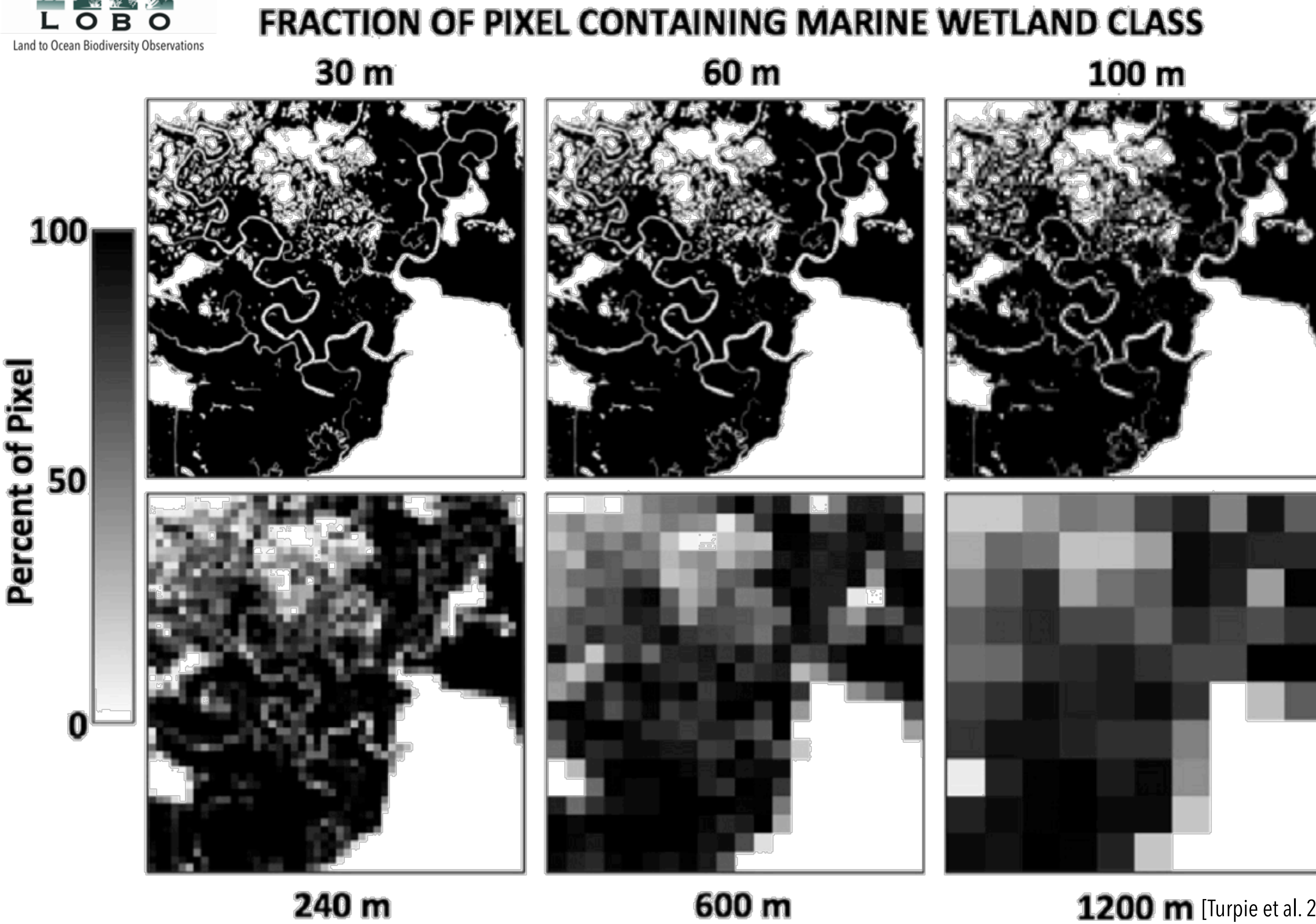
# Observation strategies:
# *H4 sensing*

1. High spatial resolution
2. High spectral resolution
3. High radiometric quality
4. High temporal resolution



Everglades Backcountry (1), NPS Photo

# Spatial resolution

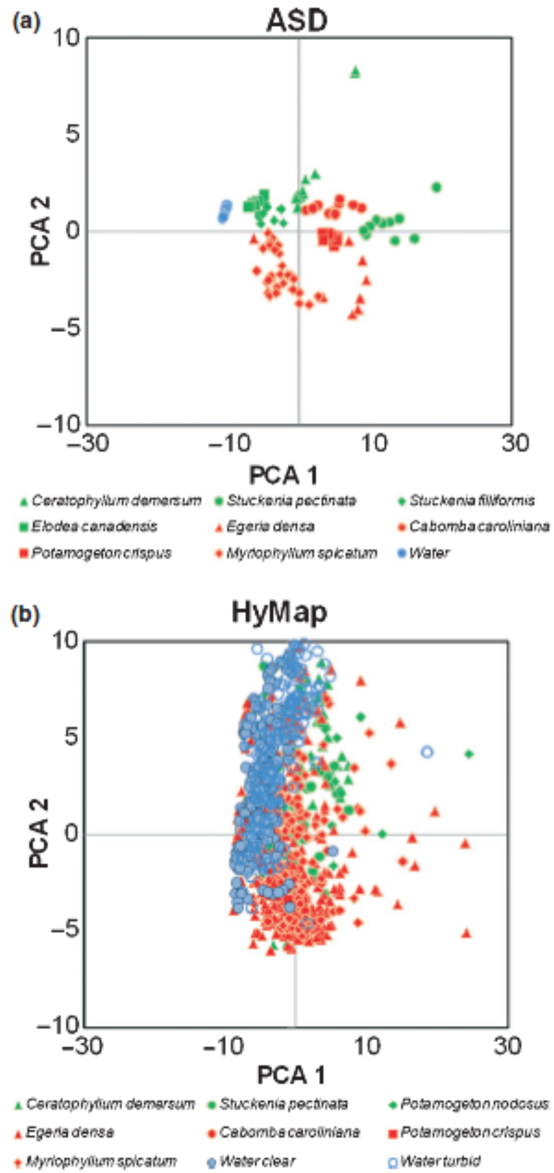


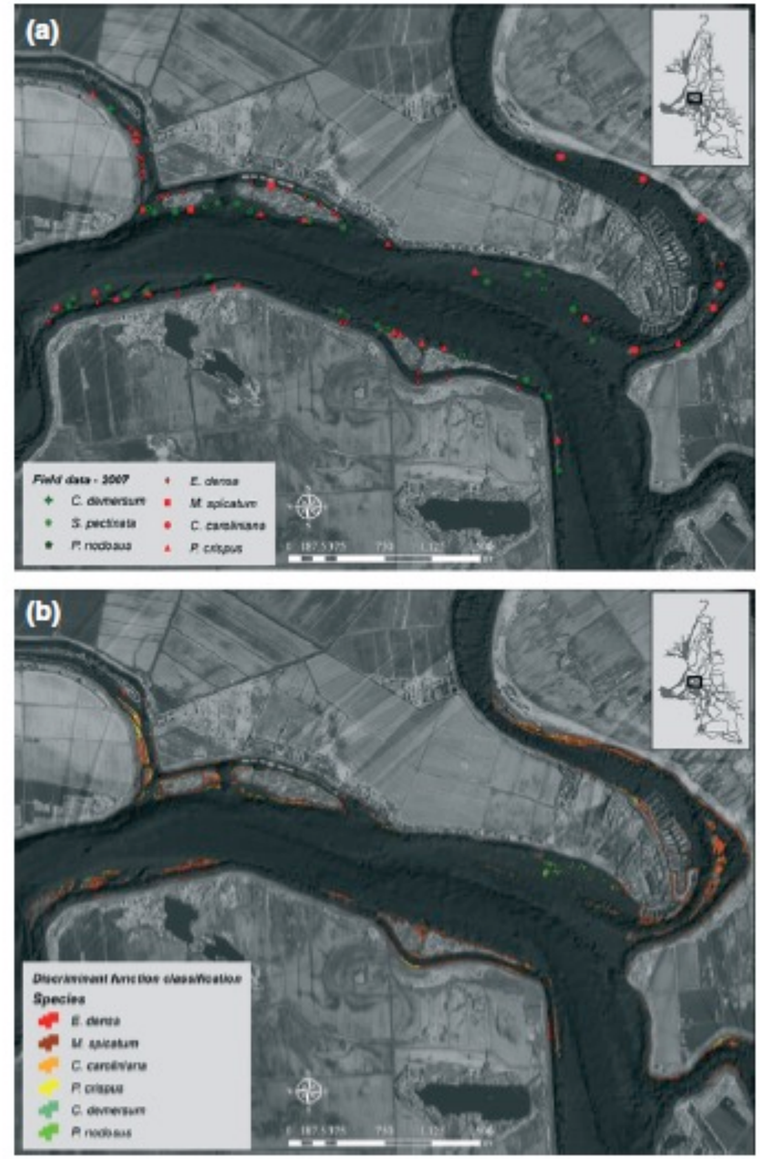

[Turpie et al. 2015]

# High spectral resolution for species discrimination

Species detectable at leaf scale

Native vs Non-native detectable at canopy (pixel) scale

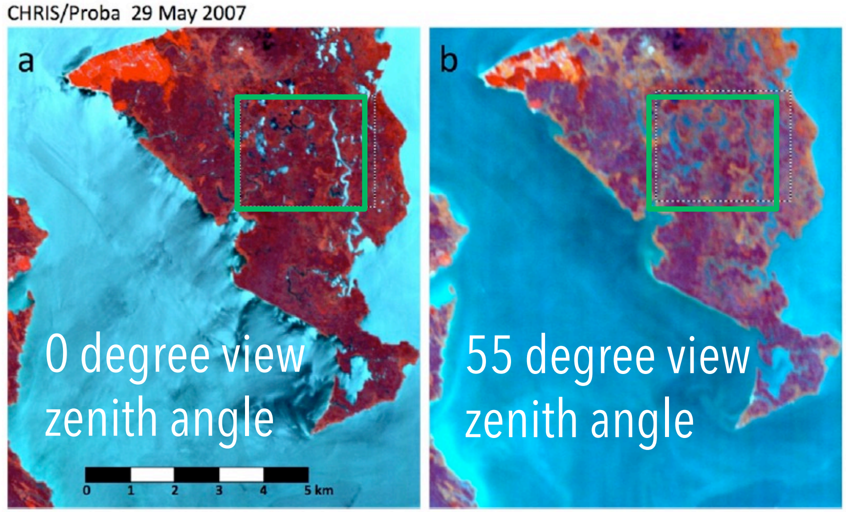



[Santos et al. 2012 New Phytologist]

# Wetlands and aquatic targets at different view angles

**Higher reflectance when looking straight down** because you see water in addition to vegetation



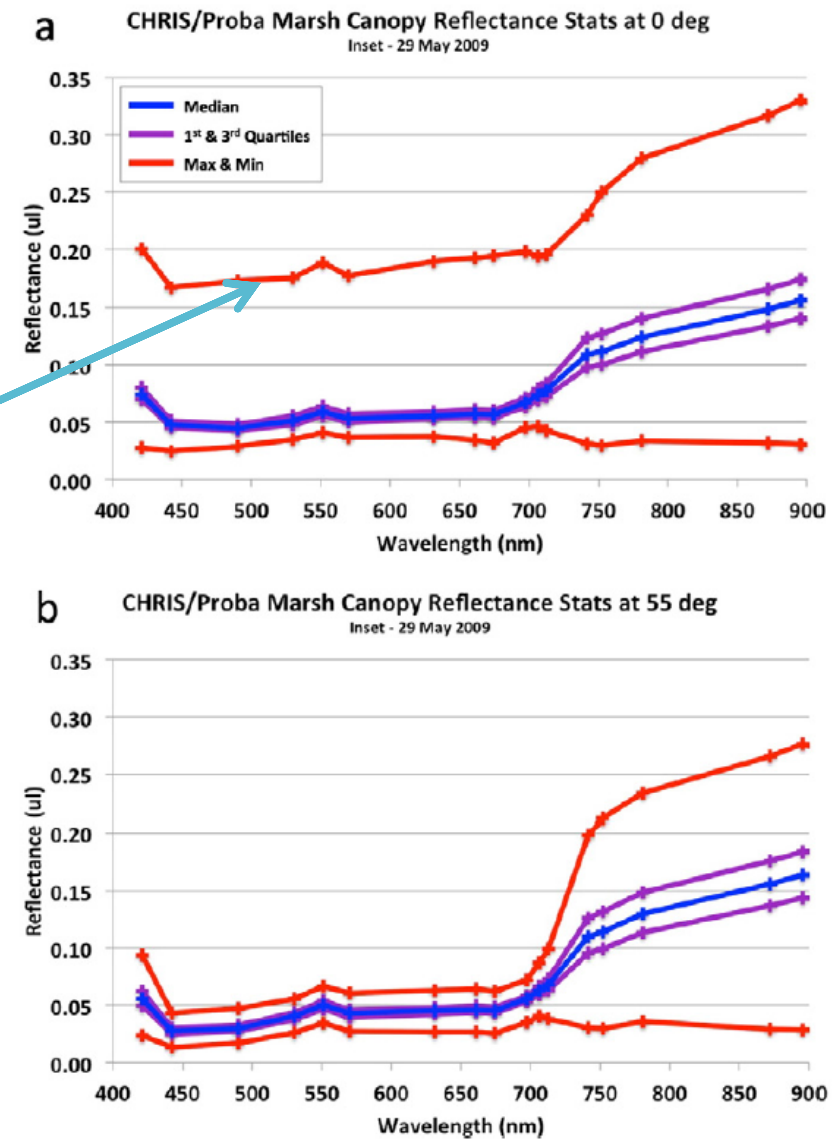
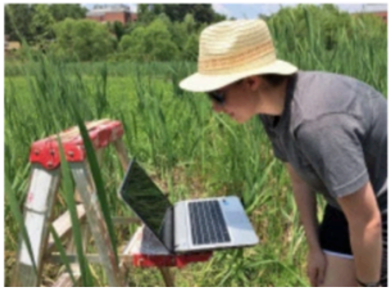
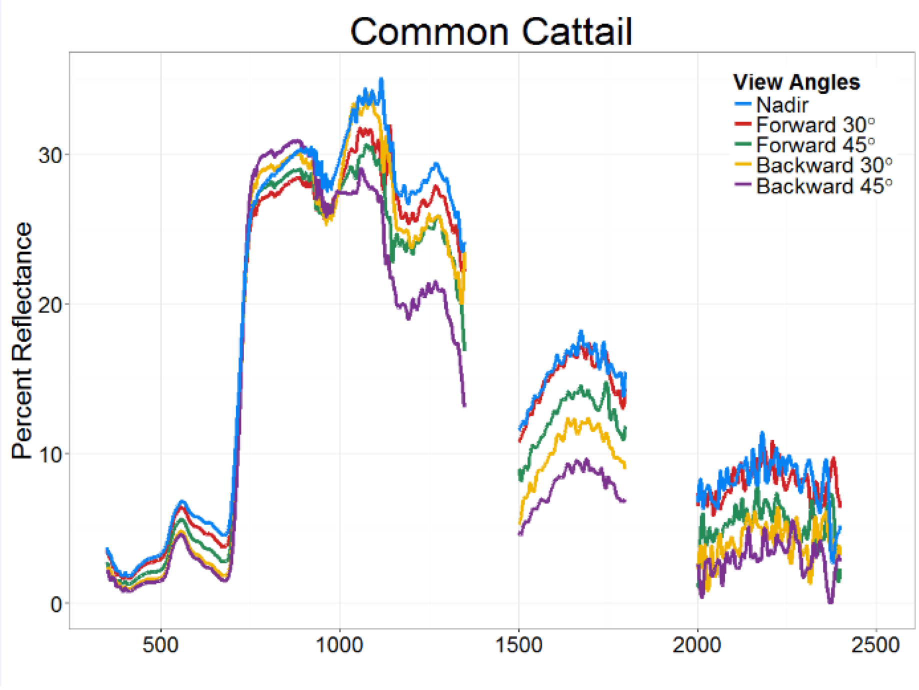




**Fig. 6.** Spectra extracted from regions highlighted by boxes in Fig. 5. (a) At 0° nominal view zenith angle, glint produces very high values across the spectrum, evidenced by the maximum spectral curve. (b) At 55° nominal view zenith angle, the glint effect is greatly reduced.

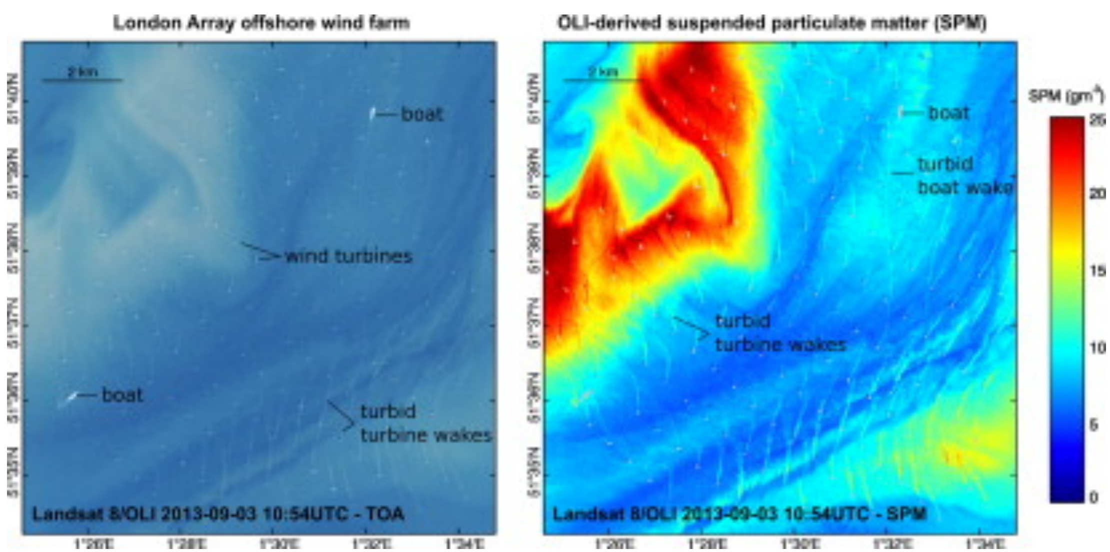
[Turpie et al 2015]

Med-high view angles are optimal for above-ground biomass estimation from spectroscopy






# Radiometric and spatial resolution



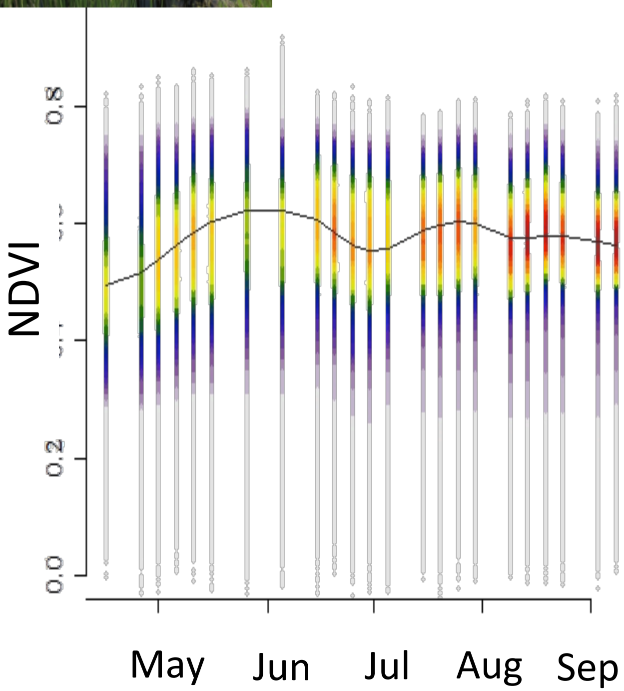

[Vanhellemont & Ruddick 2014 RSE]

Giardino et al. 2007: Hyperion SNR 30 m ➔ 150 m
Vanhellemont & Ruddick 2014: Landsat 7 to 8 SNR 30 m ➔ 270 m
Vanhellemont & Ruddick 2014: Landsat 7 to 8 bits 30 m ➔ 330 m

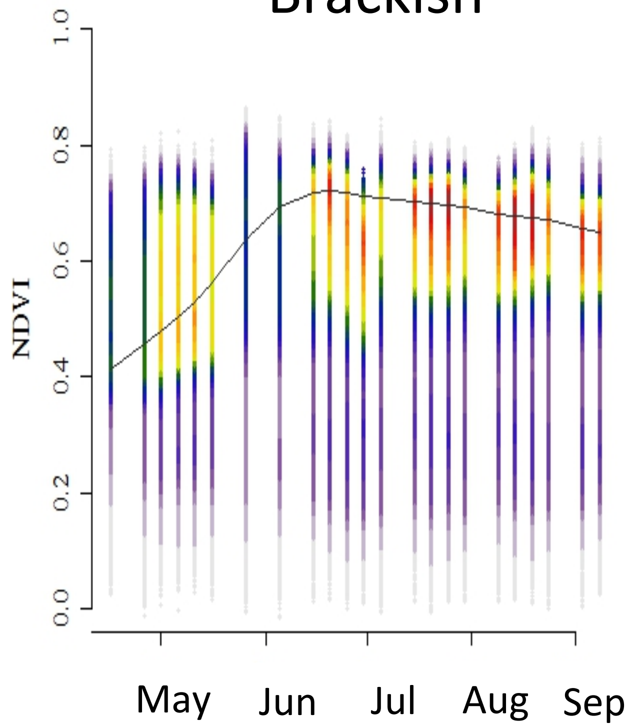
# Phenology may vary spatially

[From Christiana Ade]

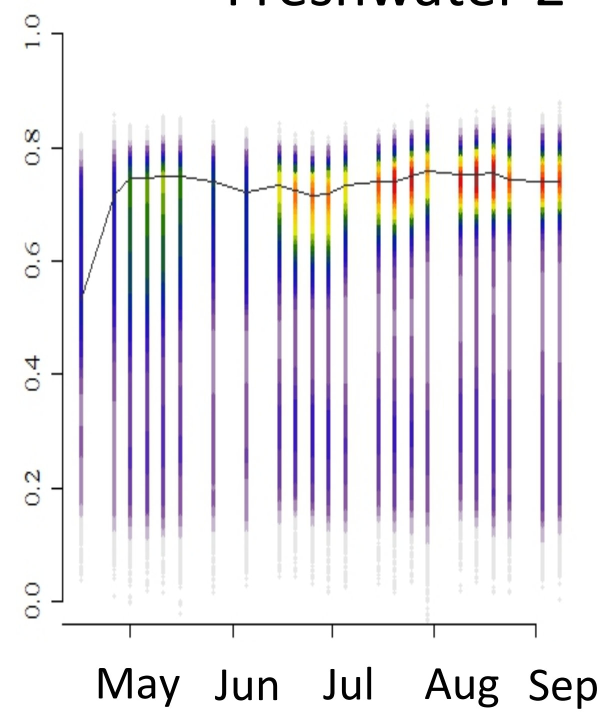
Tidal



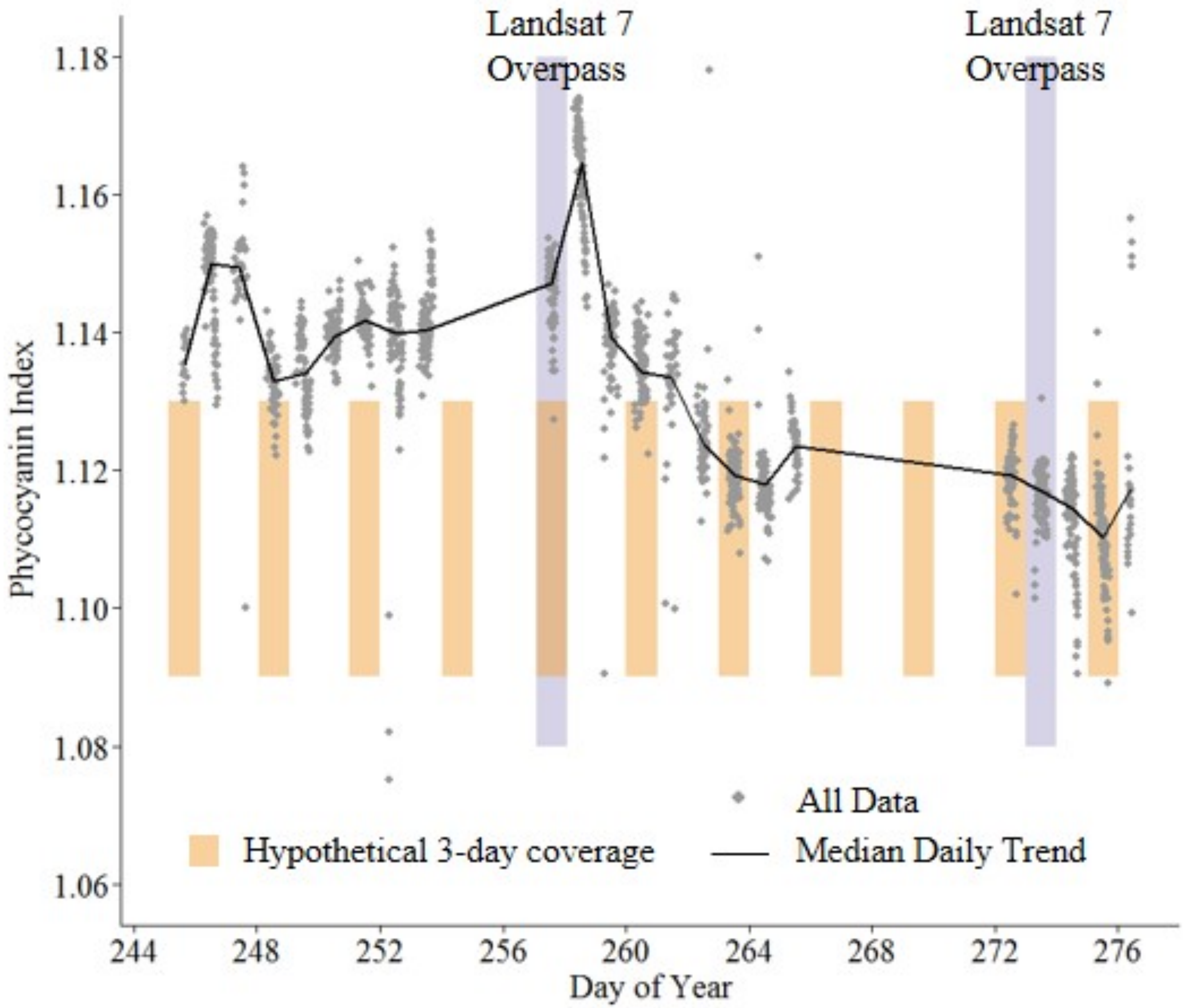

Brackish




Freshwater 2




# Temporal resolution




[Muller-Karger et al 2017]

# Stakeholder engagement for STM, implementation, sampling strategy and data users


- FL FCE LTER
- NOAA AOML
- FKNMS
- USDA Forest Service
- Everglades NPS
- South FL Water Management District
- Research Organizations
  - Smithsonian TRI
  - Universities


Let's fly Florida!
ER-2 campaigns across the land-ocean continuum will enable innovation in biodiversity observations and applications
The ABC LOBOs campaign will enable valuation of coastal ecosystem services, and help conservation and restoration planning and implementation