

# HARDBOTTOM MONITORING: OFFERING SOLUTIONS TO EXISTING-EXPENSIVE PROTOCOLS

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# OVERVIEW:

## ➤ Review of 2015 Tech Conference Hardbottom Presentations

- USACE: The Value of Hardbottom and Hardbottom Monitoring – Dipping Our Toes into the Nearshore
- DEP: Hardbottom SOP

## ➤ Issues and Limitations of Standard Methods

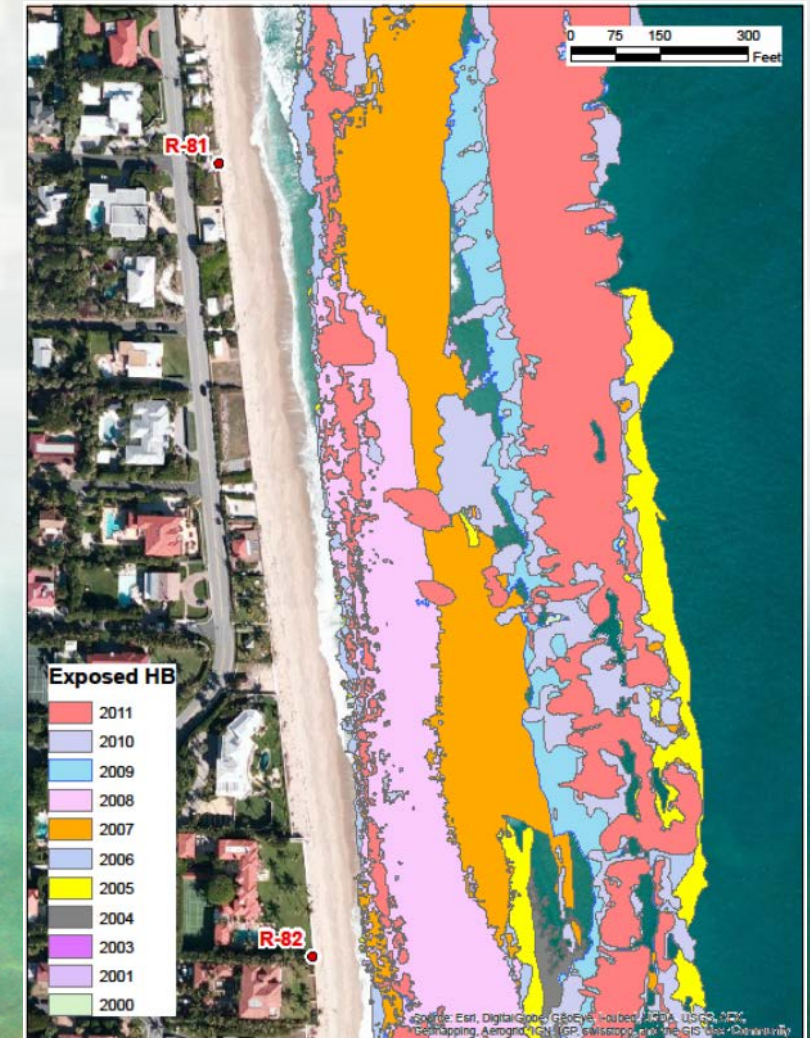
## ➤ Proposed Alternatives





# USACE: THE VALUE OF HARDBOTTOMS AND HARDBOTTOMS MONITORING

- Ephemeral hardbottoms are QUITE EPHEMERAL!
- Collecting lots of data and spending lots of money over long periods of time.
- Often unable to determine impacts of projects without firm grasp of baseline conditions and natural variability of nearshore system.
- Alternatives:
  - Re-examine risk and enhance mitigation
  - Use FSBPA as platform to examine monitoring and develop alternative options



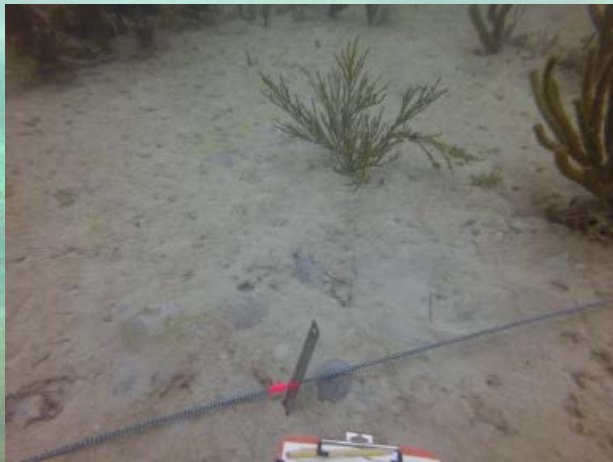


# DEP: HARDBOTTOMS SOP



- MONITORING = REASONABLE ASSURANCE
- Consistency and Standardization of Methodology, Analysis, and Reporting

- Scale
- Transects-Video, Sediment Measurements, Quadrat Surveys
- Aerial Surveys and Edge Mapping



(Images from Edwards, 2015)



# ISSUES

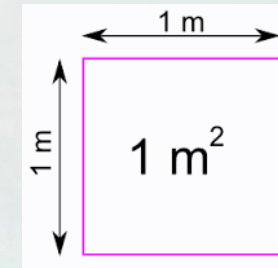
## 1. Lack of Accounting for Natural Variability in Methods, Analyses, and Results

- Baseline
- Spatial Variability
- Temporal Variability
- Scale

Baseline

## 2. Not Measuring Physical Processes Driving Biological Change

- Physical and Biological Monitoring are Decoupled



## 3. COST: Are we able to answer the questions to determine if we are responsibly managing resources? Are we getting our money's worth?

- Diving is expensive!





# ASSESSING THE ENVIRONMENTAL IMPACTS OF BEACH NOURISHMENT

(Peterson and Bishop, 2005)

➤ Reviewed 46 projects, 29 in Florida

- 11% Controlled for Both Natural Spatial and Temporal Variability

“Use of only spatial contrasts requires that no natural spatial variation exists between control and disturbed sites...structure of macrobenthic assemblages varies according to the morphology of the beach at scales of tens to hundreds of meters (Barros et al. 2002)”

“Using a temporal contrast to evaluate the impacts of nourishment requires the assumption that the response variable would remain constant over time in the absence of ANY disturbance.”

“22% included attempts to interpret observed biological responses by appeal to mechanistic processes. The conclusions of 56% of studies lacked rigorous support from evidence and analysis.”

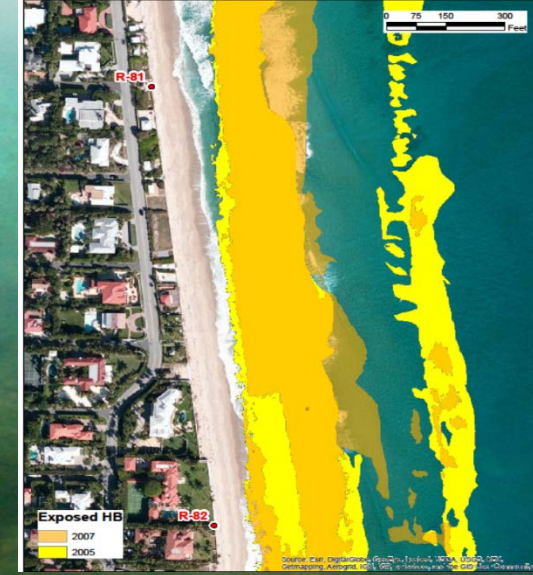


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# ISSUE: LACK OF DEFINED BASELINES

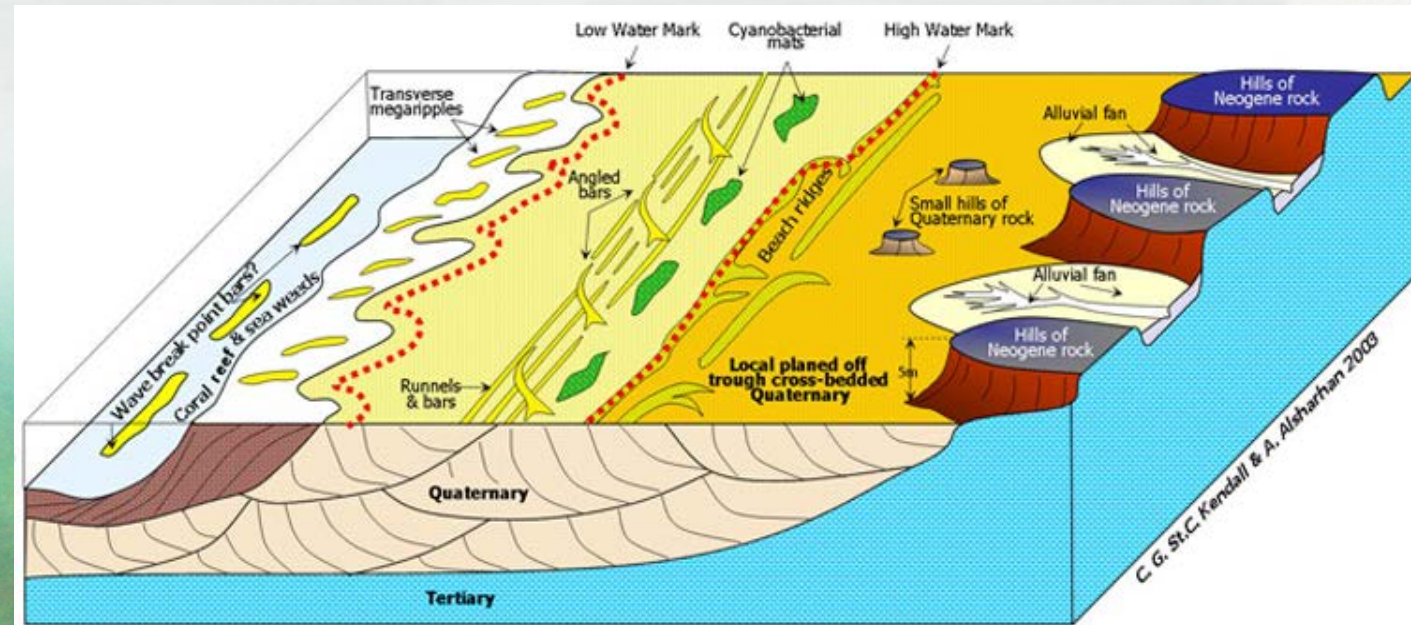
- Total Hardbottom Area
  - Often defined by aerial imagery
- What should the total area be under natural conditions?
  - Pre-project snapshot?
  - 10 year average?
  - Running average?
- What is accepted level of variability?
  - Annually?
  - Seasonally?
  - Post event?
  - Movement of interface relative to shoreline?





# ISSUE: SPATIAL RESOLUTION AND NATURAL VARIABILITY

- Generally take project-wide pre-project snapshot (aerial, side scan) at best then define transects and quadrants assuming all things the equal
- Control sites simply placed beyond the anticipated project impact area
- Nearshore morphology influences energy (waves, currents) distribution through system...influences sediment dynamics...ultimately major factor in biological response
  - Erosional/Depositional environments
  - Burial/Exposure of hardbottoms
- Is it appropriate to sample <1% of a project area and make assumptions about the entire project?
- Is it the best we can do?

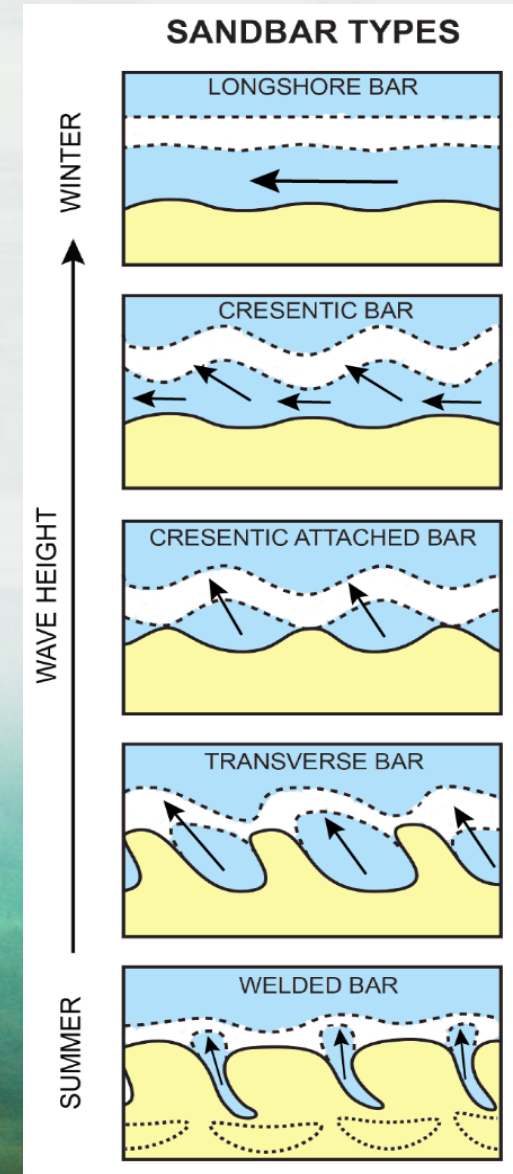


(Kendall and Alsharhan, 2003)



# ISSUE: TEMPORAL RESOLUTION AND NATURAL VARIABILITY

- Generally collect pre, post construction and out year transect and quadrant data
- Sampling bias that leads to attributing change to the project
- What is value of snapshot surveys without quantification of natural forces and events driving change?
  - Nor'easters, hurricanes, months of high wave energy?
- Is it appropriate to sample <1% of the time and make assumptions about all the time between surveys?



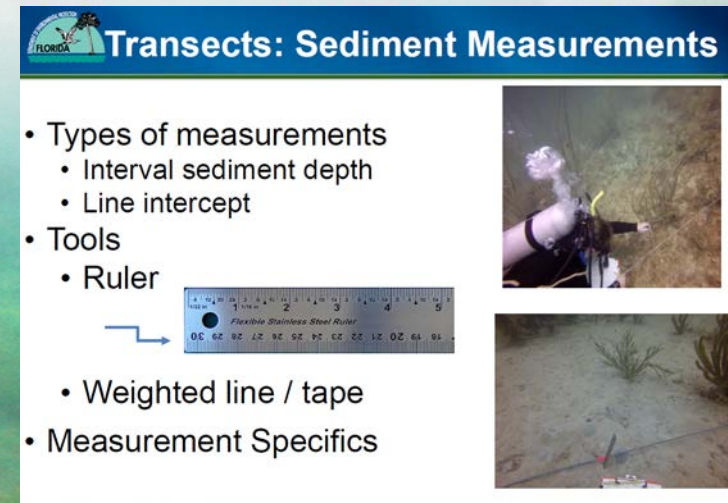
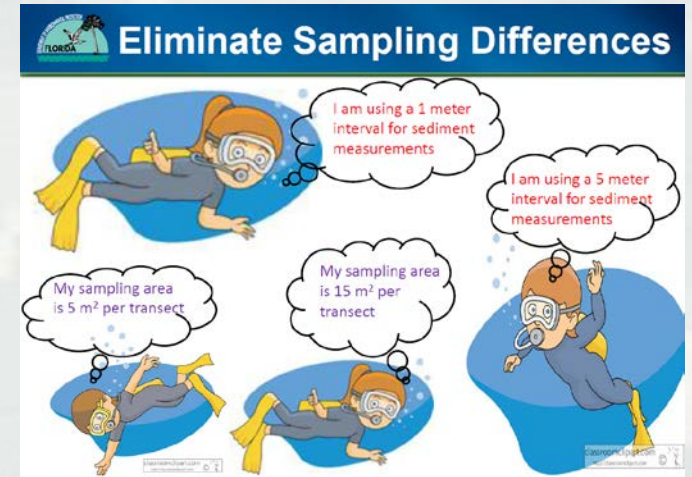
(Dynamics of Rips and Implications for Beach Safety, 2015)





# ISSUE: SCALE

- Biological: cm for sediment depth, m<sup>2</sup> for quadrants
  - Transect and quadrant data collected and assumed representative over large areas
- Physical: project several km in length and volume are tens of thousands of CY
  - Accuracy of hydrographic survey methods are 0.2 ft at best
  - Accuracy of models less accurate than survey data
  - Collect transect data and assume uniform between transects





# ISSUE SOLUTION: PHYSICAL AND BIOLOGICAL MONITORING ARE DECOUPLED

- Some studies have attempted to make correlations between biological response, natural events, and beach nourishment projects, but limited
- USACE, ASPBA, Coastal Managers need to make integrated physical oceanographic, geological, and biological studies a priority via targeted RFPs and funding (NOAA, NSF, state/private funding agencies)
  - Suggested and supported by US Commission on Ocean Policy (2004), Elko et al., 2014 and others

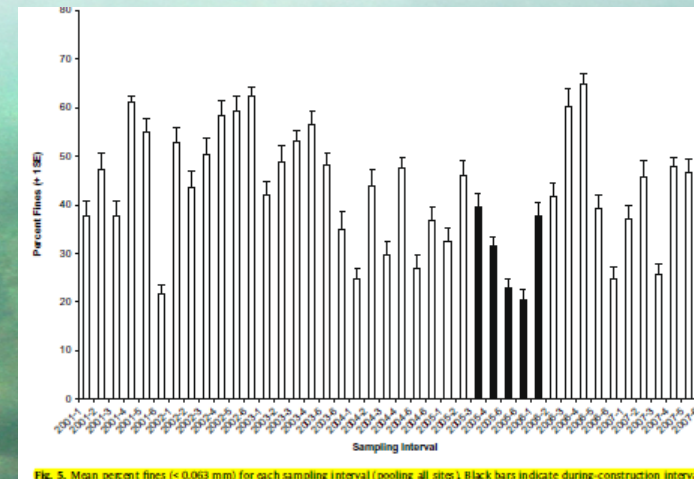
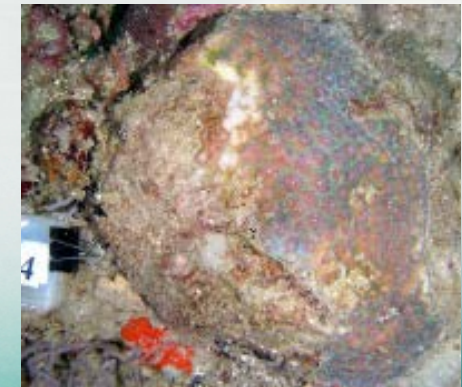


Fig. 5. Mean percent fines (<0.063 mm) for each sampling interval (pooling all sites). Black bars indicate during-construction intervals.

(Jordan et al., 2010)

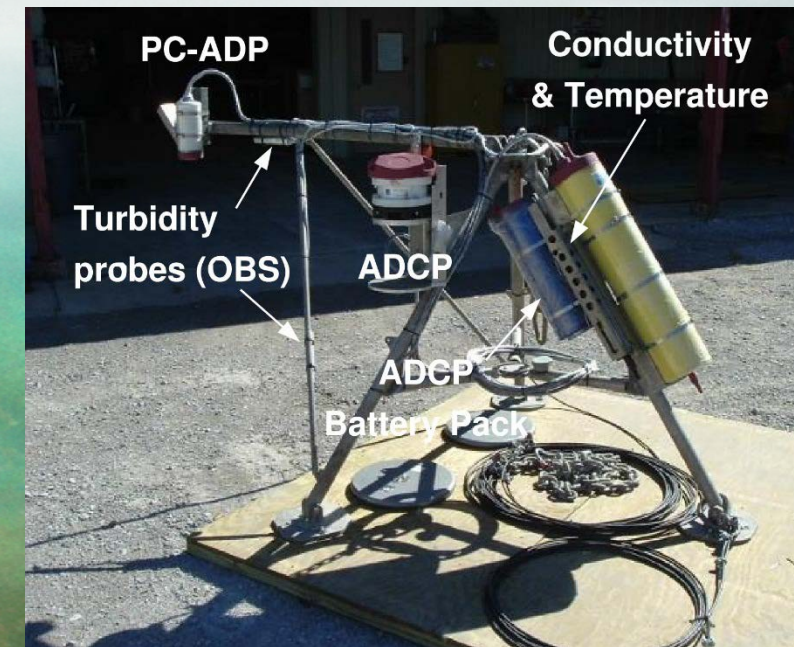
(Fisher et al., 2008)





# RESEARCH SUGGESTIONS

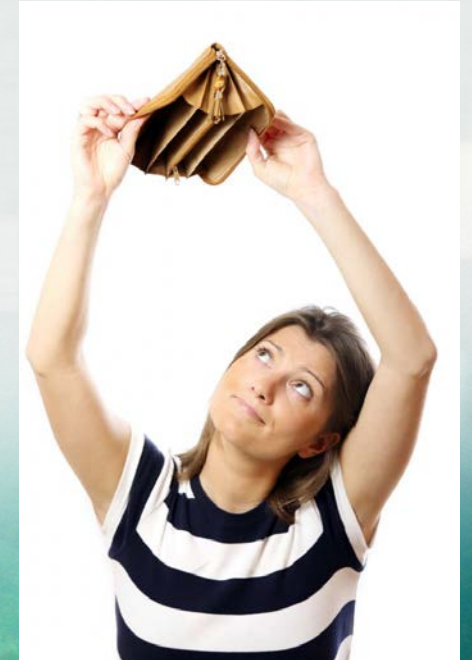
- Support development of long term nearshore monitoring protocols coupling physical oceanography and nearshore biology
  - Not new concept, but deserves additional support
  - Integrated Ocean Observing System (IOOS), SEACOORA
  - Platform for supplemental studies
  - Bridge offshore-nearshore processes
  - Correlation to project specific impacts





# MONITORING LIMITATIONS

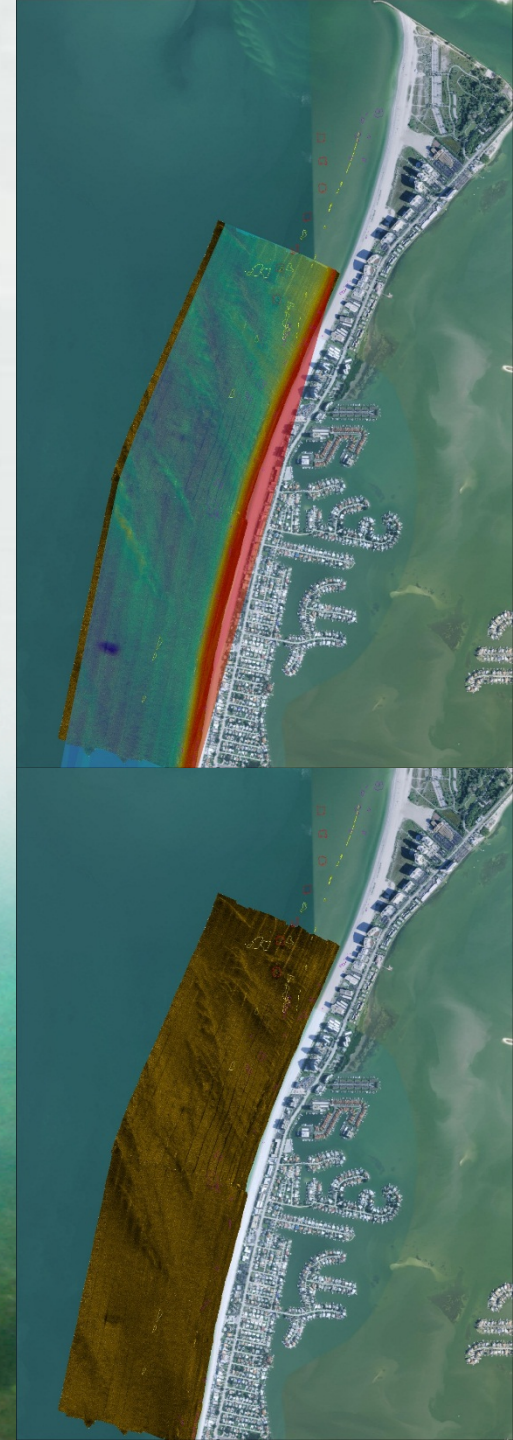
- How can we clearly delineate project specific impacts via regulatory monitoring if the science isn't clear?
  - Limited interdisciplinary scientific expertise
- What are realistic expectations of monitoring and how do we get to a comfortable level of REASONABLE ASSURANCE?
  - Easier to identify big impacts but subtle impacts and coupled impacts very difficult to define
  - Limited financial resources of local sponsors and government





# MONITORING ALTERNATIVES: SPATIAL

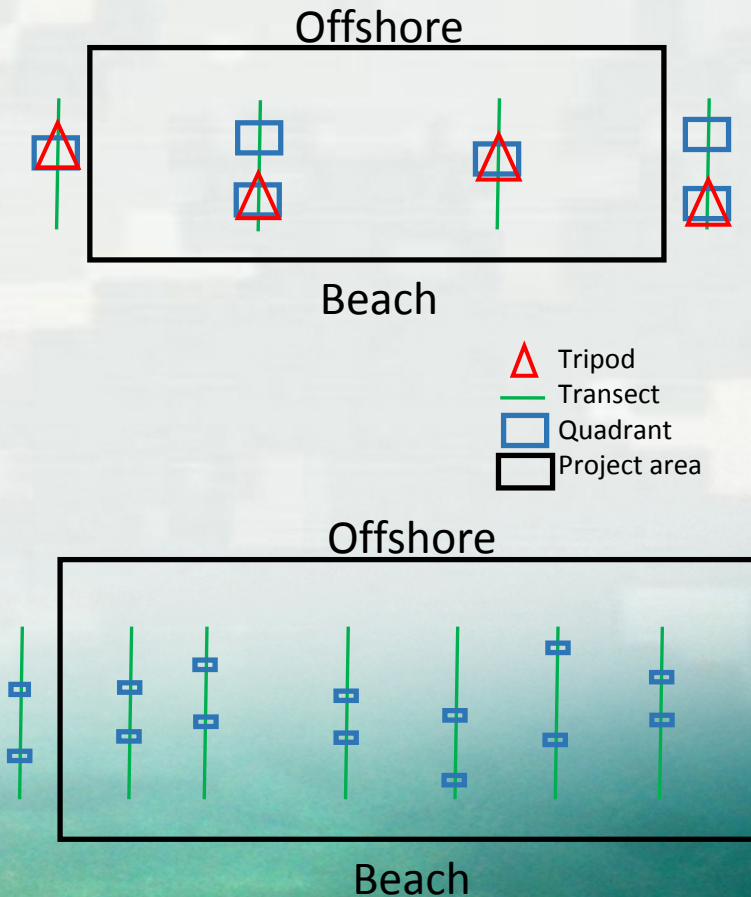
- Full coverage pre and post project multibeam/side scan surveys
  - Substitutes for aerials; eliminate edge mapping with diver
  - Serves as hydrographic component of profile surveys
  - Provides 100% high resolution spatial coverage and accurate XYZ of project area
  - Provides basic habitat classification and change over time, total HB area
  - Allows for realistic scaling of m<sup>2</sup> quadrants and transect data to project scale
  - Ability to define relief
  - Ability to visualize sediment transport pathways





# MONITORING ALTERNATIVES: TEMPORAL

- Continuous in situ imagery, turbidity, current, sediment measurements, biological monitoring via tripods at 1 site
  - Sacrifice spatial resolution of biological monitoring for exponentially greater temporal resolution
  - Upload data daily for near real-time observations or could go live – **ALLOWS FOR RAPID RESPONSE OF ADDITIONAL MONITORING IF NEEDED**
  - Collect data under all weather conditions
  - Allows for direct measurement and analysis of physical processes, natural variability, and project-induced impacts
  - Switch out equipment monthly/bimonthly and couple with diver assessments of transects and other quadrants – allows for comparison with historical data





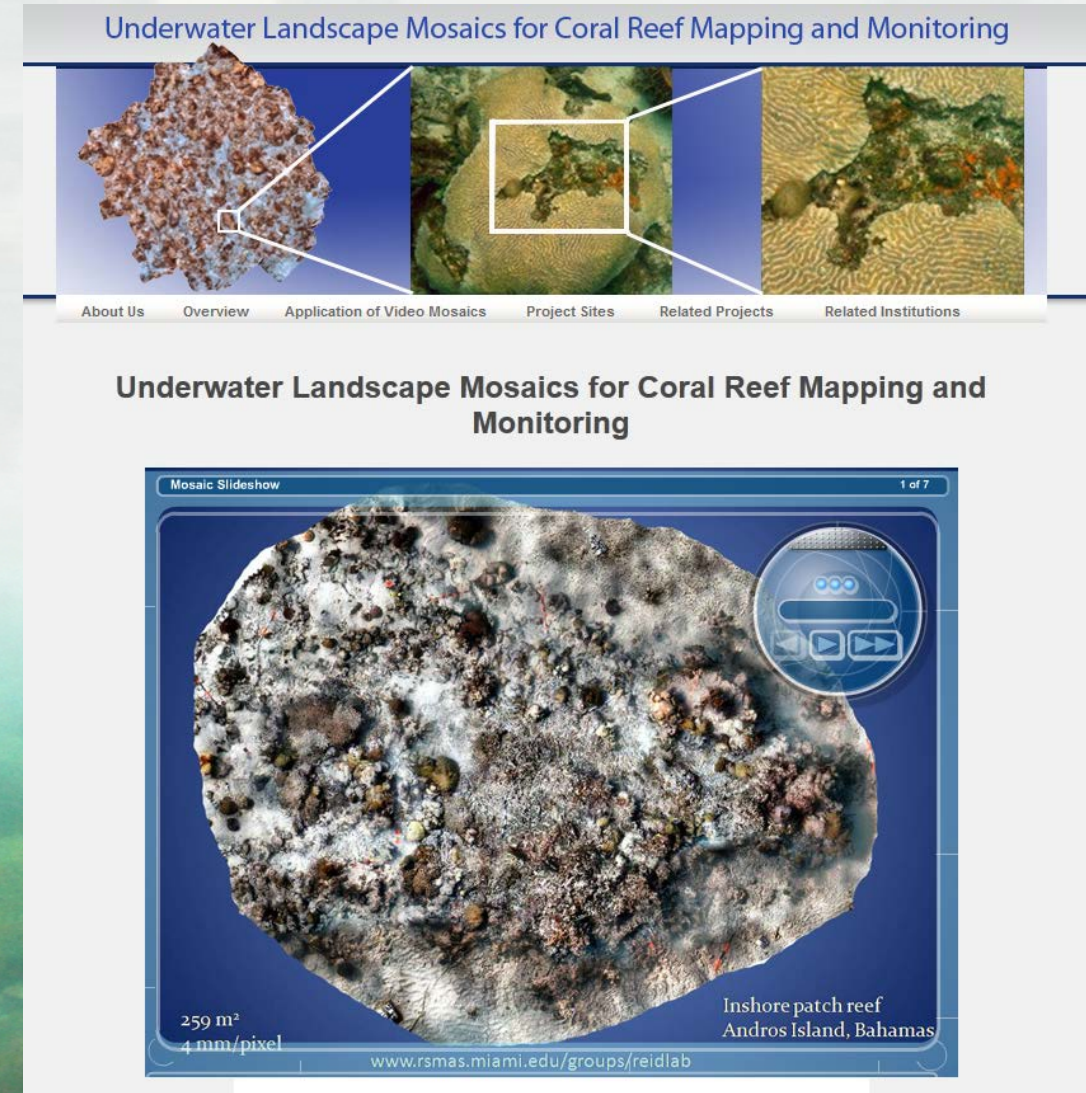
# MONITORING ALTERNATIVES

## ➤ Autonomous Underwater Vehicles (AUVs)

- Potential for rapid high resolution spatial data to track plumes
- High Resolution Landscape Imagery
- In situ measurement capacity: CTD, Turbidity, ADCP...
- No divers required, no boat required



(marinebuzz.com)



(Dr. Pamela Reid, University of Miami)





# MONITORING ALTERNATIVES BENEFITS SUMMARY

- Promotes true interdisciplinary approach to nearshore hardbottom management
- Provide daily observations of project area and hardbottoms to enable quantifiable assessment of sediment dynamics and biological response based on direct measurements
- Helps to define natural variability of nearshore system
- Data collection not limited to calm sea conditions
- Minimizes expense associated with divers in the water
- Compromises:
  - Spatial resolution of biological monitoring for enhanced temporal resolution
  - Eliminate hardbottom edge mapping
  - Eliminate aerial imagery



(mbari.org)



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# Thank You.

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