FY 2010 OER TECHNOLOGY DEVELOPMENT INVENTORY: COOPERATIVE INSTITUTE FOR OCEAN EXPLORATION, RESEARCH AND TECHNOLOGY (CIOERT)

Technology Readiness Levels (Ocean Observatories Initiative):	**NOAA Next Generation Strategic Plan Long Term Goals:**
1. Proof of Concept or developmental: Lowest level, speculative (none on OOI) 2. Research Prototype: Basic components integrated, prototype sensors used to collect data 3. Research Proven: Not commercialized, but clearly beyond prototype, collected data 4. Commercial: Proven to work in environment as expected, commercial production 5. Operational: In final form, proven to work under sustained operational conditions.	CAM: Climate Adaptation and Mitigation-- An informed society anticipating and responding to climate and its impacts WRN: Weather-Ready Nation-- Society is prepared for and responds to weather-related events HO: Healthy Oceans-- Marine fisheries, habitats, and biodiversity are sustained within healthy and productive ecosystems RCE: Resilient Coastal Communities and Economies-- Coastal and Great Lakes communities are environmentally and economically sustainable

Transform: Homeland Security Information Technology for ocean environmental applications

- NEED/BENEFITS: Information technology and models needed to predict environmental events of relevance to NOAA, e.g., temperature rise, algal blooms, ocean acidification, nutrient pulses, and low-oxygen events. NOAA goals: CAM, HO, RCE
- APPROACH: CIOERT partner, SRI International, developing MDAS (Maritime Domain Awareness System) for the U.S. Navy. MDAS modifications result in new information management and analysis platform to compile and compare environmental data with archived data, to sense and predict environmental changes. Under development: L. Adornato, SRI International.
- COMPETITION/ALTERNATIVES: eco-physical coupled models project based and generally not adaptable for variety of inputs.
- TRL 2: 2010- MDAS being reconfigured to accept new/archived data related to DWH Spill.

Transform: CISME (Coral In Situ Metabolism):

- NEED/BENEFITS: Globally, coral ecosystems degrading due to variety of stressors. Tools needed for rapid assessment of health and resilience. NOAA Goals: CAM, HO, RCE
- APPROACH: Non-destructive sensing approach for use in coral reef ecosystems; *in situ* instrument for measuring extracellular flux in marine organisms (including delta pH, oxygen, and pCO_2). Under development: A. Szmant, UNCW; Charles Mazel, Physical Sciences Inc.
- COMPETITION/ALTERNATIVES: Resulting technology may change methods for assessing coral reef ecosystem health, increase the accuracy and reliability of assessments, and greatly reduce costs over traditional visual surveys, field samples, and lab work.
- TRL 1: 2010- preliminary design, components being assembled for prototype. Deployment mechanisms under consideration.

Increment and Transform: Instrumentation for Assessing Ocean Acidification

- NEED/BENEFITS: Ocean acidification poses increasing threat to calcifying marine organisms including coral ecosystems. Sensors for rapid and accurate assessment of related carbon parameters are at varying stages of development, and how ocean pH changes impact coral calcification is poorly understood. NOAA Goals: CAM, HO, RCE
- APPROACH: Workshop with carbon cycle instrumentation and coral calcification experts resulted in report with recommendations for next steps to support NOAA Ocean Acidification Observing Network; background and content for new NOAA proposal solicitation for development of innovations. [Szmant, A, R Whitehead, and A Shepard. 2010. New Instrumentation for Assessment of Ocean Acidification in Coral Ecosystems, and Modeling of Coral Calcification. Report from Workshop, March 2010, St. Petersburg, FL. Available from Cooperative Institute for Ocean Exploration, Research and Technology, Harbor Branch at FAU, 5600 US 1 North, Fort Pierce, FL 34946. 17 pp. Available on-line at cioert.org as of Dec. 2010.]

- COMPETITION/ALTERNATIVES: Measurements on coral reefs must be at time and space scales and precision not available with existing technologies. Removing corals from in situ to in vitro changes metabolic responses.
- TRL 1-4: Recommendations include development of sensors/observing capabilities at varying levels.

Increment: Ocean Mapping Technologies

- NEEDS/BENEFITS: NOAA is facing increasing demand for offshore ecological data, for example, to map and understand new shelf-edge marine protected areas. AUV/ROV technologies offer alternative mapping approaches that move payloads closer to the seafloor and increase amount of information for mapping both seafloor and water column habitats. NOAA Goals: HO, RCE.
- APPROACH: Develop existing AUV platforms to support mapping of seafloor and water column habitats. CIOERT operations innovate, incubate and integrate several different platforms on NOAA partnership projects. On-going development/transition: A. Shepard, UNCW.
- COMPETITION/ALTERNATIVES: Ship-board acoustic mapping technologies are limited in the information they can provide as depth increases.
- TRL 3-4: Vehicles are available commercially, payloads still developing for mapping habitat (versus just bathymetry).

Increment: Rebreathers for Scientific Technical Diving

- NEEDS/BENEFITS: Most of the US EEZ is offshore in depths deeper than 40 m, beyond the reach of most air/nitrox scuba diving. Many of these areas are habitat for commercial fisheries in decline, and new management alternatives such as marine managed areas require ecological data provided by scientific diving. NOAA Goals: HO.
- APPROACH: Continue test, evaluation and transition of Closed Circuit Rebreathers (CCR) for support of scientific diving, in partnership with NOAA dive community. NOAA partners need field operations supervision, training, certification, gear, and opportunities to sustain proficiency. Advised by CIOERT activities, NOAA Dive Program is in final phases of formal U.S. Navy testing with one of commercial models. On-going transition: D. Kesling, UNCW
- COMPETITION/ALTERNATIVES: Decompression, mixed gas diving using open circuit scuba is complex and difficult. Divers must wear cumbersome and heavy array of tanks. Providing necessary breathing gas mixes is challenging if not limiting to operations in remote areas.
- TRL 4: Several commercial units in final test stages before they can be approved for NOAA divers.

Increment: Rapid Plankton Assessment

- NEEDS/BENEFITS: The least understood and explored ocean frontier is the pelagic realm. Yet, plankton is the base of the food chain for all ocean life. The overwhelming mortality for important fisheries and cornerstone species is at seed and larval stages. The challenge is sampling and processing samples from this vast realm.
- APPROACH: Partnership with Univ. of S. Florida to test, evaluate and improve optical plankton sampler, Shadowed Image Particle Profiling and Evaluation Recorder (SIPPER), and ground-truth SIPPER deployed from undersea platforms. Also, improve computer algorithms for auto-recognition and identification. Under development: T. Frank, HB/FAU; D. Remsen, USF
- COMPETITION/ALTERNATIVES: Collecting, counting and identifying plankton is tedious, time and cost limiting and requires special expertise. SIPPER and similar optical approaches will transform how plankton oceanography is conducted.
- TRL 2: 2010- deploy USF prototype and ground-truth with samples collected with nets; use data to improve database of species and auto-recognition capability