

EXTERNAL REVIEW
OF THE
COOPERATIVE INSTITUTE FOR OCEAN EXPLORATION, RESEARCH AND TECHNOLOGY
(CIOERT)
HARBOR BRANCH OCEANOGRAPHIC INSTITUTE

REVIEW PANEL MEMBERS

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SUBMITTED TO THE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SCIENCE ADVISORY BOARD

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Summary

An external review of the research, education, and outreach programs of the Cooperative Institute for Ocean Exploration, Research, and Technology (CIOERT), at the Harbor Branch Oceanographic Institute (HBOI) campus of Florida Atlantic University (FAU) was conducted on October 2 and 3, 2012 in Fort Pierce, FL. Guidelines for conducting the review were provided by the Cooperative Institute Program Office within the National Oceanic and Atmospheric Administration's (NOAA) Office of Oceanic and Atmospheric Research (OAR). The review was conducted under the auspices of the NOAA Science Advisory Board (SAB) and, therefore, is subject to the requirements of the Federal Advisory Committee Act (FACA). A list of review panel members is provided in Appendix I. The review panel's on-site agenda is provided in Appendix II.

CIOERT is a consortium of geographically distributed institutes and universities [FAU (lead), University of North Carolina Wilmington (UNCW) (co-managing partner), SRI International, and the University of Miami] and is not co-located with a NOAA laboratory or facility. These two conditions pose challenges. CIOERT efforts are currently primarily focused on exploration projects in the southeastern U.S. including the Gulf of Mexico. CIOERT's ocean exploration and use of advanced underwater technologies and techniques primarily support research on mesophotic and deep reef ecosystems.

The review panel found the CIOERT programs and research have progressed and benefited substantially from the outstanding collaborative efforts directed by the leadership team of Drs. Shirley Pomponi (HBOI/FAU) and Daniel Baden (UNCW). CIOERT is unique among the Cooperative Institutes in its alignment to the NOAA Next Generation Strategic Plan and to the Strategic Plan of the NOAA Office of Ocean Exploration and Research (OER).

I. Overview of CIOERT

CIOERT explores and studies the nation's ocean frontiers using innovation and cutting edge technologies. CIOERT is sponsored in part by NOAA's OER, and headquartered at HBOI/FAU in Fort Pierce, FL.

Receiving its initial award July 1, 2009, CIOERT is the youngest Cooperative Institute (CI) and was initiated in a challenging fiscal environment. While serving NOAA, CIOERT is not located at an OAR host facility nor are there NOAA scientists co-located with either of the managing partners.

Despite substantive obstacles, CIOERT has, under the direction of its leadership, created productive partnerships between academia and government. Through these partnerships CIOERT has leveraged an impressive array of research support that has added value not only to NOAA but to other agencies and society at large.

CIOERT, and therefore NOAA, is uniquely poised to be the leader in understanding the distribution, functioning, and dynamics of deep-water corals. CIOERT's research is in fact vital to meeting the national need for state-of-the-art assets appropriate for deep sea research and exploration. However, the ability of CIOERT to fully realize its potential is limited by the lack of available funding.

II. Strategic Planning and Vision

The primary vision of CIOERT is to motivate synergies between NOAA and academic scientists that apply advanced technologies to understanding shallow and deep ocean ecosystems. Towards these ends, CIOERT's efforts are focused towards the *Healthy Oceans* area of the NOAA mission, but aspects of their research also have application in *Climate Adaptation and Mitigation* as well as *Weather Ready Nation* mission components. CIOERT also serves more specific goals of the Next Generation Strategic Plan, OAR and OER five year research plans through their achievements in training, education, and outreach and CIOERT's three major research themes:

- I: Develop Advanced Underwater Technologies
- II: Exploring Shelf Frontiers
- III: Vulnerable Deep and Shallow Coral Reefs

Findings

1. FAU and UNCW are strategically positioned to allow efficient access to CIOERT's broad regional research focus. CIOERT's ability to forge linkages across university, industry and, agency needs in near-real-time actionable information sharing is a major asset.
2. CIOERT scientists, explorers, and technologists address several NOAA priority research themes. CIOERT's leadership and investigators provide NOAA with outstanding partners for planning and implementation of primary research product lines.
3. CIOERT is conducting high-quality exploration and research while developing, testing, and applying new and innovative uses of advanced technologies to ocean exploration and research of ecosystems and habitats of economic, hazardous, scientific, or cultural importance, primarily in the southeastern U.S. (including the Gulf of Mexico).
4. CIOERT's achievements in areas such as ocean and human health, and technology development are exceptional.
5. With the current uncertainty of program funding CIOERT does not have the critical financial resources needed to prepare for long-term planning or meet the goals proposed when the CI was initiated.

Recommendations:

1. NOAA/OER should appoint, locate, or detail liaison representatives to help facilitate NOAA-CI communication and exchange experiences at HBOI/FAU and UNCW to better enable planning, realization, and show-case research products in areas of ocean and human health, technology development, and others as appropriate.
2. CIOERT and NOAA/OER should coordinate efforts to expand and improve long-term funding streams by exploring opportunities to secure and leverage additional support for the CI's physical and human resources for the highly specialized research and development of products.

III. Science

The CIOERT leadership is highly motivated and committed to its vision to "transform the way we explore the ocean and transition our results to breakthrough products and technology". Having assembled high caliber scientists and a strong technical team with generous support from both

HBOI/FAU and UNCW the CI has the talent in place to be a critical part of the national assets to advance deep-sea research and exploration. Further their facilities are state-of-the-art.

CIOERT's scientists and researchers are focused on efforts to explore and research vulnerable deep and shallow coral ecosystems. They utilize advanced underwater technologies and techniques to improve the understanding of coral and sponge ecosystems, especially ecosystems under stress from human and climate change impacts, such as ocean acidification. Evidence of CIOERT's efficiency and speed of program initiation is found in the CI's response to the Deepwater Horizon blow-out in the Gulf of Mexico and the resulting environmental challenges.

Highlights:

- The Coral In Situ Metabolism (CISME) instrument will facilitate, and potentially revolutionize rapid *in situ* assessment of hermatypic coral health.
- The CIOERT scientists have been extremely successful in leveraging CIOERT support to obtain highly competitive National Institutes of Health and other grant funding.
- Deep submergence assets maintained and operated by CIOERT are highly valued by numerous NOAA partners.
- The drug discovery teams at FAU and UNCW are world class and conducting research with the potential to yield significant benefits to society.
- The HBOI/FAU coral research group is leading state of the art deep coral ecosystem mapping, assessment, and research of first order importance to several NOAA partners.

Findings

1. CIOERT is an asset to NOAA's efforts to meet the national need for state-of-the-art assets appropriate for deep sea research and exploration.
2. A CIOERT strength was the quality of the Institute's research, its fellows, and the leadership's ability to leverage local/state/private resources in support of NOAA goals.
3. CIOERT is poised to apply a new data system that could revolutionize information-sharing in oceanographic science with near-real time exchange of data.
4. The lack of certainty around future funding may preclude the most innovative potential long term projects and limit the full potential of the synergism between CI's teams. Current and projected levels of funding are neither sufficient to maintain the availability of the CIOERT deep submergence assets nor sustain the Institute's highly leveraged scientific agenda.

Recommendations

1. The review panel notes that many discoveries are appropriate for publication in high impact scientific journals. Publication of selected results will increase the visibility of CIOERT as research projects mature.
2. Funding should be dedicated to establish and maintain critical deep submergence capabilities for the NOAA community and for the continued development and use of CISME.
3. Enabling significant reciprocal visits between HBOI/FAU and UNCW drug development teams would help to fully realize the potential synergism between them.

IV. Education/Outreach

CIOERT has a broad set of education and outreach efforts that span NOAA goals in K-12, undergraduate, and graduate education. CIOERT expeditions provide hands-on, at-sea, multi-disciplinary opportunities for advanced undergraduate and graduate students. Students complete a full semester course (*Immersion in Ocean Sciences*) during which they develop a project (linked to a CIOERT research project), collect data, and produce a research paper and poster.

The critical outcome of this program is to develop and build a technical and scientific workforce for NOAA and the ocean exploration community through hands-on science, active participation and immersion in multidisciplinary ocean science research expeditions, followed by rigorous, laboratory based oceanographic research.

Highlights

- The CIOERT partners have an impressive record of educational work at the post-secondary level. Summer CIOERT cruises have provided ocean science research experiences for teachers, undergraduate, and graduate students, exposing participants to scientific innovations and new technologies.
- The partnership CIOERT/HBOI has successfully established with the Marine and Oceanographic Academy is a model that can be replicated by other marine research centers.
- The post-doc/MBA program is identified as an excellent tool to build the scientific workforce.

Findings

1. CIOERT's website needs significant improvements and updates that include links to partnership materials and discoveries.
2. CIOERT promotes ocean literacy and efforts to build NOAA's technical and scientific workforce through activities that engage students and teachers in hands-on science, technology development, and convey the value and excitement of exploration.

Recommendations

1. CIOERT leadership, NOAA's Office of Education and OERs Education Program Director should partner to develop and provide an outreach/education plan to showcase the research projects of direct and immediate societal importance. Educational modules incorporated into workshops and website exercises will help with the marketing/branding of CIOERT.
2. Expand the diversity of education and outreach efforts at educational facilities and schools near the partner sites (i.e. such as summer programs for teachers).
3. CIOERT should develop a website that includes links to partnering sites and research materials that proactively relate the CIOERT story.

V. Science Management

The scientific leadership for CIOERT is excellent. It was evident to the review panel that Shirley Pomponi and Daniel Baden have created a most impressive esprit de corps. The daunting fiscal challenges the geographically-dispersed CIOERT group have overcome during its first years underscore the outstanding team of scientists they have working to achieve the vision of

CIOERT. The Pomponi/Baden team has also generated a substantial amount of cost sharing from their respective universities – FAU and UNCW.

The amount of data associated with CIOERT research from cruises – latitude, longitude, depth, time, water samples, benthic samples, video, side scan, multi-beam, etc. is immense as is the associated output from subsequent shipboard and laboratory analyses. The diversity of the scientific endeavors provides an additional level of difficulty in rapidly developing “actionable” information. This underscores the challenge the CIOERT Team has to not only process the massive data stream they are creating but more importantly produce actionable information from it. AnthoSOA, one of the CIOERT initiatives, was enthusiastically embraced by Reed et al of HBOI.

The goal of the SRI International-led team that created AnthoSOA was to take the many asynchronous data outputs (navigation, CTD, video) associated with Reed’s research and turn it into immediately actionable information. The flexibility of the AnthoSOA system means it can be applied in the realm of drug discovery as well as to real time visualization that would be immensely helpful in decision making.

Highlights

- The CIOERT research teams at HBOI/FAU and UNCW have access to state-of-the-art facilities and the equipment necessary to contribute to their meaningful work in the field of drug discovery.
- Major investments to support CIOERT have been made by HBOI/FAU and UNCW.
- The CIOERT group quickly mobilized to carry out important environmental surveys along the shelf/slope boundary in the eastern Gulf that provided critical information on benthic realms following the 2010 well blow-out in the northern Gulf of Mexico.
- CIOERT is NOAA’s youngest CI yet it has developed close working relationships and is contributing meaningfully as a collaborative partner with many NOAA programs and resource managers.
- CIOERT’s partnership with SRI International is yet another testimonial to financial leverage and their drive to innovate.

Findings

1. CIOERT has excellent scientific leadership at all levels and an impressive esprit de corps.
2. CIOERT has demonstrated rapid and effective responses to environmental and fiscal challenges.
3. CIOERT has established effective interactions with, and service to, a number of NOAA programs and resource managers.
4. CIOERT and partners are focused on scientific questions appropriate to environmental management issues especially those involving the coral systems in the Flower Garden Banks Marine Sanctuary and the shelf/slope boundary in the eastern Gulf, one of the three US mega provinces for oil and gas.
5. The review panel recognizes the considerable potential for drug discovery initiatives by CIOERT partners at HBOI/FAU and UNCW.

RECOMMENDATIONS

1. The drug discovery groups at HBOI/FAU and UNCW have the potential to produce several important compounds that can be applied to cancer. Given this situation the CIOERT partners and NOAA should develop an equitable revenue sharing financial

model that not only benefits the respective universities but also CIOERT. Building an endowment would be especially relevant to the needs of the involved faculty and staff who occasionally have to “weather” periods without any support.

2. The geographic separation of the primary collaborating groups presents an obstacle to effective communication that is a key to having CIOERT thrive. While we recognize the financial challenges the group has had to face we suggest that a regular phone call/Skype/video conference between and among the research groups would provide a way to stimulate productive exchanges and encourage greater interaction between drug discovery groups at HBOI/FAU and UNCW.
3. CIOERT should focus research on the eastern Gulf of Mexico which is rapidly becoming a major region for deep-water oil and gas production.
4. CIOERT leaders should apply innovative scientific training such as working with AnthoSOA, to the entire scientific team and staff. The application of such a system to this CI represents a major technical breakthrough and the review team hopes that a more robust experiment will be funded for CIOERT.

Final Rating

Following a thorough review of the strategic planning, science, education and outreach, and science management performed by CIOERT and considering the financial climate CIOERT is functioning in, the Review Panel unanimously agreed to a performance rating of Outstanding. The Review Panel's Findings/Recommendations are items presented to strengthen CIOERT.

Appendix 1.

Review Panel

Cooperative Institute for Ocean Exploration, Research, and Technology (CIOERT)

[1] Jean May-Brett, Chair

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During her 25-years of classroom teaching Dr. May-Brett taught Earth Science, Environmental Science, and Mathematics to students in New York and Louisiana at the middle and high school levels. Before assuming her position at the LA Department of Education, Jean served as the Assistant Director of Educational Services at Louisiana Public Broadcasting. She was the Curriculum Director and Content Producer for two award winning video series - an environmental science for middle school students and a professional development series for classroom teachers. Dr. May-Brett is an officer in both the Louisiana Science Teachers Association and the Louisiana Association of Teachers of Mathematics. Jean is a past-president of the Southern Association of Marine Educators (SAME) and the National Marine Educators Association (NMEA). She has served on the Council for the National Science Teachers Association and the CGOM COSEE Management Council. Jean completed three terms on Louisiana's Environmental Education Commission.

[2] Charles Fisher, Ph.D.

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Dr. Fisher received a bachelor's degree in Biology from Michigan State University in 1977 and a Ph.D. in Marine Sciences from the University of California, Santa Barbara in 1985. His Ph.D. work was primarily on shallow coral reef species, but his post-doctoral research centered on deep sea hydrothermal vent symbioses. Dr. Fisher presently holds a faculty position in the Department of Biology at Penn State University where he teaches undergraduate and graduate courses in critical evaluation of biological literature and symbiosis. He also serves as the chair of the graduate program in Biology and the Associate head for Equity and Diversity for the department. Dr. Fisher carries out research on the physiology and ecology of deep sea animals and ecosystems. He has been working on hydrothermal vents virtually since the discovery of the vent communities with over 3 decades of NSF and NOAA support. He has also had active research programs on the cold seep communities in the Gulf of Mexico since 1986 and deep coral communities since 2003 funded primarily by BOEM and NOAA. This work has resulted in 145 peer reviewed publications. He has participated in 65 oceanographic research expeditions and served as chief scientist on 33 of them. He has made 128 dives in research submersibles and spent over 200 days at sea working with remote vehicles. He currently serves on the Steering Committee for the Deep Sea Minerals project of the Secretariat of the Pacific

Community, the steering committee for the international InDeep program, on the editorial boards of Symbiosis and Marine Ecology, and is actively working with the trustees of the National Resource Damage Assessment Program in the wake of the Deep Water Horizon disaster.

[3] Billy D. Causey, Ph.D.

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Billy Causey is the Southeast Regional Director for the National Oceanic and Atmospheric Administration's (NOAA) Office of National Marine Sanctuaries. He has managed Sanctuaries in the Florida Keys since 1983, when he became the Manager of the Looe Key Sanctuary. He served as the Superintendent of the 2900 snm Florida Keys National Marine Sanctuary from August 1991 to September 2, 2006, when he assumed his current position. Dr. Causey was the lead NOAA official in the development of the management plan for the Keys Sanctuary. He was responsible for establishing the first comprehensive marine zoning plan for the United States. Dr. Causey's academic interests are in coral reef ecology, coral reef fishes, sustainable management, regional connectivity, ecosystem-based management, marine zoning, climate change and marine policy. He has observed and recorded the impacts of climate change on the coral reef ecosystem since 1978. Dr. Causey was among the first coral reef managers to link coral bleaching with elevated sea surface temperatures and to correlate the secondary impacts of coral diseases to the stressors created by the conditions caused by increased water temperatures and other sources of environmental degradation. He has worked on the South Florida Ecosystem Restoration Project since 1993 and has been active with numerous initiatives to establish MPA networks around the region.

[4] Peter R. Betzer, Ph.D.

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Dr. Peter R. Betzer, currently serves as the President of the St. Petersburg Downtown Partnership a group that has been pivotal to the emergence of St. Petersburg, Florida as a center for marine research in the United States. He and his business colleagues are currently focused on expanding the cluster of technological businesses that are associated with St. Petersburg's extensive marine research complex. Prior to joining the partnership in 2008, Dr. Betzer served as Dean and Professor of The University of South Florida's College of Marine Science. Dr. Betzer received a B.A. in geology from Lawrence College (1964) and in 1971 was awarded a Ph.D. in chemical oceanography from the University of Rhode Island's Graduate School of Oceanography. His research interests were in the realm of geochemistry, particularly the role of organisms in modifying the chemistry of seawater, pollutant transfer in the oceans, and chemical tracers. Dr. Betzer is the author of over 60 scientific publications in journals and books and in 1985 was a co-recipient of the Distinguished Authorship Award from the National

Oceanic and Atmospheric Administration. . Dr. Betzer was appointed to the Ocean Sciences Advisory Panel for The National Science Foundation (NSF) in 1986-89 and again in 1995-99. In 1990 he was elected to The University National Oceanographic Laboratory System (UNOLS) Council for a three-year term and in 1992 and again in 1994 he was elected Vice-Chair of UNOLS. In 2005 Dr. Betzer was appointed to the Ocean Research and Resource Advisory Panel (ORRAP) a 15 member group that formulates recommendations to federal agencies. Dr. Betzer has participated in numerous oceanographic expeditions including work in the North Atlantic Ocean, Caribbean Sea, Gulf of Mexico and the North Pacific Ocean. In 1986 and 1987 he served as the chief scientist for a five-university project in the North Pacific Ocean that studied the fluxes and interactions of atmospheric dust in the upper ocean. In 1990 he was chief scientist on a cruise of R/V ENDEAVOR to the Sargasso Sea which was conducted as part of the Global Ocean Flux Experiment.

[5] Michael A. Banks, Ph.D. (*Ex-officio*, cooperative institute representative)

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Dr. Banks received a bachelor's degree in zoology and marine ecology in 1981 and a Higher Diploma in Education (1982) from the University of Cape Town, a MS in zoology and mariculture from Louisiana Tech University in 1988 and a Ph.D. in population genetics from the University of California in Davis in 1994. Dr. Banks presently holds a faculty position at the Department of Fisheries and Wildlife at Oregon State University where he teaches graduate courses in coastal population genetics and conservation. Dr. Banks carries out research in marine fisheries genetics in service to the west coast fishing and local community as part of the Coastal Oregon Marine Experiment Station. He is also Director of the Cooperative Institute (CI) for Marine Resources Studies and currently serves on the National CI Executive Committee.

Appendix II.
Agenda for the Review of

Cooperative Institute for Ocean Exploration, Research, and Technology (CIOERT)

Cooperative Institute for Ocean Exploration, Research, & Technology (CIOERT)
 Science Review Agenda
 Harbor Branch Oceanographic Institute-Florida Atlantic University
 Tuesday, October 2, 2012
 Johnson Marine Education & Conference Center Annex (unless noted otherwise)

7:30 – 8:00	Travel from hotel to HBOI-FAU	Transport provided by HBOI
8:00 – 8:50	Science Review Panel Executive Session	Board Room (Closed session: Panel only)
9:00 – 9:15	Welcome	Margaret Leinen, FAU Associate Provost for Marine & Environmental Initiatives & HBOI Executive Director
9:15 – 9:45	CIOERT Introduction and Overview	Shirley Pomponi, CIOERT Exec Dir, FAU
9:45 – 10:15	Permanent Innovation Drives CIOERT Activities	Daniel Baden, CIOERT Mng Dir, UNCW
10:15 – 10:45	Break	
10:45 – 11:30	CIOERT Science Highlights & Accomplishments: Theme I: Technology Development	
	CISME: New Technology Development for Measuring Coral <i>In Situ</i> Metabolism	Robert Whitehead, UNCW
	Development of a Fluorescence-Based Receptor Binding Assay for Brevetoxins and Ciguatoxins	Jennifer McCall, UNCW
	AnthoSQA: Immediate Actionable Data	Lori Adornato, SRI
11:30 – 12:30	CIOERT Science Highlights & Accomplishments: Theme II: Continental Shelf Edge Exploration	
	Discovery of Novel Therapeutic Agents from Marine Frontier Habitats	Amy Wright, HBOI-FAU
	Genomic Mining to Discover New Marine Natural Products	Jeffrey Wright, UNCW
	The Development of Polyether Escortins for Use in Drug Delivery	Andrea Bourdelais, UNCW Andrew Shepard, USF
	C4: Platforms for Exploration, Research, & Innovation	
12:30 – 1:30	Working lunch	
	Ocean Discovery: At-Sea Opportunities for the Next Generation of Scientists	Dennis Hanisak, HBOI-FAU Elizabeth Skellam, UNCW
1:30 – 2:30	Tour of CIOERT-HBOI PI labs: Marine Biotechnology	Marine Science Lab: Amy Wright
2:30 – 2:45	Break	
2:45 – 3:15	UNCW CREST Research Park: A Virtual Tour	Dan Baden, UNCW
3:15 – 4:15	CIOERT Science Highlights & Accomplishments: Theme III: Vulnerable Coral Ecosystems	
	Exploring Shelf Frontiers: Vulnerable Deep and Mesophotic Coral/Sponge Ecosystems	John Reed, HBOI-FAU Joshua Voss, HBOI-FAU
	Evaluating Coral Reef Resources and Ecosystem Health Genetic Analysis of the Coral, <i>Montastraea cavernosa</i> , from Mesophotic Reefs of the Flower Garden Banks	Sara Edge, HBOI-FAU
4:15 – 5:00	Science Review Panel Executive Session	Board Room (Closed session: Panel only)
5:00 – 5:30	Questions to CIOERT Directors re: Day 1 presentations	Board Room (Closed session: Panel and CIOERT Directors only—Pomponi, Baden, Hanisak, Ortner, Langebrake)
5:30 – 7:00	Reception and poster session	Education Center Gallery

Wednesday, October 3, 2012
 Link Engineering Building: Rooms 246-247 (unless otherwise noted)

7:30 – 8:00	Travel from hotel to HBOI-FAU	Transport provided by HBOI
8:00 – 9:00	Executive Session with CIOERT Partner Directors Directors only (Drs. Pomponi, Baden, Hanisak, Langebrake, & Ortner)	Closed session: LE 247: Panel & CIOERT
9:00 – 9:15	Break	LE 246
9:15 – 10:15	Panel discussion with NOAA Partners: Tim Arcano, John McDonough, Nathalie Valette-Silver, and Gene Smith, NOAA OAR Ocean Exploration & Research Tom Hourigan & John Tomczuk, NOAA Deep Sea Coral Research & Technology Program Andrew David, NOAA Fisheries Emma Hickerson, Flower Gardens Bank National Marine Sanctuary Kimberly Puglise, NOAA NOS National Centers for Coastal Ocean Science Roger Pugliese, South Atlantic Fishery Management Council	LE 247 (and by conference call) Moderated by Peter Ortner (Open to all participants)
10:15 – 10:45	Innovation in Environmental Information Management	Larry Langebrake, SRI
11:00 – 12:00	Tour of CIOERT-HBOI PI labs: Coral Reef Research	John Reed, Joshua Voss, Sara Edge, Dennis Hanisak
12:15 – 1:15	Working lunch and wrap-up NOAA & SAFMC partners	LE 246: CIOERT directors & project PIs,
1:15 – 4:00	Review Panel Executive Session	LE 247 (Closed session: Panel only)
4:00	Debrief	LE 247 (Closed Session: Panel & CIOERT Directors only)

****Unless otherwise noted, all sessions are open to all participants.**