2nd International
Indian Ocean
Expedition
US Steering Committee

US IIOE-2 Steering Committee Activities and Planning Workshop

Report to OCB

Raleigh R. Hood

OCB Meeting, June 29, 2017

Outline:

- The Second International Indian Ocean Expedition (IIOE-2)
- US IIOE-2 Steering Committee Membership
- US IIOE-2 Steering Committee Activities
- ***US IIOE-2 Research Planning Workshop***

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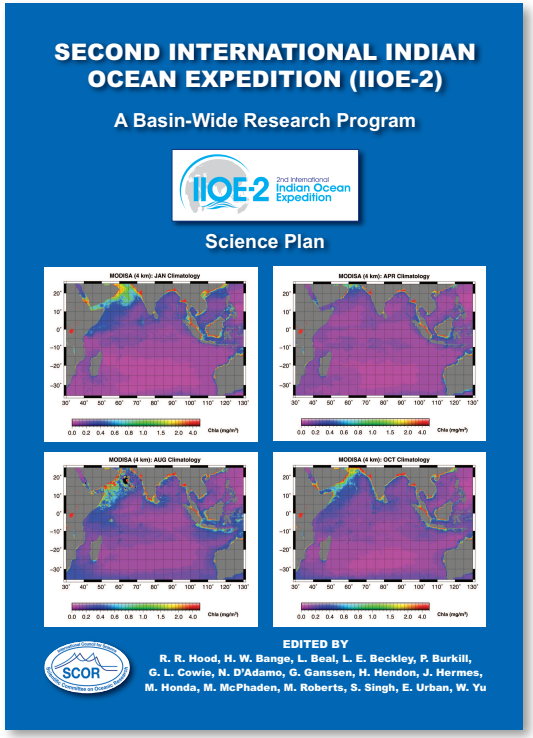
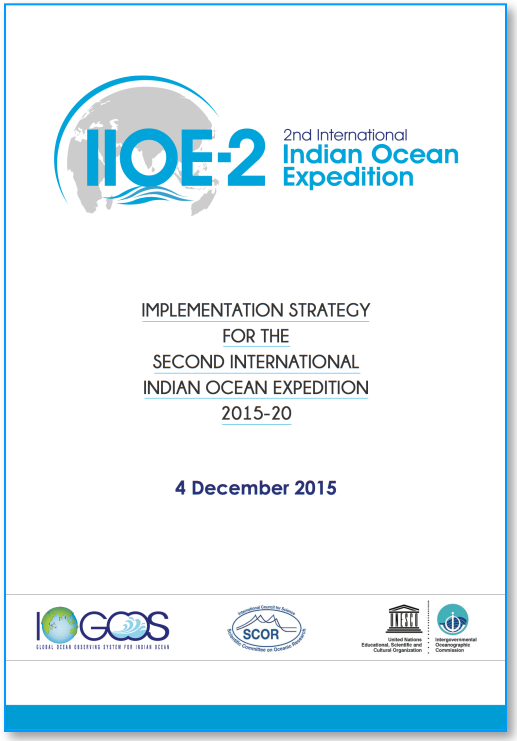
IIOE-2 Science Plan and Implementation Strategy:

- Planning for the Expedition started in 2012.
- The IIOE-2 Science Plan was commissioned by SCOR and published in 2015.
- The IIOE-2 Implementation strategy was commissioned by IOC and published in 2015.
- The Expedition was officially launched December 5, 2015.





Available at: http://www.iioe-2.incois.gov.in or just Google “IIOE-2”

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Overarching goal:

The overarching goal of IIOE-2 is to advance our understanding of interactions among geologic, oceanic and atmospheric processes that give rise to the complex physical dynamics of the Indian Ocean region, and determine how those dynamics affect climate, extreme events, marine biogeochemical cycles, ecosystems and human populations.

Six Research Themes:

Theme 1: Human Impacts

Theme 2: Boundary current dynamics, upwelling variability and ecosystem impacts

Theme 3: Monsoon variability and ecosystem response

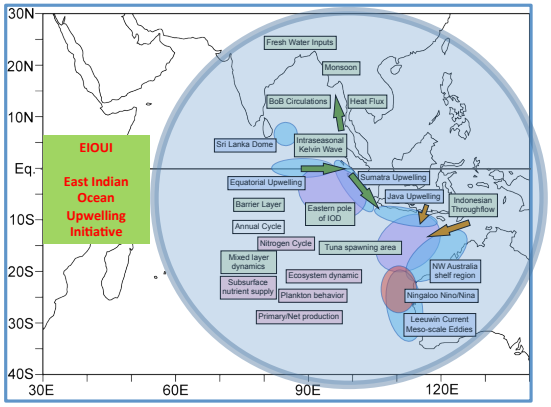
Theme 4: Circulation, climate variability and change

Theme 5: Extreme events and their impacts on ecosystems and human populations

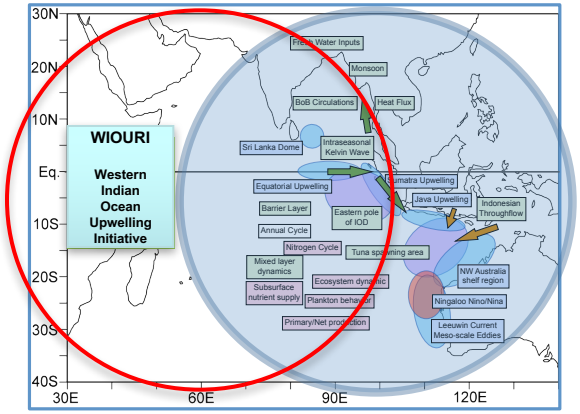
Theme 6: Unique geological, physical, biogeochemical and ecological features of the Indian Ocean

IIOE-2 RESEARCH INITIATIVES:

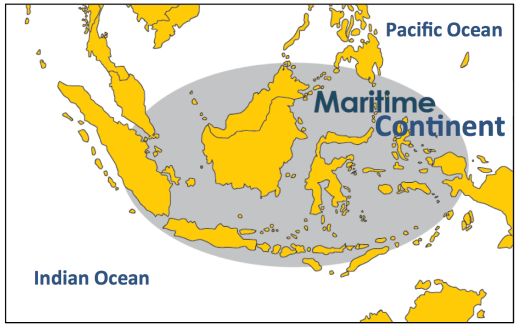
The Eastern Indian Ocean Upwelling Research Initiative: The Eastern Indian Ocean Upwelling Research Initiative (EIOURI) is ongoing with multiple cruises already undertaken and planned. The main foci of this initiative is on the upwelling regions that develop seasonally off Java, Sumatra, and northwestern Australia.



The Western Indian Ocean Upwelling Research Initiative: In addition to EIOURI, efforts are underway to develop a complementary upwelling research initiative on the western side of the basin: A Western Indian Ocean Upwelling Research Initiative (WIOURI).



The Year of the Maritime Continent: In addition to these research initiatives, the IIOE-2 coincides with and embraces the Year of the Maritime Continent (YMC) as a major IIOE-2 field champagne in 2017-2018. Multiple cruises are happening.



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Summary of National IIOE-2 Efforts:

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- **India:** IIOE-2 National Organizing Committee formed and active, hosting JPO in Hyderabad / INCOIS, hosting website, multiple cruises undertaken and planned (Shenoi, et al.)
- **Japan:** Hosted and convened first EIOURI workshop, co-leading EIOURI, research cruises undertaken and planned (Masumoto, Honda, JAMSTEC)
- **Germany:** IIOE-2 organizational meeting convened, National Committee formed and active, science plan published, multiple cruises planned (Bange, Gaye, et al.)
- **Indonesia:** Delegation sent to the USA with strong emphasis on IIOE-2, ship support committed to the effort, hosting 2nd IIOE-2 SC meeting, leading IIOE-2 capacity development efforts (Arifin, Susanto, et al.)
- **China:** Hosted and convened RG-2 meeting, and leading EIOURI effort, research cruises undertaken and planned (Weidong Yu, SOA)
- **Australia:** IOC Perth Office hosting JPO secretariate (D'Adamo), National Committee formed and active, science priorities developed and published, 110°E repeat line proposal funded (Beckley), EIOURI cruise funded (Wijffels) , strong backing from UWA/IOMRC, hosted first IIOE-2 SC meeting and symposium
- **Mauritius:** Hosted and Convened RG-3 meeting with strong SWIO representation including South Africa and eastern African countries (Badal, Roberts, D'Adamo)
- **USA:** OSB/NAS informed and updated, US National Committee formed and active, science planning workshop funded (September 11-13, 2017 at SIO)
- **UK:** IIOE-2 Organizational meeting convened and proto-national committee formed, high level talks of India-UK collaboration / cruises (Burkill, Cowie, et al.)
- **Thailand:** Hosted EIOURI science plan writing workshop and fully engaged in IIOE-2 through SIBER (Khokiattiwong, Yu, Matsumoto, et al.)
- **South Africa:** WIOURI under development, strong engagement by Dept. of Environmental Affairs, ship time promised
- **Other eastern African Countries:** Engaged through IOC and have expressed desire to participate, promotional videos developed, need capacity development
- **Saudi Arabia:** Initiated discussions to develop a Red Sea Research Initiative (RSRI) under IIOE-2, glider missions through Bab-el-Mandeb discussed
- **Pakistan:** Engaged through IOC and have expressed strong desire to participate. Submissions to DSR II Special Issue on IIOE-2 planned
- **South Korea:** Engaged through NOAA, especially related to supporting RAMA / IndOOS, science planning workshop to set South Korean science priorities for participating in IIOE-2 will be convened in November, 2017 (McPhaden, Hood, Wiggert, and South Korean counterparts)

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Joint Project Office:

Hosted by India (INCOIS/Hyderabad) and Australia (IOC Perth Office)

IIOE-2 Joint Project Office (JPO)

Perth Australia Node

IOC IIOE-2 Coordinator

Dr Nick D'Adamo
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c/- Commonwealth Bureau of Meteorology
3rd Floor, 1 Ord Street (corner of Havelock Street),
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:+61-8-92262899 (Direct)

: +61-8-92260599

: nick.dadamo@bom.gov.au

(PO Box 1370, West Perth, Western Australia, 6005, Australia)

Hyderabad India Node

JPO INDIA IIOE-2 Coordinator

Dr S. Rajan
Indian National Centre for Ocean Information Services (INCOIS),
"Ocean Valley", Pragathi Nagar (BO), Nizampet (SO),
Hyderabad - 500 090, Telangana, India.

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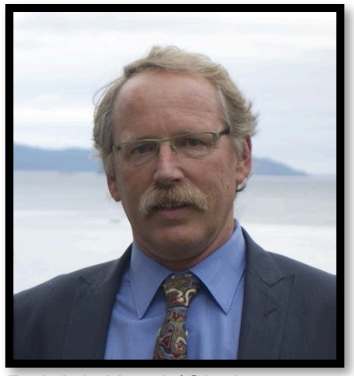
:+91-9545509861

:+91-40-23895001

: iioe-2@incois.gov.in, rajan.s@incois.gov.in

Information available at: http://www.iioe-2.incois.gov.in, or just Google “IIOE-2”

US IIOE-2 Steering Committee



Raleigh Hood (Chair, University of Maryland, biological oceanography)

Dwi Susanto (University of Maryland, physical oceanography)

Lisa Beal (University of Miami, RSMAS, physical oceanography)

Mike McPhaden (NOAA, PMEL, physical oceanography and climate)

Lynne Talley (Scripps Institution of Oceanography, physical oceanography)

Greg Cutter (Old Dominion University, chemical oceanography)

Mike Landry (Scripps Institution of Oceanography, biological

Chidong Zhang (NOAA, PMEL, atmospheric science)

Subrahmanyam Bulusu (University of South Carolina, physical oceanography and satellite oceanography)

Joaquim Goes (Columbia University, LDEO, biological oceanography and satellite oceanography)

Karen Lloyd (University of Tennessee Knoxville, deep-sea microbiology)

Jerry Wiggert (University of Southern Mississippi, interdisciplinary modeling)

Henry Dick (Woods Hole Oceanographic Institution, marine geology and geophysics)

Steering Committee Membership

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US IIOE-2 Steering Committee Activities:

- Website (courtesy of SCOR): http://www.scor-int.org/US-IIOE2.htm
- Recent ASLO Bulletin Article on IIOE-2
- Newsletter
- US email distribution
- Indian Ocean cruise/research spreadsheet
- ***US IIOE-2 research planning workshop at SIO in September***

US IIOE-2 Research Planning Workshop:

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- Funded by OCB, NASA PO, NOAA and IUSSTF.
- We can provide support to attend if needed.
- Goal is to define US research priorities in the Indian Ocean.
- And motivate and energize the US research community.
- Produce guiding documents for US participation in IIOE-2.
- Workshop will be convened September 11-13, 2017 at Scripps Institution of Oceanography.
- ***Registration deadline is July 14, 2017.***

Register via OCB website at: http://web.whoi.edu/ioworkshop2017/

Or email me and I will send you the link: rhood@umces.edu

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US IIOE-2 Research Planning Workshop:

Revolves Around Four Research Themes / Breakout Sessions:

Theme 1: Boundary fluxes, upwelling, ecosystem and atmospheric feedbacks

Theme 2: Monsoon onset, variability, and change, and impacts on biogeochemistry

Theme 3: Ventilation, oxygen and carbon variability and change

Theme 4: Geological and deep-ocean biogeochemical processes

The terms of reference for the US IIOE-2 Steering Committee establish the following goals:

- Convene a science planning and implementation workshop to attract both scientists interested in the Indian Ocean region and agency program managers.

- Write a U.S. IIOE-2 Science Plan and Implementation Strategy based on the workshop.

- Coordinate ongoing U.S. research in the Indian Ocean region and coordinate planning of new research.

- Provide a forum for U.S. interagency discussions of Indian Ocean research and a liaison between the scientific community and these agencies.

- Communicate U.S. research in the Indian Ocean region to national and international audiences through a Web site, newsletters, articles in the peer-reviewed and other literature, Twitter, and other approaches.

- Represent the U.S. community on the international IIOE-2 Steering Committee.

- Represent the U.S. community in international IIOE-2 meetings and discussions.

- Liaise with U.S. SCOR and IOC committees.

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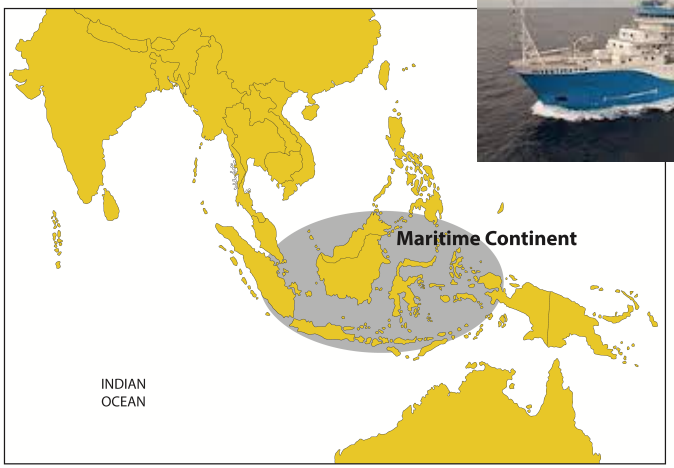
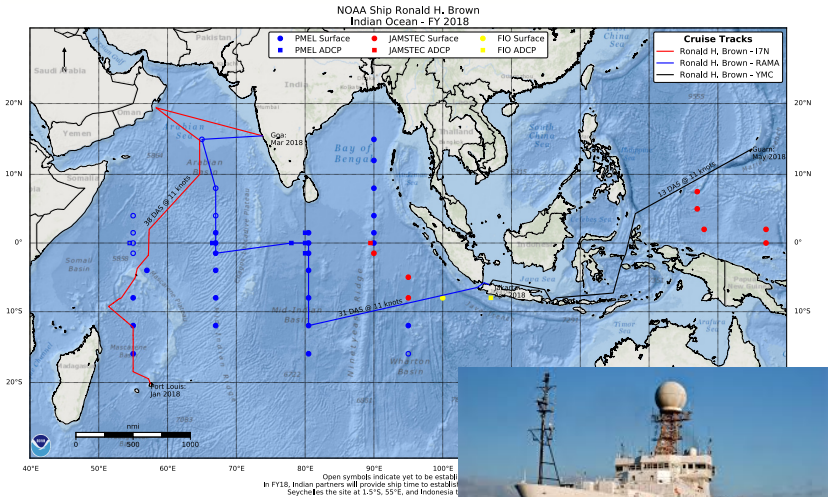
Activities and Accomplishments: YMC and RAMA update

- An Australian proposal to involve the R/V *Investigator* in the Years of the Maritime Continent (YMC) received good reviews.
- The chief scientist of the cruise would be Susan Wijffels and the cruise would focus on waters off the west coast of Sumatra or in Timor Sea, the cruise location will depend on the acquisitions of permissions to work in the Indonesian Exclusive Economic Zone.
- The *Ron Brown* has been proposed to work in the Indian Ocean in early 2018 to occupy GO-SHIP line (IO-7N), deploy new RAMA mornings in the Arabian Sea, and continue with work to contribute to IIOE-2 and YMC.
- There was a Jan. 23 briefing to Craig McLean's deputy.
- Proposals for the work on the *Brown* will be submitted to NSF.
- If Indonesian scientists are interested to be aboard the *Brown*, that should be possible.
- Sydney Thurston has play a key role in these developments.





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Activities and Accomplishments: Website

http://www.scor-int.org/US-IIOE2.htm

- Hosted by SCOR
- Simple but effective:
  - -Documents
  - -Committee
  - -Links
  - -US Activities
  - -US IIOE-2 Newsletters

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Activities and Accomplishments: ASLO Bulletin Article

- Sections:

-Overview

-IIOE and the Dawn of Modern Indian Oceanography

-Scientific Advances of the 21st Century and Challenges in the Indian Ocean

-IIOE-2 Science

-IIOE-2 Research Initiatives

-IIOE-2 Implementation

-The Goa 50th Anniversary Symposium and Official Launch of IIOE-2

-Engagement of Early Career Scientists

-Legacy

ASLO Bulletin, 25(4): 117-124.

article

The 2nd International Indian Ocean Expedition (IIOE-2): Motivating New Exploration in a Poorly Understood Basin

Raleigh R. Hood, Edward R. Urban, Michael J. McPhaden, Danielle Su, and Eric Raes

Overview

The Indian Ocean remains one of the most poorly sampled and overlooked regions of the world ocean. Today, more than 25% of the world's population lives in the Indian Ocean region and the population of most Indian Ocean rim nations is increasing rapidly. These increases in population are giving rise to multiple stressors in both coastal and open ocean environments. Combined with warming and acidification due to global climate change, these regional stressors are resulting in loss of biodiversity in the Indian Ocean and also changes in the phenology and biogeography of many species. These pressures have given rise to an urgent need to understand and predict changes in the Indian Ocean, but the measurements that are needed to do this are still lacking. In response, SCOR, IOC, and IOGOOS have stimulated a second International Indian Ocean Expedition (IIOE-2). An international Science Plan and an Implementation Strategy for IIOE-2 have been developed, the formulation of national plans is well underway in several countries, and new research initiatives are being motivated. An Early-Career Scientist Network for Indian Ocean Research has self-organized to support the Expedition. The success of IIOE-2 will be gauged not just by how much it advances our understanding of the complex and dynamic Indian Ocean system, but also by how it contributes to sustainable development of marine resources, environmental stewardship, ocean and climate forecasting, and training of the next generation of ocean scientists. We encourage ASLO members to get involved.

IIOE and the Dawn of Modern Indian Oceanography

The Scientific Committee on Ocean Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC) identified more than 50 yr ago that the Indian Ocean was one of the least studied ocean basins. To address this gap in knowledge, SCOR and IOC motivated one of the greatest oceanographic expeditions of all time, the International Indian Ocean Expedition (IIOE). The IIOE was a 6-yr endeavor (1960–1965) that stimulated new activities by about a dozen nations, in which all areas of oceanography and meteorology were studied across the basin (Fig. 1).

At the first meeting of the Special Committee on Oceanic Research (renamed "Scientific Committee on Oceanic Research" some years later) in 1957, participants recognized that the International Geophysical Year (then in progress) was showing the benefits of an intensive multinational focus on geoscience for a limited time period. At the same time, SCOR meeting participants identified that the Indian Ocean, largely because of its remoteness from most major oceanographic institutions, had not been much studied and would benefit most from a concerted international research effort (Deacon 1957). In addition to the fundamental knowledge in science that could be gained, it was recognized that human societies in the region would benefit from a better understanding of how the annual monsoon cycle worked and how it affected Indian Ocean fisheries and weather in the region.

Planning for the IIOE began in 1957 and the project officially continued through 1965,

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Activities and Accomplishments: Newsletter

- First US IIOE-2 Newsletter came out in December, 2016.
- Announcements.
- US Science Activities in the Indian Ocean (6 articles):

-The IIOE-2 Science Plan and Implementation Strategy, by Raleigh R. Hood and Ed Urban

-The Indian Ocean Subseafloor Microbial Habitat, by Karen Lloyd

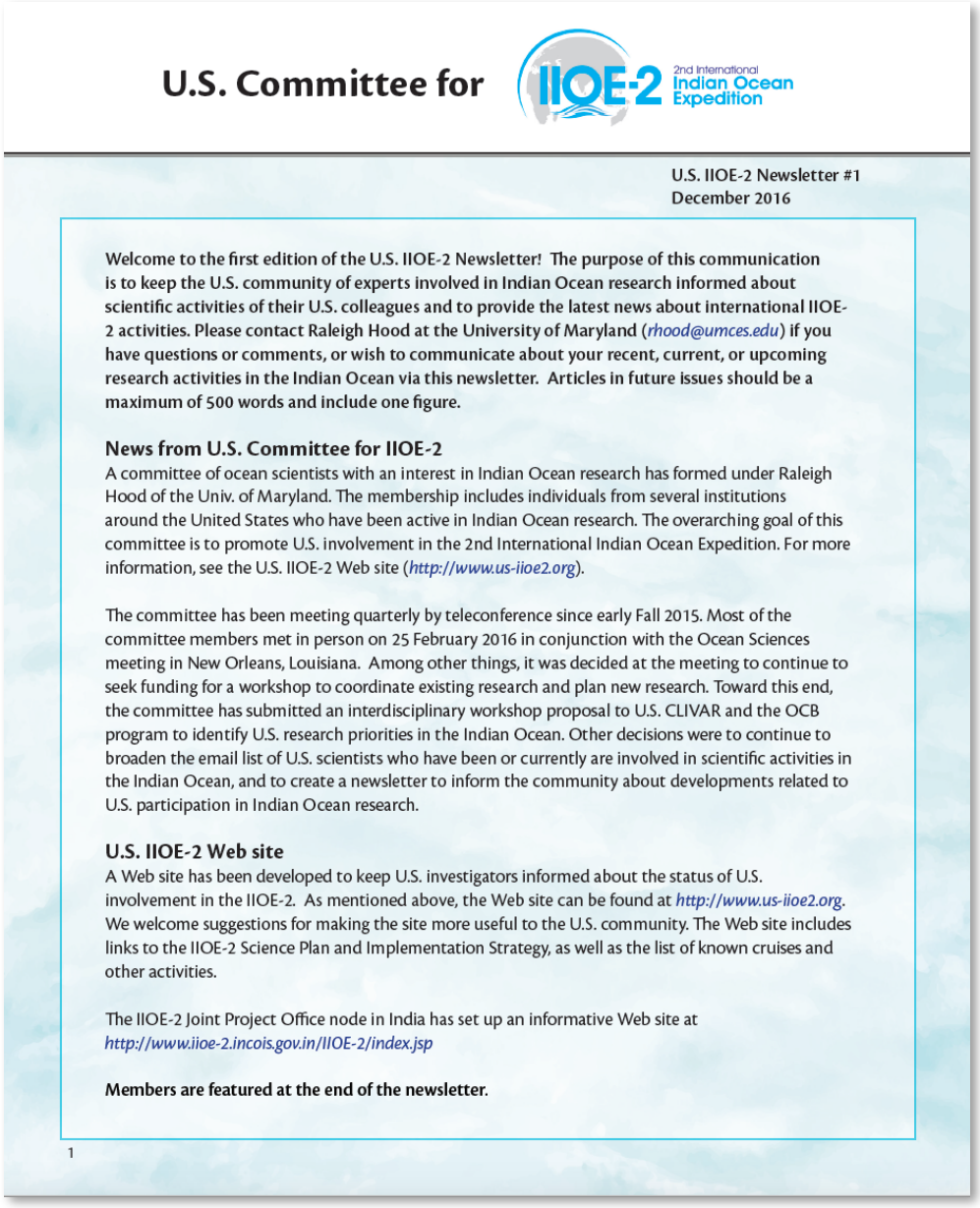
-GEOTRACES in the Indian Ocean, by Gregory A. Cutter

-The Arabian Sea – an ecosystem in transition, by Joaquim Goes et al.

-Project SloMo – Drilling through the crust to the Moho in the Indian Ocean, by Henry Dick

-U.S. Cruises in the Indian Ocean and Endorsement of Projects

- Hope to generate 2-3 newsletters per year.



U.S. Committee for IIOE-2 2nd International Indian Ocean Expedition

U.S. IIOE-2 Newsletter #1
December 2016

Welcome to the first edition of the U.S. IIOE-2 Newsletter! The purpose of this communication is to keep the U.S. community of experts involved in Indian Ocean research informed about scientific activities of their U.S. colleagues and to provide the latest news about international IIOE-2 activities. Please contact Raleigh Hood at the University of Maryland (*rhood@umces.edu*) if you have questions or comments, or wish to communicate about your recent, current, or upcoming research activities in the Indian Ocean via this newsletter. Articles in future issues should be a maximum of 500 words and include one figure.

News from U.S. Committee for IIOE-2

A committee of ocean scientists with an interest in Indian Ocean research has formed under Raleigh Hood of the Univ. of Maryland. The membership includes individuals from several institutions around the United States who have been active in Indian Ocean research. The overarching goal of this committee is to promote U.S. involvement in the 2nd International Indian Ocean Expedition. For more information, see the U.S. IIOE-2 Web site (*http://www.us-iioe2.org*).

The committee has been meeting quarterly by teleconference since early Fall 2015. Most of the committee members met in person on 25 February 2016 in conjunction with the Ocean Sciences meeting in New Orleans, Louisiana. Among other things, it was decided at the meeting to continue to seek funding for a workshop to coordinate existing research and plan new research. Toward this end, the committee has submitted an interdisciplinary workshop proposal to U.S. CLIVAR and the OCB program to identify U.S. research priorities in the Indian Ocean. Other decisions were to continue to broaden the email list of U.S. scientists who have been or currently are involved in scientific activities in the Indian Ocean, and to create a newsletter to inform the community about developments related to U.S. participation in Indian Ocean research.

U.S. IIOE-2 Web site

A Web site has been developed to keep U.S. investigators informed about the status of U.S. involvement in the IIOE-2. As mentioned above, the Web site can be found at *http://www.us-iioe2.org*. We welcome suggestions for making the site more useful to the U.S. community. The Web site includes links to the IIOE-2 Science Plan and Implementation Strategy, as well as the list of known cruises and other activities.

The IIOE-2 Joint Project Office node in India has set up an informative Web site at *http://www.iioe-2.incois.gov.in/IIOE-2/index.jsp*

Members are featured at the end of the newsletter.

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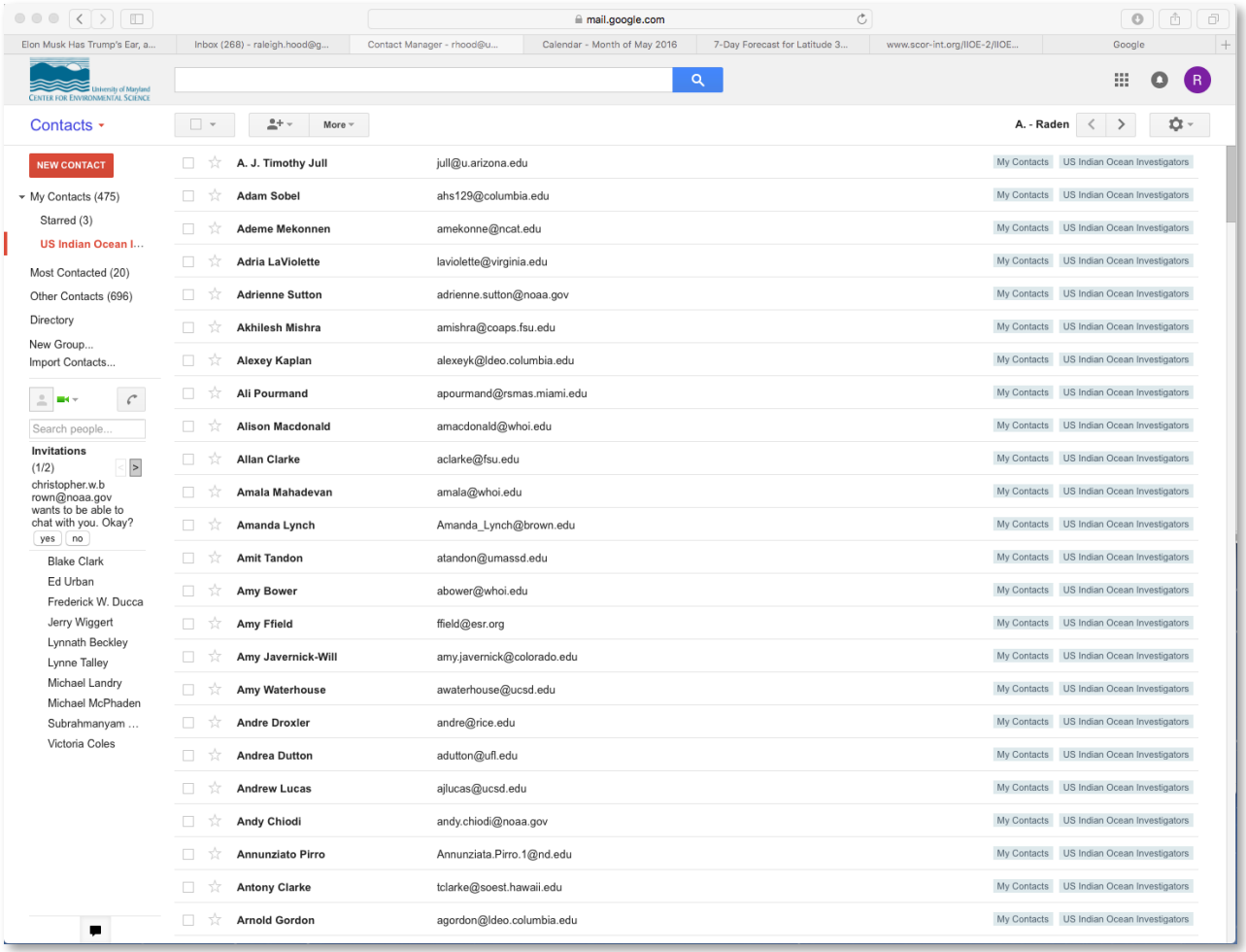
Activities and Accomplishments: US Email Distribution

- We have compiled an email contact list of US Indian Ocean principal Investigators and interested parties.
- 354 email address.
- Oceanography.
- Atmospheric Science.
- Soon also MG&G.
- A powerful tool for reaching out to the US research community.



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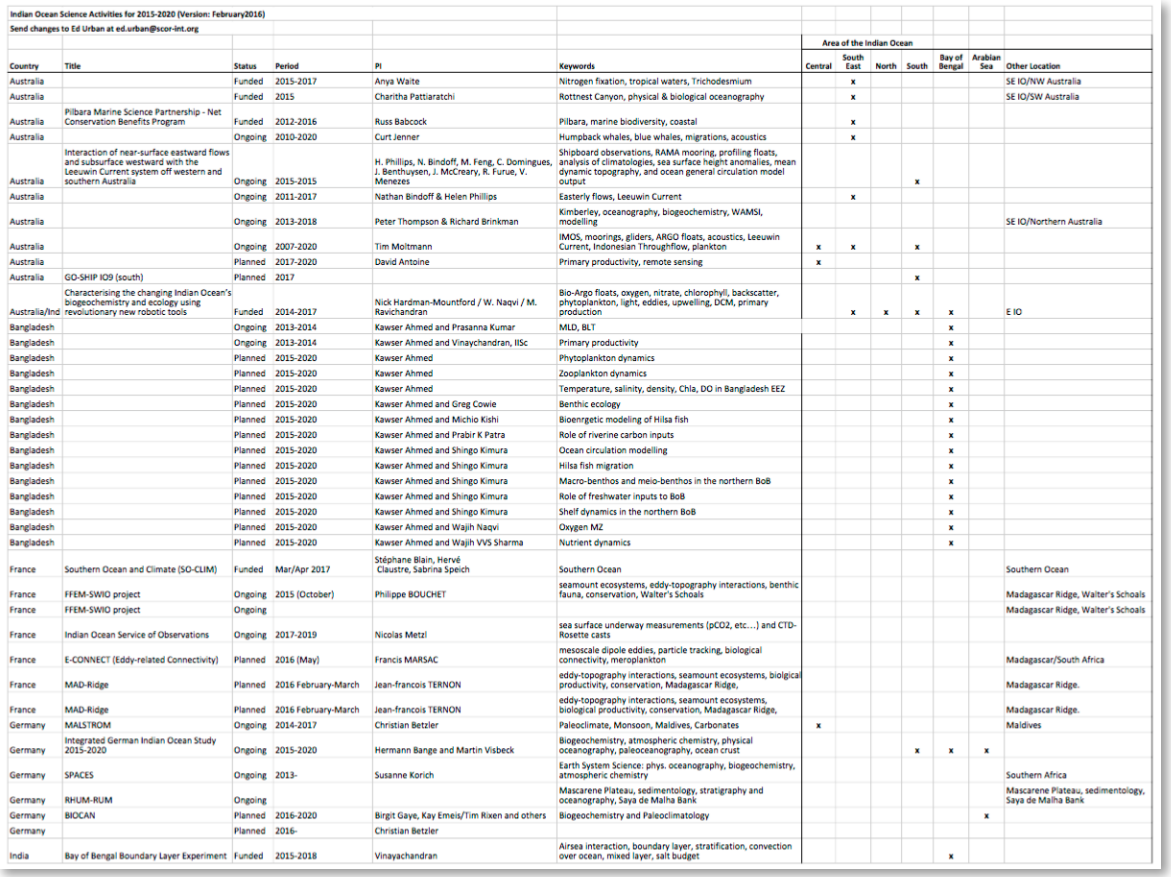
Activities and Accomplishments: Indian Ocean cruise/research spreadsheet

- We tracking Indian Ocean research activities.
- Over 130 cruises and activities captured in IIOE-2 time frame.
- Includes US and many other countries.
- Compiled by SCOR.
- Will this be taken over by the IPO?



Indian Ocean Science Activities for 2015-2020 (Version: February2016)

Send changes to Ed Urban at ed.urban@scor-int.org

						Area of the Indian Ocean						
Country	**Title**	**Status**	**Period**	**PI**	**Keywords**	**Central**	**South East**	**North**	**South**	**Bay of Bengal**	**Arabian Sea**	**Other Location**
Australia		Funded	2015-2017	Anya Waite	Nitrogen fixation, tropical waters, Trichodesmium		x					SE IO/NW Australia
Australia		Funded	2015	Charitha Pattiaratchi	Rottnest Canyon, physical & biological oceanography		x					SE IO/SW Australia
Australia	Pilbara Marine Science Partnership - Net Conservation Benefits Program	Funded	2012-2016	Russ Babcock	Pilbara, marine biodiversity, coastal		x					
Australia		Ongoing	2010-2020	Curt Jenner	Humpback whales, blue whales, migrations, acoustics		x					
Australia	Interaction of near-surface eastward flows and subsurface westward with the Leeuwin Current system off western and southern Australia	Ongoing	2015-2015	H. Phillips, N. Bindoff, M. Feng, C. Domingues, J. Benthuysen, J. McCreary, R. Furue, V. Menezes	Shipboard observations, RAMA mooring, profiling floats, analysis of climatologies, sea surface height anomalies, mean dynamic topography, and ocean general circulation model output				x			
Australia		Ongoing	2011-2017	Nathan Bindoff & Helen Phillips	Easterly flows, Leeuwin Current		x					
Australia		Ongoing	2013-2018	Peter Thompson & Richard Brinkman	Kimberley, oceanography, biogeochemistry, WAMSI, modelling							SE IO/Northern Australia
Australia		Ongoing	2007-2020	Tim Moltmann	IMOS, moorings, gliders, ARGO floats, acoustics, Leeuwin Current, Indonesian Throughflow, plankton	x	x		x			
Australia		Planned	2017-2020	David Antoine	Primary productivity, remote sensing	x						
Australia	GO-SHIP IO9 (south)	Planned	2017						x			
Australia/Ind	Characterising the changing Indian Ocean's biogeochemistry and ecology using revolutionary new robotic tools	Funded	2014-2017	Nick Hardman-Mountford / W. Naqvi / M. Ravichandran	Bio-Argo floats, oxygen, nitrate, chlorophyll, backscatter, phytoplankton, light, eddies, upwelling, DCM, primary production		x	x	x	x		E IO
Bangladesh		Ongoing	2013-2014	Kawser Ahmed and Prasanna Kumar	MLD, BLT					x		
Bangladesh		Ongoing	2013-2014	Kawser Ahmed and Vinaychandran, IISc	Primary productivity					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed	Phytoplankton dynamics					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed	Zooplankton dynamics					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed	Temperature, salinity, density, Chla, DO in Bangladesh EEZ					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Greg Cowie	Benthic ecology					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Michio Kishi	Bioenrgetic modeling of Hilsa fish					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Prabir K Patra	Role of riverine carbon inputs					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Shingo Kimura	Ocean circulation modelling					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Shingo Kimura	Hilsa fish migration					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Shingo Kimura	Macro-benthos and meio-benthos in the northern BoB					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Shingo Kimura	Role of freshwater inputs to BoB					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Shingo Kimura	Shelf dynamics in the northern BoB					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Wajih Naqvi	Oxygen MZ					x		
Bangladesh		Planned	2015-2020	Kawser Ahmed and Wajih VVS Sharma	Nutrient dynamics					x		
France	Southern Ocean and Climate (SO-CLIM)	Funded	Mar/Apr 2017	Stéphane Blain, Hervé Claustre, Sabrina Speich	Southern Ocean							Southern Ocean
France	FFEM-SWIO project	Ongoing	2015 (October)	Philippe BOUCHET	seamount ecosystems, eddy-topography interactions, benthic fauna, conservation, Walter's Schoals							Madagascar Ridge, Walter's Schoals
France	FFEM-SWIO project	Ongoing										Madagascar Ridge, Walter's Schoals
France	Indian Ocean Service of Observations	Ongoing	2017-2019	Nicolas Metzl	sea surface underway measurements (pCO2, etc…) and CTD-Rosette casts							
France	E-CONNECT (Eddy-related Connectivity)	Planned	2016 (May)	Francis MARSAC	mesoscale dipole eddies, particle tracking, biological connectivity, meroplankton							Madagascar/South Africa
France	MAD-Ridge	Planned	2016 February-March	Jean-francois TERNON	eddy-topography interactions, seamount ecosystems, biolgical productivity, conservation, Madagascar Ridge,							Madagascar Ridge.
France	MAD-Ridge	Planned	2016 February-March	Jean-francois TERNON	eddy-topography interactions, seamount ecosystems, biological productivity, conservation, Madagascar Ridge,							Madagascar Ridge.
Germany	MALSTROM	Ongoing	2014-2017	Christian Betzler	Paleoclimate, Monsoon, Maldives, Carbonates	x						Maldives
Germany	Integrated German Indian Ocean Study 2015-2020	Ongoing	2015-2020	Hermann Bange and Martin Visbeck	Biogeochemistry, atmospheric chemistry, physical oceanography, paleoceanography, ocean crust				x	x	x	
Germany	SPACES	Ongoing	2013-	Susanne Korich	Earth System Science: phys. oceanography, biogeochemistry, atmospheric chemistry							Southern Africa
Germany	RHUM-RUM	Ongoing			Mascarene Plateau, sedimentology, stratigraphy and oceanography, Saya de Malha Bank							Mascarene Plateau, sedimentology, Saya de Malha Bank
Germany	BIOCAN	Planned	2016-2020	Birgit Gaye, Kay Emeis/Tim Rixen and others	Biogeochemistry and Paleoclimatology						x	
Germany		Planned	2016-	Christian Betzler								
India	Bay of Bengal Boundary Layer Experiment	Funded	2015-2018	Vinayachandran	Airsea interaction, boundary layer, stratification, convection over ocean, mixed layer, salt budget					x		

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