

Report of the

Tropical Moored Buoy Implementation Panel

to the

27th Session of the Data Buoy Cooperation Panel

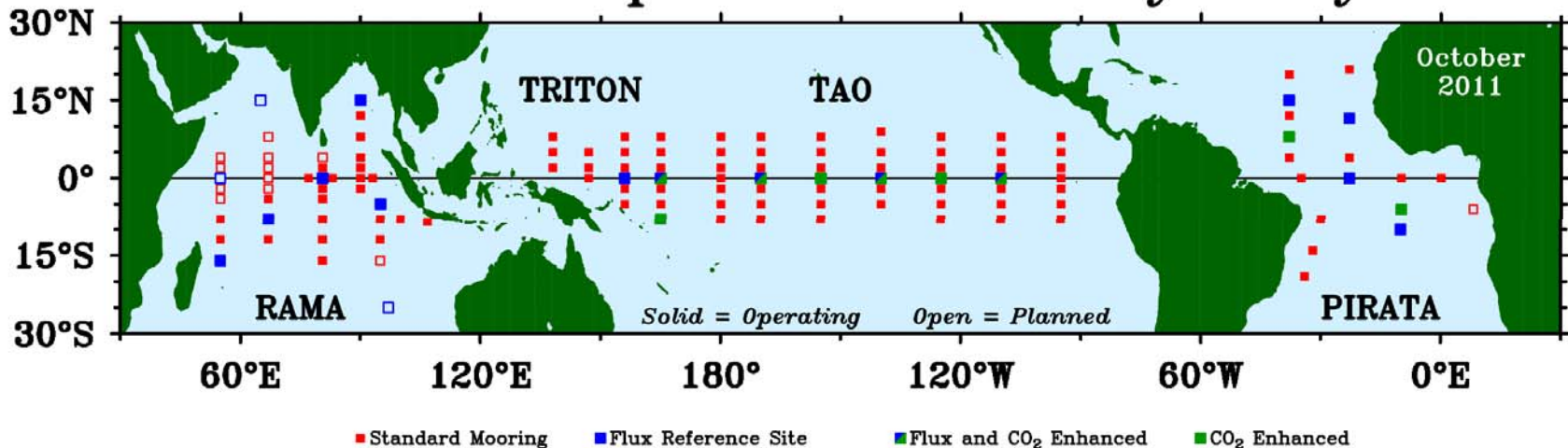


September 26-30, 2011
Geneva, Switzerland

Global Tropical Moored Buoy Array:
A coordinated, sustained, multi-national effort to develop and implement moored buoy observing systems for climate research and forecasting throughout the global tropics



Global Tropical Moored Buoy Array



TAO Project Office, NOAA/PMEL

A contribution to GOOS, GCOS, and GEOSS

October
TAC

PIRATA:

Regional partners provide ship time

123 sea days

RAMA:

Regional partners provide ship time

247 sea days

India - 142 days (PMEL and NIO sites)

Indonesia - 50 days (PMEL and FIO sites)

Japan - 34 days

ASCLME – 21 days

NOAA provides most equipment

30 moorings

US - 21 moorings

Japan - 4 moorings

India - 3 moorings

China - 2 moorings

equipment

and ships



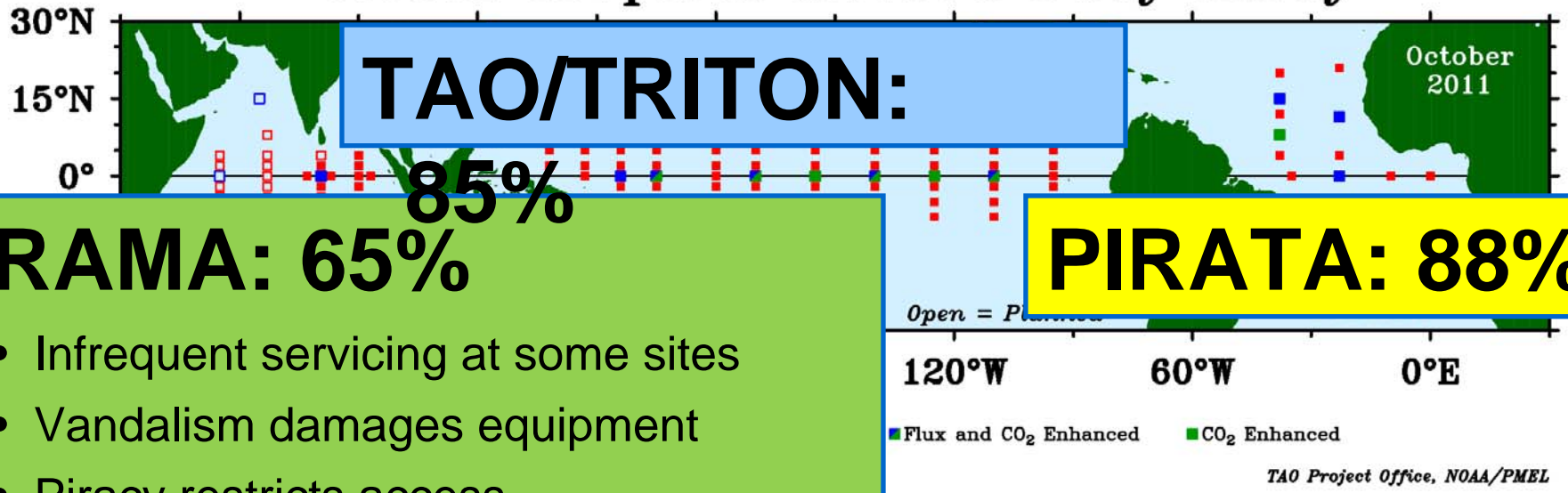
0°E

Office, NOAA/PMEL

GTMBA Data Return

September 2010 – August 2011

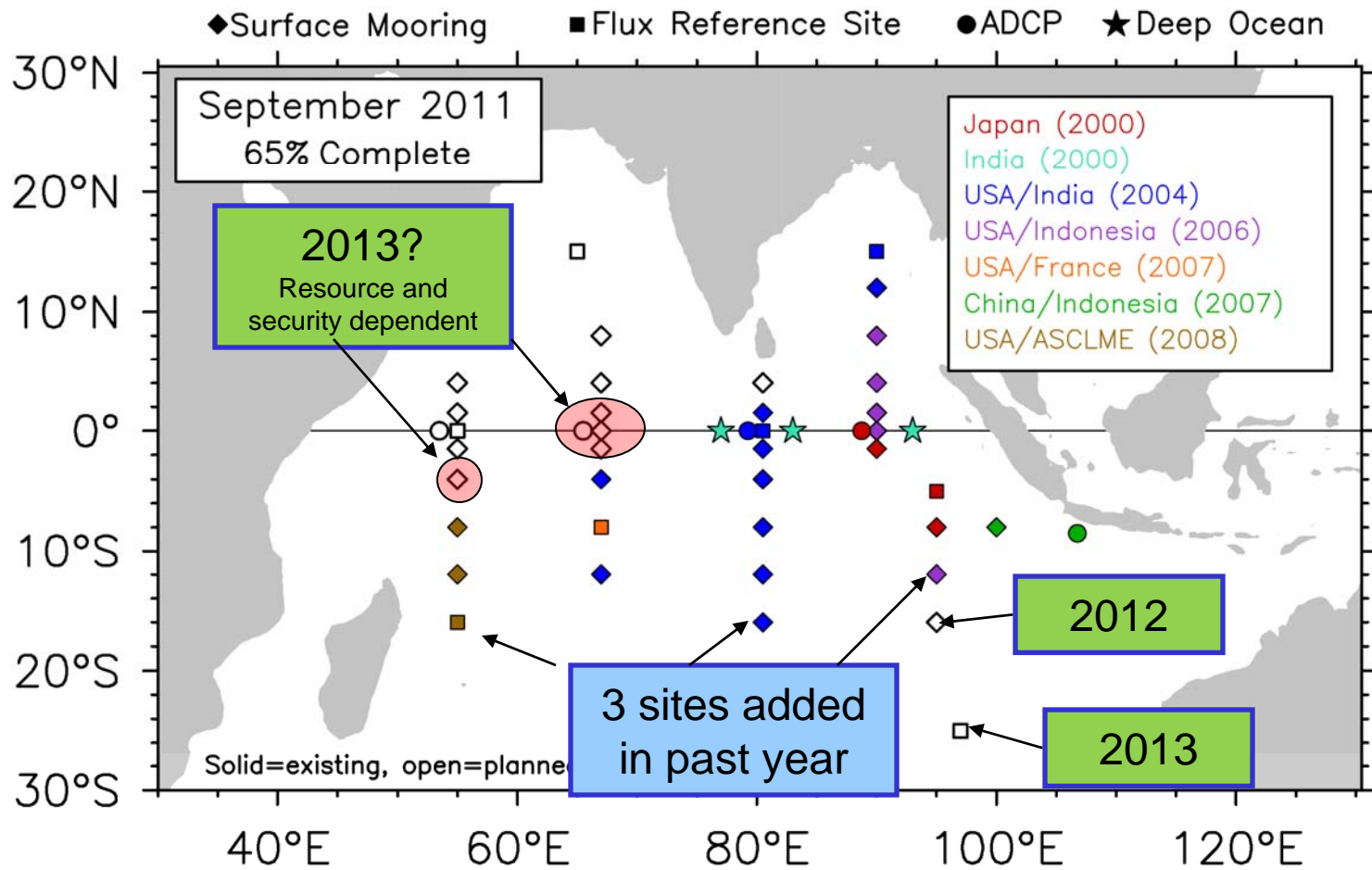
Global Tropical Moored Buoy Array



RAMA: 65%

- Infrequent servicing at some sites
- Vandalism damages equipment
- Piracy restricts access

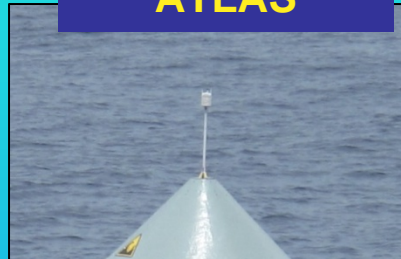
RAMA Present Status and Plans



Tropical Moored Buoy Technological Dispersion



Conehead
ATLAS



Mini-
TRITON



PMEL
"T-Flex"



Data continuity requires:

- Common measurement standards
- Common calibration protocols
- In situ comparison between established and new systems



FIO
Bai Long



ATLAS



TRITON

Others:

KORDI (deployed in Pacific)

USP ATLAS-B (under development)

Tropical Moored Buoy Technology

Mini TRITON

- Smaller size and weight than TRITON
- Assembled by hand
- Recover/deploy with smaller vessel
- Argos 3 telemetry
- Lower cost to build and maintain
- Field tested against TRITON
- 2 Deployed in RAMA



ATLAS Refresh

- Same met sensor suite as ATLAS
- Replaces PMEL built CPU/Logger with commercially built unit
- PMEL built T/S/P modules replaced with COTS (SBE)
- 10-min data telemetry via Iridium
- Field tested against ATLAS
- 3 deployed in TAO
- Transition completed by 2015



Tropical Moored Buoy Technology

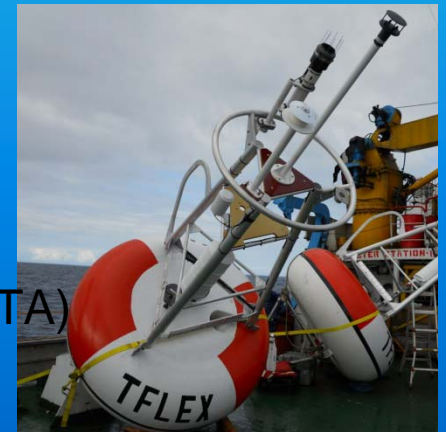
Bai Long

- Met sensor suite similar to ATLAS (Gill, BAROCAP)
- CPU/Logger commercially built
- SBE T/S/P, RDI DVS
- Hourly data telemetry via Iridium (GTS link TBD)
- 1 Deployed in RAMA



T-Flex

- Similar met sensor suite as ATLAS (Gill, Hygroclip, Druck)
- CPU/Logger designed and built by PMEL
- PMEL T/S/P replaced with COTS (SBE)
- Argonaut replaced with Aquadopp
- Hourly data telemetry via Iridium (GTS link TBD)
- Some additional data (s.d., scalar wind, gust)
- Field testing against ATLAS (1 in RAMA, 1 in PIRATA)



TIP Session 10

26 September 2010, Oban, UK

Established a Technical Working Group

- Define a set of measurement standards for Tropical Arrays
- Establish procedures to exchange information
- Monitor and publish array status

Established protocols for expanding the moored buoy arrays

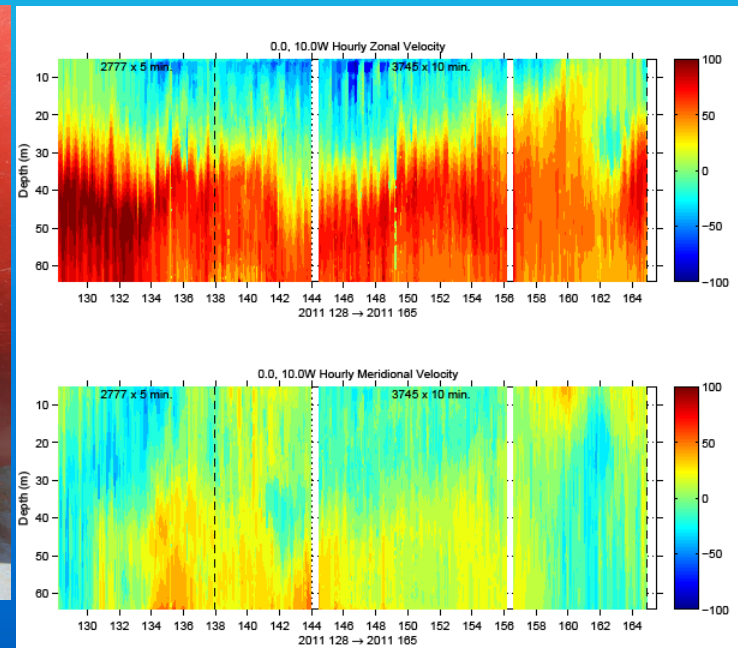
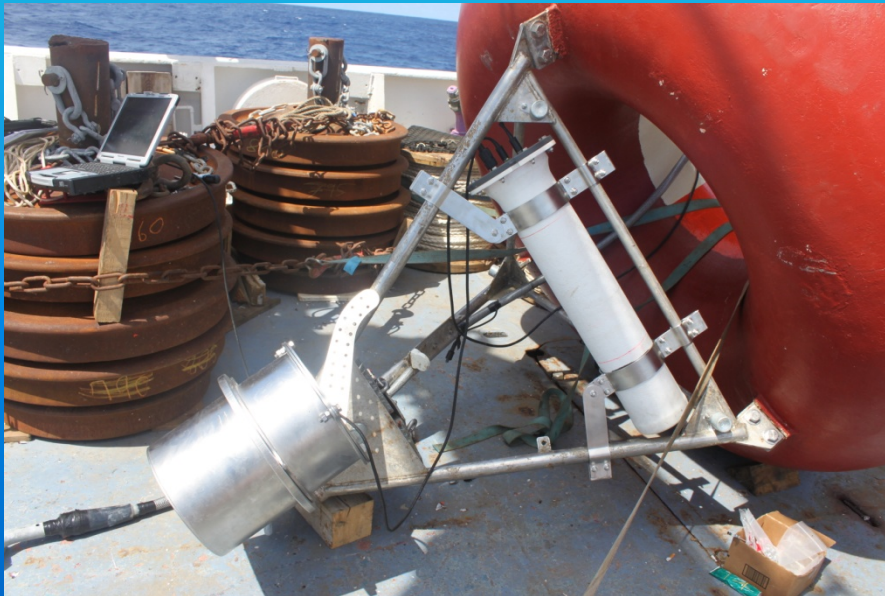
- Proposal for expansion submitted to scientific body for review
- Three-year demonstration project for evaluation
- Permanently added to array if successful and long term funding identified

Related Technology Developments

Real time ADCP:

PMEL contribution to IFM glider swarm experiment based in PIRATA

- Downward TRDI Sentinel ADCP mounted on buoy bridle
- Standalone system independent of ATLAS
- High resolution velocity profiles telemetered via Iridium
- Includes GPS at same rate for removal of horizontal buoy motion.
- Two-way Iridium communication provides control of sampling rate



Research Experiments

Dynamics of the Madden-Julian Oscillation



S-Pol Radar



SMART-R



DoE / ARM



R/V Revelle

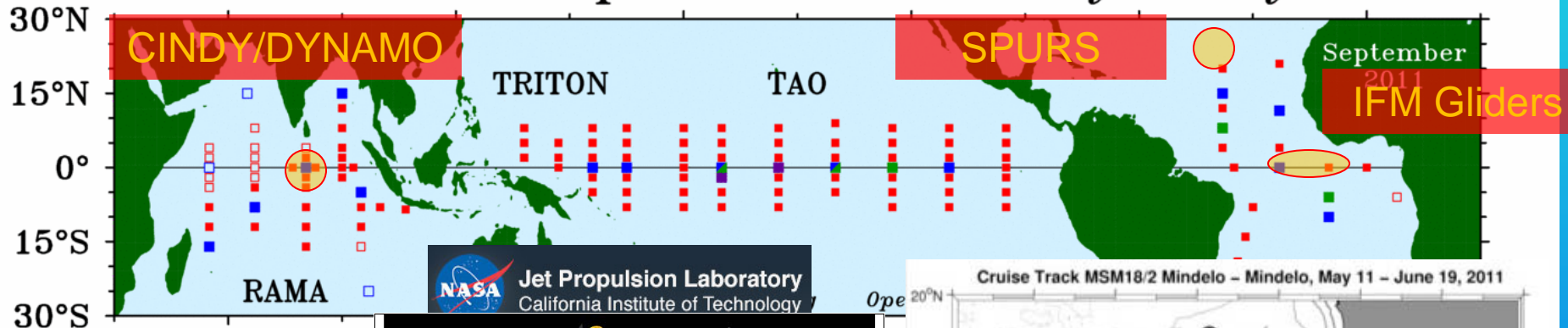


NOAA P-3

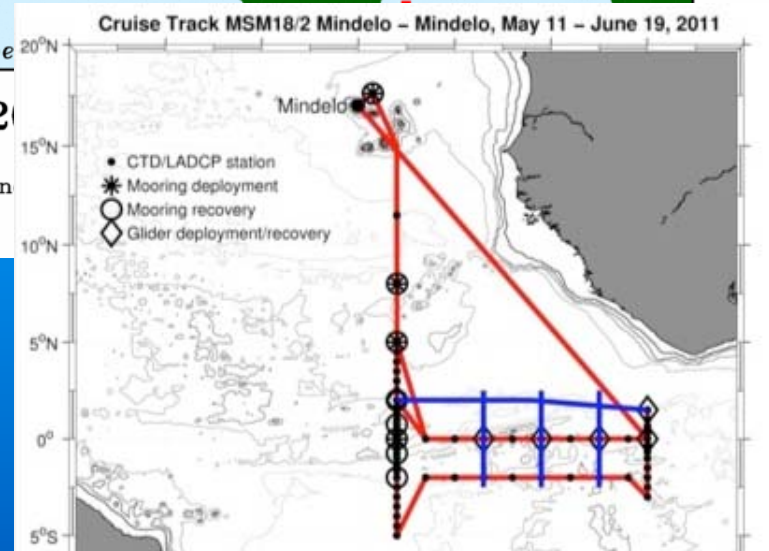
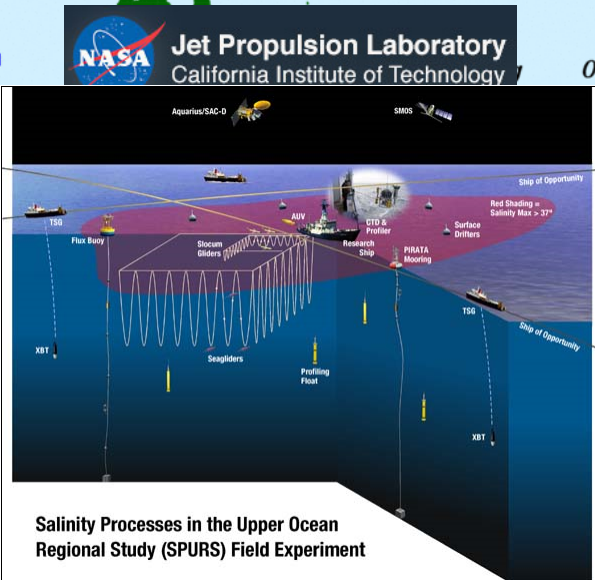


SAFIRE F20

Global Tropical Moored Buoy Array



60°E
 ■ Standard Mooring



PMEL PRAWLER

Standard:

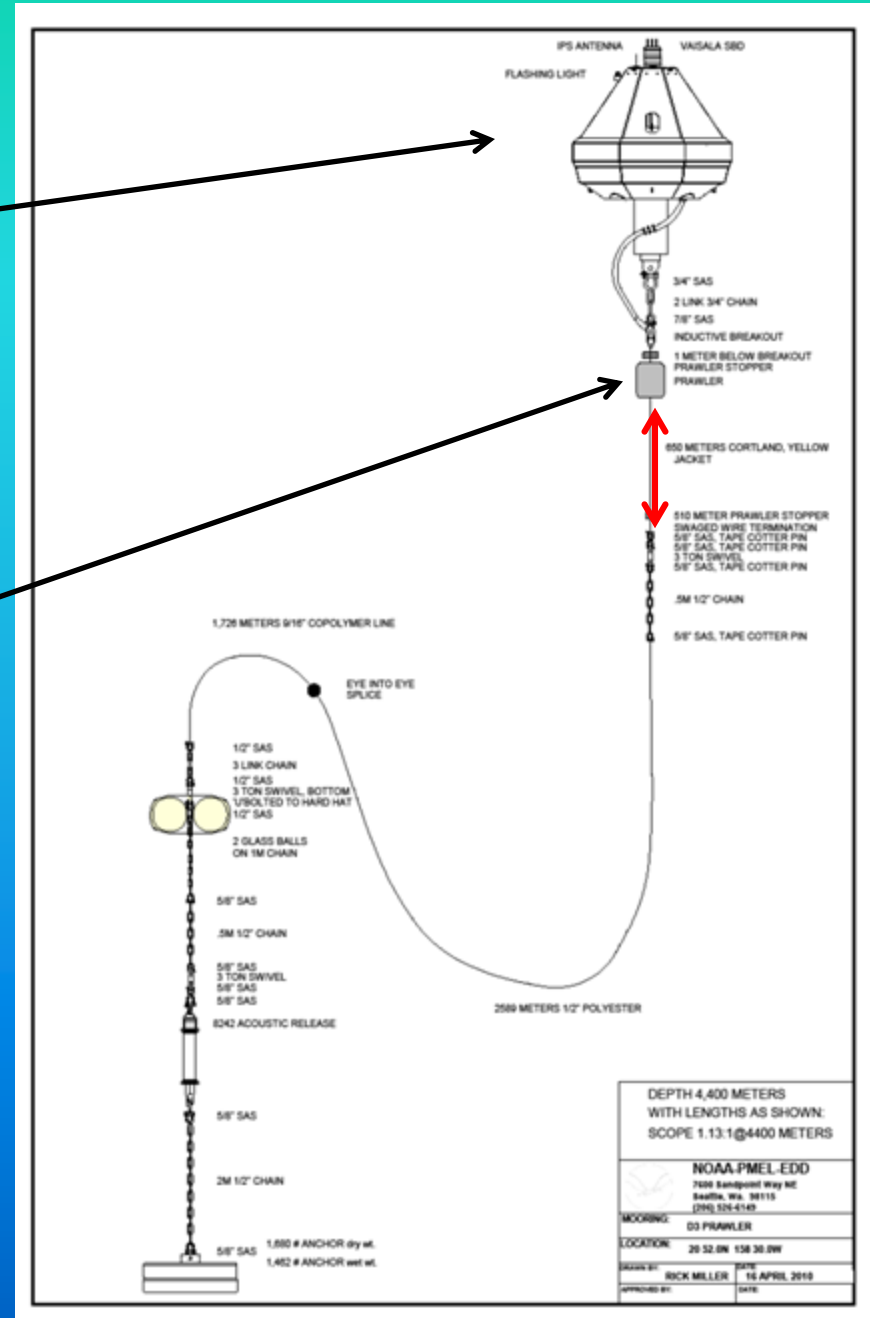
- Vaisala WTX-520 (ATRH, Wind, BP, Rain)
- Inductive link
- Iridium coms

Optional:

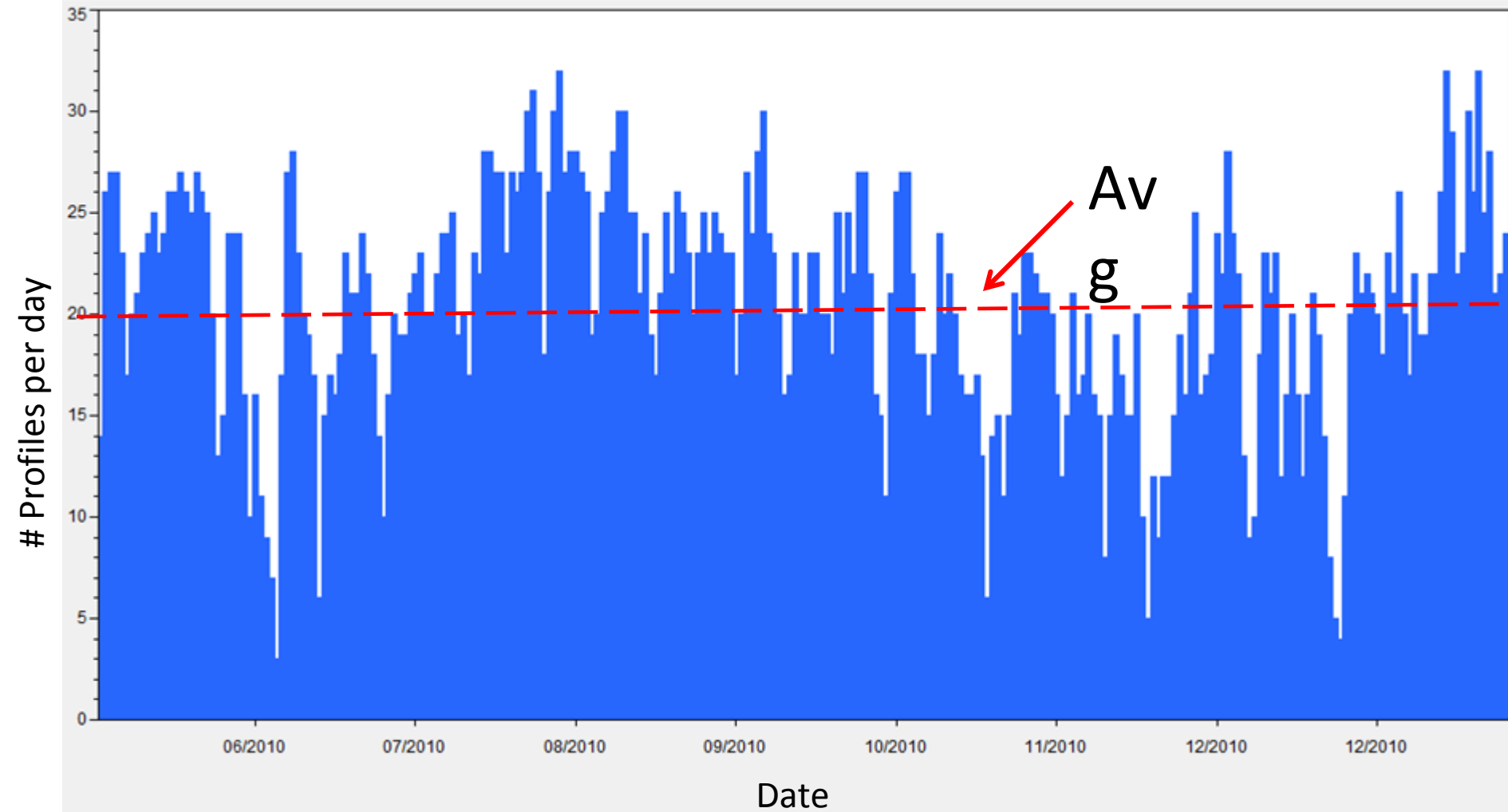
- SSTC, others

Prawler:

- SBE pumped CTD
- CTD cycle depth ~3-500m
- Realtime command/control
- DO??

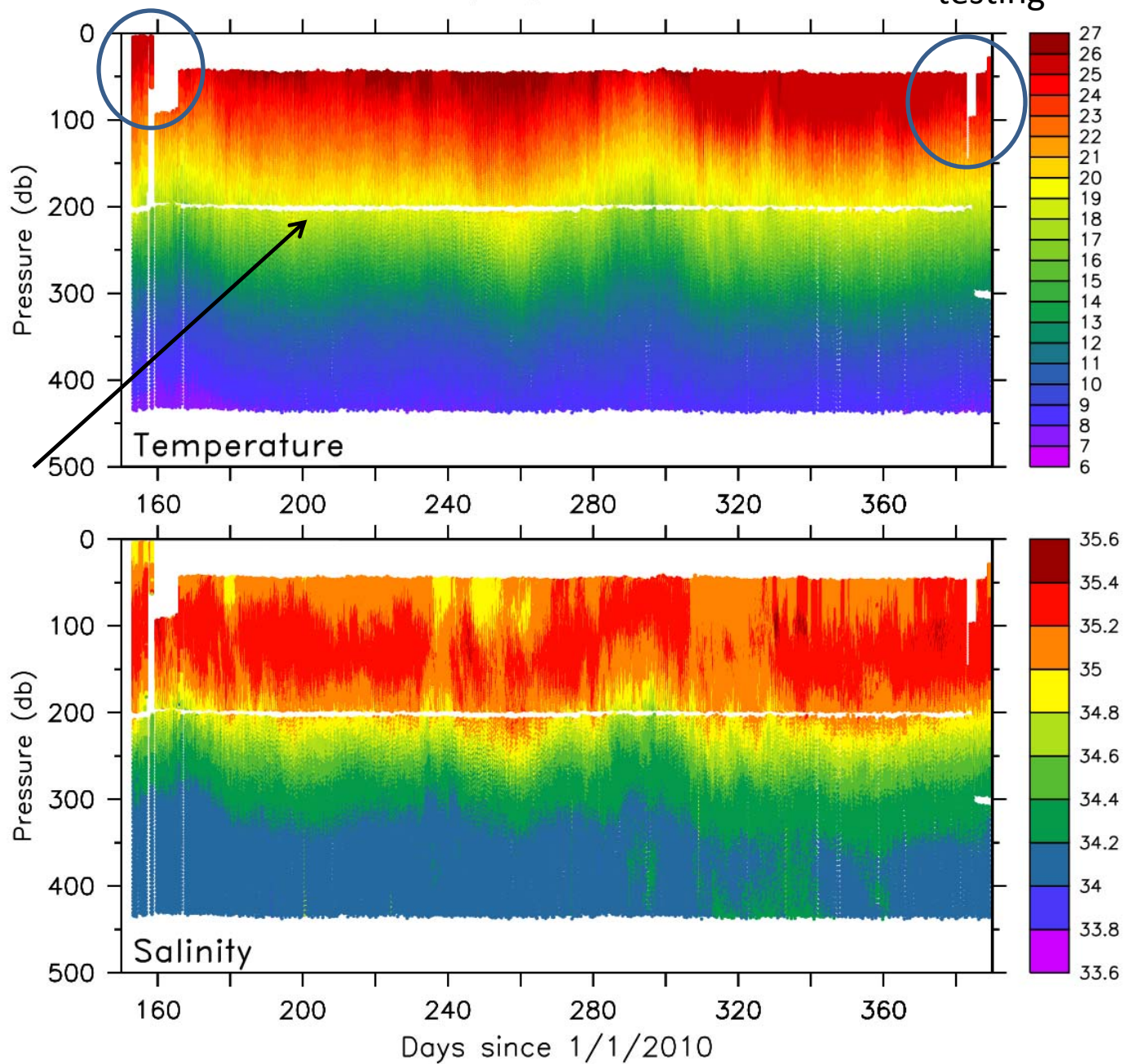


Prawler Stats (off Hawaii)



Total distance traveled= 4390km in 264 days

Hawaii deployment T and S



Software bug

~3m

testing

Pressure (db)

Pressure (db)

Temperature

Salinity

Days since 1/1/2010

Training, Capacity Building and Formal Agreements

USP visits PMEL, October 2010 - B-ATLAS development.

Japan/Indonesia workshop May 2011 – transfer of TRITON service.

MOA between the UNDP and NOAA signed in May 2011 - ASCLME.

Indonesians visit AOML and NDBC in July 2011.

Indian Technicians on RAMA cruises in August 2011 follow up with training at PMEL in October.

7th Annual Indonesia-U.S. Ocean and Climate Observations, Analysis, and Applications Partnership Meeting, *September 2011, KKP, BPPT, BMKG, BALITBANG, OCO, AOML, NDBC, PMEL*

RAMA Web Pages

<http://www.pmel.noaa.gov/tao/rama>



Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA)

Home

Research

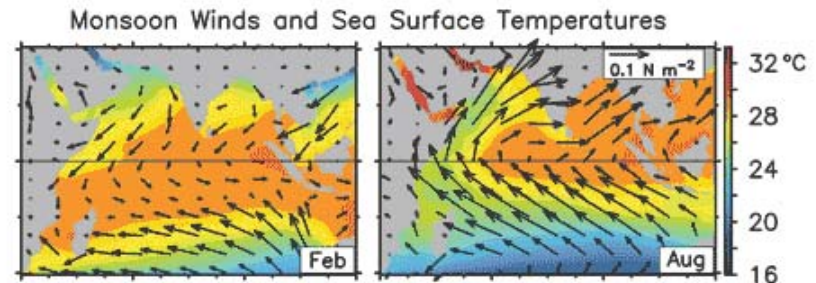
Data and Display

Technical

Global Tropical Array



A new moored buoy array in the historically data-sparse Indian Ocean provides measurements to enhance monsoon research and forecasting



[View progress towards completion](#)

Support for RAMA is provided by

United States (NOAA/PMEL), Japan (JAMSTEC), India (MoES, INCOIS, NIOT, NIO), Indonesia (BPPT, KKP), China (SOA, FIO), Africa (ASCLME), and France (IRD, INSU, Meteo-France)

RAMA Web Pages

Date	Site	Date	Sponsor	Sequence #	% Complete
2000	0-93E Deep Ocean	2/15/00	NIO	1	2.2%
	0-90E ADCP	11/15/00	JAMSTEC	2	4.3%
	0-83E Deep Ocean	12/14/00	NIO	3	6.5%
2001	2S90E	10/23/01	JAMSTEC	4	8.7%
	5S95E	10/26/01	JAMSTEC	5	10.9%
2002	0-76/77E Deep Ocean	3/20/02	NIO	6	13.0%
2004	2N81E	10/20/04	NOAA/NIO	7	15.2%
	0-81E				
	0-81E ADCP				

for African-Asian-Australian
and Prediction (RAMA)

Display

Technical

Global Tropical Array

RAMA Cruises


	Dates	Ship (Country)	Supporting Agencies	Ports	Cruise designation	Sites serviced	
2004	2581E						
	0-90E	21 Jul - 19 Aug 2011	SAGAR KANYA	MoES/NOAA	Chennai - Chennai, India	IO4-11-SK / SK-287	1.5N/0.15S/4S,80.5E; 0,80.5EADCP
2006	2N90E	20 May - 22 Jun 2011	SAGAR NIDHI	MoES/NOAA	Chennai - Chennai, India	IO1-11-SN	4S/8S/12S/16S, 80.5E; 12S,67E
	8N90E	18 May - 10 Jun 2011	BARUNA JAYA-3	BBPT/KKP/NOAA	Jakarta - Padang, Indonesia	IO3-11-BJ	8N/4N/1.5N/0,90E
2007	4N90E	15 - 26 Mar 2011	BARUNA JAYA-3 (Indonesia)	BBPT/KKP/NOAA	Jakarta - Jakarta, Indonesia	IO2-11-BJ	12S,93E
	8S67E	21 Feb - 6 Mar 2011	BARUNA JAYA-3 (Indonesia)	FIO/AMFR(BRKP)/BPPT	Jakarta - Jakarta, Indonesia		8S,100E; 8.5S,107EADCP
	12N90E						
	15N90E	31 Dec 2010 - 2 Feb 2011	MIRAI (Japan)	JAMSTEC	Palau - Yokohama, Japan	MR11-01	0,90EADCP; 1.5S,90E; 5S/8S,95E
2008	8S107E AD	7 - 24 Dec 2010	SAGAR SAMPADA (India)	MoES/NOAA	Kochi - Kochi, India	IO5-10-SP	0,80.5EADCP
	4S81E	28 Oct - 18 Nov 2010	SAGAR KANYA (India)	MoES/NOAA	Chennai - Chennai, India	IO6-10-SK	15N/12N/8N,90E
	8S81E	11 - 31 Oct 2010	ALGOA (South Africa)	ASCLME/NOAA	Toamasina, Madagascar - Port Elizabeth, South Africa	IO4-10-AG	8S/12S/16S,55E
	8S55E						
2009	12S55E	16 Sep - 17 Oct 2010	SAGAR KANYA (India)	NIO	Chennai - Marmagoa, India	SK-276	0,93E; 0,83E; 0,77E
	12S67E	24 Jun - 16 Jul 2010	BARUNA JAYA (Indonesia)	BBPT/KKP/NOAA	Jakarta - Padang, Indonesia	IO3-10-BJ	4N/1.5N/0,90E
	4S67E	18 May - 2 Jun 2010	BARUNA JAYA-3 (Indonesia)	FIO/AMFR(BRKP)/BPPT	Jakarta - Jakarta, Indonesia		8S,100E; 8.5S,107EADCP
2010	8S95E	3 - 28 May 2010	SAGAR KANYA (India)	MoES/NOAA	Chennai - Chennai, India	IO2-10-SK	1.5N/0.15S/4S/8S/12S,80.5E
	8S100E	21 Feb - 1 Mar 2010	BARUNA JAYA-3 (Indonesia)	FIO/AMFR(BRKP)/BPPT			
	12S81E						
2011	16S55E	6 Nov - 11 Dec 2009	KAIYO (Japan)	JAMSTEC	Bali - Bali, Indonesia	KY09-09 Leg 2	0,90EADCP; 1.5S,90E; 5S/8S,95E
	12S93E	30 Oct - 12 Nov 2009	SAGAR NIDHI (India)	MoES/NOAA	Chennai - Chennai, India	IO4-09-SN	15N/12N/8N,90E
	22 Sep	22 Sep - 28 Oct 2009	SAGAR KANYA (India)	MoES			
	16S81E	6 - 11 Sep 2009	GEOMARIN III (Indonesia)	FIO/AMFR(BRKP)/BPPT	Jakarta - Jakarta, Indonesia		8.5S,107EADCP
	25 Sep	25 Sep - 30 Oct 2009	SAGAR KANYA (India)	NIO	Chennai - Marmagoa, India	SK-264	0,93EADCP; 0,83EADCP; 0,77EADCP
	22 Aug	22 Aug - 24 Sep 2009	SAGAR NIDHI (India)	MoES/NOAA	Chennai - Chennai, India	IO3-09-SN	1.5N/0.15S/4S/8S,80.5E; 4S/8S/12S,67E; 0,80.5EADCP

PIRACY

A global problem, but heavily concentrated in the northwestern Indian Ocean

International Chamber of Commerce


US Office of Naval Intelligence

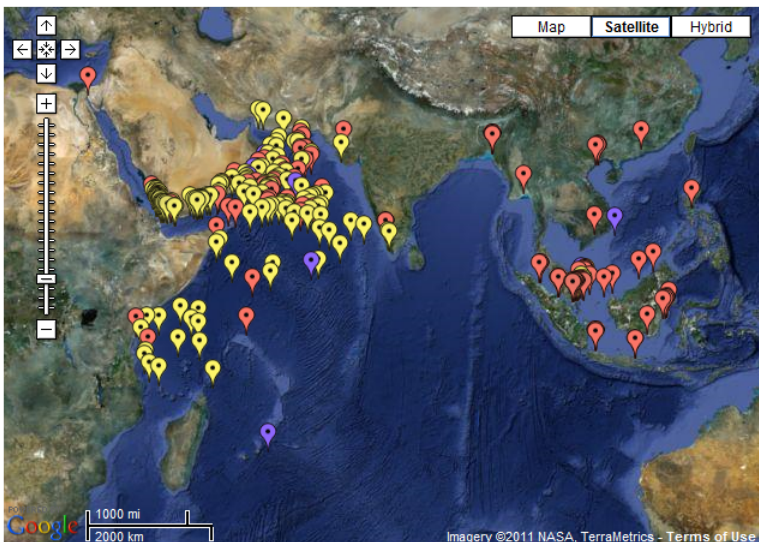
 ICC Commercial Crime Services
Helping business stay in business

Home | About Us | Courses / Training | Publications | Membership

IMB Live Piracy Map 2011

This map shows all the piracy and armed robbery incidents reported to the IMB Piracy Reporting Centre during 2011. If exact coordinates are not provided, estimated positions are shown based on information provided. Zoom-in and click on the pointers to view more information of an individual attack. Pointers may be superimposed on each other.

 = Actual Attack  = Attempted Attack  = Suspicious vessel



Map | Satellite | Hybrid

1000 mi
2000 km

Imagery ©2011 NASA, TerraMetrics - Terms of Use

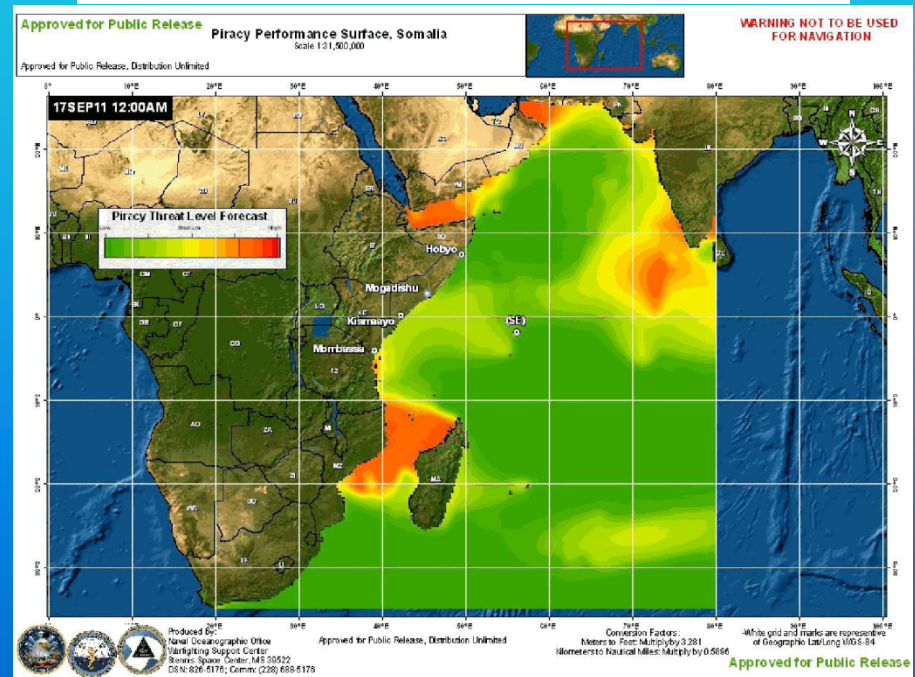
UNCLASSIFIED

 *Maritime OPINTEL Report*

(U) SOMALIA: Piracy Analysis and Warning Weekly (PAWW) Report (Horn of Africa) for 8 - 14 Sep 2011

Maritime Crime/Piracy

15 September 2011



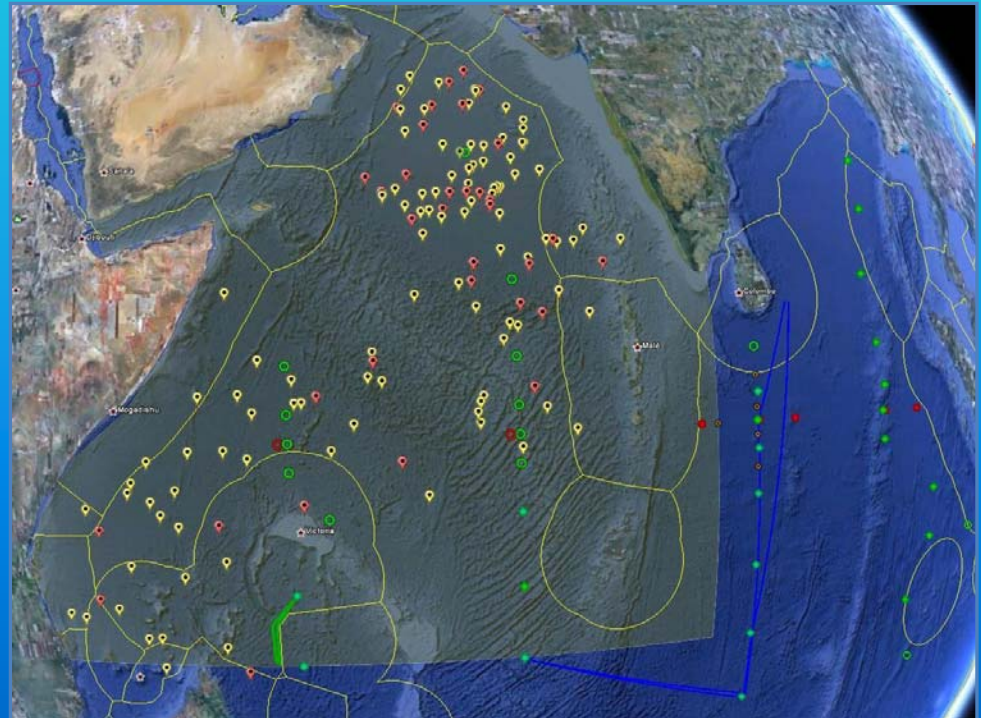
<http://www.icc-ccs.org/piracy-reporting-centre/imb-live-piracy-map>

http://www.oni.navy.mil/intelligence_Community/piracy.htm

PIRACY

In response to numerous piracy incidents in the western Indian Ocean, Lloyds of London declared an Exclusion Zone within which additional premiums are required to provide insurance to merchant vessels. In early 2011 the eastern border of the zone was extended to 78°E. The zone includes most implemented and planned RAMA sites along 55°E and 67°E. Security measures need to be implemented to ensure the safety of all aboard RAMA cruises within the Exclusion Zone .

- A security escort was arranged for a cruise to 8°S, 55°E in 2010
- Lack of security arrangements resulted in the omission of necessary mooring maintenance at 4°S, 67°E and 8°S, 67°E in 2011



PIRACY

Security measures can add cost, logistical complexity, and time to RAMA cruises.

- National security forces may not provide service beyond their EEZ
- Private security services can be much more expensive than national
- Placing security forces on board the research vessel may be a lower-cost option compared to vessel escorts.

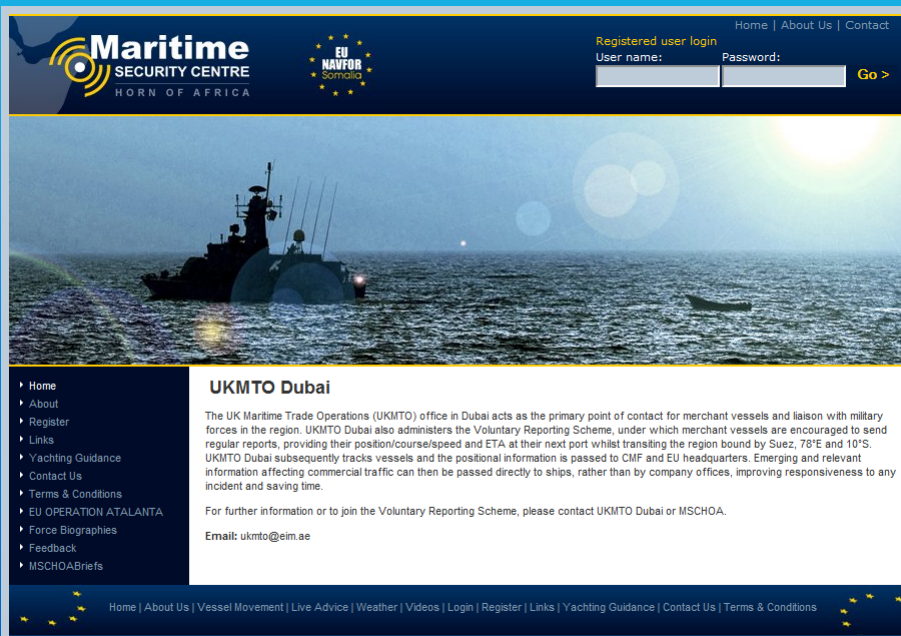


The screenshot shows the AdvanFort website homepage. At the top is the AdvanFort logo and a navigation menu with links for Home, Frontline Photos, About Us, Government Relations, and Global Operations. Below this is a secondary menu with categories: Counter-Piracy Solutions, Protective Services, Port Security, Military and Security Training, Logistics and Assets Management, Crisis Management, Homeland Security, and Border Control. The main content area features a large heading "Maritime Escort and Protective Force" with a sub-headline "We are Pirates-Ready". To the right is the company's crest, which includes a red tower and the text "Maritime Escort & Protective Task Force" and "How we Work, How we Live, How we Succeed". Below the main heading is a section for the "Emergency Coordination Center" with a warning icon and text about emergency information. To the right of this is a section titled "Our Guards, Our Heroes - Team146" featuring a photo of three crew members in military-style uniforms. Below that is a "Press Releases" section with several dated entries. On the right side, there is a "Your Crew Demands It. AdvanFort Delivers It." section with a photo of a person in silhouette aiming a rifle. At the bottom right, there is an "EMERGENCY COORDINATION CENTER" section with an "Emergency Update #31" dated May 5, 2011, regarding an "Attempted Piracy" on the vessel "MV Free Board 5.8m".

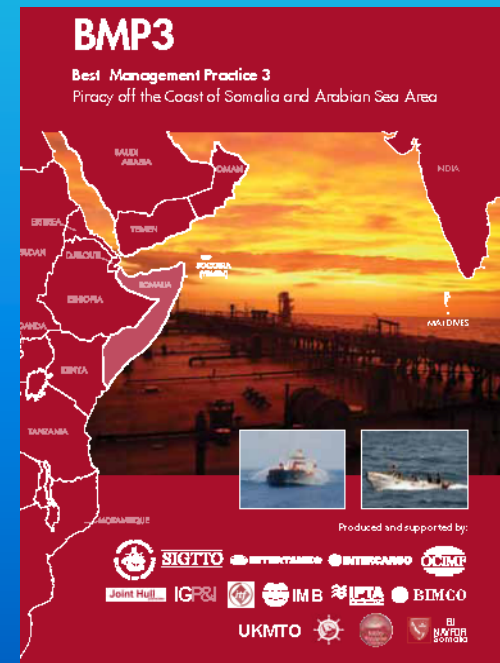
PIRACY

Much can be done by ship operators to enhance security on board. In some cases (e.g., areas within the Exclusion Zone, but at which piracy has not occurred) may be sufficient.

- Registering with and reporting daily to a regional security authority such as the UK Maritime Trade Operations (UKMTO) <http://www.mschoa.org/Links/Pages/UKMTO.aspx>
- Implementation of a security policy, e.g., <http://www.mschoa.org/bmp3/Pages/BestManagementPractises.aspx>



The screenshot shows the website for the Maritime Security Centre, Horn of Africa. The header includes the logo and navigation links: Home | About Us | Contact. A login section for registered users is present with fields for 'User name:' and 'Password:' and a 'Go >' button. The main content area features a large image of a ship at sea and a section titled 'UKMTO Dubai' which provides information about the office's role in the region, including the Voluntary Reporting Scheme. A sidebar on the left lists various navigation options like 'Home', 'About', 'Register', 'Links', 'Yachting Guidance', 'Contact Us', 'Terms & Conditions', 'EU OPERATION ATALANTA', 'Force Biographies', 'Feedback', and 'MSCHOABriefs'. The footer contains a comprehensive list of navigation links and the EU flag.



The image displays the cover of 'BMP3 Best Management Practice 3 Piracy off the Coast of Somalia and Arabian Sea Area'. The cover features a map of the region with labels for countries like SAUDI ARABIA, SOMALIA, YEMEN, OMAN, INDIA, MALDIVES, and TANZANIA. Below the map are two small images of ships. The bottom section lists logos for supporting organizations: SIGTTO, INTERCARGO, OCIMP, Joint Hull, IGP&I, IMB, IATA, BIMCO, and UKMTO. The text 'Produced and supported by:' is visible above the logos.

CLIVAR/GOOS Indian Ocean Panel

8th Annual Meeting

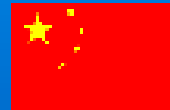
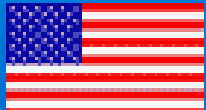
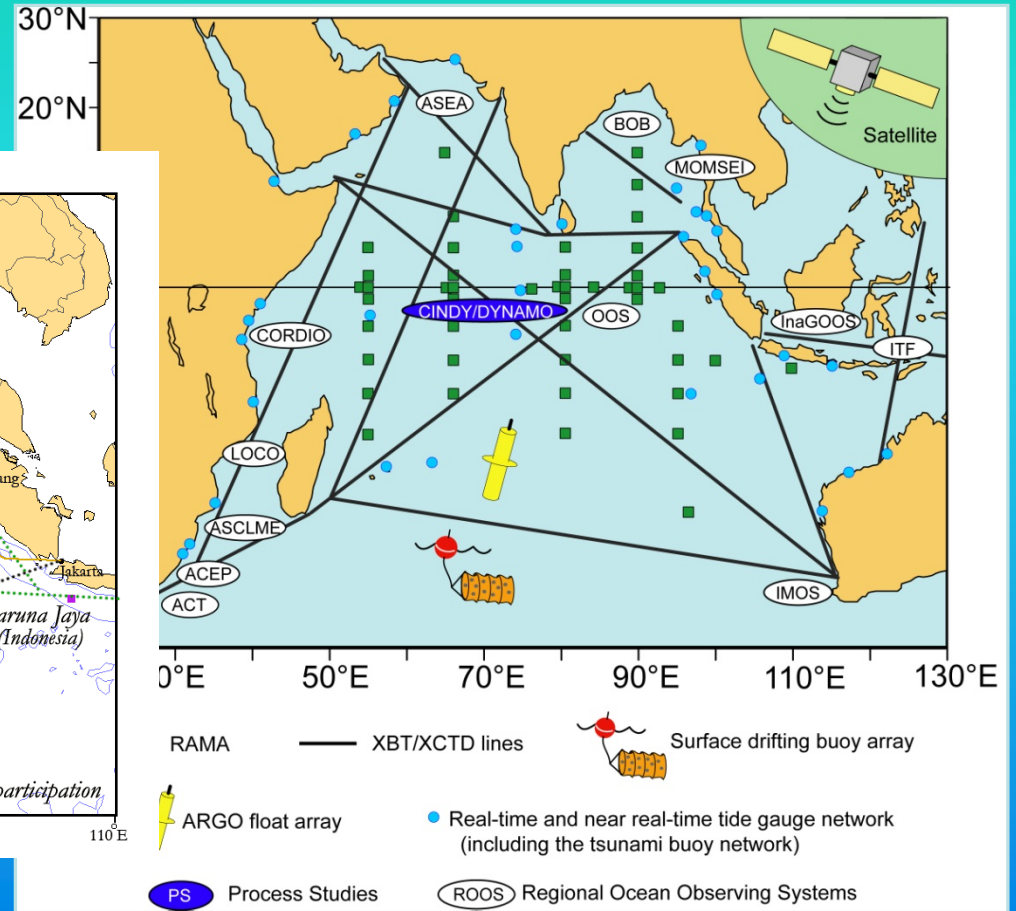
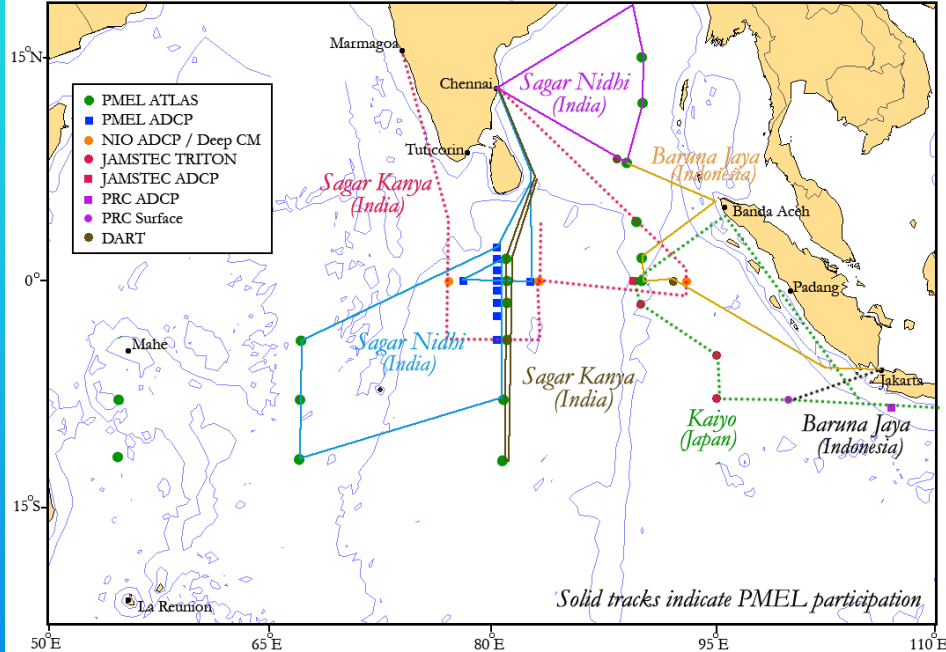
Chennai, India, 25-29 July 2011

Draft Action Items

- Define the research and **explore the possibility of replacing moorings with Argo floats and gliders.** Request IRF to support it. (IOP members)
- Engage with the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System in order to facilitate resources and data sharing (co-chairs)
- Discuss at IOP-9 issues related about drifters in the Indian Ocean (co-chairs)
- Request IRF to discuss the possibility of **multi-institutional ship-time coordination** in the eastern Indian Ocean (co-chairs)
- Develop a review paper on decadal variability in the Indian Ocean (W. Han to lead with help from J. Vialard, T. Lee, G. Vecchi)
- Update IOP webpages (ICPO)
- Endorse the proposal of Chapman Conference on the Agulhas System (co-chairs)
- Organise, jointly with the SIBER SSC and IRF, the IOP-9 meeting in September 2012 in South Africa, in conjunction with the Chapman Conference proposed by the SCOR Agulhas System WG. (co-chairs, ICPO)
- Request IRF **to formulate a strong statement and examine potential high-level solutions to deal with piracy issues** in the Western Indian Ocean (co-chairs)
- Follow up with OOPC and GCOS on the possibility of funding five mooring in the western Indian Ocean (T. Lee)
- Make statement to NOAA on the impact that reducing the XBT network in the IO would have on climate research in the region. (co-chairs)
- Recommend to CLIVAR SSG that M. Ravichandran replaces Yukio Masumoto as IOP co-chair (co-chairs, ICPO)

IndOOS Resource Forum

Indian Ocean Cruises Jun 2009 - May 2010



Logistics



Capacity Building Training



Thank you!

Vandalism



2011.09.03

Technology

