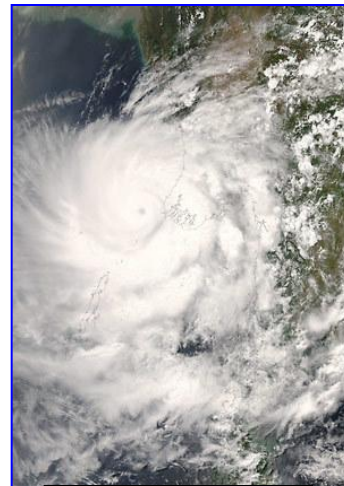
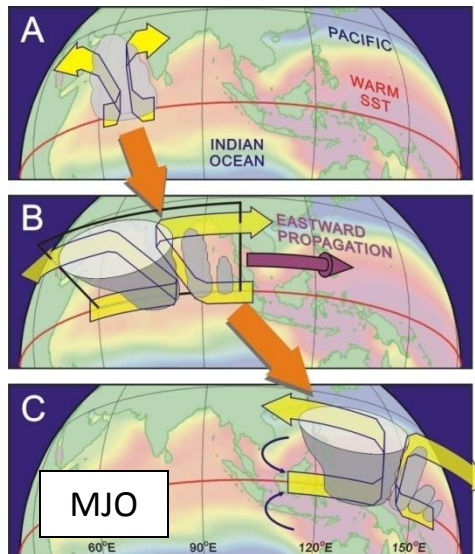
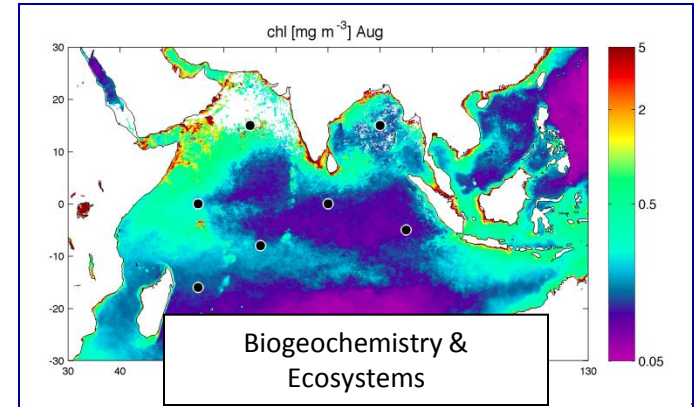
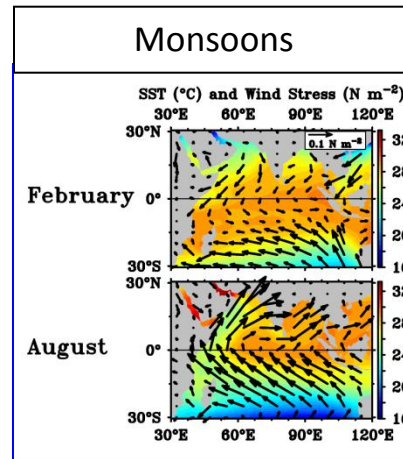
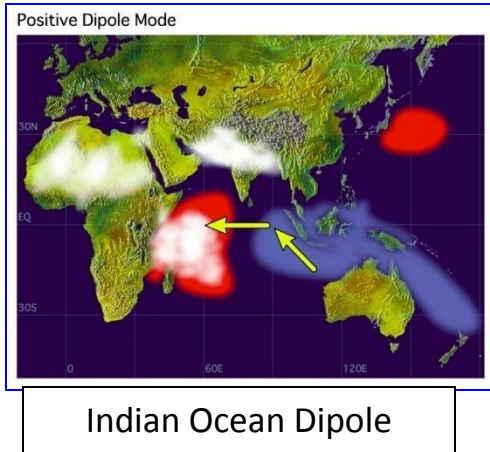


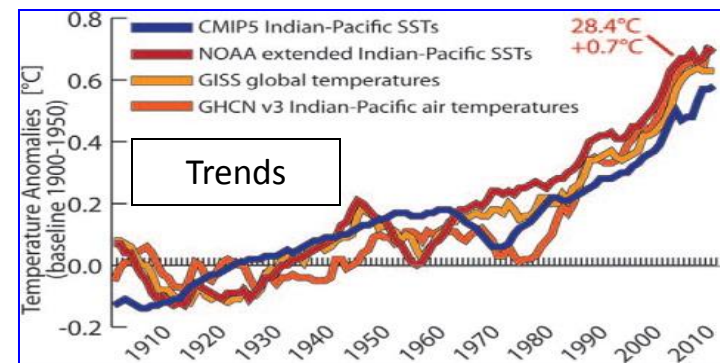
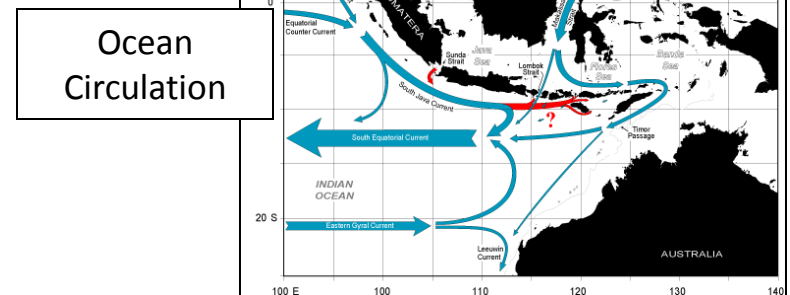
Report from IOP

Weidong Yu and M. Ravichandran
(Co-Chairs, IOP)
&
Members, IOP

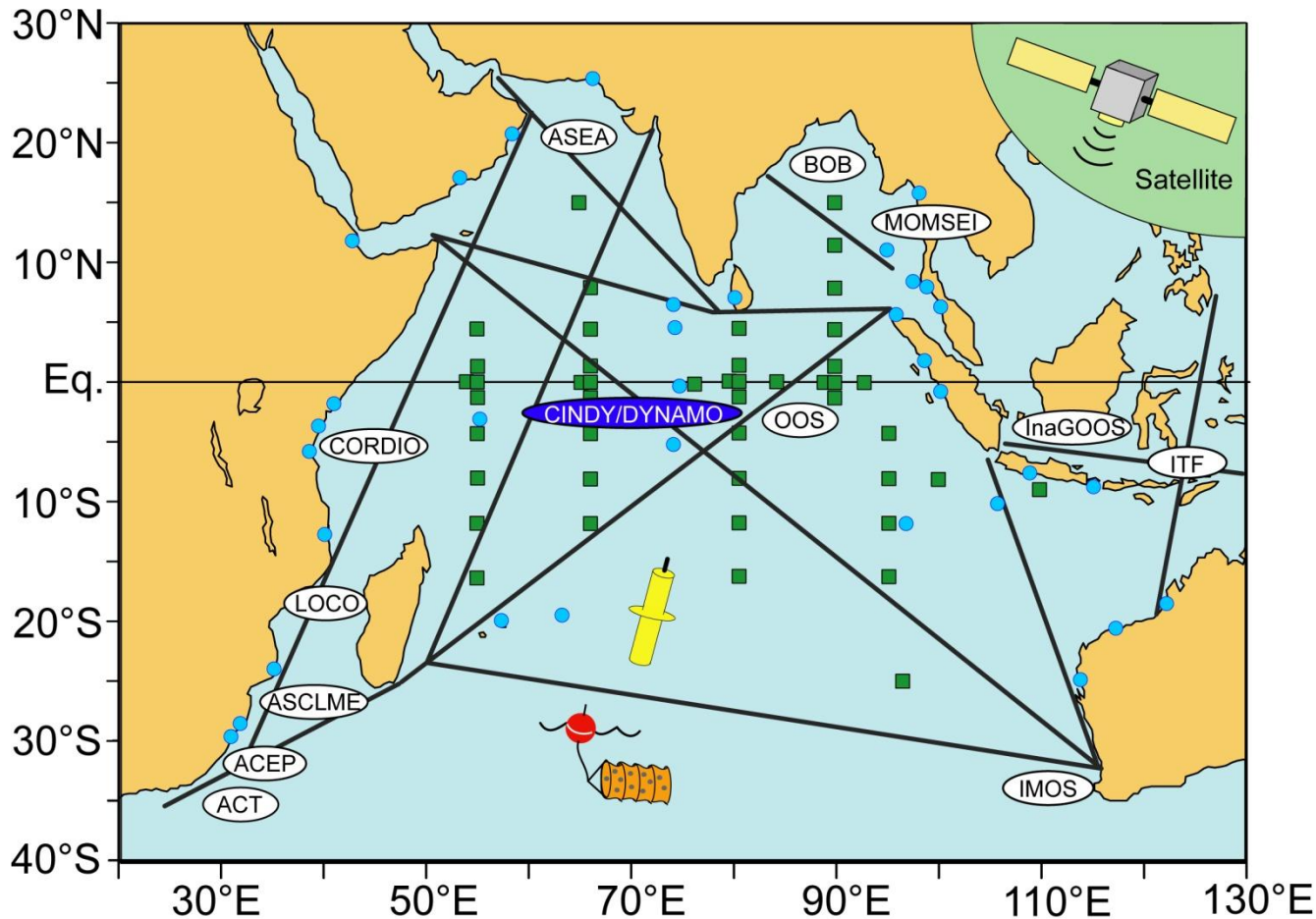
Interacting Variations in Time and Space



Cyclones



Indian Ocean Observing System (IndOOS)



- Planned by CLIVAR/GOOS Indian Ocean Panel in 2004
- Basin scale with regional elements
- Supports short term process studies
- Design supported by numerical model observing system simulation studies

■ RAMA

— XBT/XCTD lines

● Surface drifting buoy array

● ARGO float array

● Real-time and near real-time tide gauge network (including the tsunami buoy network)

PS Process Studies

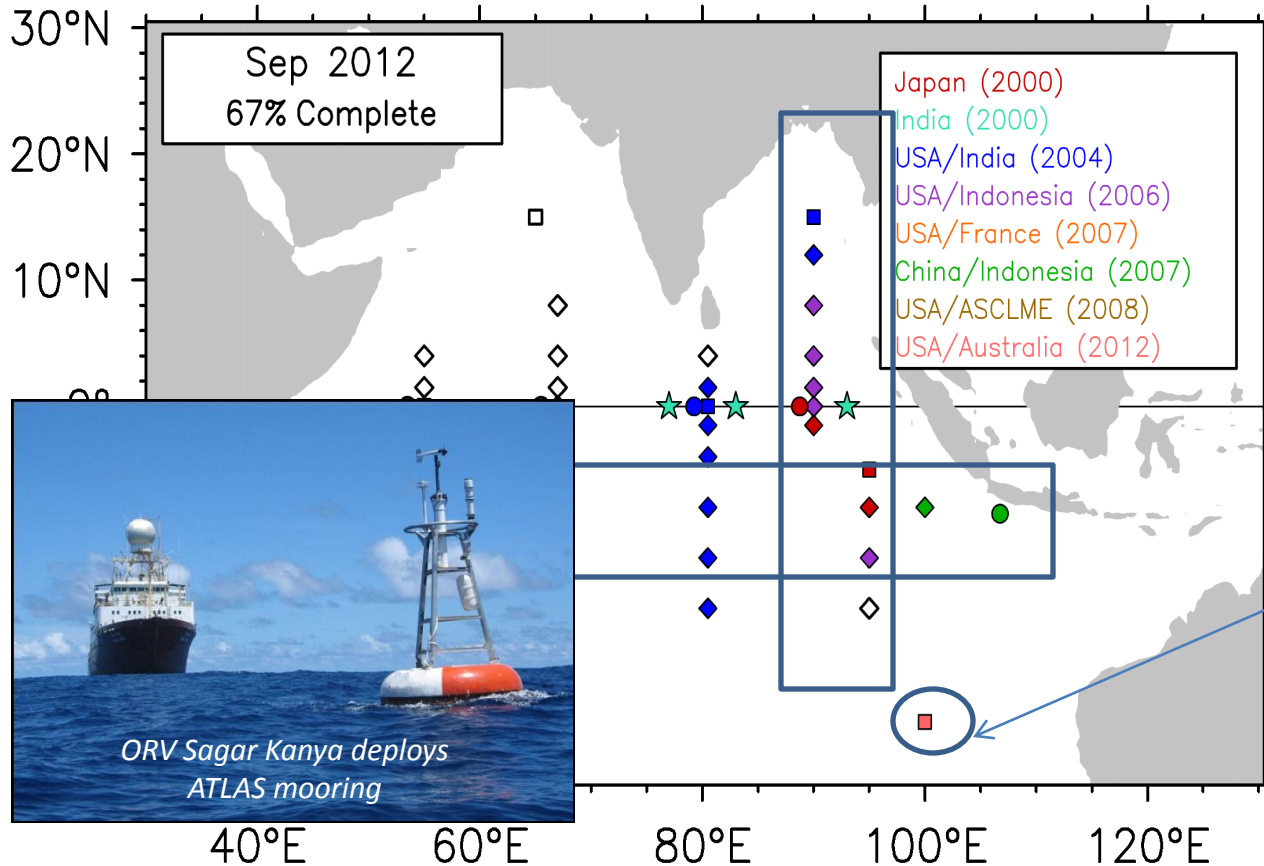
ROOS Regional Ocean Observing Systems

Multi-platform
Long-term
Observation
Network

RAMA

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

◆ Surface Mooring ■ Flux Reference Site ● ADCP ★ Deep Ocean



- 67 % complete
(31 out of 46 Sites;
5 Flux Reference Sites)
- All the moorings were serviced

- Recent deployments

ATLAS: 25° S, 100° E,

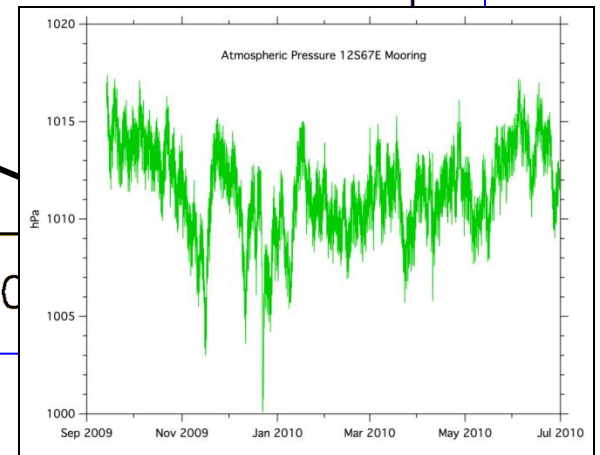
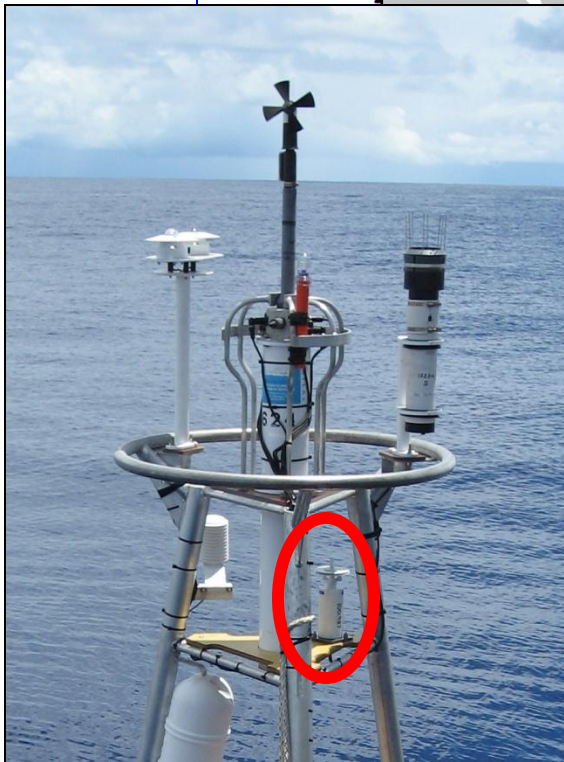
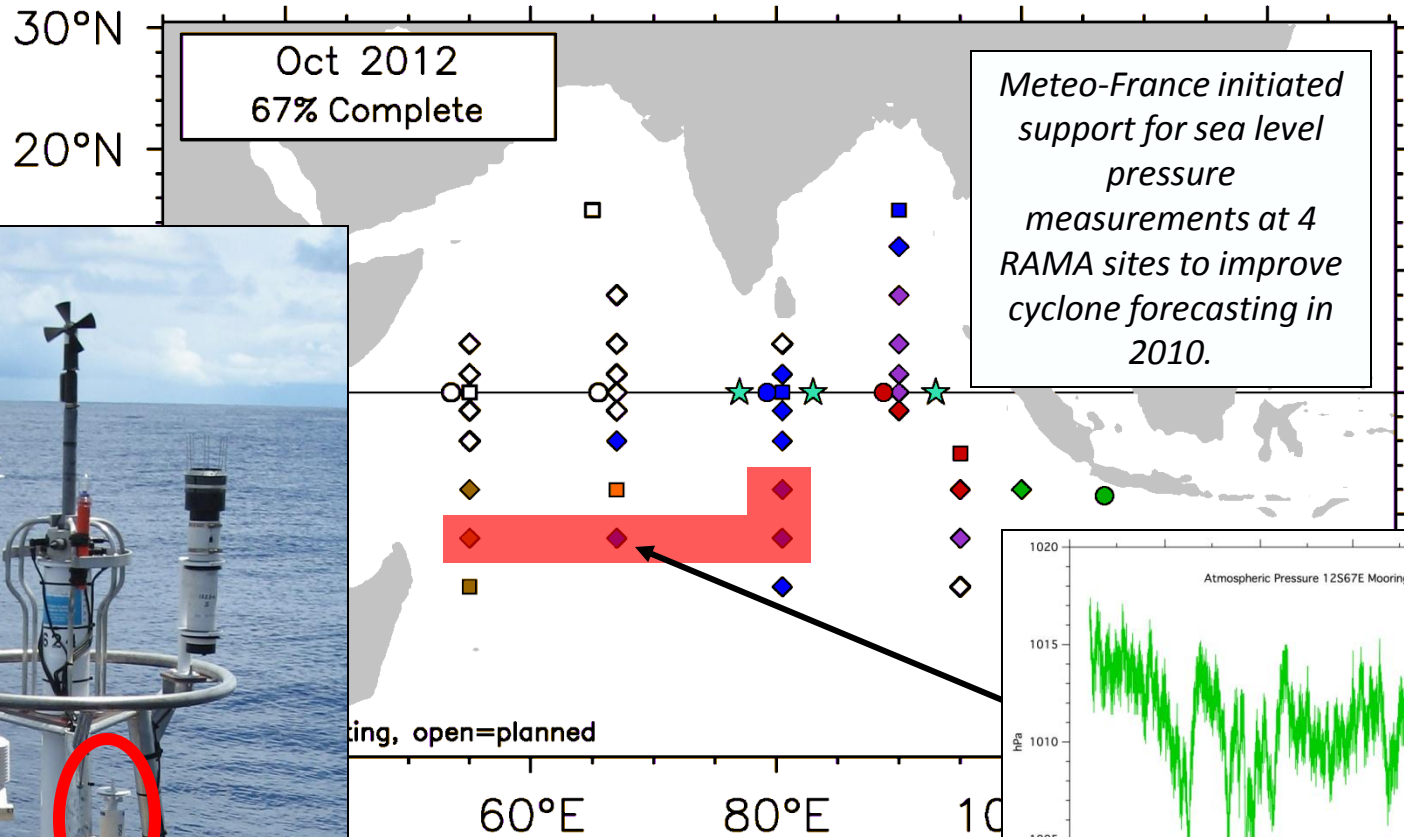
Resource Formula:

- IndOOS Resources Forum (IRF) is important function for this activity
- ✓ NOAA provides most equipment (+JAMSTEC, NIO, FIO)
- ✓ Regional partners provide ship time (INCOIS, KKP/BPPT, ASCLME, CSIRO,...)

Meteo-France Pressure Sensors

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

◆ Surface Mooring ■ Flux Reference Site ● ADCP ★ Deep Ocean

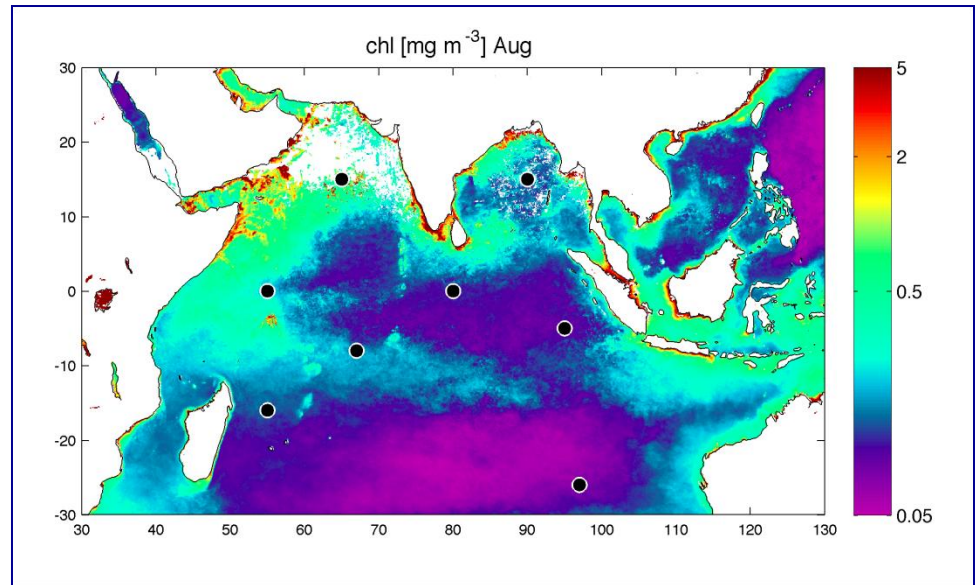


RAMA Biogeochemical Measurements: In Collaboration with SIBER*

Objectives:

- A) Define & understand biogeochemical variability;
- B) Develop models of ocean-atmosphere-biosphere interactions;
- C) Assess the impacts of climate change on ocean primary productivity and air-sea CO₂ exchange.

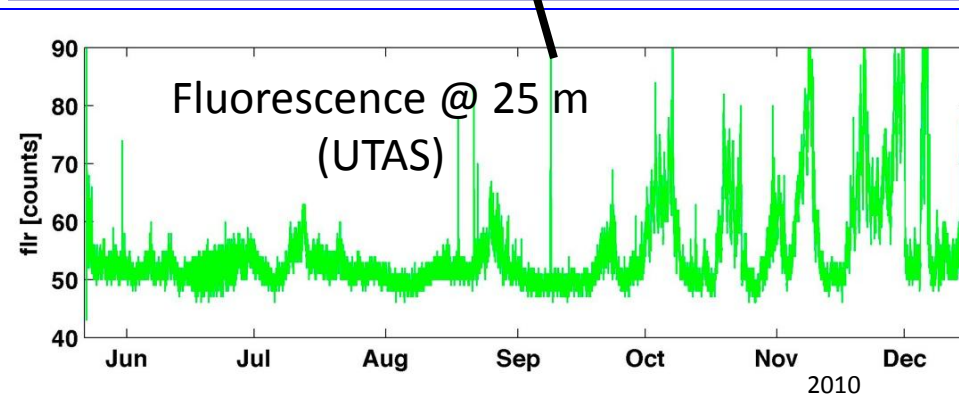
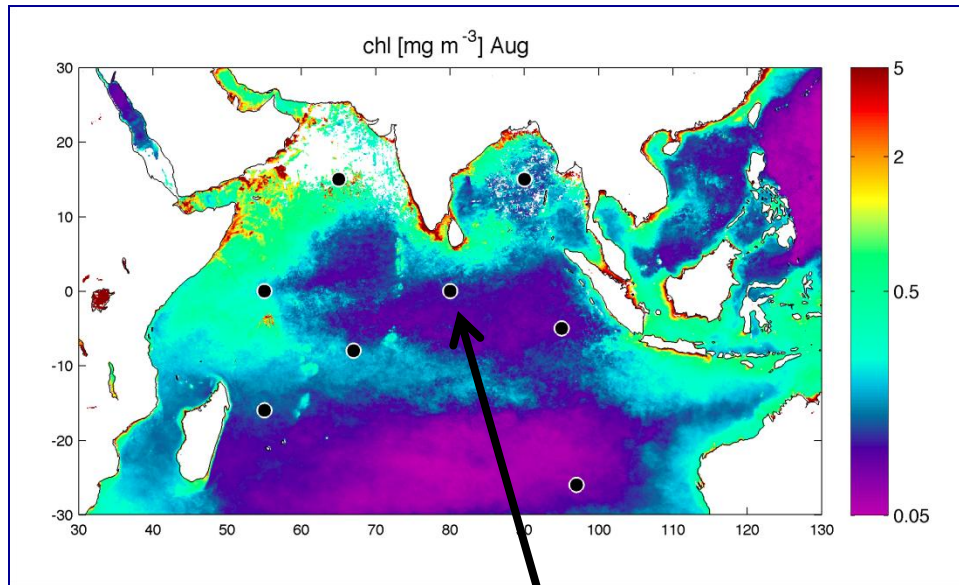
Monthly SeaWiFS Chl-a Concentrations (Solid
Dots are RAMA Flux Reference Sites)



Key Measurements: CO₂, pH, Fluorescence,
Particle Backscatter, O₂

*SIBER=Sustained Indian Ocean Biogeochemical and Ecosystem Research Program

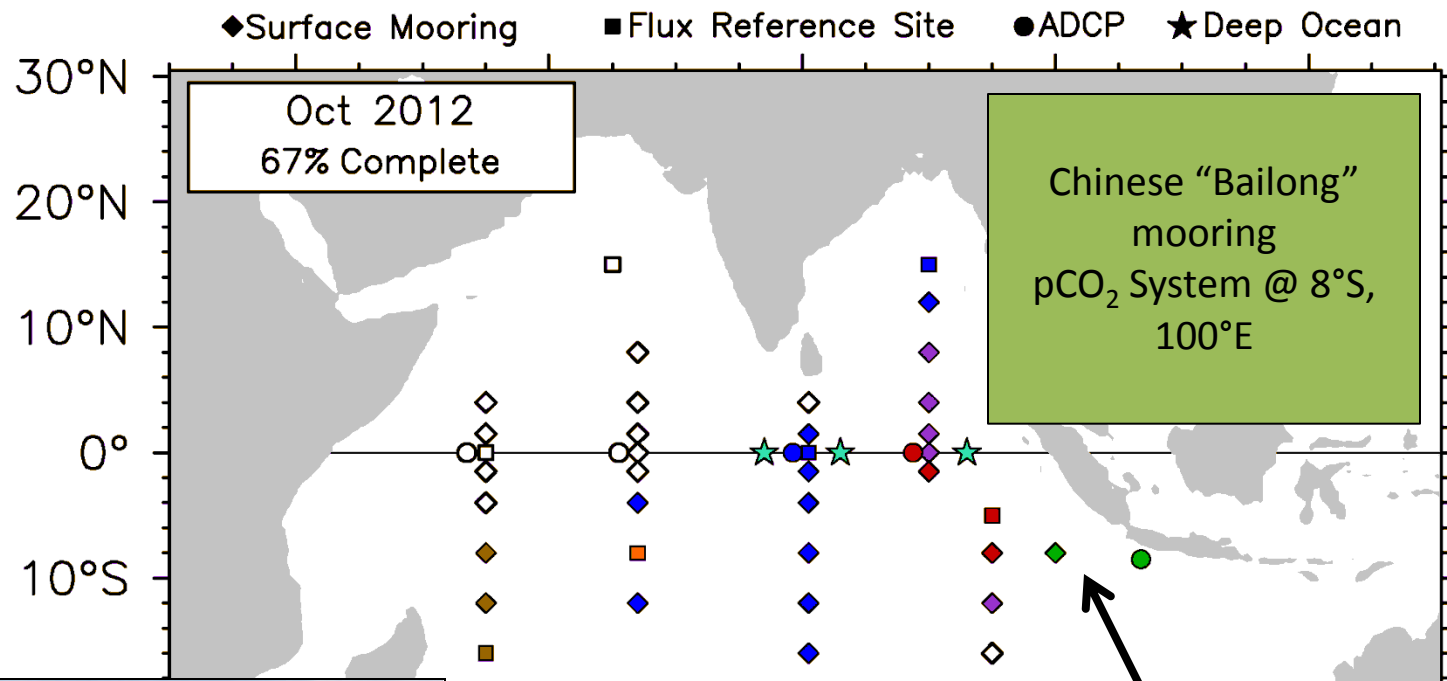
First Biogeochemical Measurements in RAMA



Deployment of a similar system on an ATLAS mooring in the Pacific from a NOAA ship

First CO₂ Measurements in RAMA

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



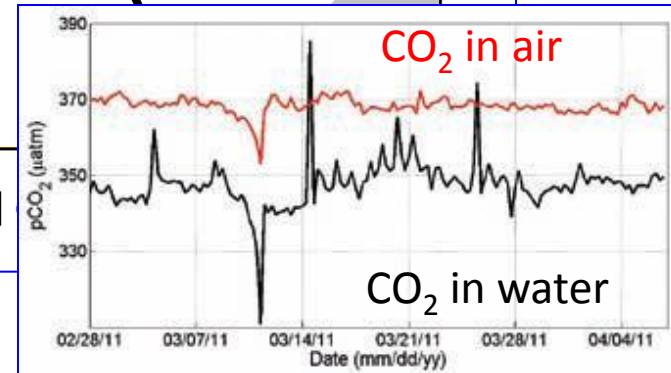
open=planned

60°E

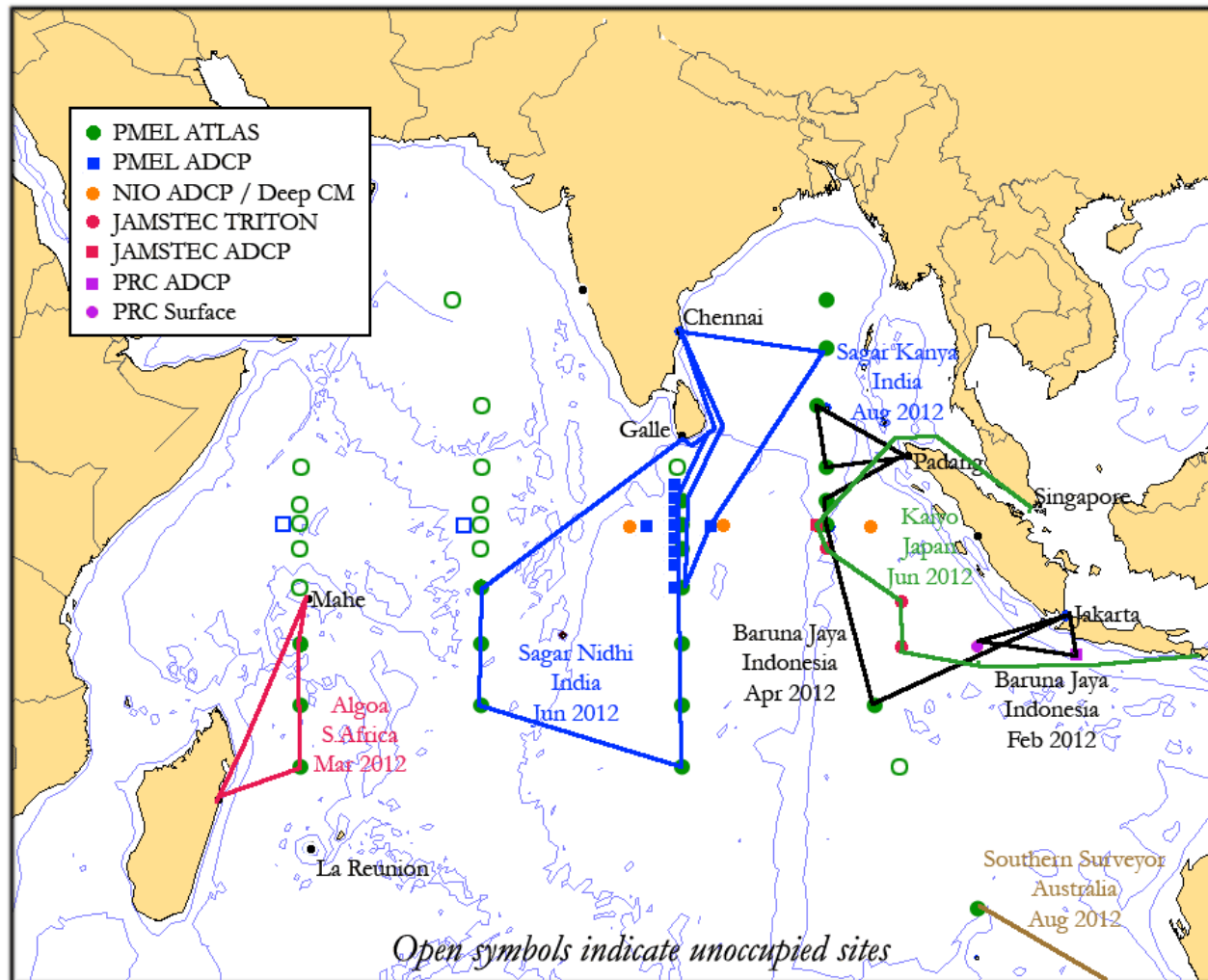
80°E

1

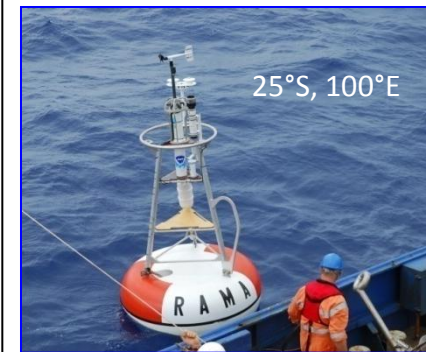
Bai Long



RAMA Cruises Oct 2011 - Sept 2012



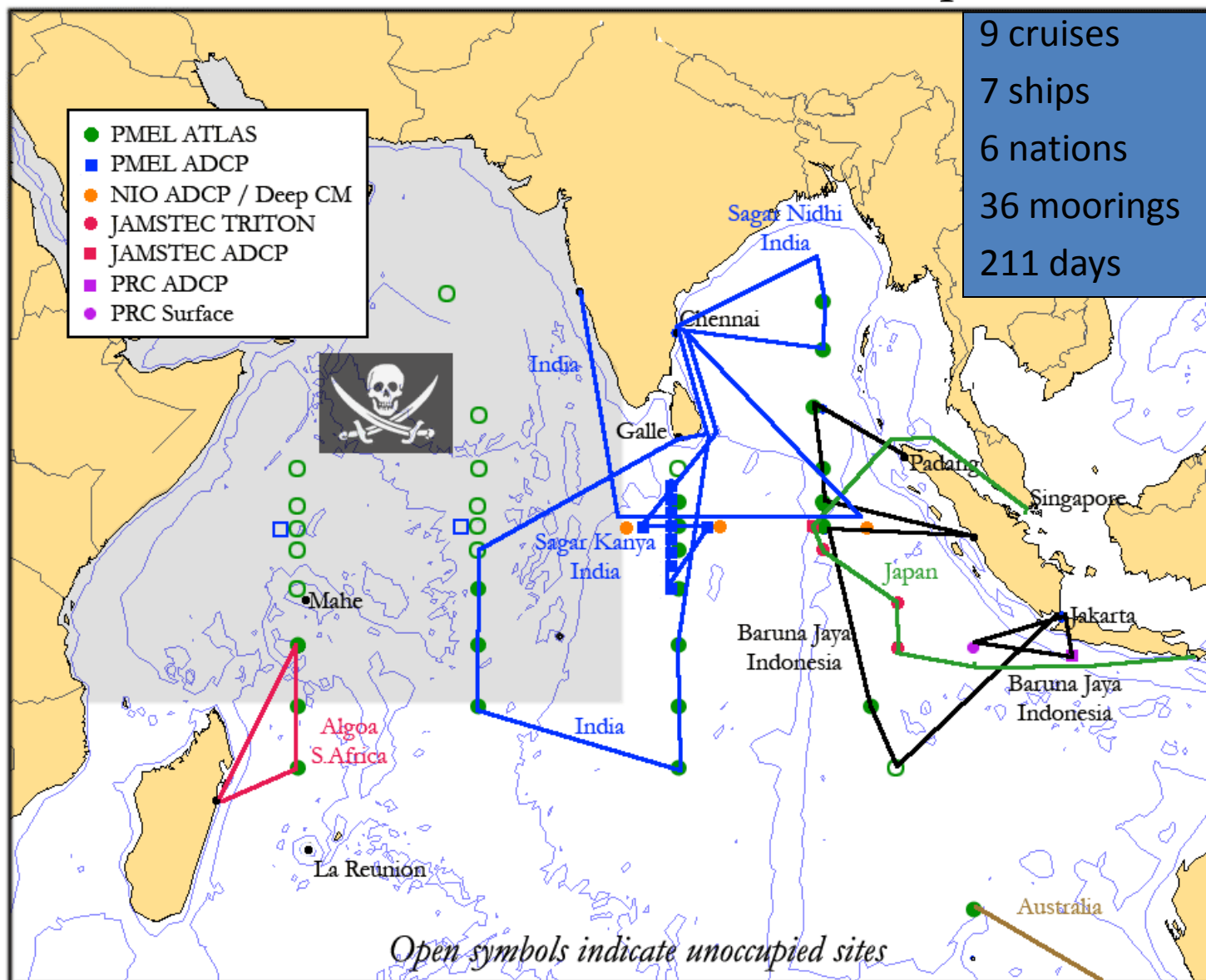
7 cruises
6 ships
7 nations
27 moorings
153 days



RV Southern Surveyor



Planned RAMA Cruises Oct 2012 - Sept 2013



Challenges

- *Increasing data return (64% now)*
 - *Securing and coordinating ship time*
 - *Mitigating vandalism*
 - *Piracy*
- *Implementing biogeochemical measurements*

RAMA Data Access

Tropical Atmosphere Ocean project

[Home](#) [Project overview](#) [Data display and delivery](#) [El Niño & La Niña](#) [Site Map](#)

T•A•O Data display and delivery

To select mooring sites, click orange boxes to select lines of sites, click and hold on your mouse to draw a box around sites, or click single sites. Red indicates which sites are selected. Solid squares show where all selected variables are available. Half filled squares show where some are available. Empty squares show where none are available. This page may take a few moments to load on slower networks and computers.

TAO/TRITON (Pacific) **PIRATA (Atlantic)** **RAMA (Indian)**

[Learn About RAMA](#)

De-Select Sites

Time Series **Profiles** **Time Section** **Lat Lon Map** **Depth Section**

☒ One Variab ☐ One Site ☒ Separate Plot ☐ Overlay

☐ SW Rad ☐ LW Rad ☐ Rain ☐ Wspd ☐ Uwnd ☐ Vwnd ☐ Wdir ☐ Wnd Ve ☐ RH

☐ Air T ☐ SLP ☒ SST ☐ T(z) ☐ SSS ☐ S(z) ☐ SSD ☐ D(z) ☐ Heat

☐ Dyn Ht ☐ 20C ☐ Ucur ☐ Vcur ☐ Cur Vec ☐ Uadc ☐ Vadc ☐ Long ☐ Lat

2004 October 2.. 2010 June 2.. Monthly

files by site ascii None

[Definitions](#) [Availability](#) [Clear](#) [Deliver](#) [Display](#)

[Problems?](#) [Non-JAVA Version](#) [Old Data Display](#) [Old Data Delivery](#) [Comments or Suggestions?](#)

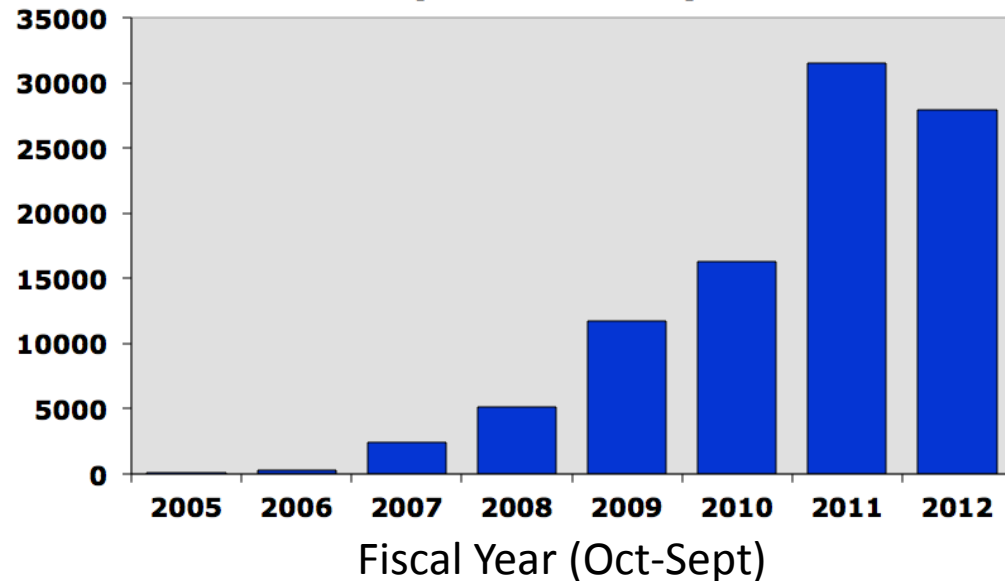
Mac OS X Users: [Safari and Firefox are the recommended browsers](#)

[Acknowledgment for use of TAO, PIRATA, and RAMA data](#)

[Home](#) | [Project overview](#) | [Data display](#) | [Data delivery](#) | [El Niño & La Niña](#) | [Site map](#)

TAO Project Office
[NOAA](#) | [Pacific Marine Environmental Laboratory](#)
7600 Sand Point Way NE
Seattle, WA 98115
oar.pmel.taotech@noaa.gov
[Credits](#) | [Disclaimer](#) | [Privacy Policy](#)

RAMA Data Files Delivered via the Web (Total=95379)



+ FTP/WEB: 458,386



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

[Home](#)[Research](#)[Data and Display](#)[Technical](#)[Global Tropical Array](#)

Journal Publications

Jump to year: [2012](#), [2011](#), [2010](#), [2009](#), [2008](#), [2007](#), [2005](#), [2004](#)

2012

Blockley, E. W., M. J. Martin, and P. Hyder, 2012: Validation of FOAM near-surface ocean current forecasts using Lagrangian drifting buoys, *Ocean Sci.*, 8, 551-565, doi:10.5194/os-8-551-2012.

Cronin, M.F., R.A. Weller, R.S. Lampitt, and U. Send, 2012: Ocean reference stations. In *Earth Observation*, R.B. Rustamov and S.E. Salahova (eds.), InTech, ISBN: 978-953-307-973-8.

Drushka, K., J. Sprintall, S. T. Gille, and S. Wijffels, 2012: In situ observations of Madden-Julian Oscillation mixed layer dynamics in the Indian and Western Pacific Oceans. *J. Climate*, 25, 2306-2328. doi:10.1175/JCLI-D-11-00203.1.

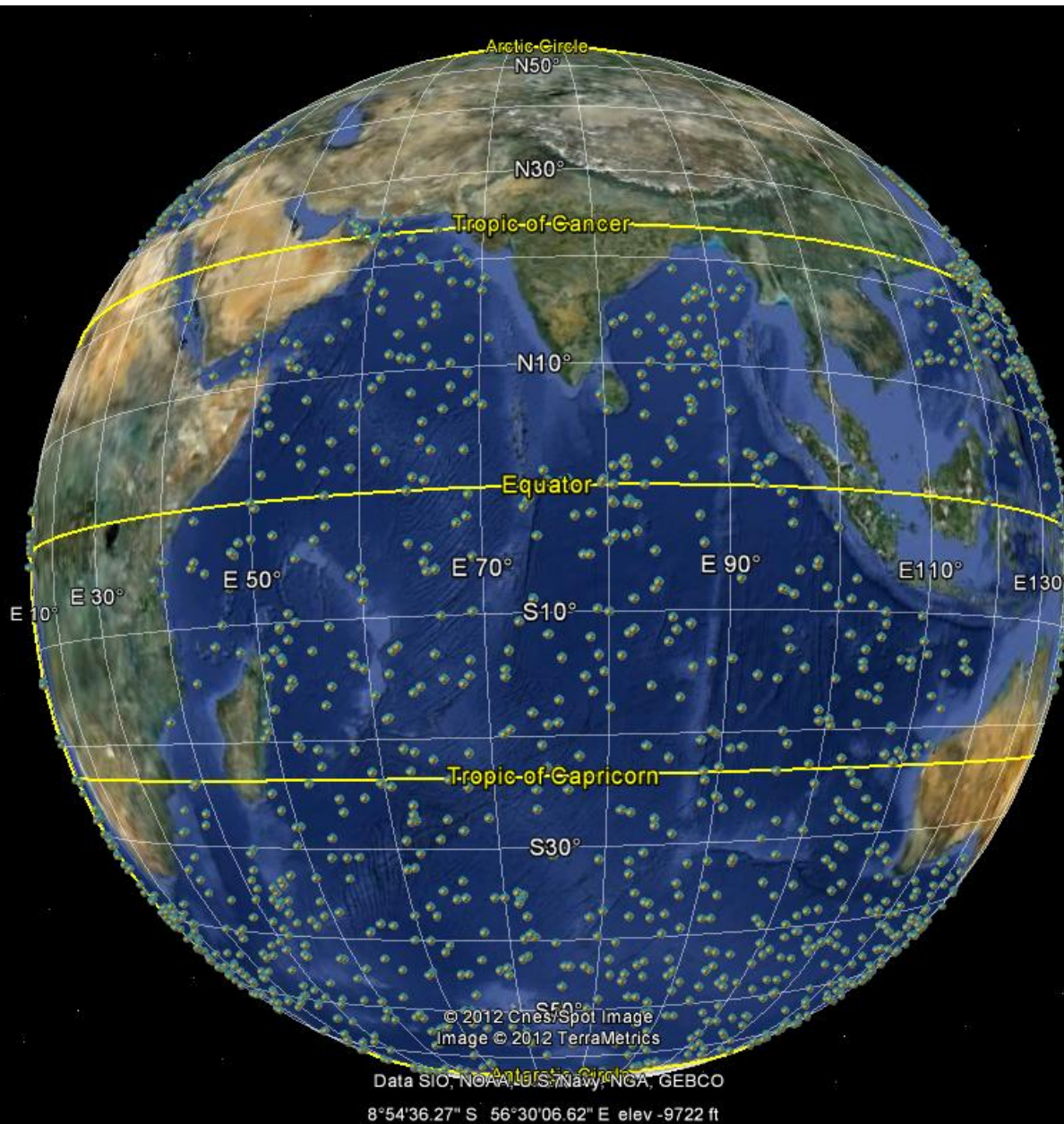
Gnanaseelan, C., A. Deshpande, and M. J. McPhaden, 2012: Impact of Indian Ocean Dipole and El Niño/Southern Oscillation forcing on the Wyrтки jets. *J. Geophys. Res.*, 117, C08005, doi:10.1029/2012JC007918.

Joseph, S., A. J. Wallcraft, T. G. Jensen, M. Ravichandran, S. S. C. Sheno, and S. Nayak, 2012: Weakening of spring Wyrтки jets in the Indian Ocean during 2006-2011, *J. Geophys. Res.*, 117, C04012, doi:10.1029/2011JC007581.

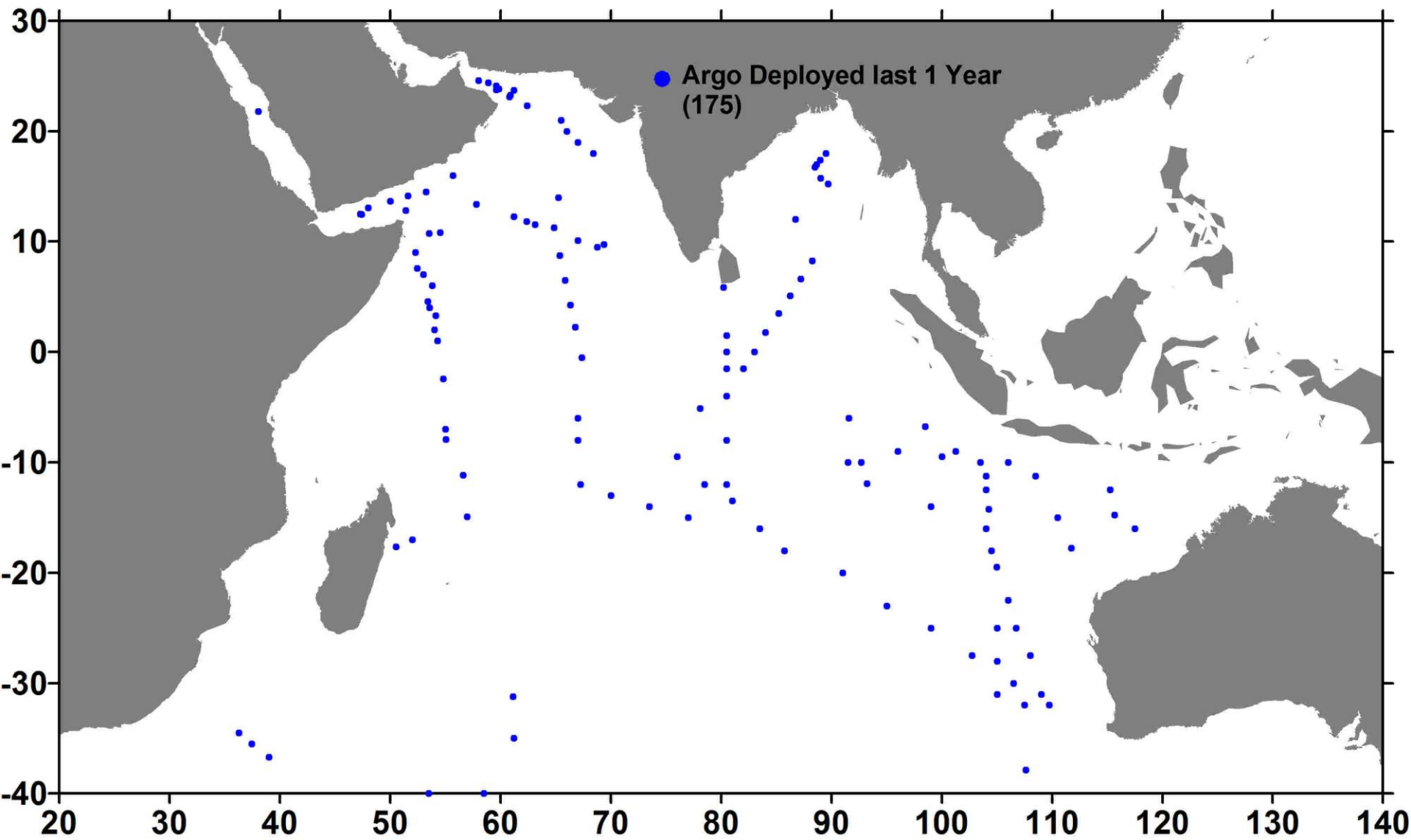
Keerthi, M. G., M. Lengaigne, J. Vialard, C. de Boyer Montégut, and P. M. Muraleedharan, 2012: Interannual variability of the Tropical Indian Ocean mixed layer depth, *Clim. Dyn.*, doi:10.1007/s00382-012-1295-2.

Maneesha, K., V. S. N. Murty, M. Ravichandran, T. Lee, Weidong Yu, and M. J. McPhaden, 2012: Upper ocean variability in the Bay of

Status of Active floats in the Indian Ocean

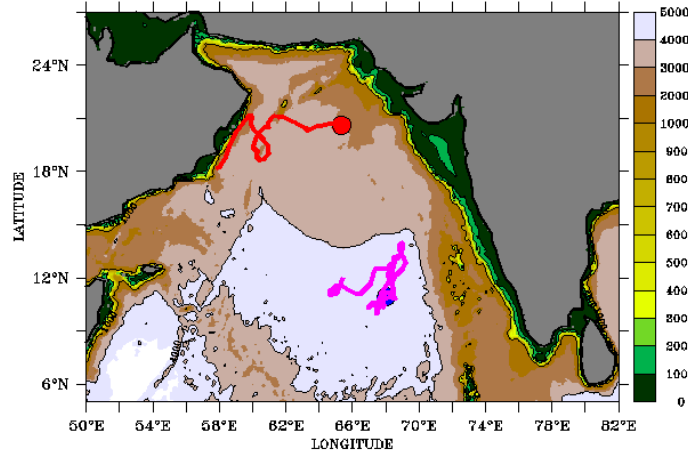


- 769 floats are active in the Indian Ocean (about 491 floats north of 40 S)
- 68% profiles subjected to DMQC
- New deployments during past one year: 175

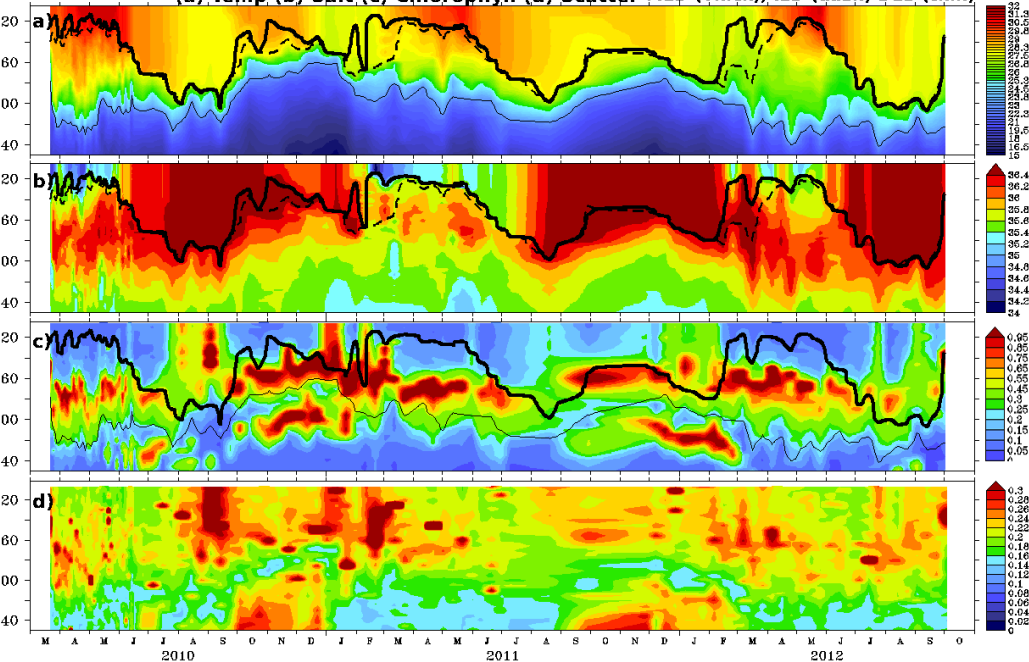


Bio-Argo

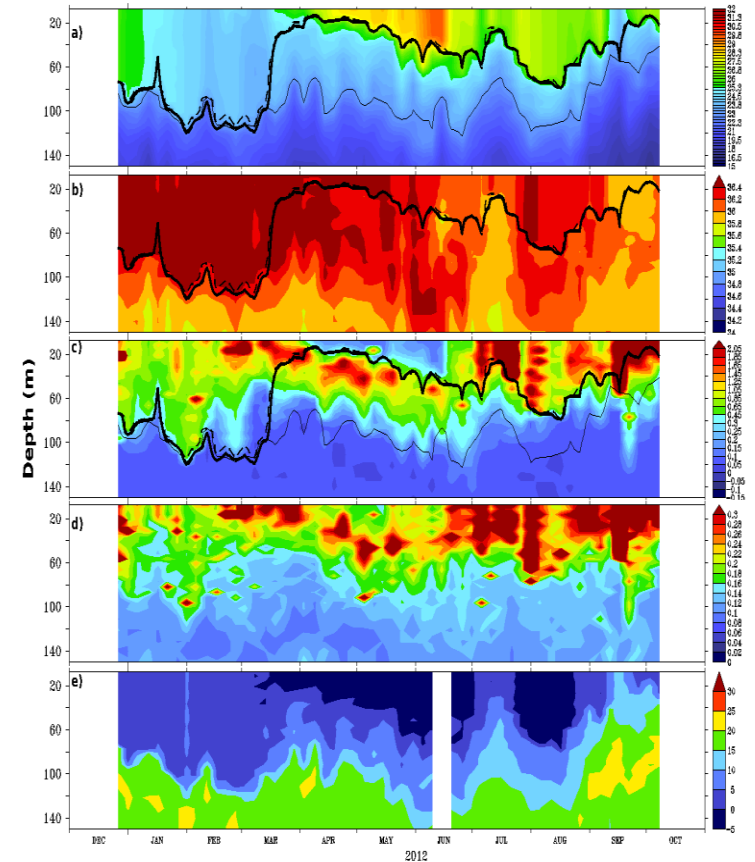
Temperature
Salinity
Oxygen
Chlorophyll-a
Backscatter @ 700 nm
Nitrate



(a) Temp (b) Salt (c) Chlorophyll (d) Scatter MLD (Thick), ILD (dash) D23 (thin)



(a) Temp (b) salt (c) Ch-a (d) Scatter (e) Nitrate (MLD-Thick, ILD-dash, D23-Thin)



Photos

▼ Documents

Argo bibliography

Complete float
bibliographyArgo research in
pressNewsletter:
ArgonauticsArgo user group
reports

Argo brochures

Argo design papers

News archive

▼ Argo Steering Team

Argo Steering Team

Members

Meeting reports

► Meetings

► Links

► FAQ

► Contact

► Site Map

2012 (144)

Alory, G., C. Maes, T. Delcroix, N. Reul, and S. Illig, 2012: Seasonal dynamics of sea surface salinity off Panama: The far Eastern Pacific Fresh Pool. *J. Geophys. Res.*, **117**, C04028, <http://dx.doi.org/10.1029/2011JC007802>

Baird, M. E. and K. R. Ridgway, 2012: The southward transport of sub-mesoscale lenses of Bass Strait Water in the centre of anti-cyclonic mesoscale eddies. *Geophysical Research Letters*, **39**, L02603, <http://dx.doi.org/10.1029/2011GL050643>

Banks, C. J., C. P. Gommenginger, M. A. Srokosz, and H. M. Snaith, 2012: Validating SMOS Ocean Surface Salinity in the Atlantic With Argo and Operational Ocean Model Data. *Geoscience and Remote Sensing, IEEE Transactions on*, **50**, 1688-1702, <http://dx.doi.org/10.1109/tgrs.2011.2167340>

Bhaskar, T. V. S. U., C. Jayaram, and E. P. Rama Rao, 2012: Comparison between Argo-derived sea surface temperature and microwave sea surface temperature in tropical Indian Ocean. *Remote Sensing Letters*, 1-10, <http://dx.doi.org/10.1080/2150704X.2012.711955>

Boutin, J., N. Martin, Y. Xiaobin, J. Font, N. Reul, and P. Spurgeon, 2012: First Assessment of SMOS Data Over Open Ocean: Part II-Sea Surface Salinity. *Geoscience and Remote Sensing, IEEE Transactions on*, **50**, 1662-1675, <http://dx.doi.org/10.1109/TGRS.2012.2184546>

Boyer, T., S. Levitus, J. Antonov, J. R. Reagan, C. Schmid, and R. A. Locarnini, 2012: Subsurface salinity. *In State of the Climate 2011*, J. Blunden and D. S. Arndt, Eds., Bulletin of the American Meteorological Society, S72-S75.

Calafat, F. M., G. Jordá, M. Marcos, and D. Gomis, 2012: Comparison of Mediterranean sea level variability as given by three baroclinic models. *J. Geophys. Res.*, **117**, C02009, <http://dx.doi.org/10.1029/2011JC007277>

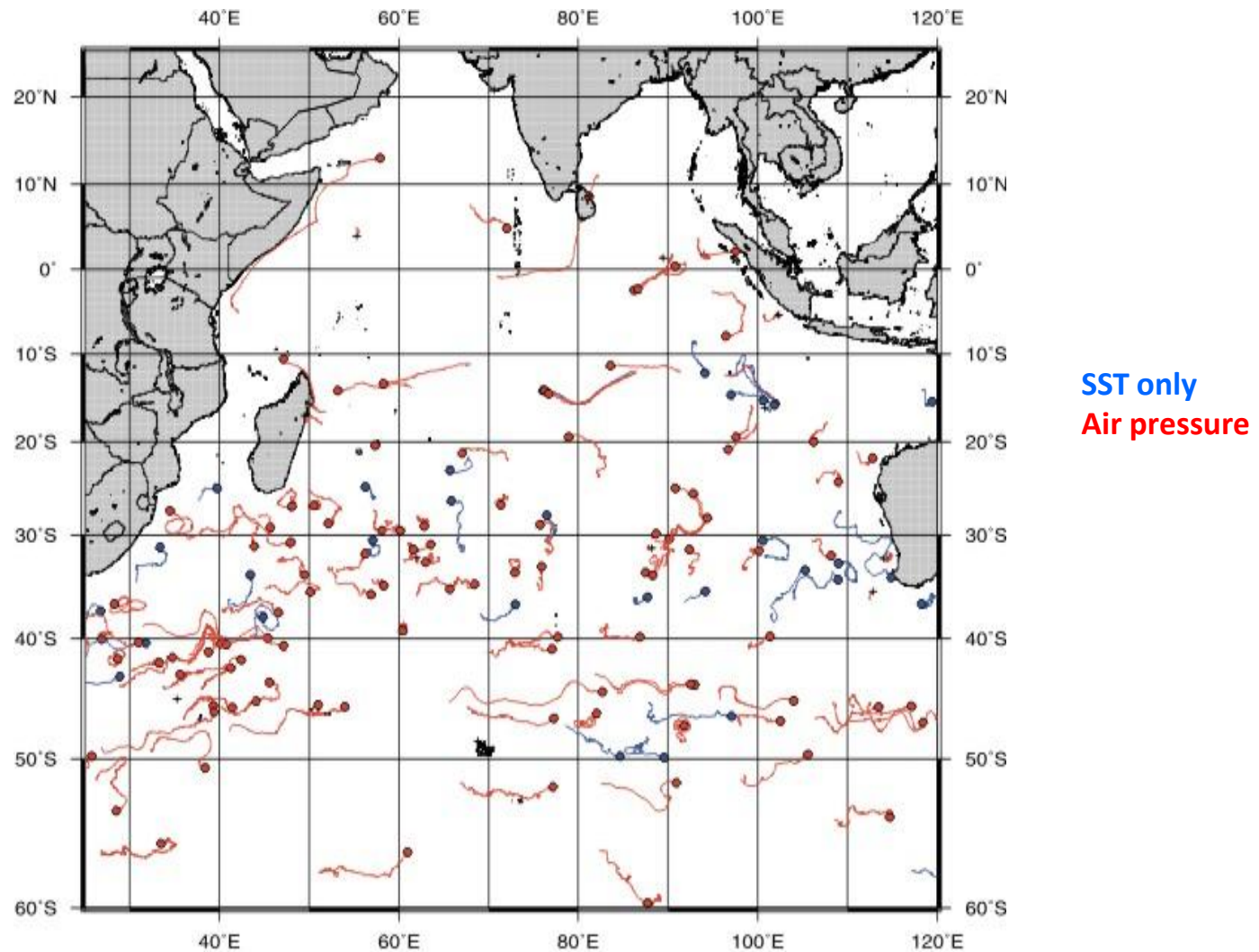
Carton, J. A., H. F. Seidel, and B. S. Giese, 2012: Detecting historical ocean climate variability. *J. Geophys. Res.*, **117**, C02023, <http://dx.doi.org/10.1029/2011JC007401>

Carton, X., P. L'Hegaret, and R. Baraille, 2012: Mesoscale variability of water masses in the Arabian Sea as revealed by ARGO floats. *Ocean Science*, **8**, 227-248, <http://www.ocean-sci.net/8/227/2012/>

Castro-Morales, K. and J. Kaiser, 2012: Using dissolved oxygen concentrations to determine mixed layer depths in the Bellinghausen Sea. *Ocean Science*, **8**, <http://dx.doi.org/10.5194/os-8-1-2012>

Chacko, N., M. Ravichandran, R. Rao, and S. Shenoi, 2012: An anomalous cooling event observed in the Bay of Bengal during June 2009. *Ocean Dynamics*, **62**, 671-681, <http://dx.doi.org/10.1007/s10236-012-0525-9>

Drifters: Trajectories in June 2012



233 drifters deployed during last one year

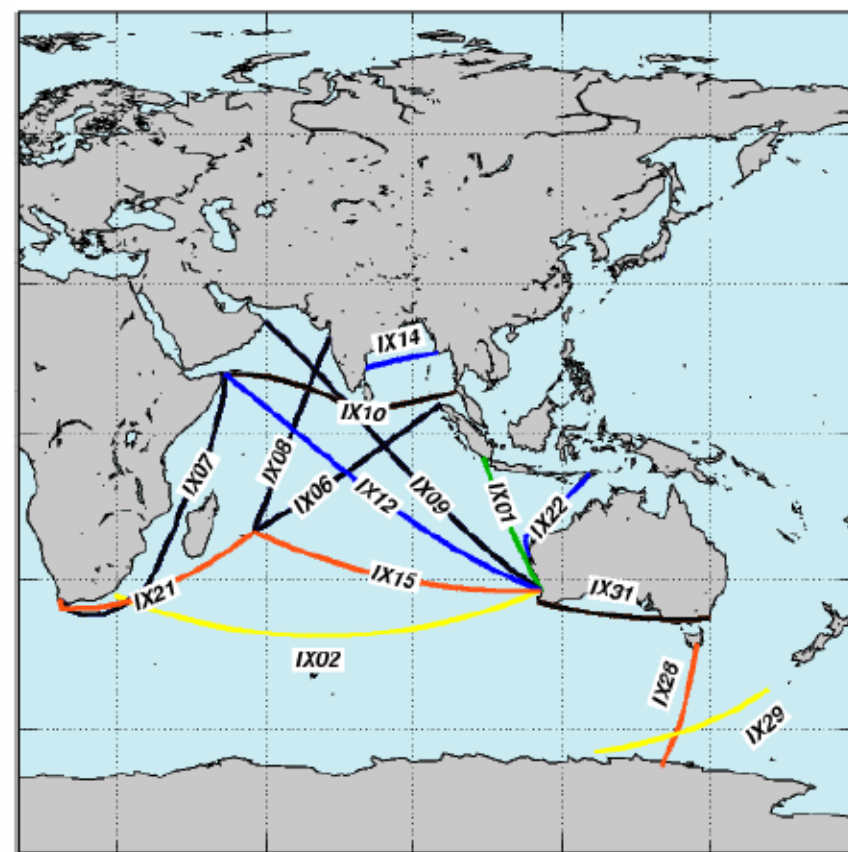
Indian Ocean XBT Transects



Transect	Agency	Mode (Target)	Status	Year
IX01	9, 1	FR (37)	Active	1987
IX06	6, 2		Suspended	2007
IX07			Inactive	
IX08	12		Inactive	1992
IX09			Inactive	
IX10			Inactive	
IX12	9, 2	FR (14)	Active	1986
IX14	12	FR (1)	Active	1990
IX15	2, 4, 6	HD (3)	Active	1994
IX21	2, 4, 6	HD (3)	Active	1994
IX22	9	FR (7)	Active	1986
IX28	4, 2	HD (5)	Active	1993
IX31	2		Suspended	2006
IX02	2	HD (1)	Targeted	
IX29	4	HD (1)	Active	

1 USA-NOAA/AOML
 2 USA-SIO
 4 AUS-CSIRO
 6 ZAF-UCT
 9 AUS-BOM
 12 IND-NIO

Indian Ocean XBT transects (2010)



Blue line: Active (FR)
 Orange line: Active (HD)
 Green line: Active (FR and HD)
 Black line: Inactive
 Yellow line: Not Recommended

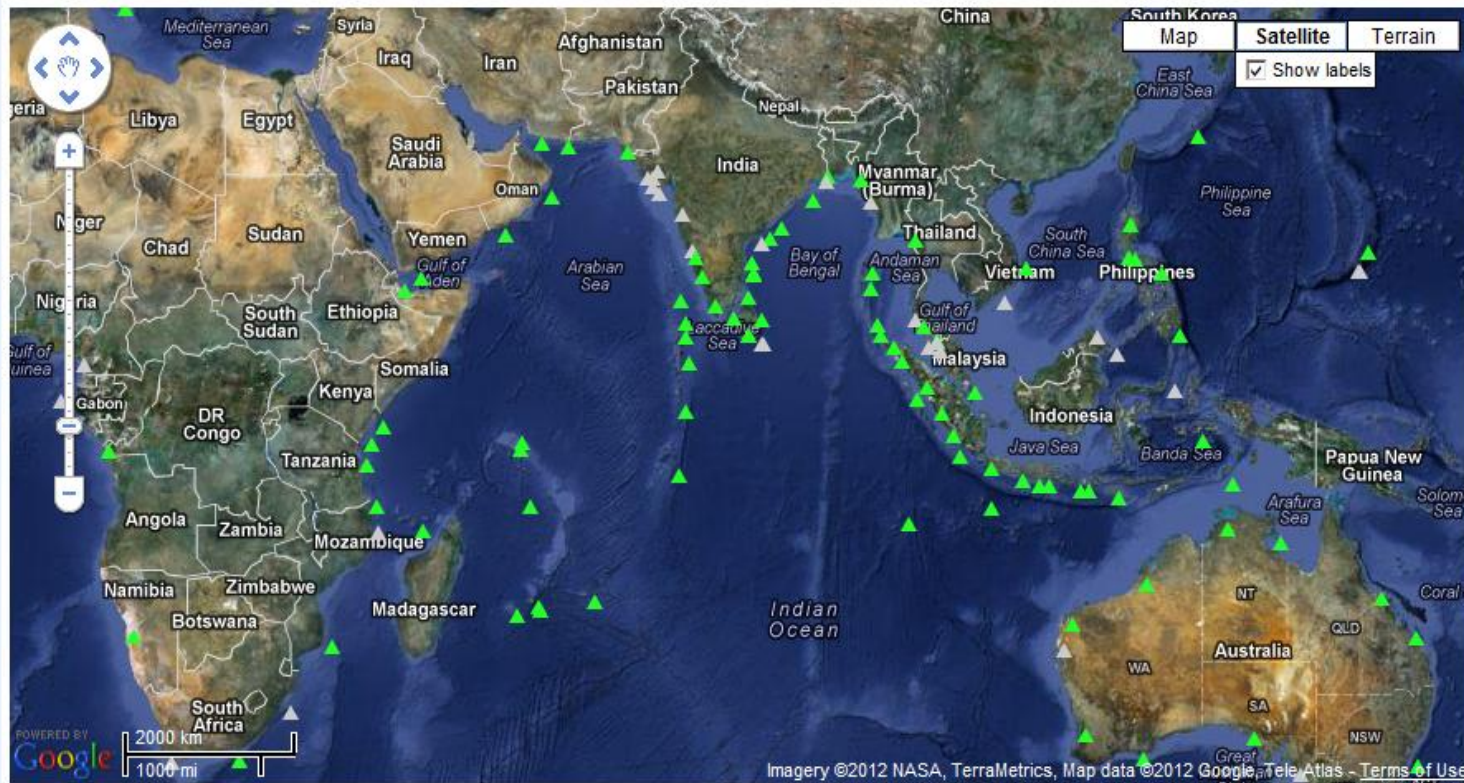
Source: Francis Bringas

Tide gauge locations

Indian National Tsunami Early Warning System
Ministry of Earth Sciences, Government of India

Date & Time in UTC

[Home](#) Realtime Tidegauge Information



Map Satellite Terrain

☒ Show labels

☒ National

☒ International

TideGauge

☒ Reporting Stations

☐ Non-Reporting Stations

67 Tide gauges are active in the Indian Ocean

Process studies (CINDY2011 / DYNAMO)

Purpose:

To collect in-situ observations to advance our understanding of the MJO initiation process and to improve the MJO simulation and prediction.

Periods:

Special Observing Period	Oct 1, 2011 – Nov 28, 2011
Intensive Observing Period	Oct 1, 2011 – Jan 15, 2012
Extended Observing Period	Oct 1, 2011 – Mar 31, 2012

Participants :

Over 60 institutes/universities/agencies from

US, Japan, India, Indonesia, France,
Kenya, Seychelles, Maldives, Sri Lanka, Singapore,
Papua New Guinea,
UK, Taiwan, Korea, Poland, and Australia

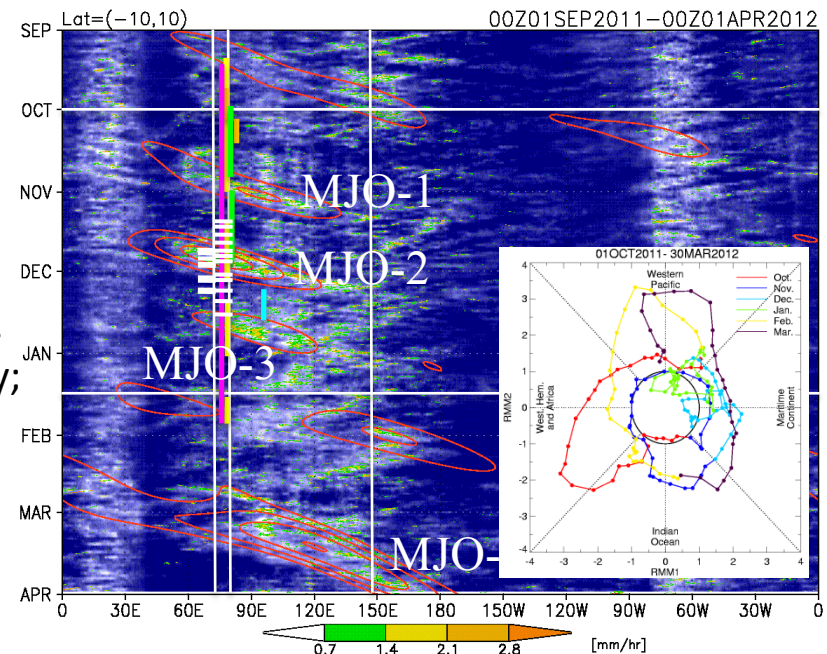
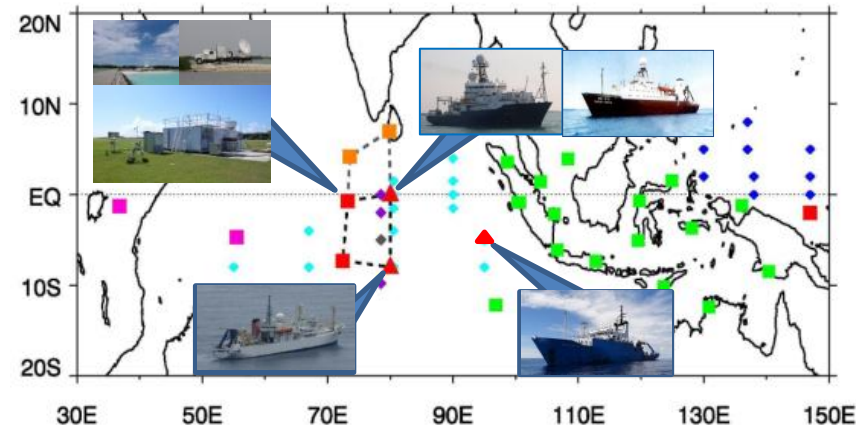
Early results :

Captured 3 MJOs during IOP, but Dec case is controversial.
Preliminary analyses suggest the following factors may key;

- Behavior of dry air during moistening process
- Interaction between ITCZ and MJO
- Influences on moisture from the maritime continent

Other interesting findings;

- Unseasonal Wyrтки jet,
- Meander of SCTR, etc.



Thank you for your attention