Tropical Moored Buoy Implementation Panel (TIP)

"To promote an integrated approach to moored buoy observations of the climate system in the tropics, through development of common calibration standards, sampling, and reporting procedures…"

TIP Background:

1) Inaugurated in 1992 as the TOGA-TAO Implementation Panel (TTIP; then TIP in 1995)
2) Became Tropical Moored Buoy Implementation Panel (TIP) in 2001 under CLIVAR
3) Supports Indian Ocean Panel, CLIVAR Pacific Panel, PIRATA Scientific Steering Group
4) Action Group of the DBCP

http://www.pmel.noaa.gov/tao/proj_over/tip/newpanel.html

TIP Workshop
Oban, Scotland
26 September 2010

Tropical Moored Buoy Implementation Panel (TIP)

Purpose of today's meeting:

1) To review measurement standards for tropical moored buoy programs;

2) To update the status of moored buoy array developments in the tropical Pacific, Atlantic, and Indian Oceans;

3) To recommend actions to strengthen international cooperation

TIP Workshop
Oban, Scotland
26 September 2010

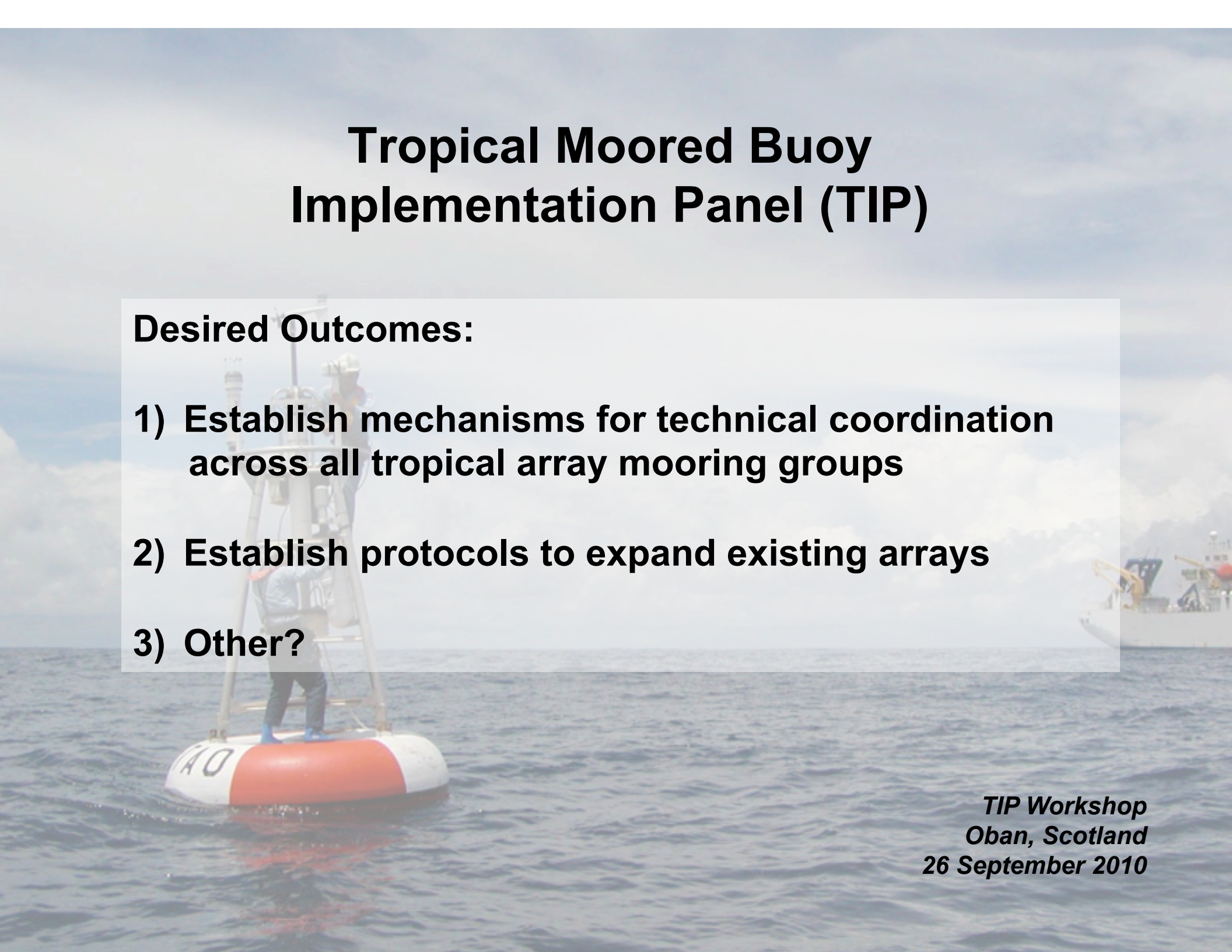
Tropical Moored Buoy Implementation Panel (TIP)

Desired Outcomes:

1) **Establish mechanisms for technical coordination across all tropical array mooring groups**

2) **Establish protocols to expand existing arrays**

3) **Other?**



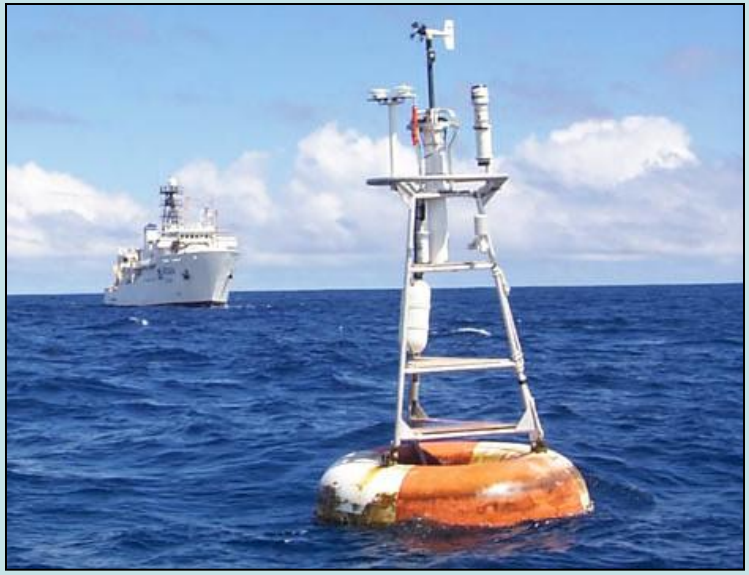
TIP Workshop
Oban, Scotland
26 September 2010

The Global Tropical Moored Buoy Array

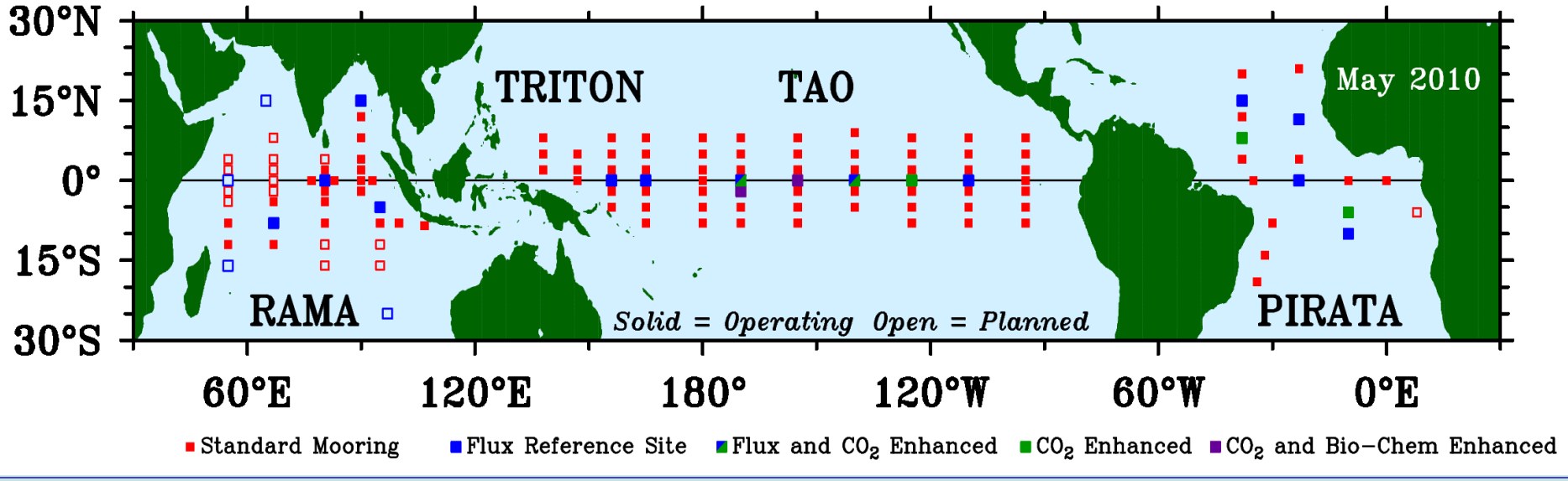
Mike McPhaden
NOAA/PMEL
Seattle, Washington

TIP Workshop
Oban, Scotland
26 September 2010

Tropical Moored Buoy Array Program:
A coordinated, multi-national effort to implement a sustained moored buoy observing system in the global tropics for climate research and forecasting



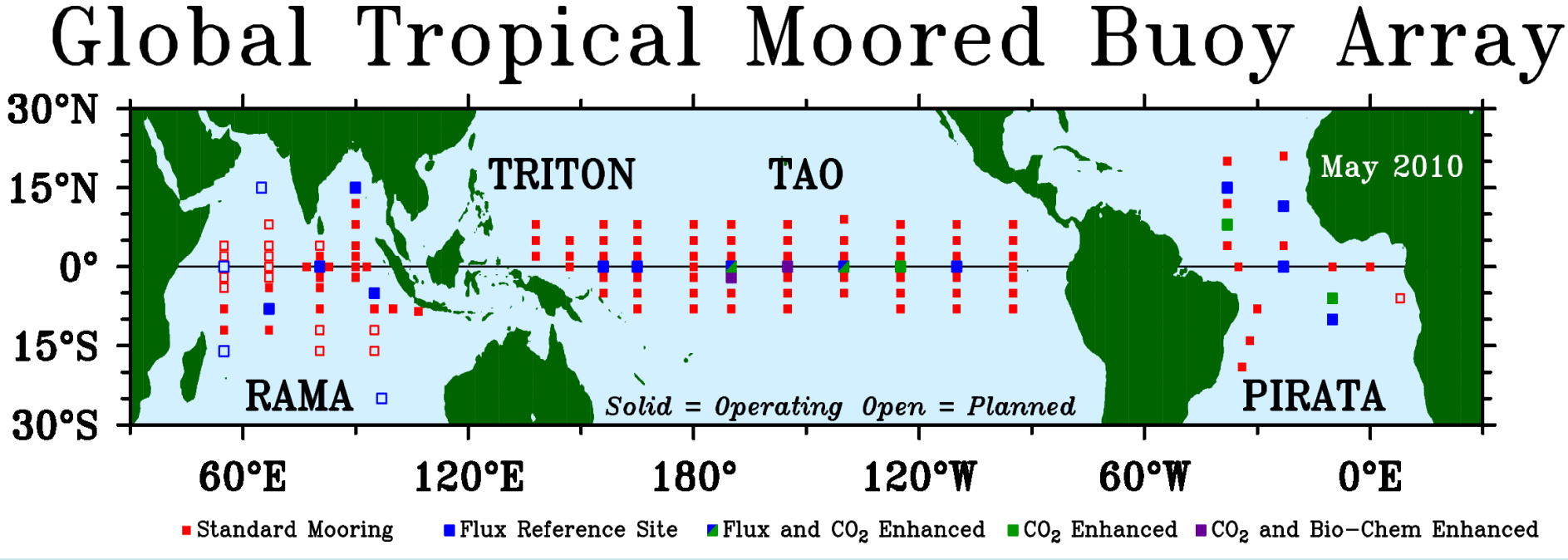
Global Tropical Moored Buoy Array



A contribution to the Global Ocean and Global Climate Observing System (GOOS & GCOS)

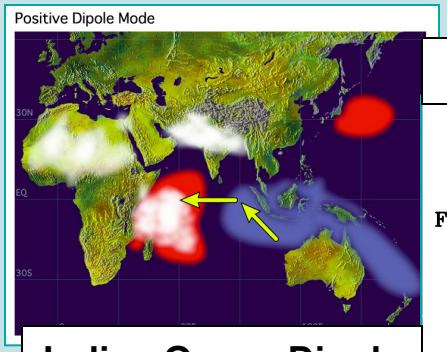
Indian (2000)	Pacific (1984)	Atlantic (1997)
Japan	Japan	Brazil
India	U.S.	France
Indonesia		U.S.
China		
France		
U.S.		
ASCLME		

Contributing Nations



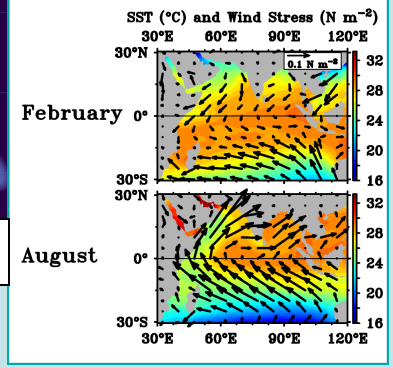
A contribution to the Global Ocean and Global Climate Observing System (GOOS & GCOS)

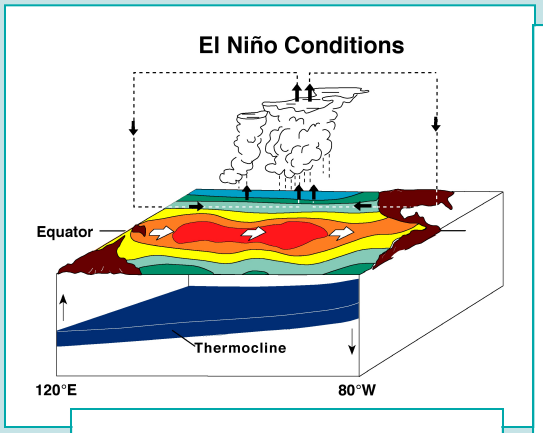
Science Drivers

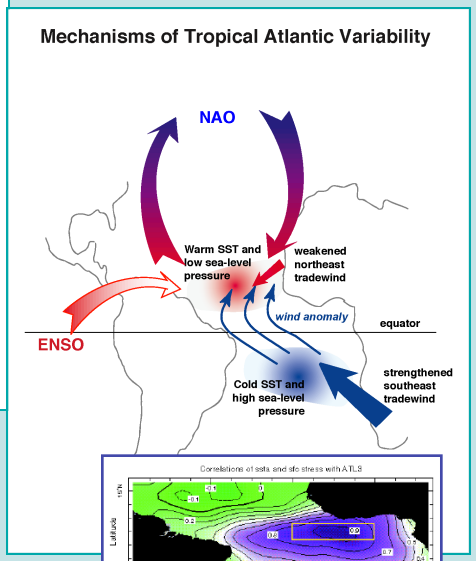


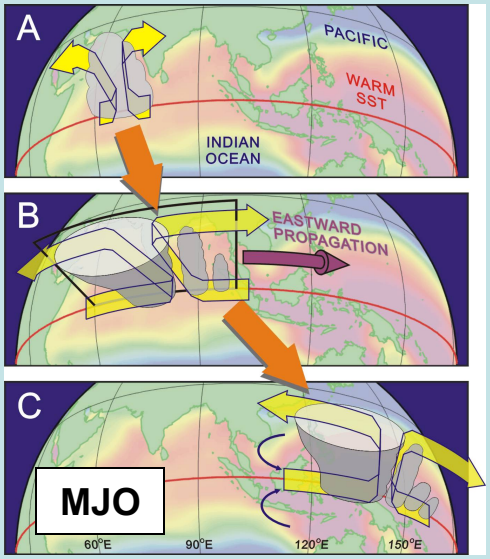
Indian Ocean Dipole

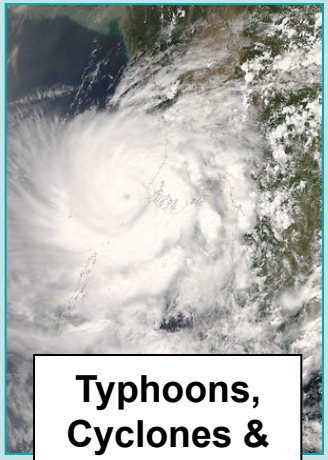
Monsoons



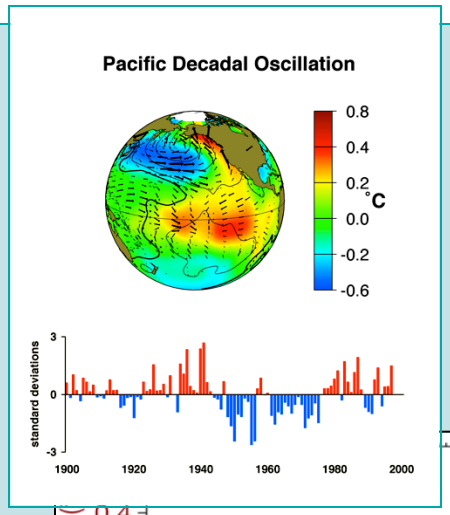


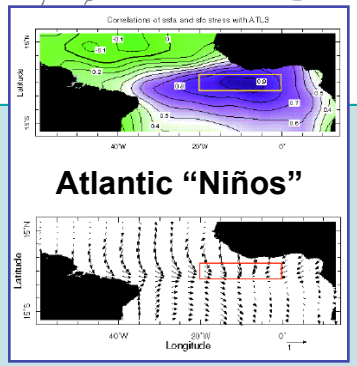


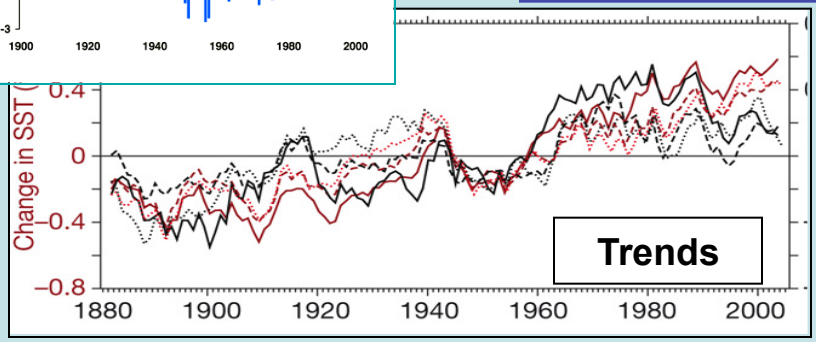




Typhoons, Cyclones & Hurricanes

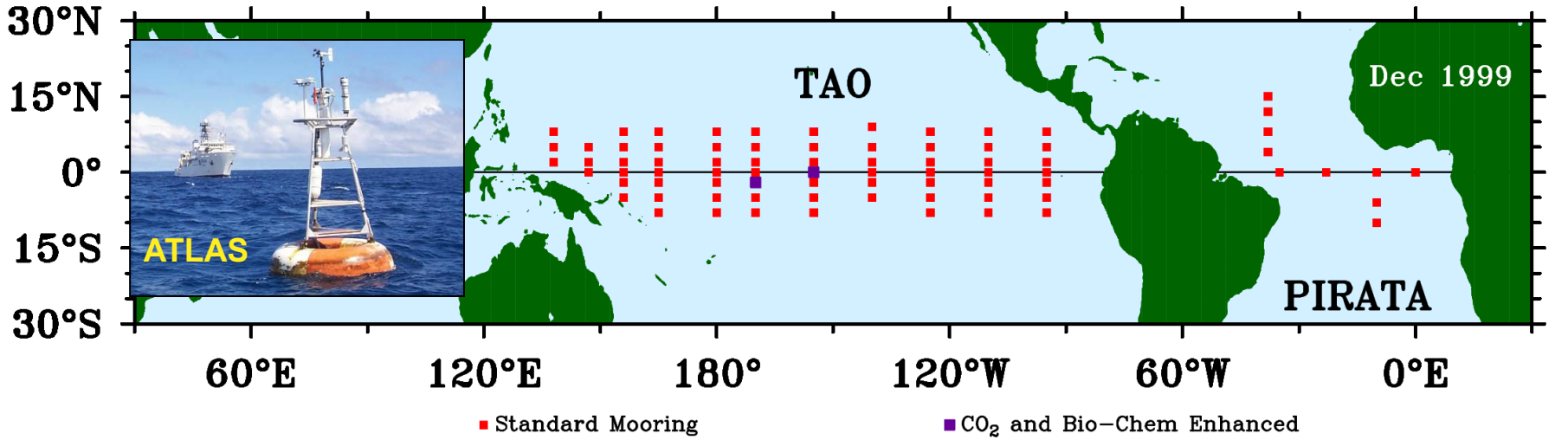


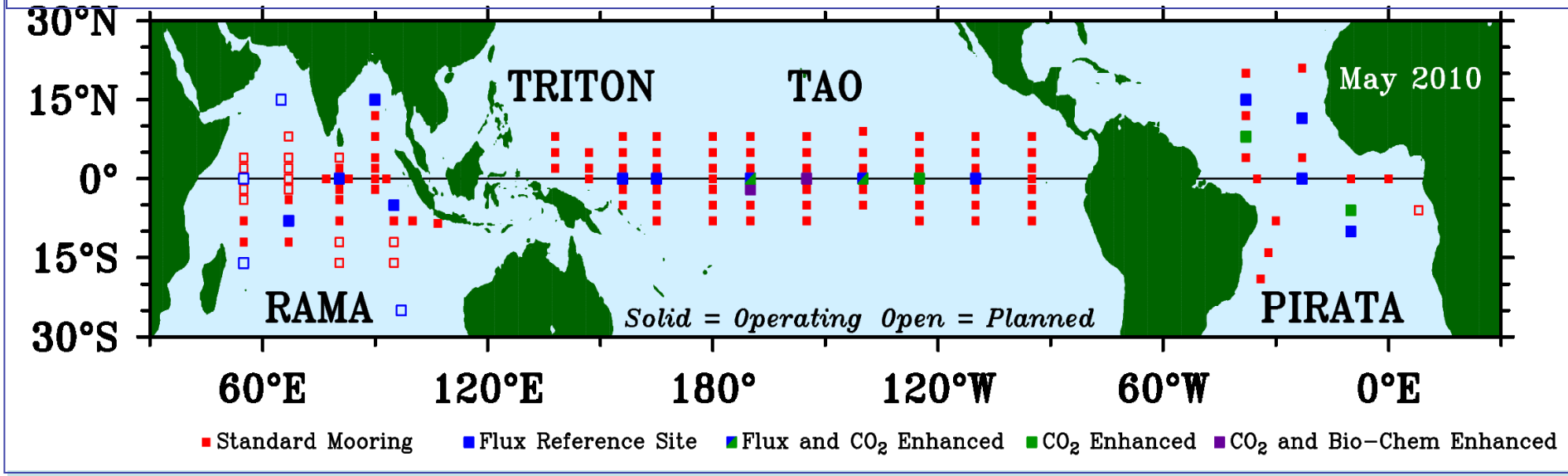




Trends

Global Tropical Moored Buoy Array

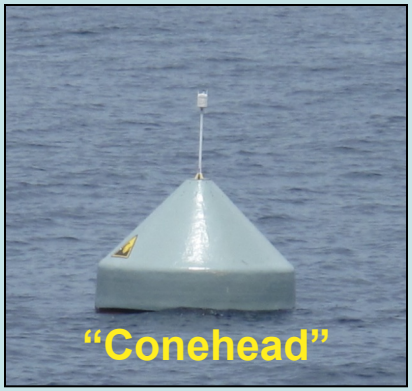




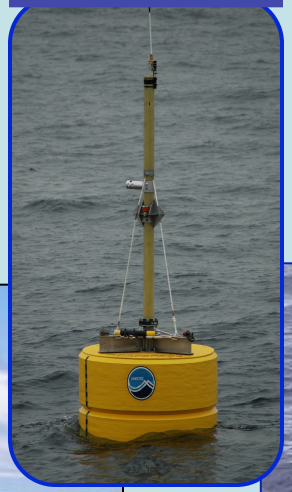
Tropical Moored Buoy Systems

Purpose#1: To review measurement standards for tropical moored buoy programs that contribute to CLIVAR, GOOS, and GCOS.

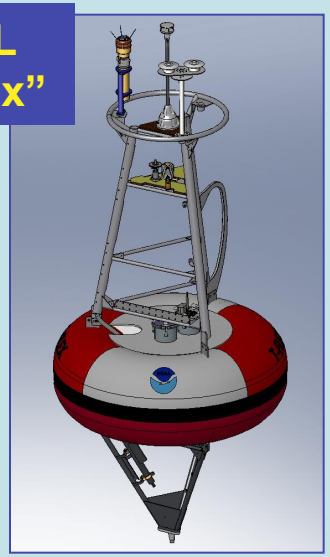

NDBC "ATLAS Refresh"


"Conehead"

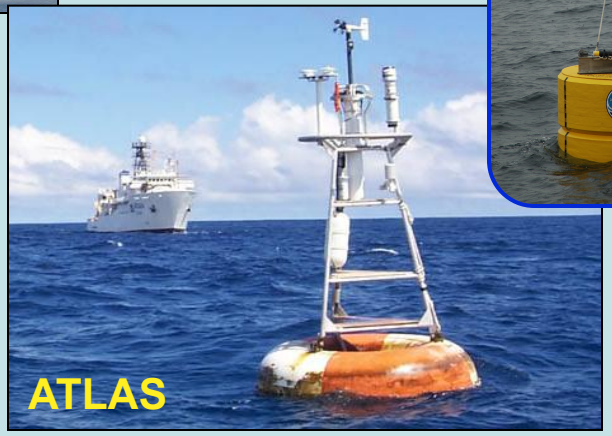
Mini-TRITON



PMEL "T-Flex"




Chinese "ATLAS"

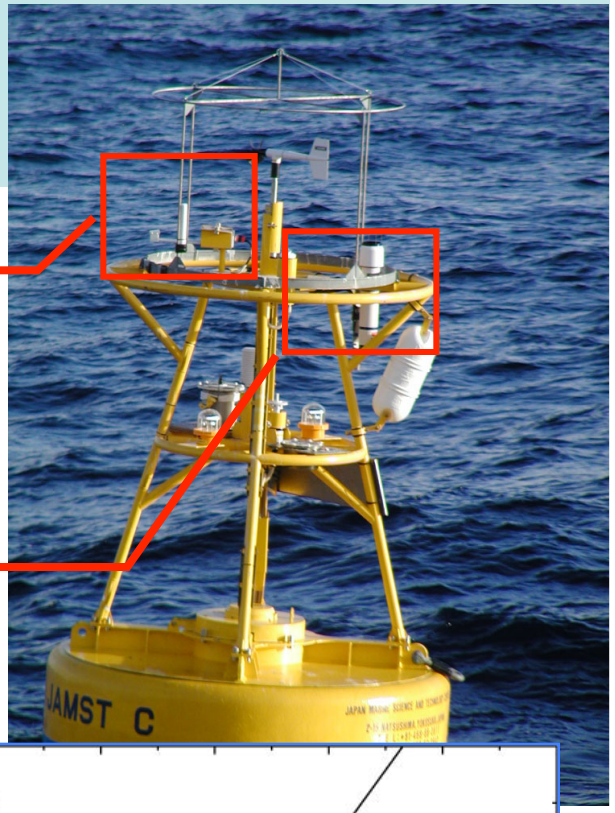

ATLAS

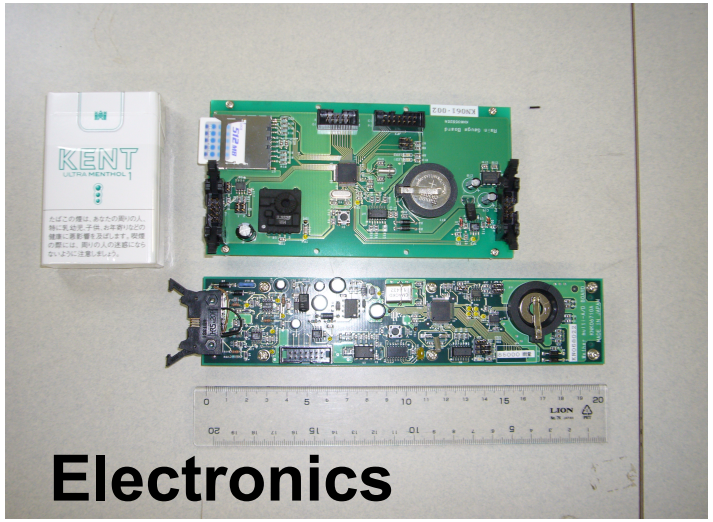

TRITON

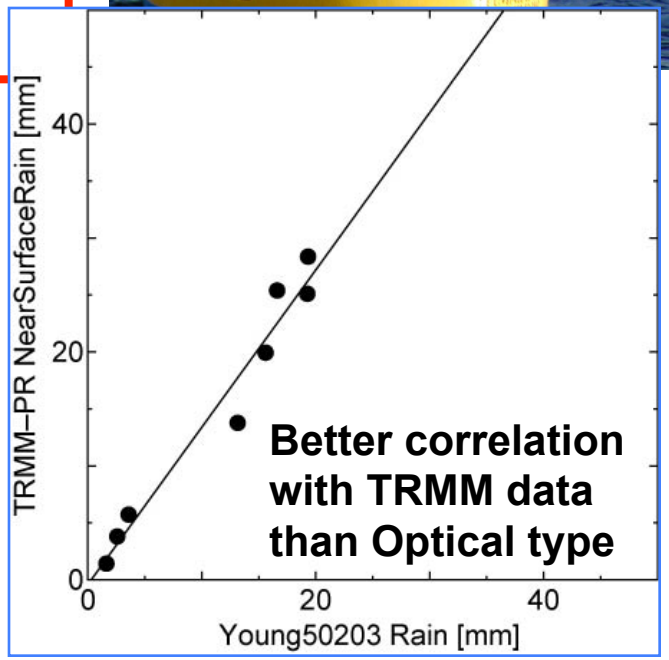
Rain gauge Change

- **Former type: Optical Rain gauge**

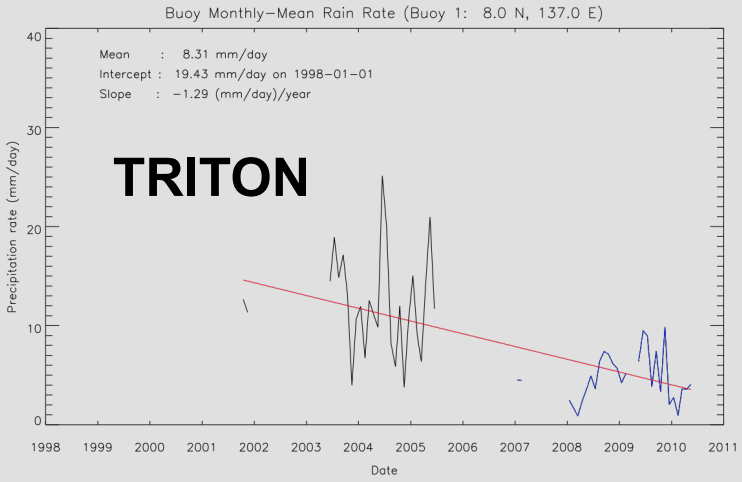
- **New type: Siphon Rain gauge**



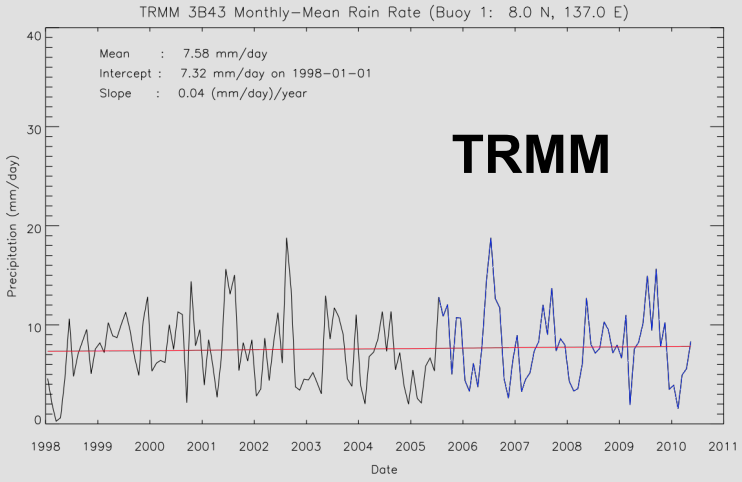


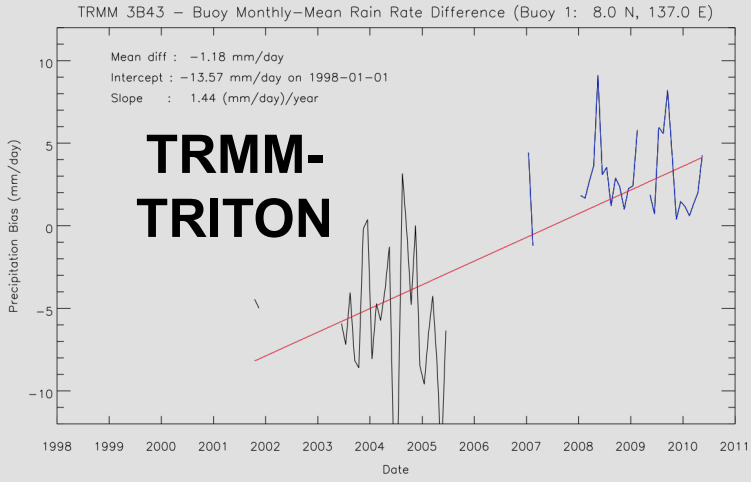


Effect of Change in Instrumentation

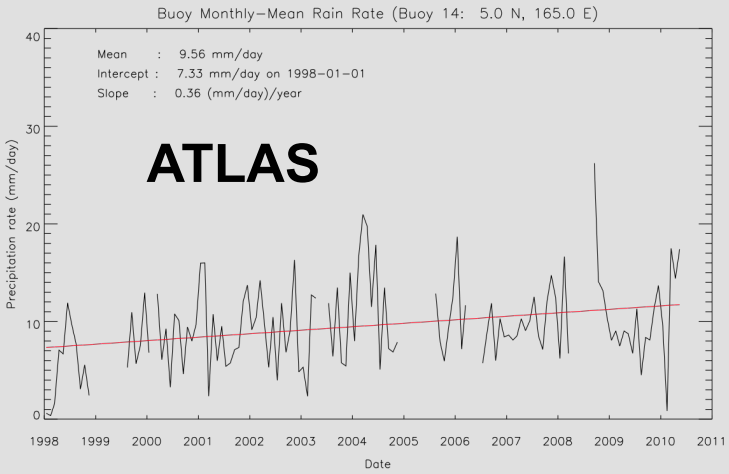


Jump in rain rate measurements due to instrumentation change → contamination of the climate record!





Effect of Change in Instrumentation



8°N, 165°E

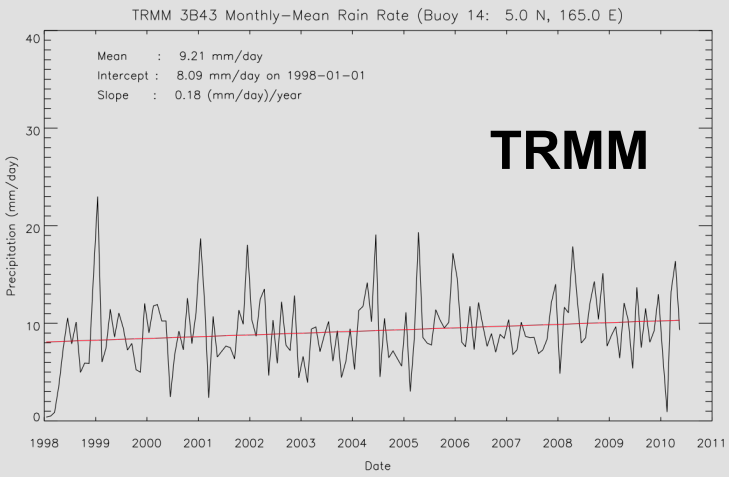
Nichole M. Kinney and Kenneth P. Bowman

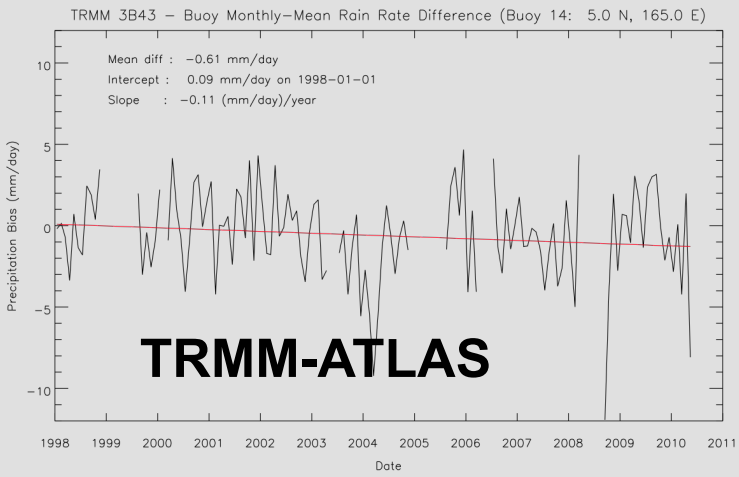
Dept. of Atmospheric Sciences

Texas A&M University

Buoy data from NOAA/PMEL TAO Project

Satellite data from NASA Tropical Rainfall Measuring Mission (TRMM)

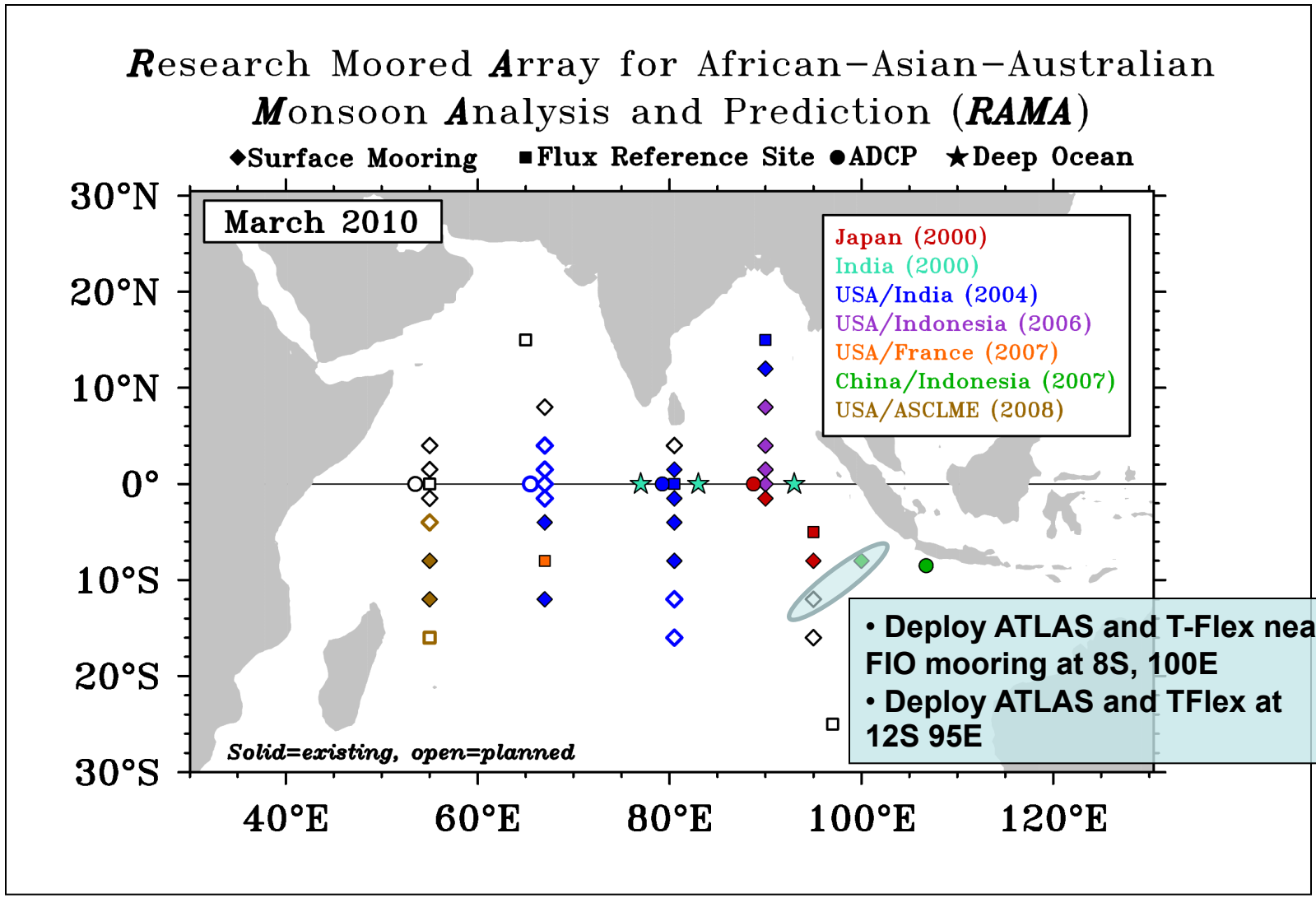




Maintaining Technical Standards

1. Field comparisons (e.g., ATLAS/ TRITON in late 1990s)
2. Shore-based comparisons (ATLAS/ TRITON/IMET in 2000)
3. Exchange of meta-data (as well as data)

Side-by-Side Field Comparisons in 2011



SUPPLEMENT

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

BY M. J. MCPHADEN, G. MEYERS, K. ANDO, Y. MASUMOTO, V. S. N. MURTY, M. RAVICHANDRAN, F. SYAMSUDIN, J. VIALARD, L. YU, AND W. YU

This document is a supplement to "RAMA: The Research Moored Array for African—Asian—Australian Monsoon Analysis and Prediction," by M. J. McPhaden, G. Meyers, K. Ando, Y. Masumoto, V. S. N. Murty, M. Ravichandran, F. Syamsudin, J. Vialard, L. Yu, and W. Yu (*Bull. Amer. Meteor. Soc.*, **90,** xxx–xxx) • ©2009 American Meteorological Society • *Corresponding author:* Dr. Michael J. McPhaden, Pacific Marine Environmental Laboratory, 7600 Sandpoint Way NE, Building 3, Seattle, WA 98115-6349 • E-mail: Michael.J.Mcphaden@noaa.gov • DOI:10.1175/2008BAMS2608.2

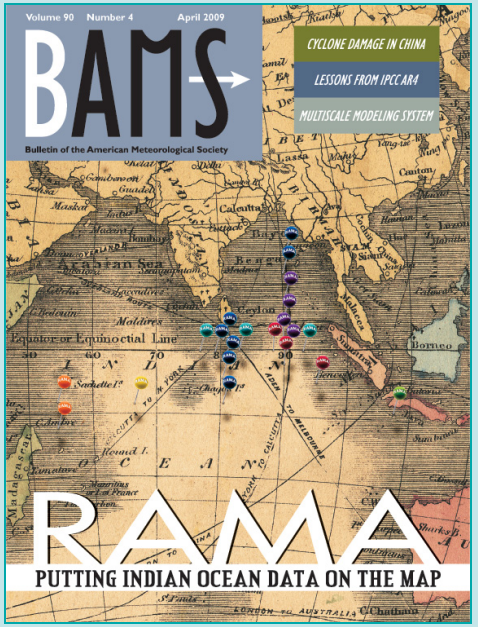
TABLE S1A. (top) Autonomous Temperature Line Acquisition System (ATLAS) mooring meteorological and (bottom) oceanographic sensor specifications. Accuracies listed are based on predeployment and postrecovery calibrations for groups of sensors, and are supplied by the manufacturer (indicated by *), or, in the case of the SonTek current meter, are based on intercomparisons of acoustic Doppler current profiler data of known accuracy. Except for the SonTek current meter, ranges listed are ranges over which instruments are calibrated (tuned for the tropics) rather than over the full range of possible measurements. Data quality control procedures are described in full at www.pmel.noaa.gov/tao/proj_over/qc.html. Adapted from a table published online at www.pmel.noaa.gov/tao/proj_over/sensors.shtml.

Measurement	Model	Range	Resolution	Accuracy
Wind speed	R. M. Young 05103	1–20 m s^{-1}	0.2 m s^{-1}	±0.3 m s^{-1} or 3%
Wind direction	R. M. Young 05103	0°–355°	1.4°	5°
	E. G. and G. 63764 or KVH LP101-5	0°–359°	1.4°	
Air temperature	Rotronic Instrument Corp.: MP-100	14°–32°C	0.01°C	±0.2°C
Relative humidity		55%–95%	0.4% real time 0.02% delayed mode	±2.7%
Rainfall	R. M. Young 50203-34	0–50 mm	0.2 mm h^{-1}	±0.4 mm h^{-1} on 10 min filtered data
Downwelling shortwave radiation	Eppley PSP-TAO, Delrin case	200–1000 W m^{-2}	0.4 W m^{-2}	±2%
Downwelling longwave radiation	Eppley PIR-TAO, Delrin case, 3-output	200 W m^{-2} @ 20°C (thermopile only)	0.1 W m^{-2} 0.03°C	±1% (*)
Barometric pressure	Paroscientific MET1-2	800–1100 hPa	0.1 hPa	±0.01% of reading (*)

Measurement	Model	Range	Resolution	Accuracy
Sea surface and subsurface temperature	Yellow Springs Instruments (YSI) thermistor 46006	6°–32°C	0.001°C	±0.02°C
Sea surface and subsurface conductivity	Sea-Bird Electronics SBE37	3–6 S m^{-1}	0.0001 S m^{-1}	±0.02 psu (equivalent salinity)
	Sea-Bird cell with PMEL electronics	Same as above	0.002 S m^{-1}	Same as above
Water pressure	Paine 211-30-660-01	400–800 psi	0.03 psi	±1.4 psi
Current	SonTek Argonaut	0–600 cm s^{-1}	0.1 cm s^{-1} 0.1°	±5 cm s^{-1} ±5°

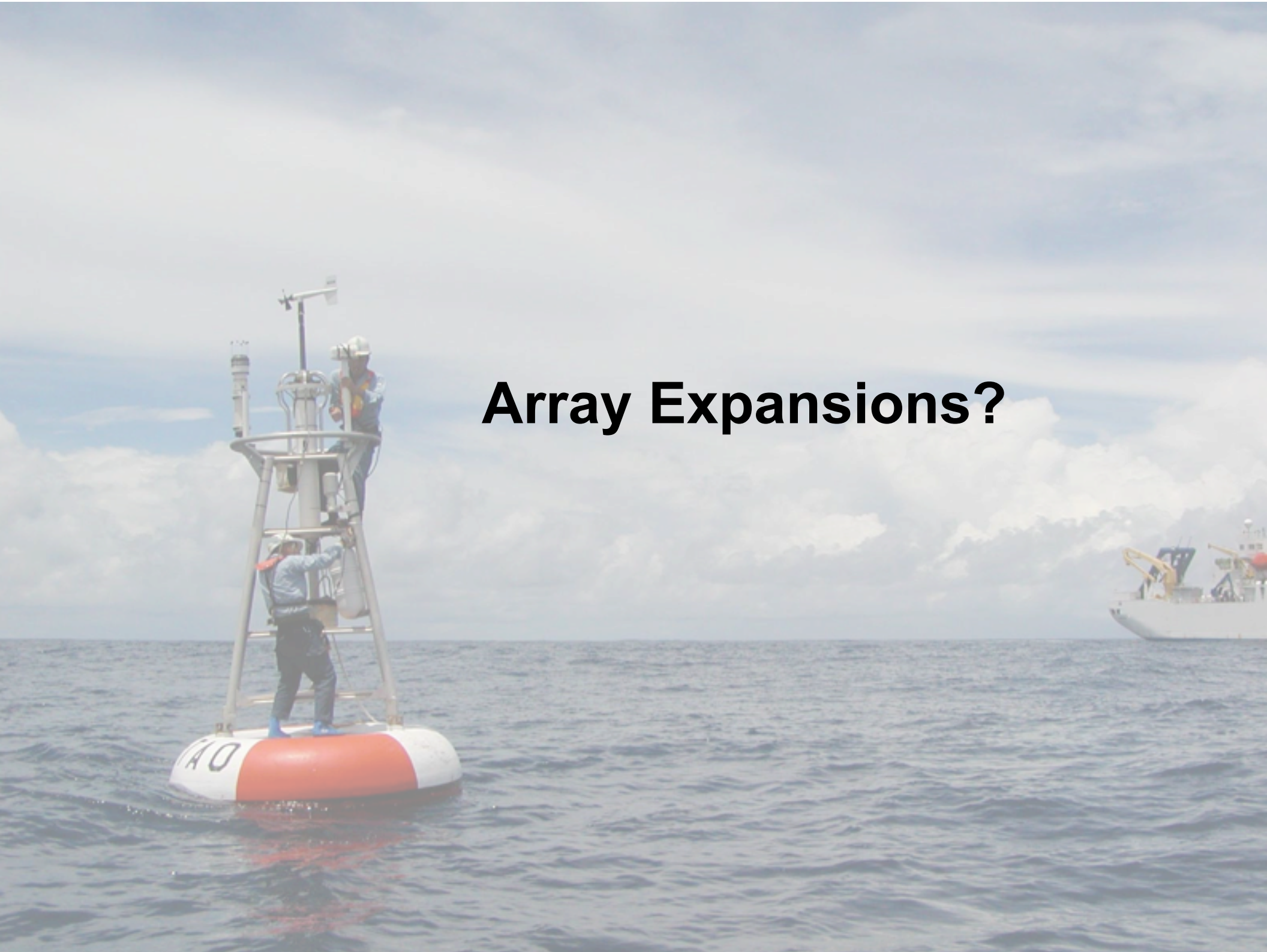
BAMS Supplement to RAMA article (April 2009). Sensor info for:

- **ATLAS**
- **TRITON**
- **m-TRITON**

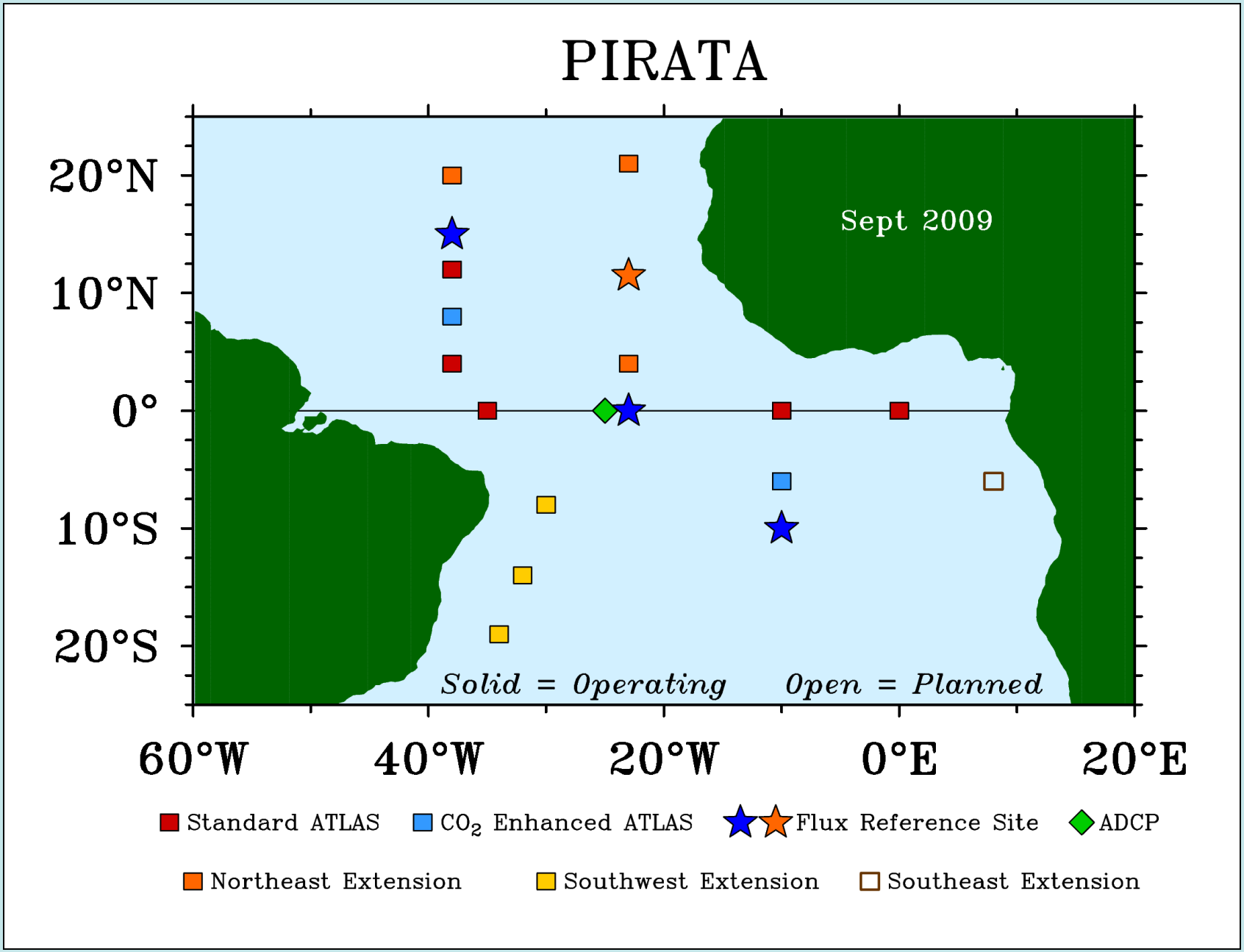


Proposal: Create a TIP Technical Coordination Group & Designate a Lead Coordinator

1. Track system status (# moorings deployed, # sea days used, cruise schedules, etc).
2. Coordinate and/or advise on field comparison studies
3. Maintain a web meta-data base for all mooring systems
4. Other?



Array Expansions?


PIRATA
Sept 2009
20°N
10°N
0°
10°S
20°S
60°W
40°W
20°W
0°E
20°E
Solid = Operating
Open = Planned
Standard ATLAS
CO2 Enhanced ATLAS
Flux Reference Site
ADCP
Northeast Extension
Southwest Extension
Southeast Extension

PIRATA Array Expansion Protocols

1. Interested group submits proposal to PIRATA SSG (scientific rationale, technical feasibility, system compatibility, data policy)
2. Proposal sent out to three reviewers
3. Proposal revised & resubmitted to SSG
4. Successful projects commissioned for three year pilot phase
5. Successful pilot leads to permanent inclusion into array.

Summary

1) Maintaining high technical standards to ensure interchangeability of data sets is essential

2) Recommend establishing a TIP technical coordination group and group leader to advise on standards and track system performance

3) Recommend adopting PIRATA expansion protocols for the TAO/TRITON and RAMA