

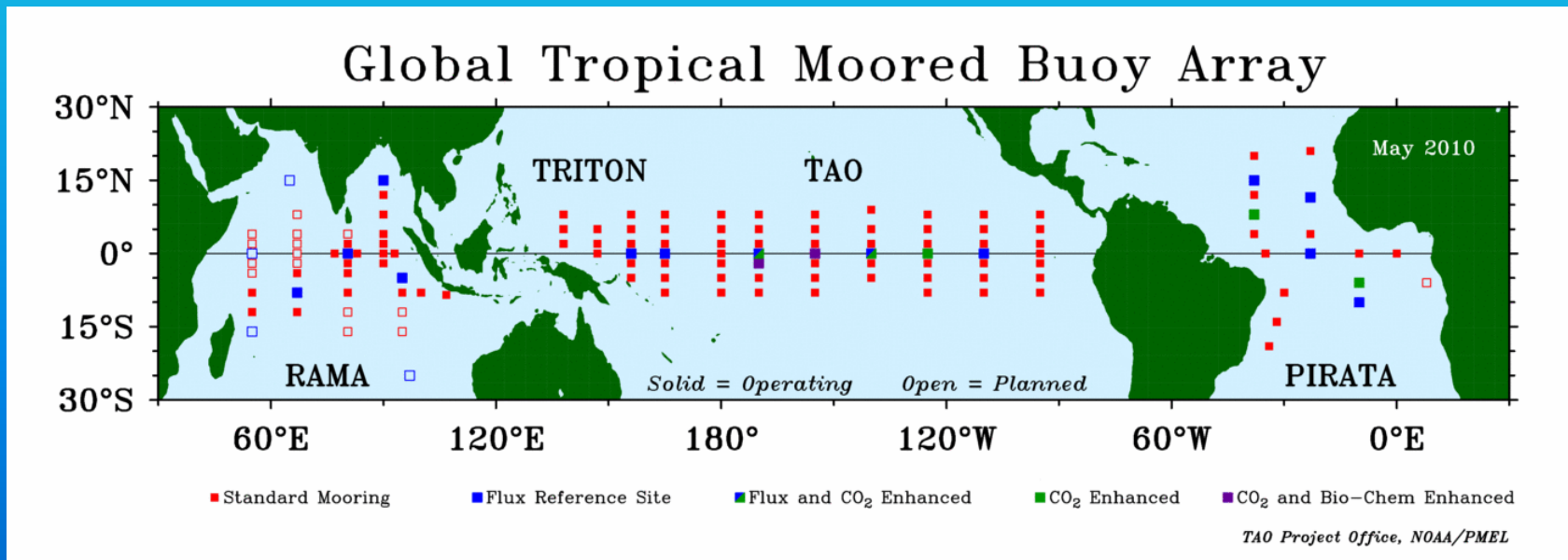
**Comparison of near surface currents measured  
from point Doppler current meters and an ADCP  
from an equatorial PIRATA mooring**

**NortekUSA Users Symposium  
19-21 May 2010  
Seattle, WA**

**Patricia Plimpton & Paul Freitag  
NOAA/ Pacific Marine Environmental Laboratory  
Seattle, WA**

**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

**NOAA Strategic Plan Goal:**  
Understanding climate variability and change to enhance society's ability to plan and respond.



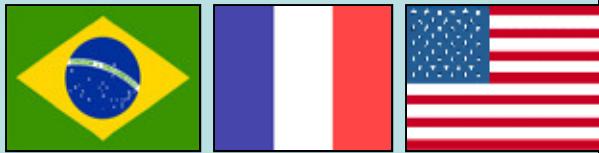
Information and data available at [www.pmel.noaa.gov/tao/global/global.html](http://www.pmel.noaa.gov/tao/global/global.html)

# PIRATA

## Goals:

- 1) Describe, understand and predict processes controlling SST
- 2) Understand the role of ocean-atmosphere interactions in West African Monsoon, NE Brazil drought & Atlantic hurricane activity
- 3) Identify internal vs remote climate influences in the tropical Atlantic

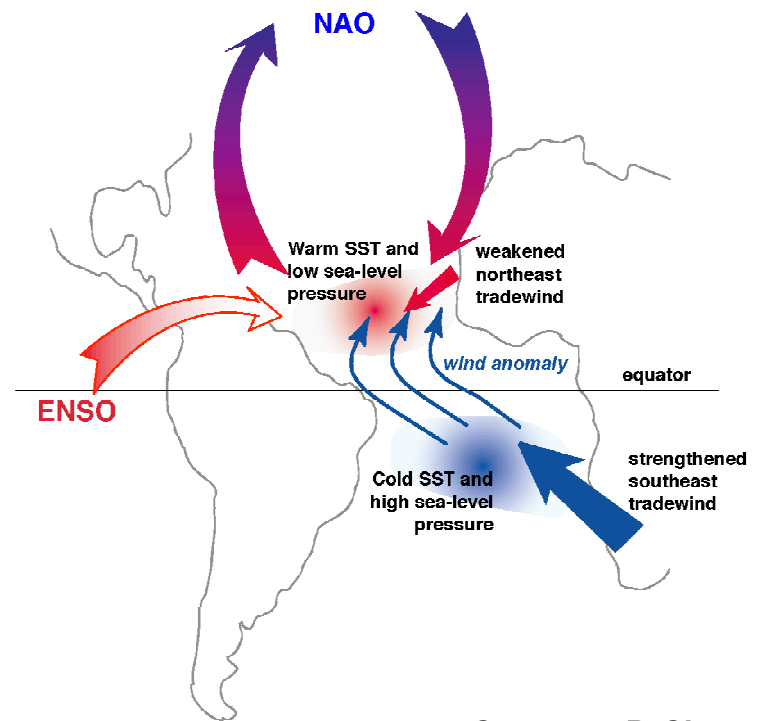
## Partners:



✓ Brazil & France provide logistic support & most ship time

✓ USA (NOAA) provides most mooring equipment & data processing

## Mechanisms of Tropical Atlantic Variability



Courtesy, P. Chang

Bourles et al, 2008

## THE PIRATA PROGRAM

History, Accomplishments, and Future Directions\*

BY BERNARD BOURLES, RICK LUMPKIN, MICHAEL J. MCPHADEN, FABRICE HERNANDEZ, PAULO NOBRE, EDMO CAMPOS, LISAN YU, SERGE PLANTON, ANTONIO BUSALACCHI, ANTONIO D. MOURA, JACQUES SERVAIN, AND JANICE TROTTE

A network of deep ocean moored buoys in the tropical Atlantic, developed through a multinational partnership and maintained from 1997, provides unique data for climate research and prediction.

**T**he Pilot Research Moored Array in the tropical Atlantic (PIRATA) was developed as a multinational observation network established by Brazil, France, and the United States to improve our knowledge and understanding of ocean-atmosphere variability in the tropical Atlantic Ocean. The variability of the ocean-atmosphere system in the tropical Atlantic, from intraseasonal to multidecadal time scales, strongly influences regional variations in rainfall, and consequently the economies of the adjacent continental regions. For example, variations in the intertropical convergence zone (ITCZ) and the West African monsoon affect rainfall and droughts in Africa and northeastern Brazil. ▶

Deployment of an ATLAS buoy from the RV Atalante during the Pirata-FR11 campaign (November 2001). Photo by Jacques Servain, IRD.

\*NOAA/Pacific Marine Environmental Laboratory Contribution Number 3124.

## PIRATA

August 2008



### Highlights:

- 1) *Advances in understanding SST*
- 2) *New discoveries (e.g. role of intraseasonal variability)*
- 3) *Development of new ocean & climate analysis & forecast systems*

# PIRATA Current Meter Experiment

Scientific Focus: Momentum Transfer from Atmosphere to Ocean

## Background:

Wind stress is a main driver of ocean circulation. Understanding how it forces the upper ocean is central to interpreting observations and developing reliable dynamical ocean models.

## Objectives:

- a) Examine the dependence of eddy diffusivity ( $A$ ) on wind stress, vertical shear, stratification, Richardson number, and other large scale properties.
- b) Test the validity of conventional parameterizations for  $A$  in the equatorial cold tongue of Atlantic.

## Technical Issues:

- a) Bias of profilers by other instruments or fish.
- b) Comparison of point current meters to profiler.

$$\vec{\tau} = A \frac{\partial \vec{u}}{\partial z}$$

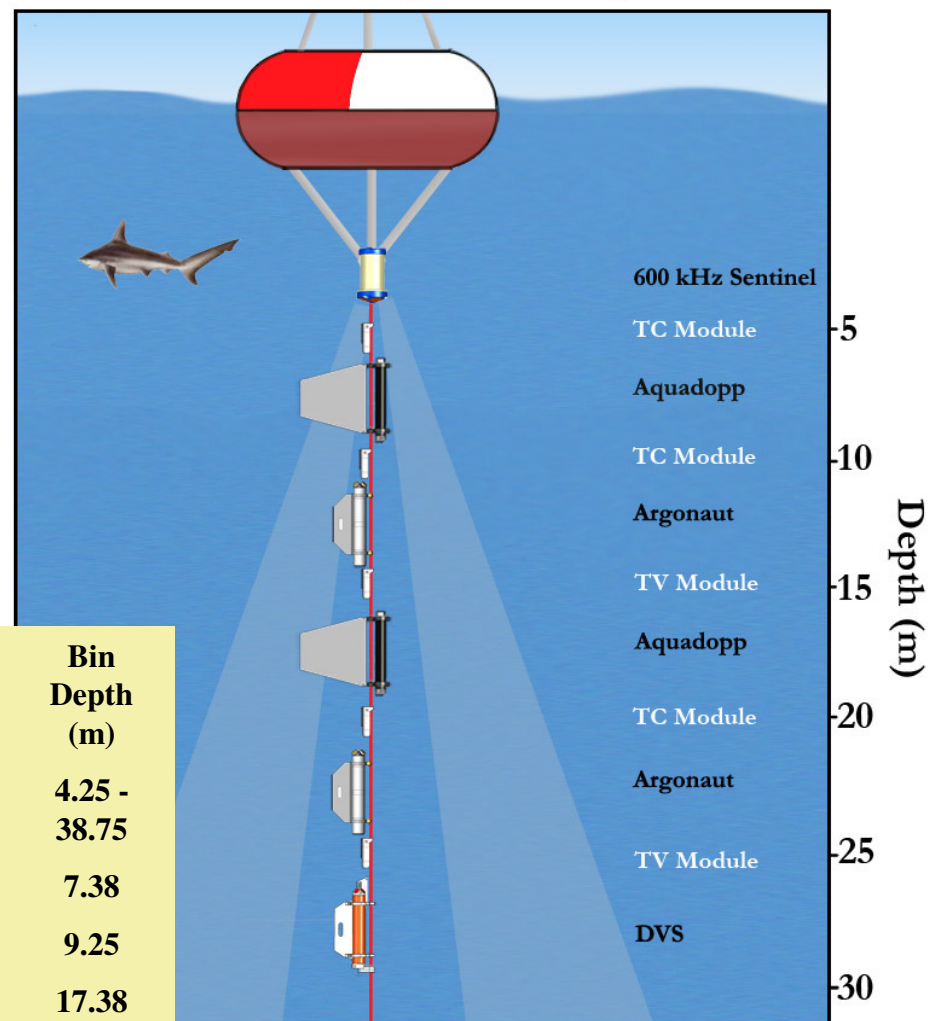
# PIRATA Current Meter Experiment

Deployed 13 Oct 08

Recovered 18 Jun 09



Current Meter Experiment 0°, 23°W



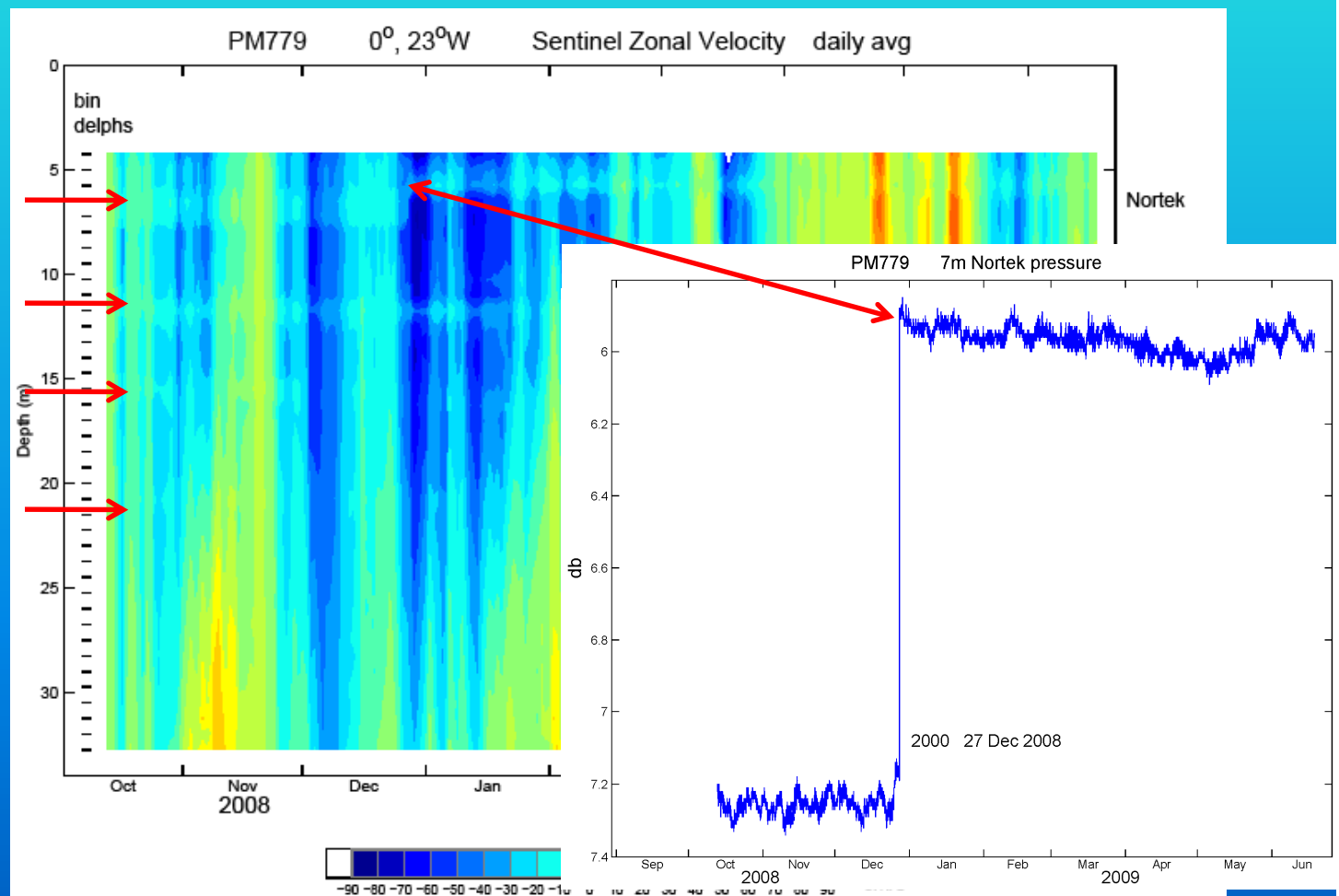
Instrument	Freq.	Head Depth (m)	N Bins	Bin Width (m)	Bin Depth (m)
RDI Sentinel	600 KHz	2	47	0.75	4.25 - 38.75
Nortek Aquadopp	2.0 MHz	7	1	0.75	7.38
Sontek Argonaut	1.5 MHz	12	1	2.5	9.25
Nortek Aquadopp	2.0 MHz	17	1	0.75	17.38
Sontek Argonaut	1.5 MHz	22	1	2.5	19.25
RDI DVS	2.4 MHz	27	5	0.5	23.75 - 25.75

# PIRATA Current Meter Experiment

Deployed 13 Oct 2008

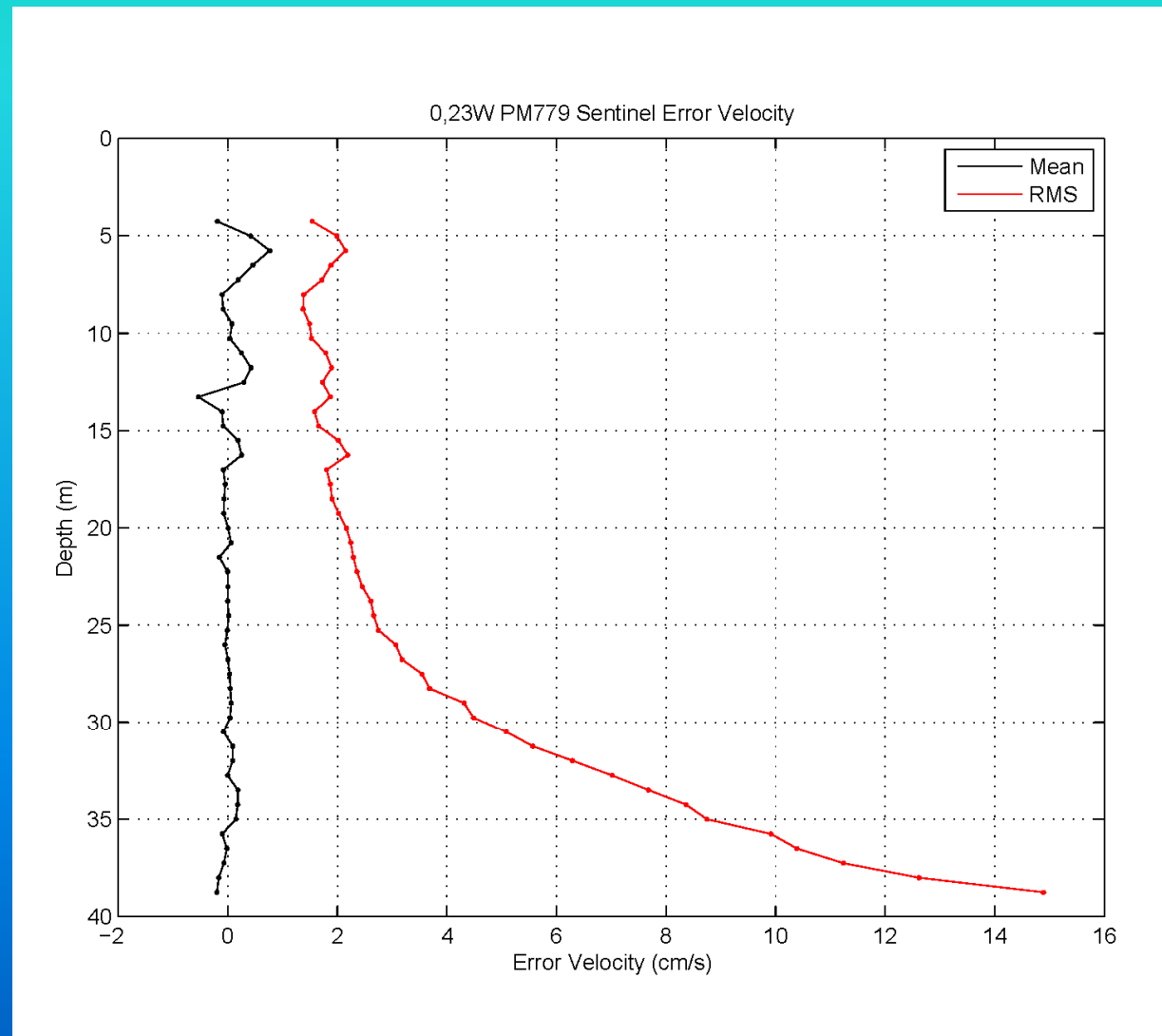
Recovered 18 Jun 2009

ADCP returned complete high temporal (hourly) and vertical (0.75 m) resolution data. Data at a few levels are biased by signal returned from point Doppler current meters



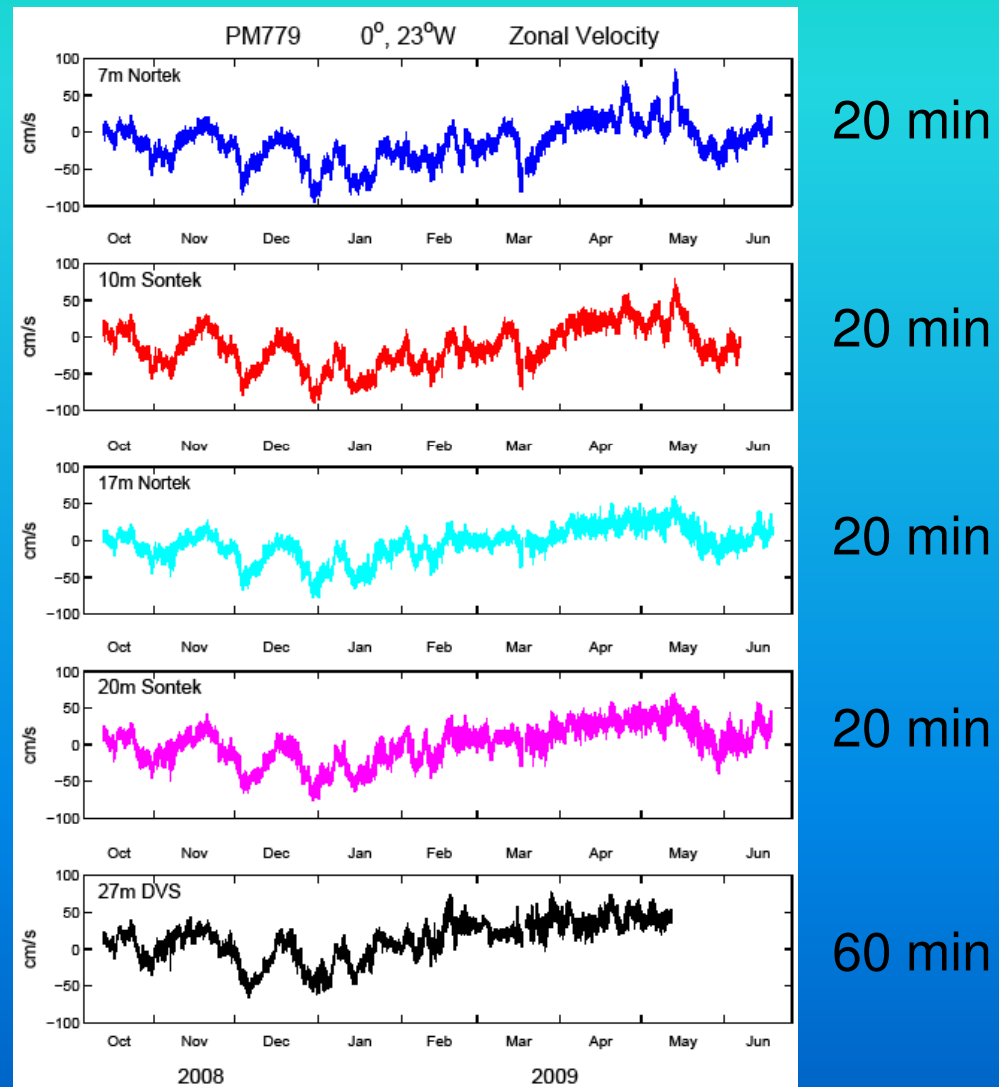
# PIRATA Current Meter Experiment

- **Mean Error Velocity near zero at all depths.**
- **Evidence of inline instruments.**
- **RMS relatively constant down to 20 m, below which it increases rapidly**



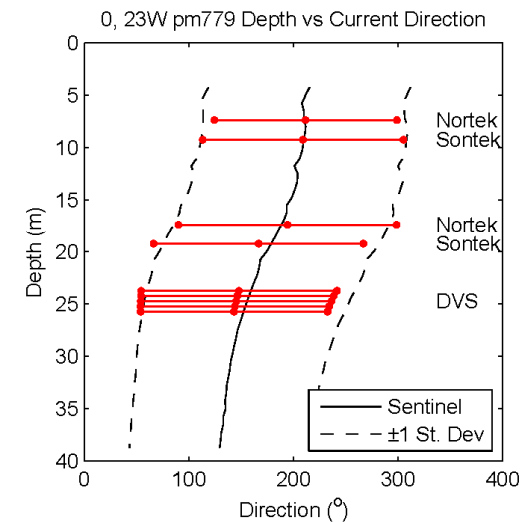
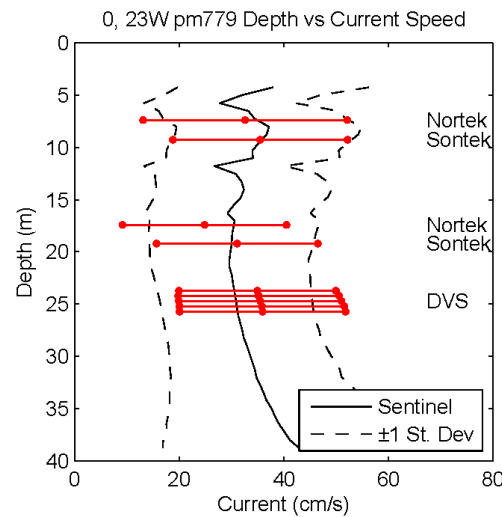
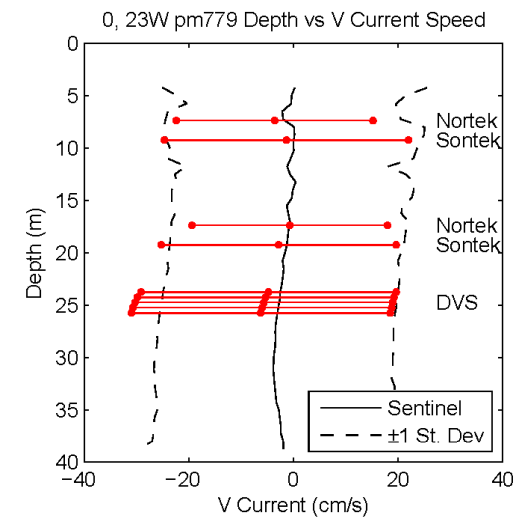
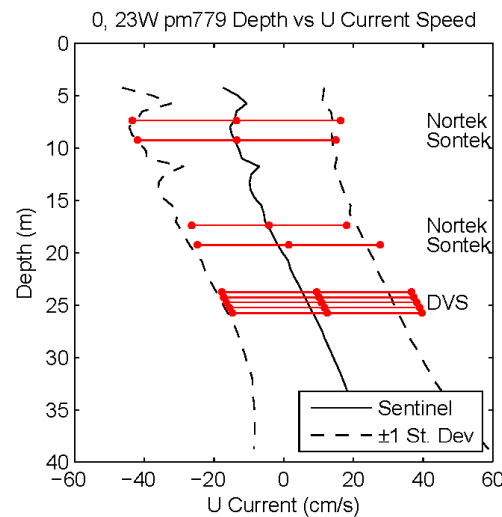
# PIRATA Current Meter Experiment

- Point Doppler current meters returned nearly complete high-resolution time series.
- Time series are comparable to first order.
- Some features are depth dependent.



# PIRATA Current Meter Experiment

- Mean and s.d. of hourly Sentinel and point Doppler.
- Point Doppler measurement cells are outside Sentinel cells biased by inline instruments.
- Mean and s.d. are comparable, some better than others.
- Similar vertical shear (including 5 DVS cells).



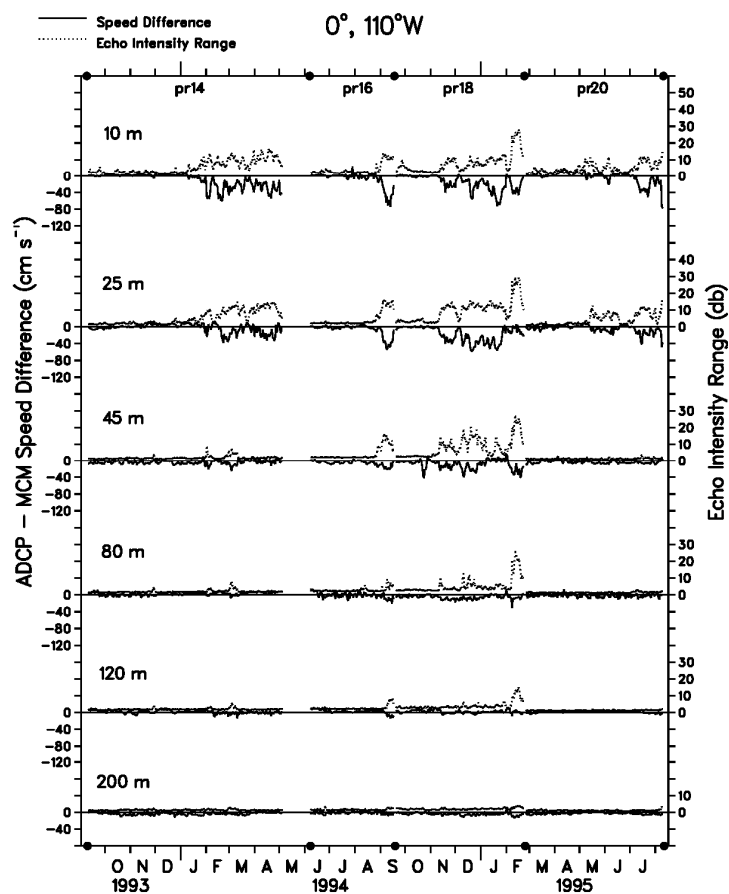
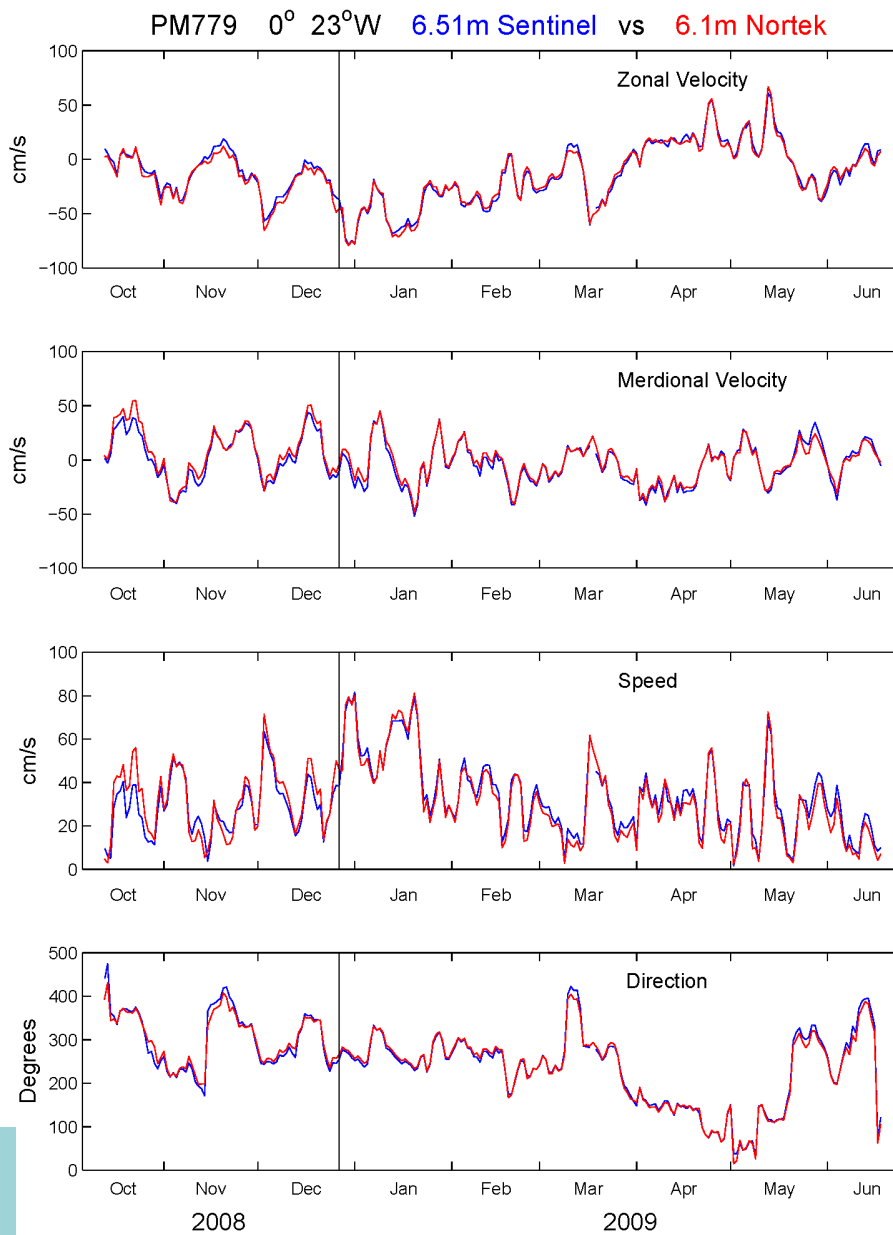


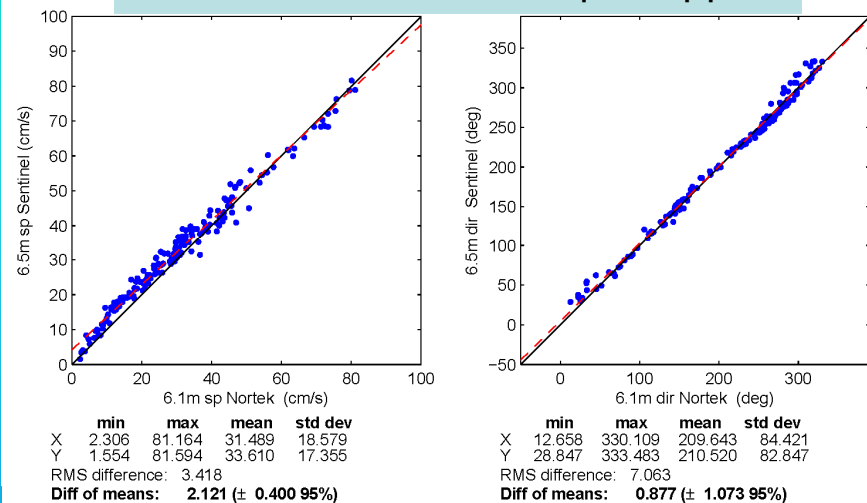
Figure 5: Time series of ADCP-MCM speed difference and echo intensity range for four deployments at  $0^\circ, 110^\circ\text{W}$ . Deployment and recovery times of the moorings are shown by black dots at the abscissas. At 10 m depth, the ADCP speed data have been linearly extrapolated from the bin 1 depth of 14 m for the comparison.



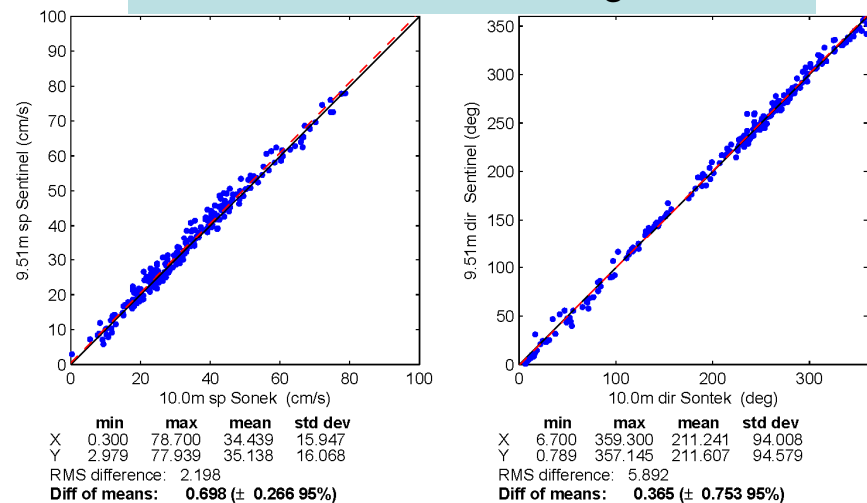
# PIRATA Current Meter Experiment

## Daily Averaged Data

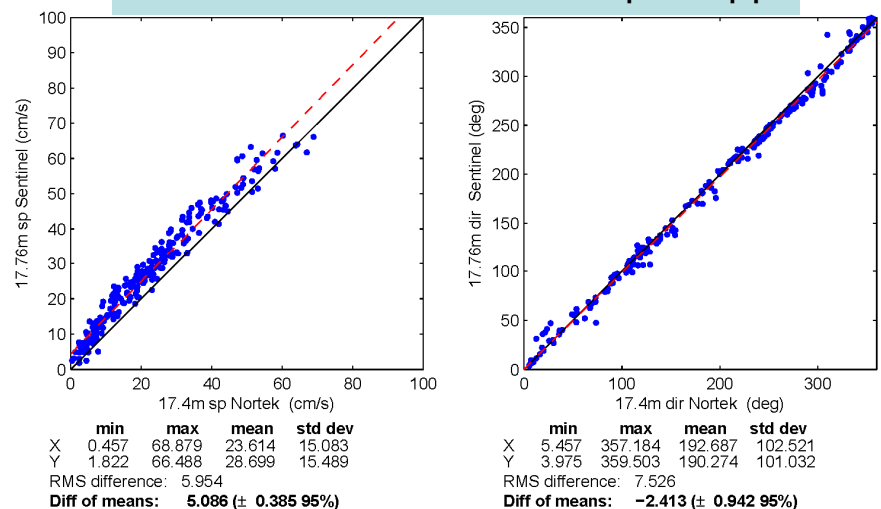
### 6.5m Sentinel - 6.1m Aquadopp



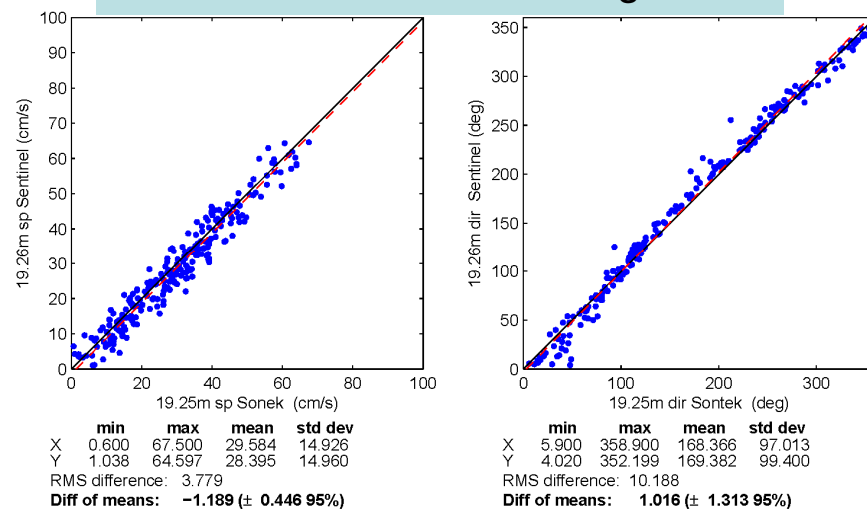
### 9.5m Sentinel - 9.3m Argonaut



### 17.8m Sentinel - 17.4m Aquadopp



### 19.3m Sentinel - 19.3m Argonaut



# PIRATA Current Meter Experiment

## Daily Averaged Data

	Current Speed			Current Direction*		
	Mean Difference (cm/s)	RMS Difference (cm/s)	R	Mean Difference (Deg.)	RMS Difference (Deg.)	R
6.5 m Sentinel 6.1 m Aquadopp	2.1	3.4	0.99	0.9	7.1	1.00
9.5m Sentinel 9.3 m Argonaut	0.7	2.2	0.99	0.4	5.9	1.00
17.8 m Sentinel 17.4 m Aquadopp	5.1	6.0	0.98	-2.4	7.5	1.00
19.3 m Sentinel 19.3 m Argonaut	-1.2	3.8	0.97	1.0	10.2	0.99
26.0 m Sentinel 26.4 m DVS	-4.8	8.4	0.88	-8.3	16.8	0.99

\*For Speed > 5 cm/s.

Sentinel compass corrected for hardware bias.

# PIRATA Current Meter Experiment

## Summary

- **Preliminary** analysis indicates that profilers and single-point current meters can produce comparable near-surface velocity measurements.
- Daily mean (RMS) speed differences of  $\sim 2$  cm/s ( $\sim 4$  cm/s) are attainable.
- Daily mean (RMS) direction differences of  $\sim 2^\circ$  ( $\leq 10^\circ$ ) are attainable.
- Mooring design and instrument sampling schemes must be carefully planned to reduce interference between instruments.