



A Comparison of Near Surface Current Measurement Methods

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Motivation

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Near Surface Processes

- Oil Spill Tracking
- Freshwater Layer
- Suspended Sediments
- Harmful Algal Blooms
- Search and Rescue



Inherent Difficulties

- Blanking Distance
- Sidelobe Contamination
- Near Surface Velocity
Low Bias
(Mayer et al. 2007)
J. Atmos. and Oceanic Tech





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Goals

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- Experiment with Near Surface Measurement Methods
 - Aquadopp Surface Current Meter (ASCM)
 - Vector Acoustic Doppler Velocimeter (Vector)
- Evaluate Performance of Aquadopp Surface Current Meter
 - Data Quality?
 - New Information?

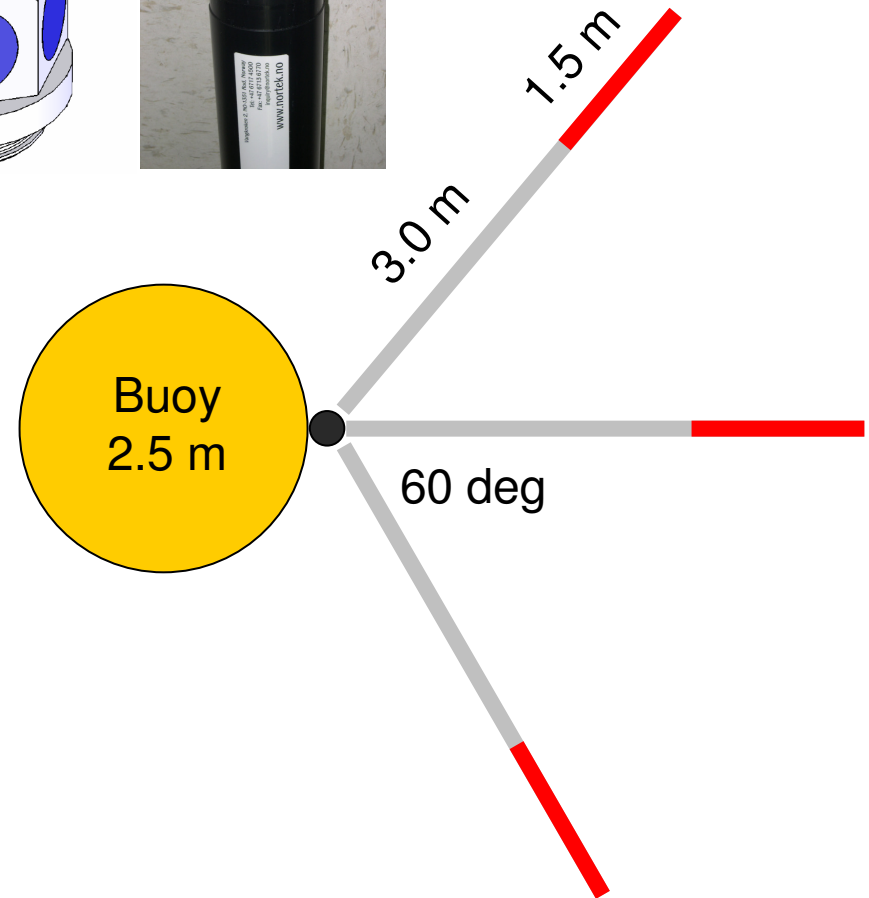
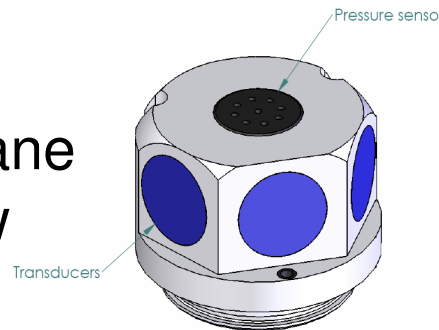


Aquadopp Surface Current Meter

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- Acoustic beams in narrow horizontal plane positioned just below surface.
- Adjustable blanking distance.
- Measures heading, pitch & roll at 1 Hz.
- Transforms velocities into North (v) & East (u) coordinates.
- Internal batteries & memory or on-line.



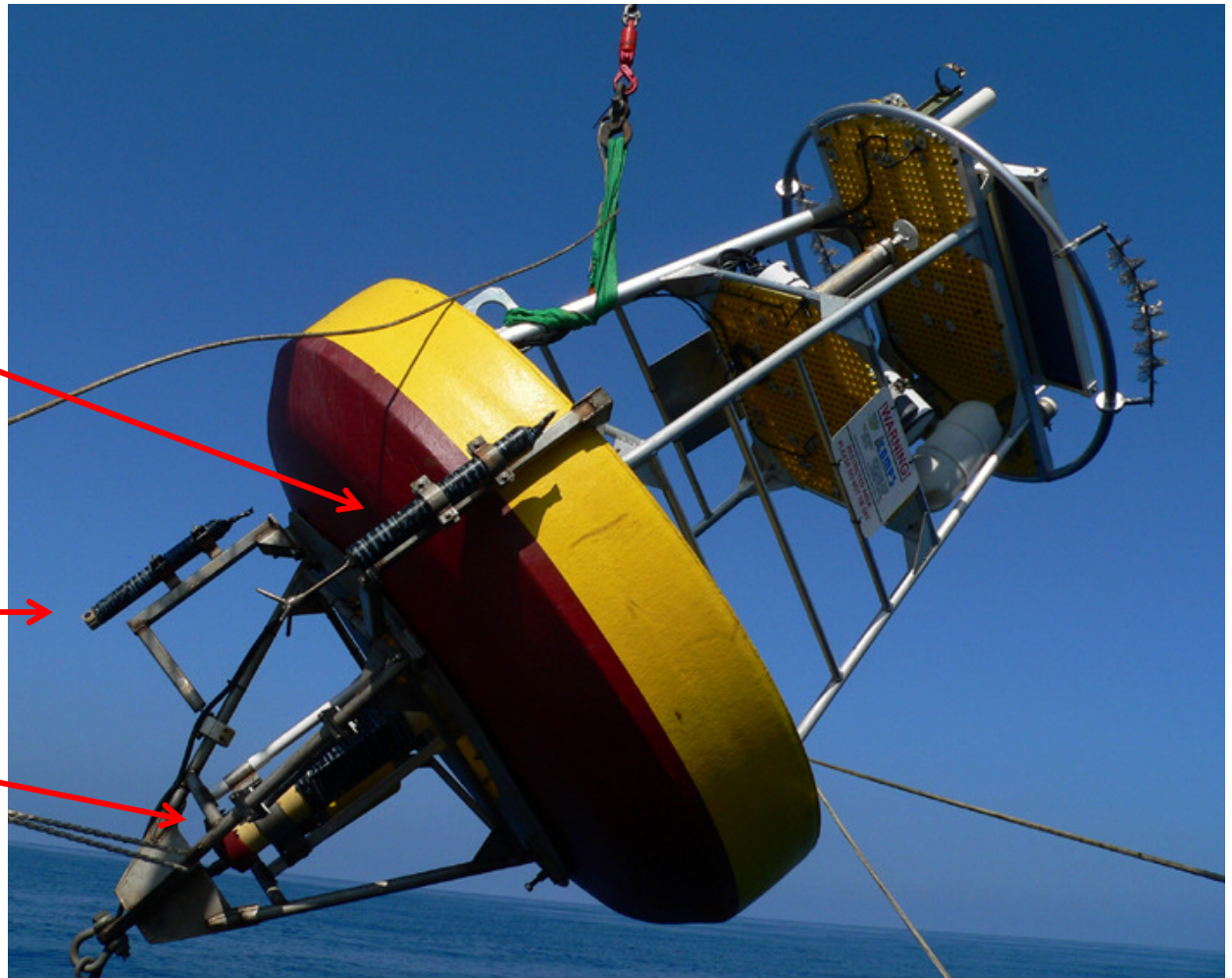


Buoy Installation – USF C10

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- Vector Velocimeter
- Aquadopp Surface Current Meter (ASCM)
- 600 kHz ADCP





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Buoy Installation – USF C10

- Vector Velocimeter (0.8 m)
- Aquadopp Surface Current Meter (1.1 m)
- ADCP (4.0 – 21.0 m)

0.0 m

0.8 m

1.1 m

4.0 – 21.0 m





Deployment Site

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Buoy Location

- West Florida Shelf
- 35 km offshore Sarasota, Florida
- 25 m isobath
- 1.5 month deployment (July-August 2006)



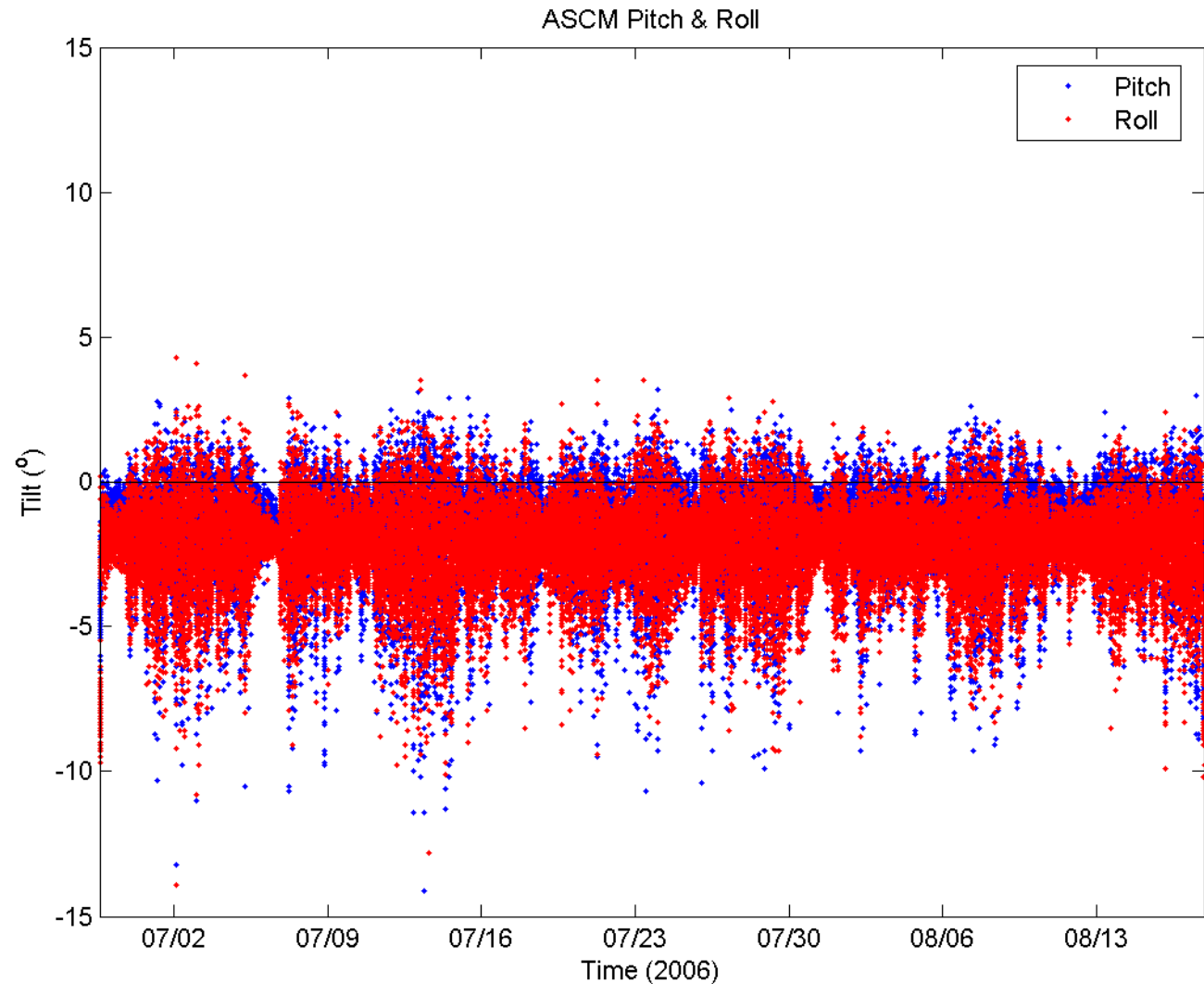


Buoy Performance

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- Typical pitch & roll is $\pm 2^\circ$ to 5°
- Maximum is 10°
- Tilt greater than 15° could allow acoustic beams to touch surface



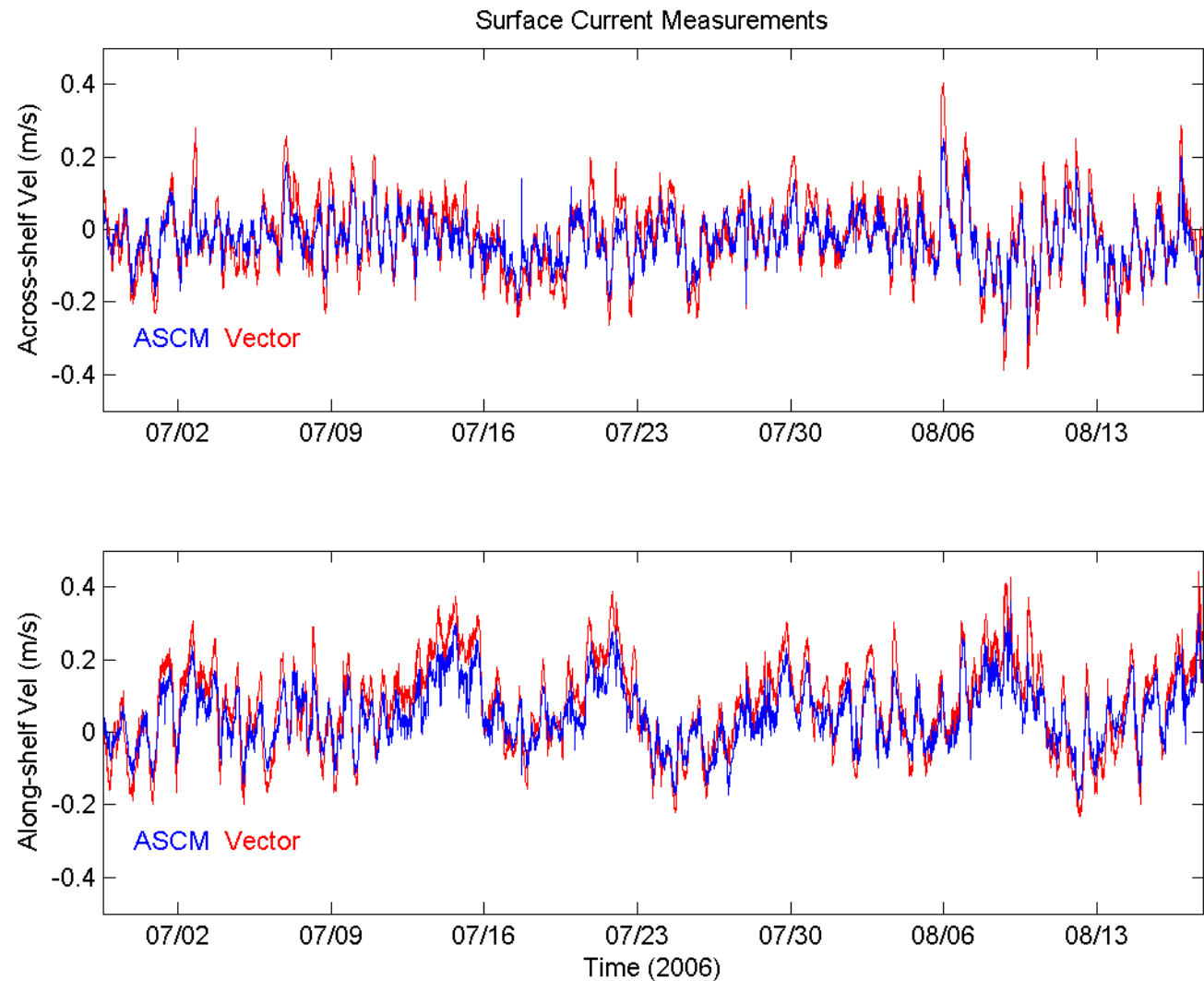


Near Surface Current Measurements

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- ASCM & Vector show similar current patterns
- Vector shows consistently higher magnitudes





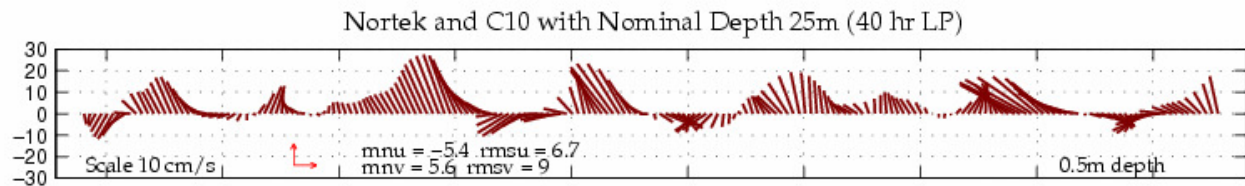
ADCP Current Measurements

40 hour low pass filtered

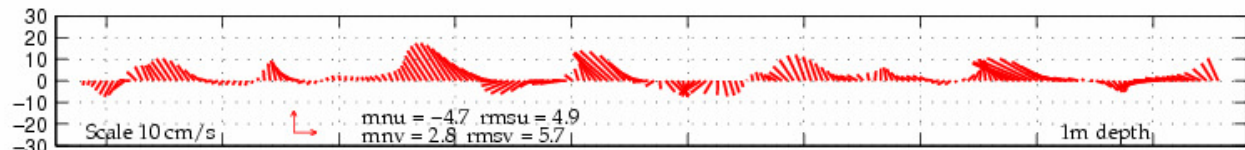
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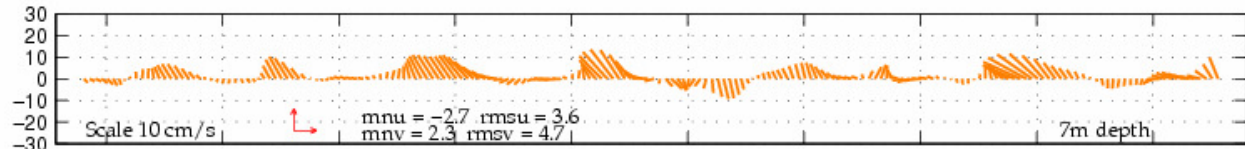
Vector (0.8 m)



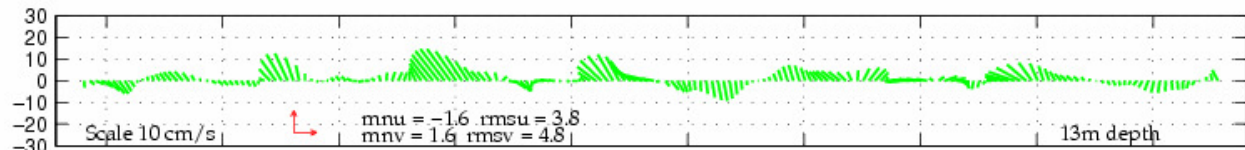
ASCM (1.1 m)



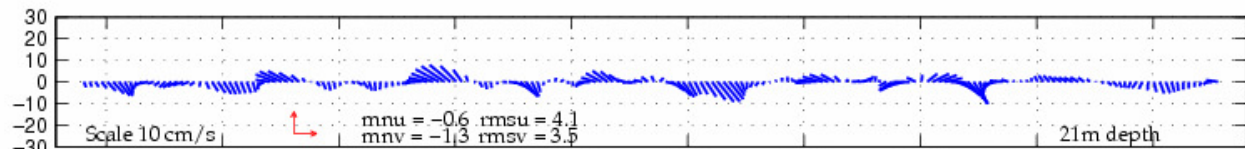
ADCP (7 m)



ADCP (13 m)



ADCP (21 m)



06/30 07/05 07/10 07/15 07/20 07/25 07/30 08/04 08/09 08/14
2006



Rotary Cross Spectra

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- Rotary cross spectra describes the frequency dependence of the velocity field between two independent measurements.
- The quantities computed include:
 - Correlation squared (ρ^2)
 - Phase lag (θ)
 - Veering angle (α)
 - Relative ellipse orientation (φ)
 - Transfer function (gain)



Amplitude & Gain

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	Synoptic Band (0.005 cph)		M2 Tidal Band (0.081cph)	
	Amplitude	Gain	Amplitude	Gain
Vector (0.8 m)	13.3 cm/s	1.73	6.4 cm/s	1.39
ASCM (1.1 m)	9.1 cm/s	1.18	4.9 cm/s	1.07
ADCP (4.0 m)	7.5 cm/s	0.97	4.3 cm/s	0.95
ADCP (7.0 m)	7.7 cm/s	1.00	4.6 cm/s	1.00

Current amplitude and gain (relative to ADCP at 7 m) for peak correlation (>0.95) at tidal and synoptic bands.



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Rotation Angle

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Observation	Synoptic Band (40 hr low pass filtered)	M2 Tidal Band (0.081cph)
	Rotation	Rotation
Vector (0.8 m)	-23°	+29°
ASCM (1.1 m)	-35°	+33°
ADCP (4.0 m)	-30°	+35°
ADCP (7.0 m)	-34°	+31°
ADCP (13.0 m)	-35°	+32°

Rotation angle is degrees with respect to North.



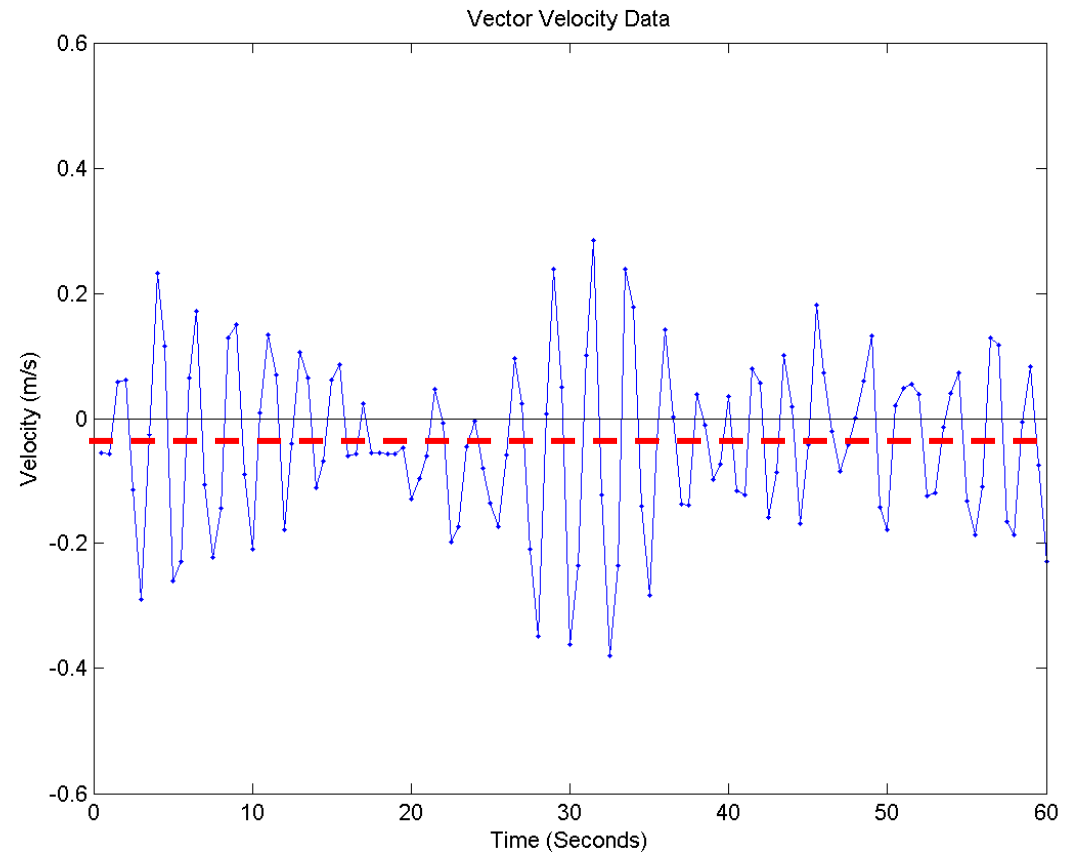
Buoy Motion & Averaging

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Buoy Motion

- Diagnostic mode measures & logs velocity at 1 Hz (ASCM & Vector)
- Measure combination of:
 - Buoy motion
 - Wave orbital velocity
 - Mean current





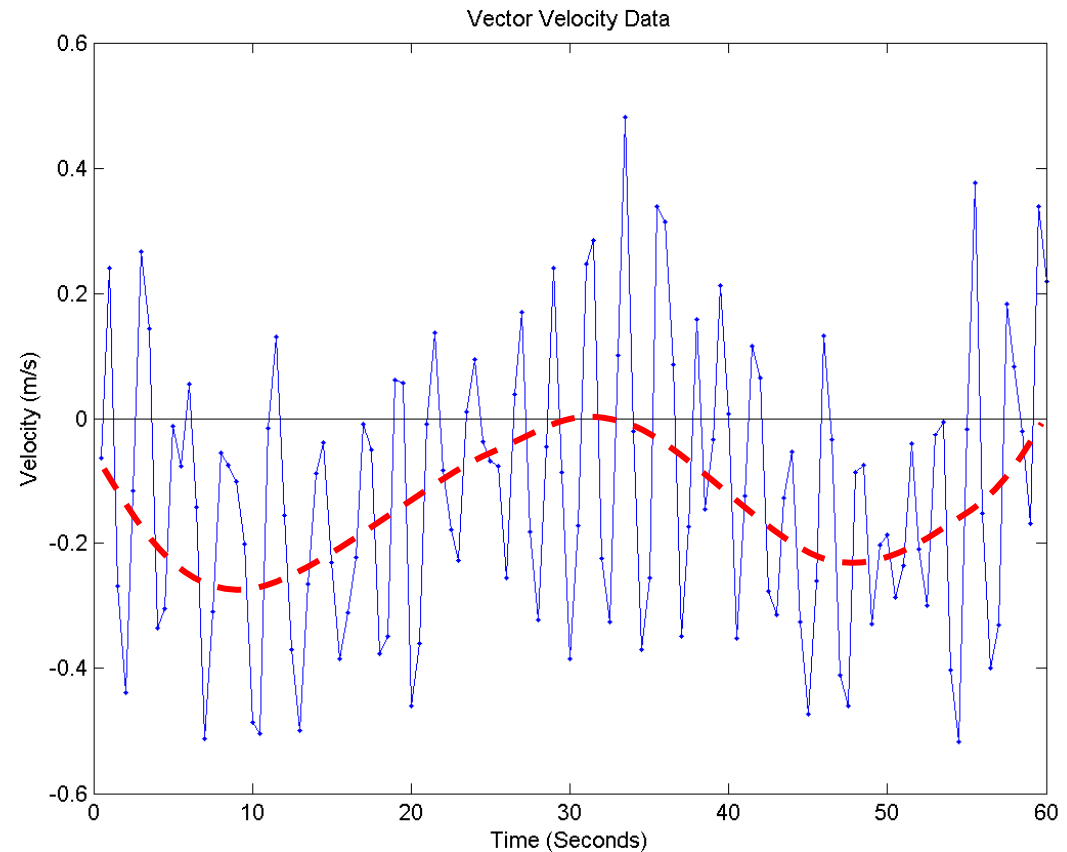
Buoy Motion & Averaging

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Buoy Motion

- Diagnostic mode measures & logs velocity at 1 Hz (ASCM & Vector)
- Measure combination of:
 - Buoy motion
 - Wave orbital velocity
 - Mean current
- Buoy motion responding to wave groups or wind gusts?



30 - 60 sec period



Summary

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- Velocity shear between ADCP (7 m) and ASCM (1.1 m):
 - 7% gain at tidal band
 - 18% gain at synoptic band
- Different gains are consistent with barotropic (tidal) vs baroclinic (synoptic) forcing.
- Negligible near-surface velocity rotation in both tidal and synoptic bands compared to 7 m ADCP measurement.
- ADCP velocity at 4 m showed low-bias (3 - 5%) in both bands and direction inconsistent with measurements above and below 4 m.



Conclusions

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- Data from Aquadopp surface current meter (ASCM) were of good quality and provide robust near-surface velocity measurements 1.1 m below surface in open ocean setting.
- Validated data can provide important information on speed and direction of near-surface currents.
- Buoy motion is an important variable to understand better and account for in data collection settings such as average interval and blanking distance.
- Near-surface measurements from the Vector (0.8 m) indicate correct signs for rotation, but the large rotation and shear suggests a very strong surface Ekman layer, flow disturbance, or perhaps a realization Stokes drift.