Sediment Transport Measurements from the Coastal Ocean Monitoring Program in Onslow Bay, North Carolina

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STUDY OBJECTIVES

- Quantify sediment transport at a mid continental shelf location adjacent to a marine hardbottom

- Identify physical forcing mechanisms
  - fair weather
  - storms
  - Seasonal variations

- Evaluate impacts of geologic disturbances on benthic communities

Study Rationale

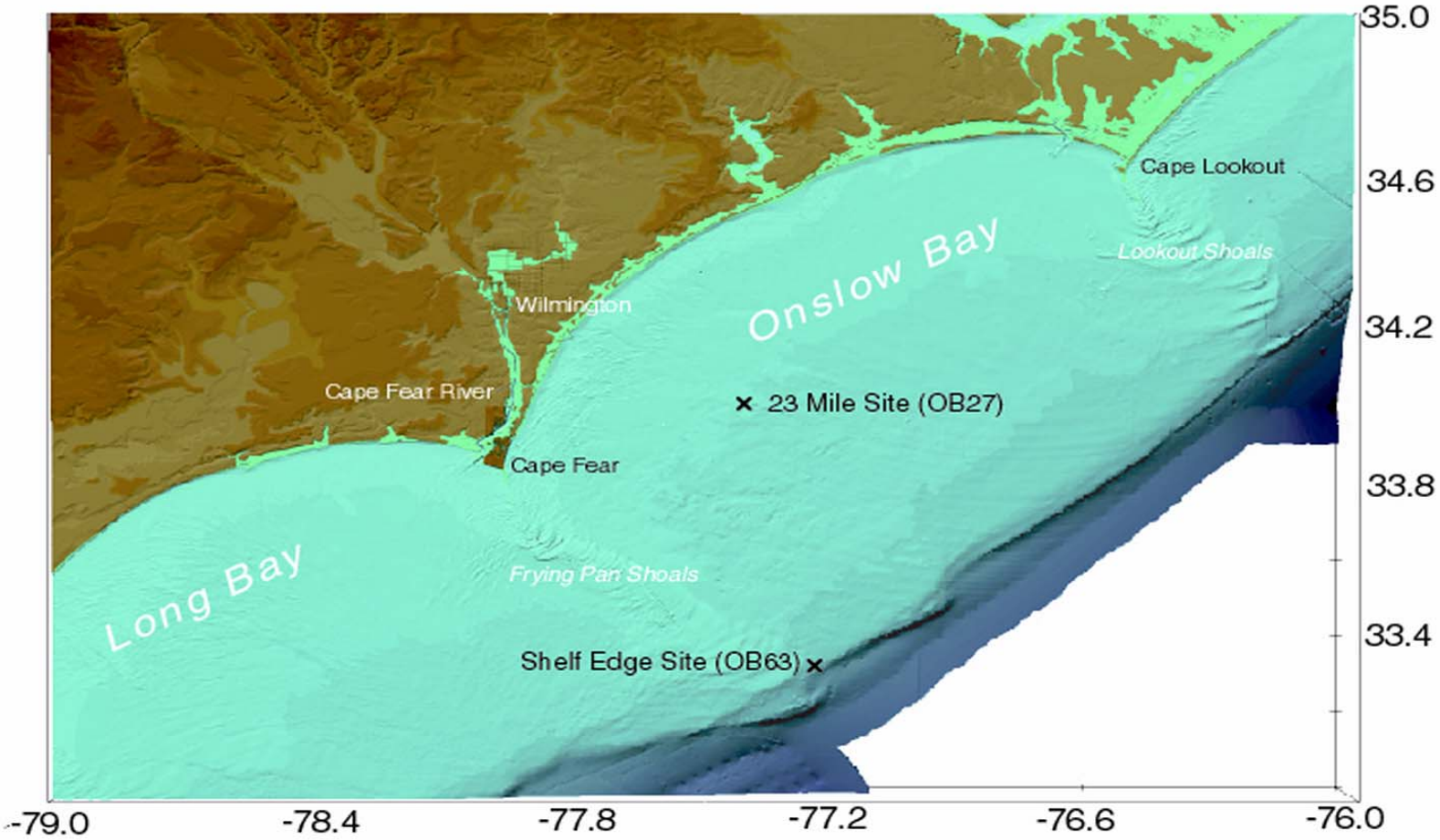
- Few long-term measurements of both physical and geological aspects of the continental shelf (especially on the mid to outer shelf)
- Limited understanding of:
  - how and when sediments are transported across the continental shelf
  - what are the factors (e.g. water column dynamics and sediment mobility) controlling benthic community structure
- Data are critical to the development of:
  - process-oriented, predictive models of sediment transport
  - management strategies for utilization of offshore sand resources and commercial fisheries

Hypotheses

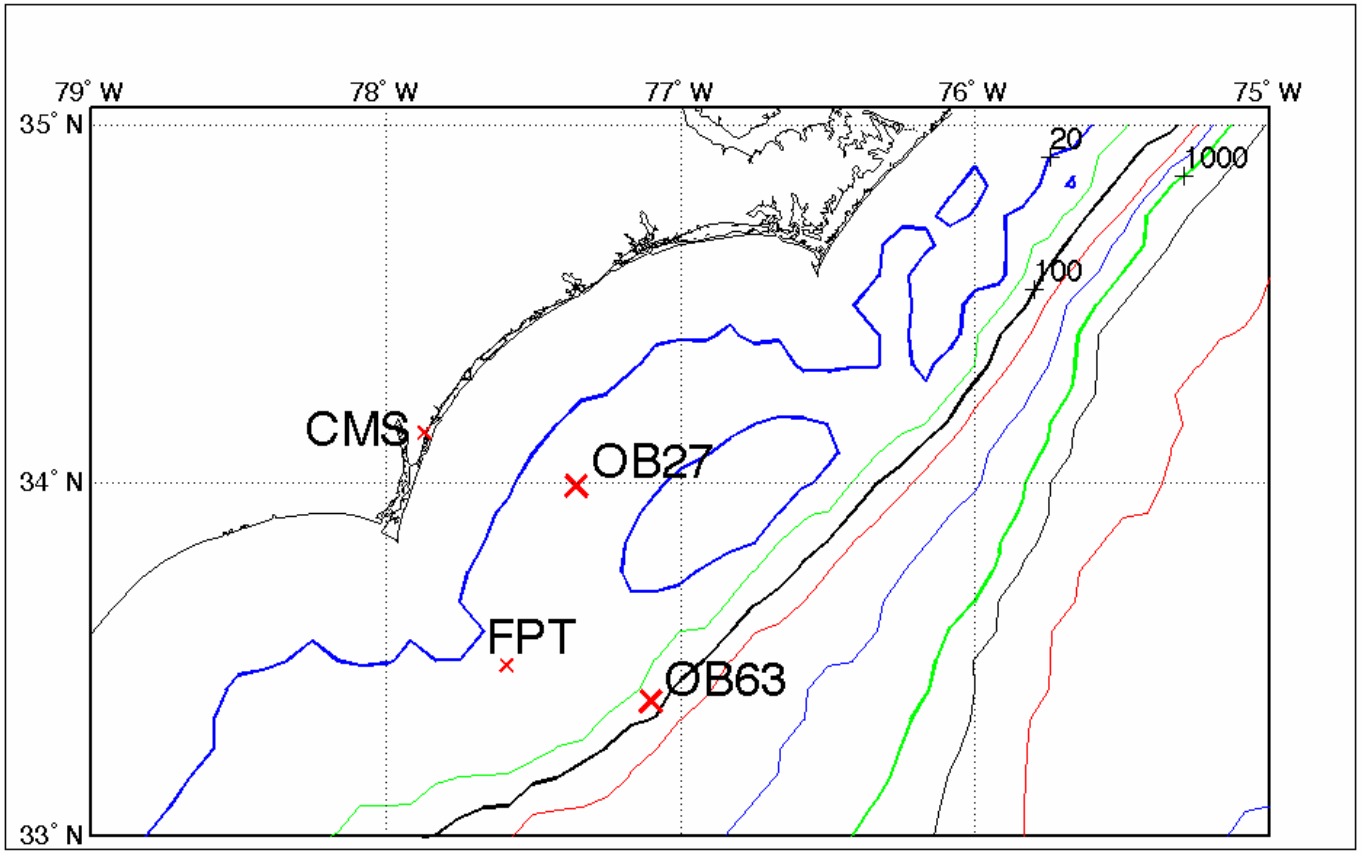
- During storms, near bed fluid forces on the mid-continental shelf will mobilize sediments thereby promoting cross-shelf sediment transport, and modifying bed state, bed roughness and substrate granulometry

- Sediment mobilization, and consequent changes in microhabitat will cause significant changes in the composition and abundance of benthic invertebrate communities

COASTAL RELIEF MODEL:
FRYING PAN SHOALS REGION OF THE SOUTH ATLANTIC BIGHT

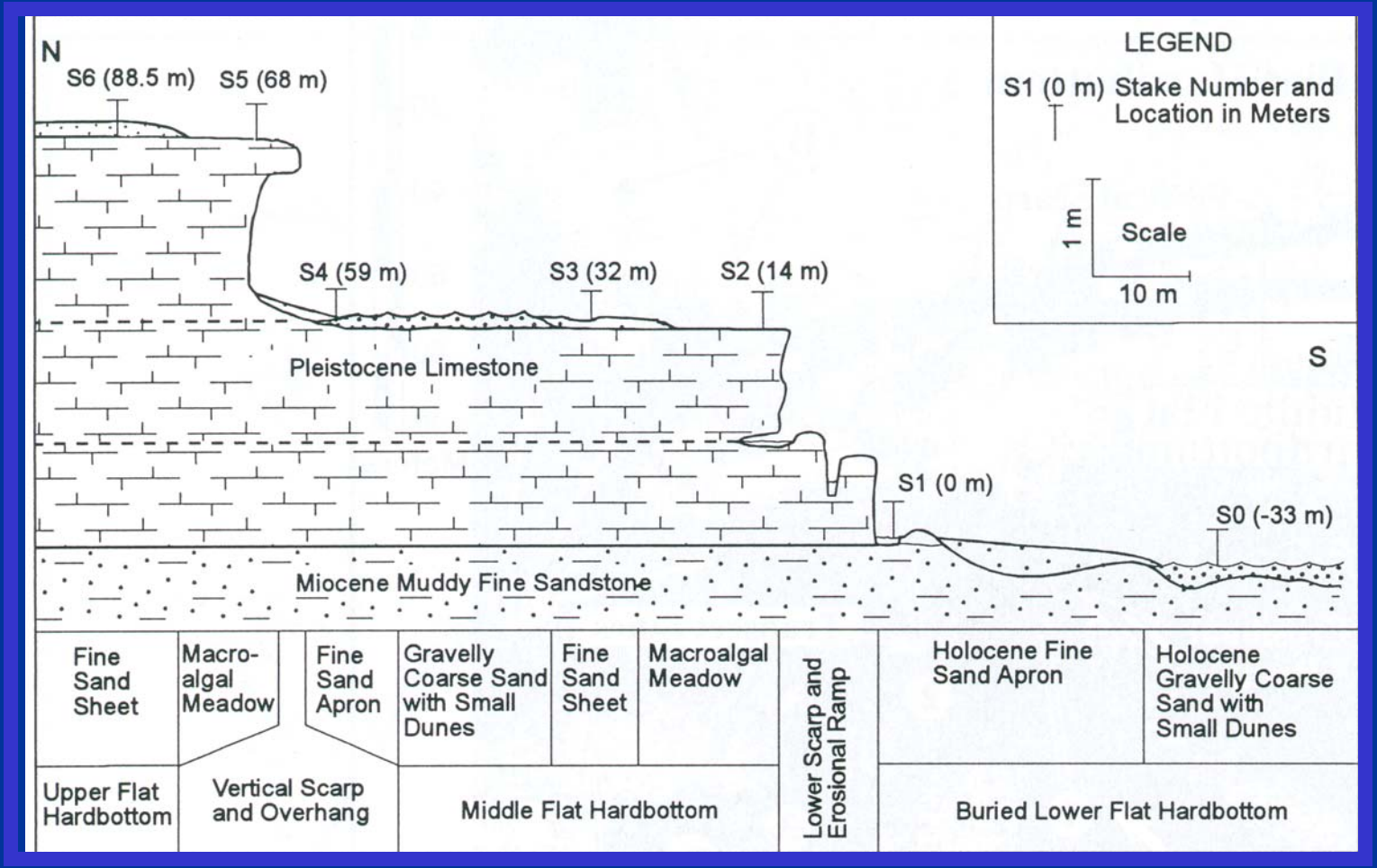


Bathymetry for Frying Pan Shoals Region of the SAB



“23 Mile Rock” Side Scan Mosaic

GEOLOGY



(Riggs et al., 1998)

Sidescan Sonar Mosaic

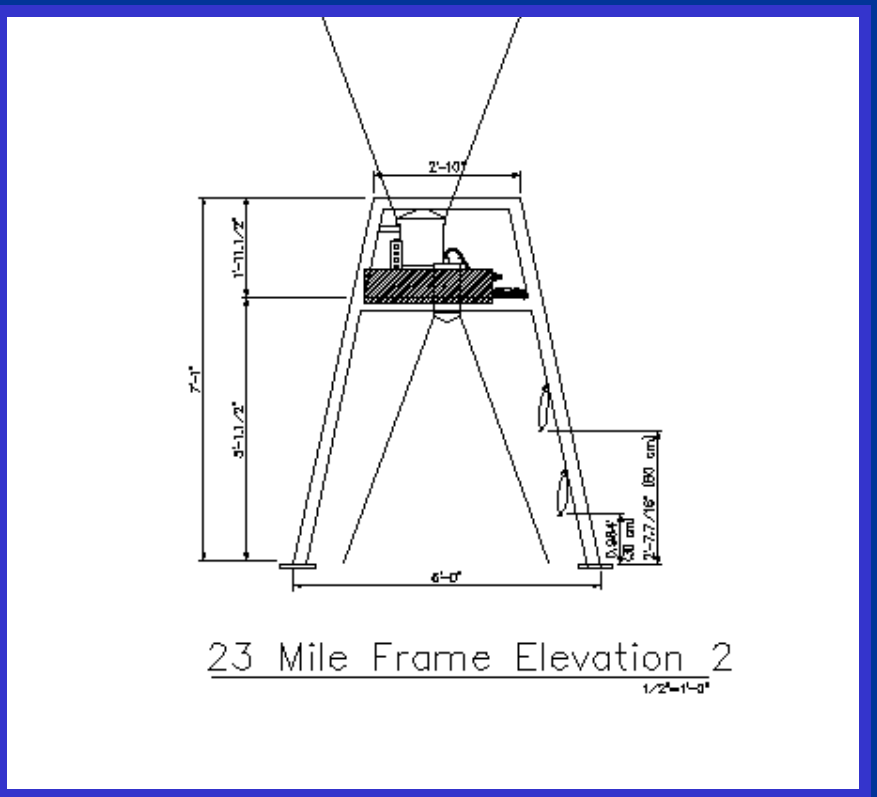
Coarse gravelly sand with dunes

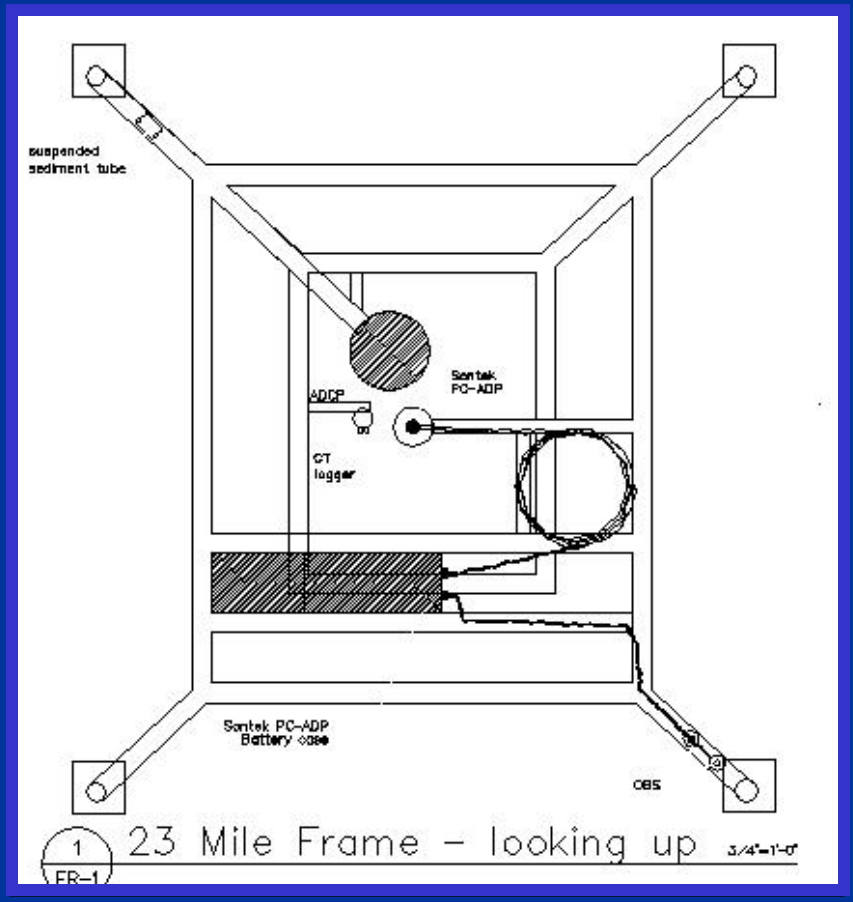
100m

Fine-grain sand flat

100 m

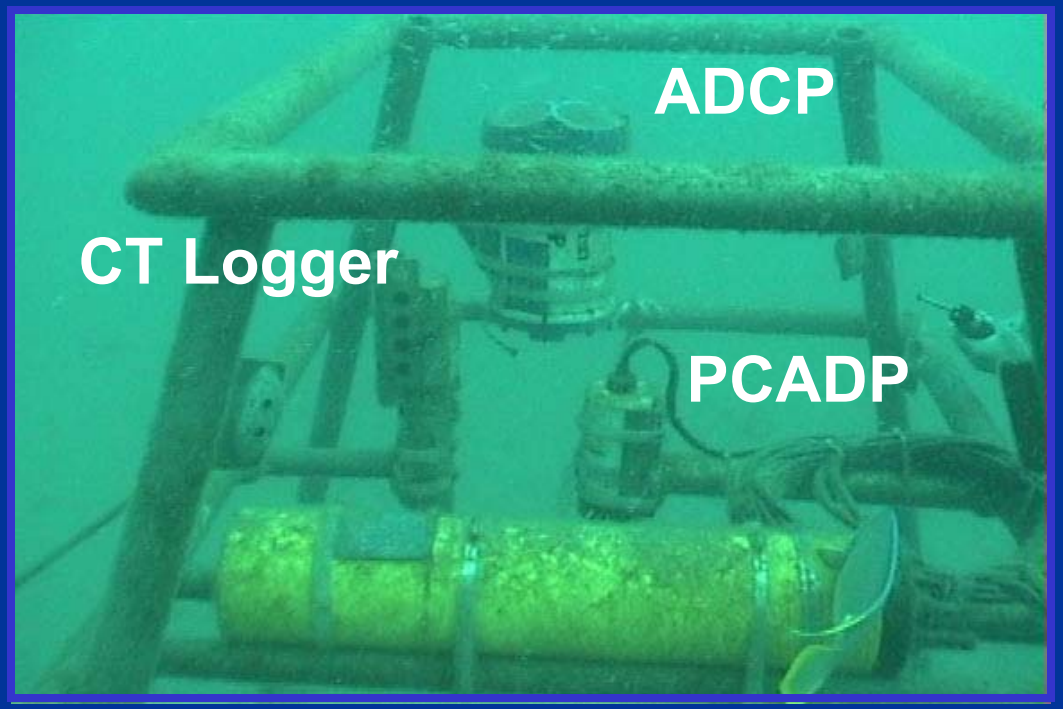
FRAME DESIGN

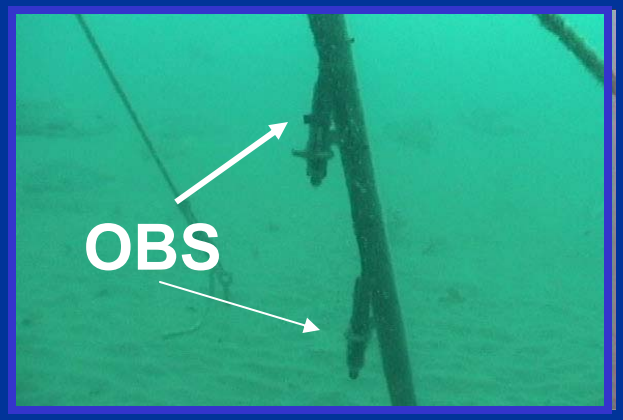


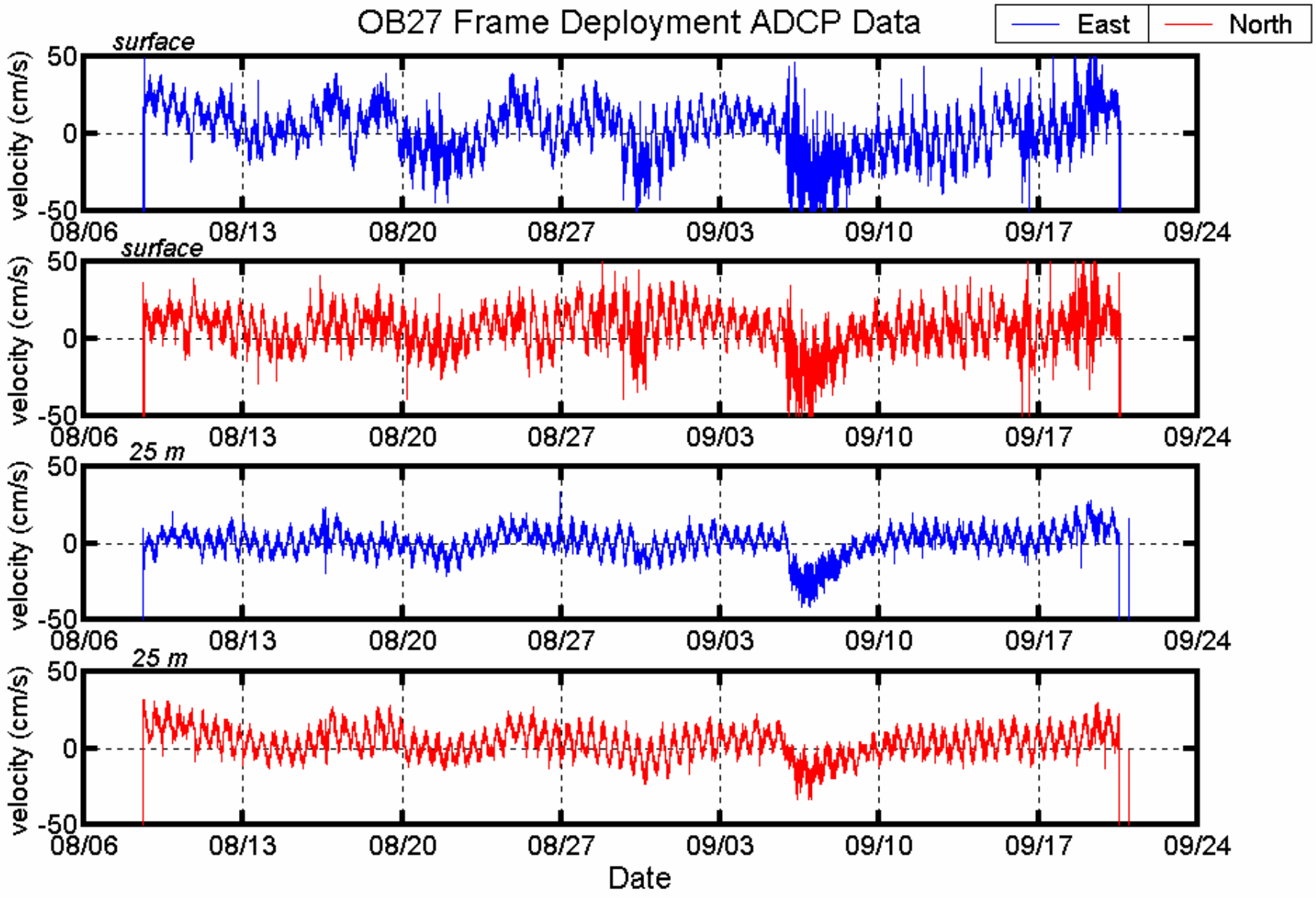


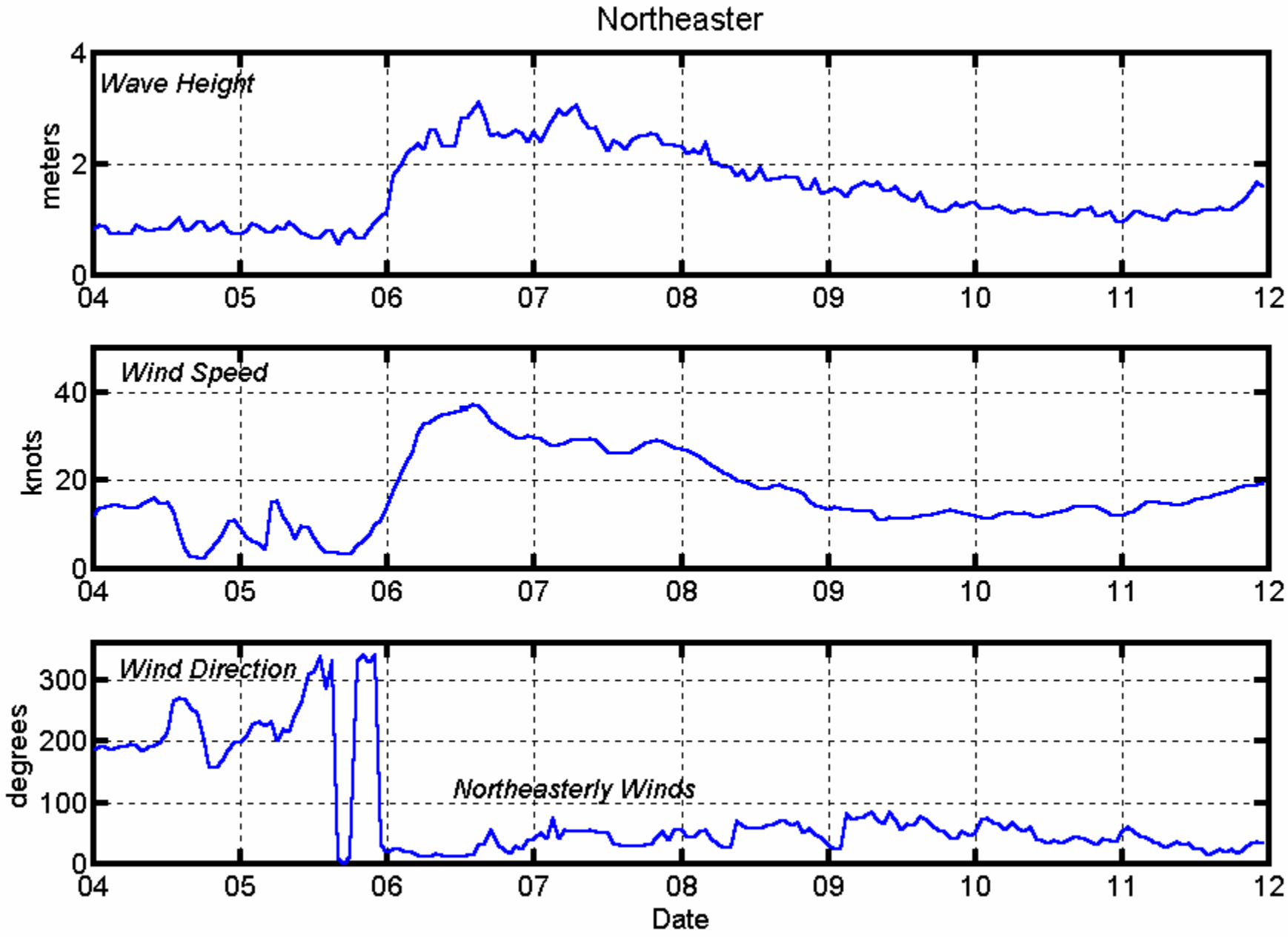
SAMPLING DESIGN

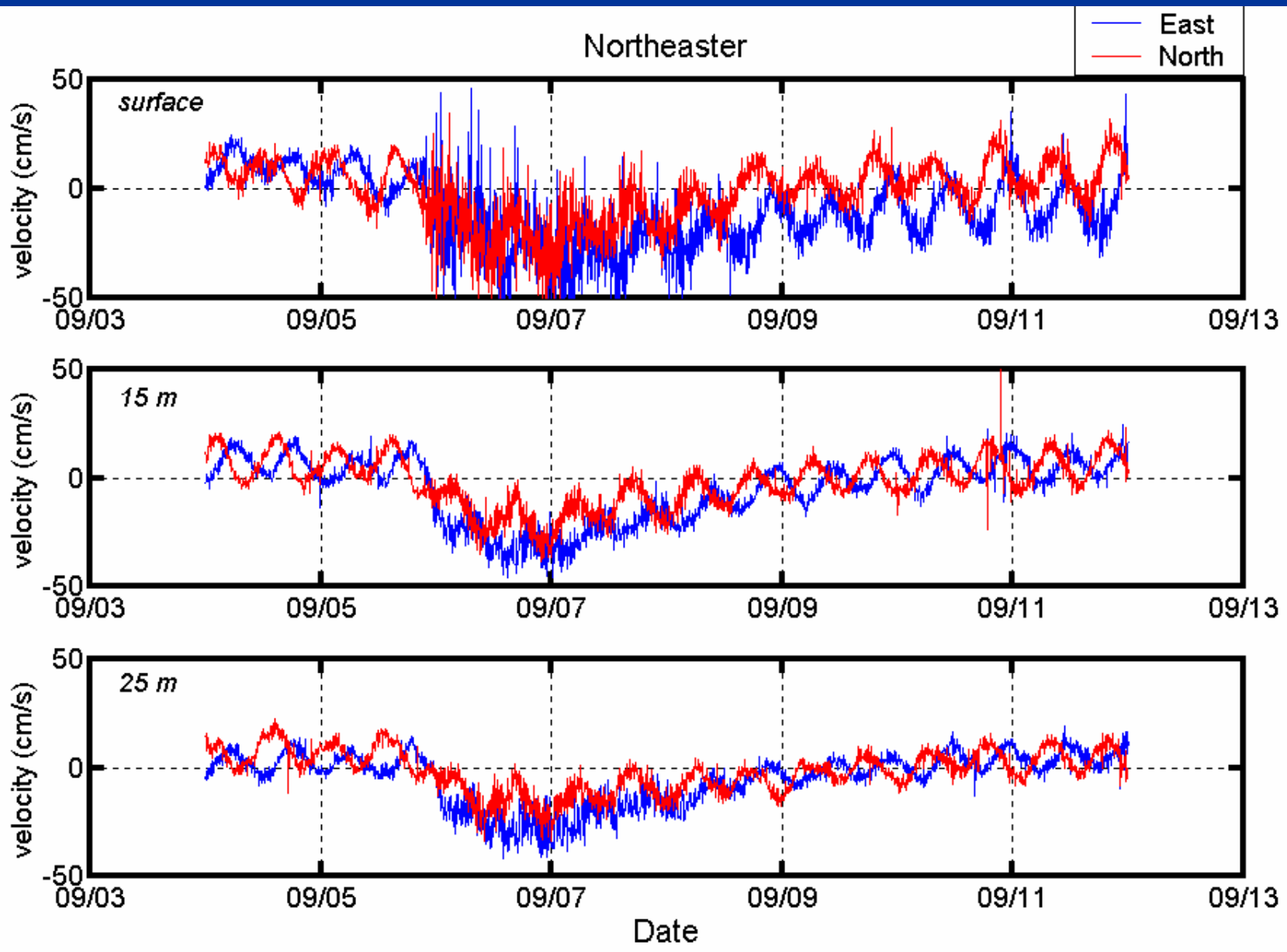
ADCP continuous 5 minute averages
PCADP and OBS: 1 Hz for 17 min every 2 hours
Retrieved & Redeployed every 4-6 weeks



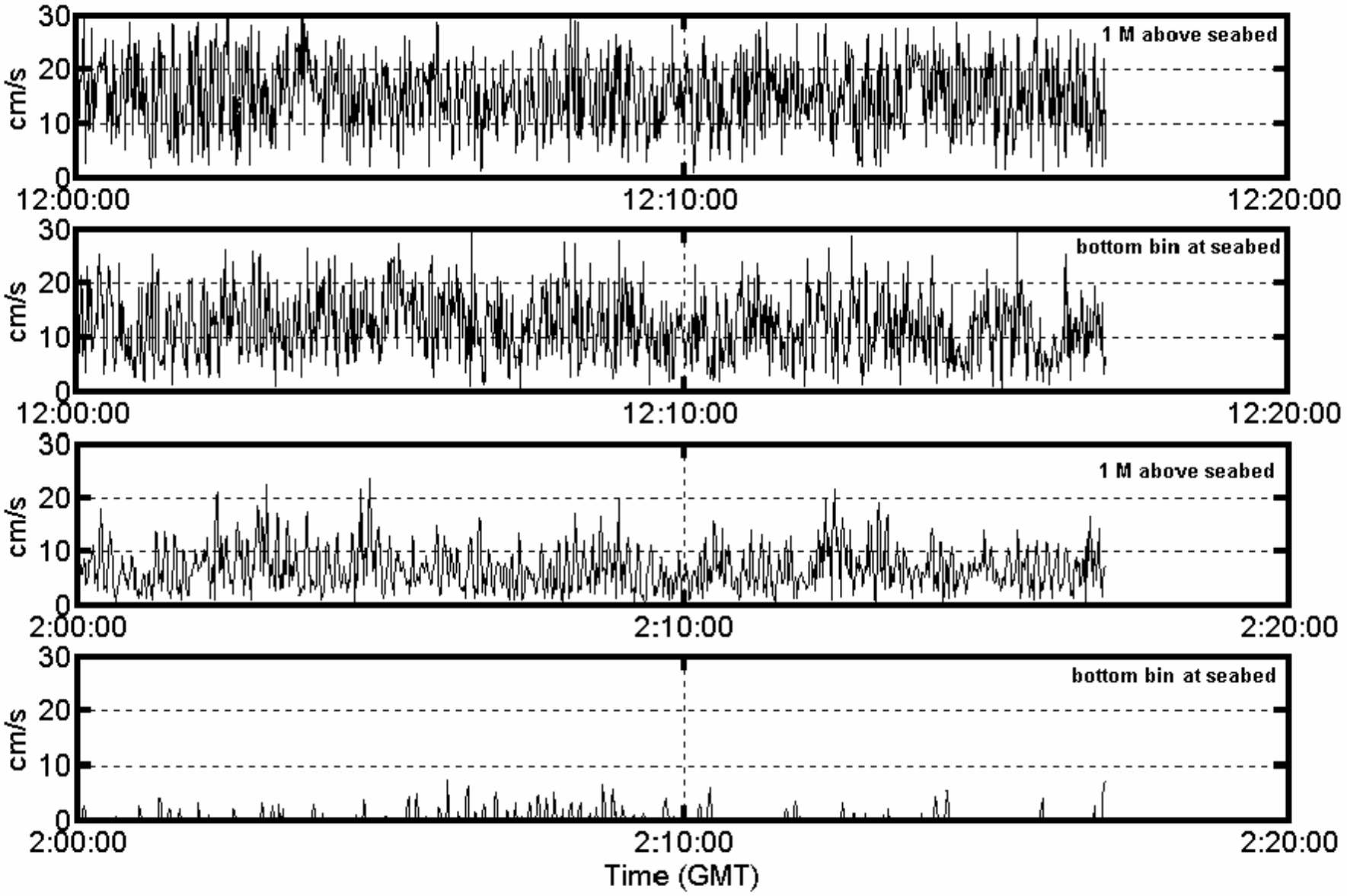


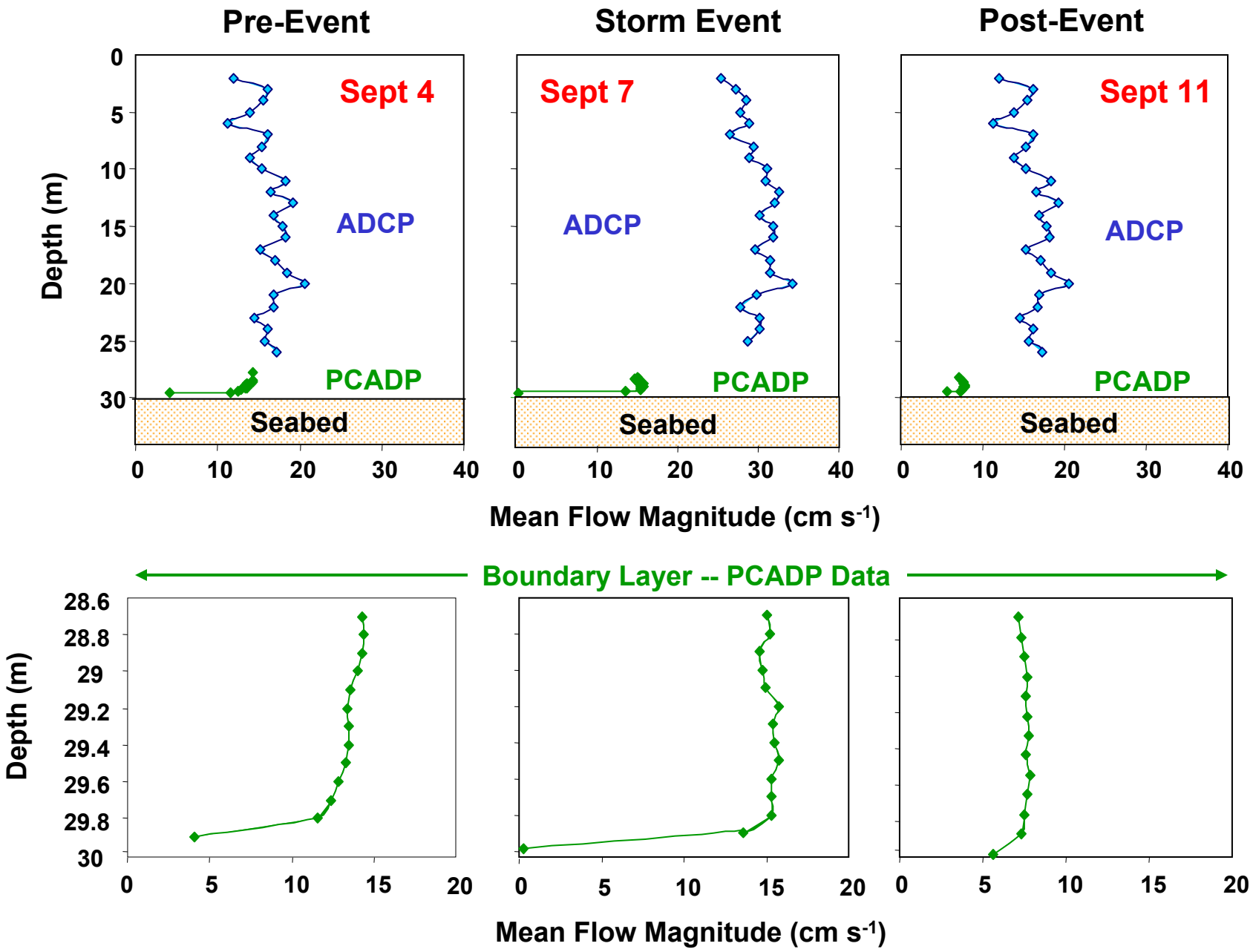

OB27 Frame Deployment ADCP Data
East
North
surface
surface
25 m
25 m
velocity (cm/s)
50
0
-50
08/06
08/13
08/20
08/27
09/03
09/10
09/17
09/24
Date


Northeaster
Wave Height
meters
0
2
4
Wind Speed
knots
0
20
40
Wind Direction
degrees
0
100
200
300
Northeasterly Winds
04
05
06
07
08
09
10
11
12
Date

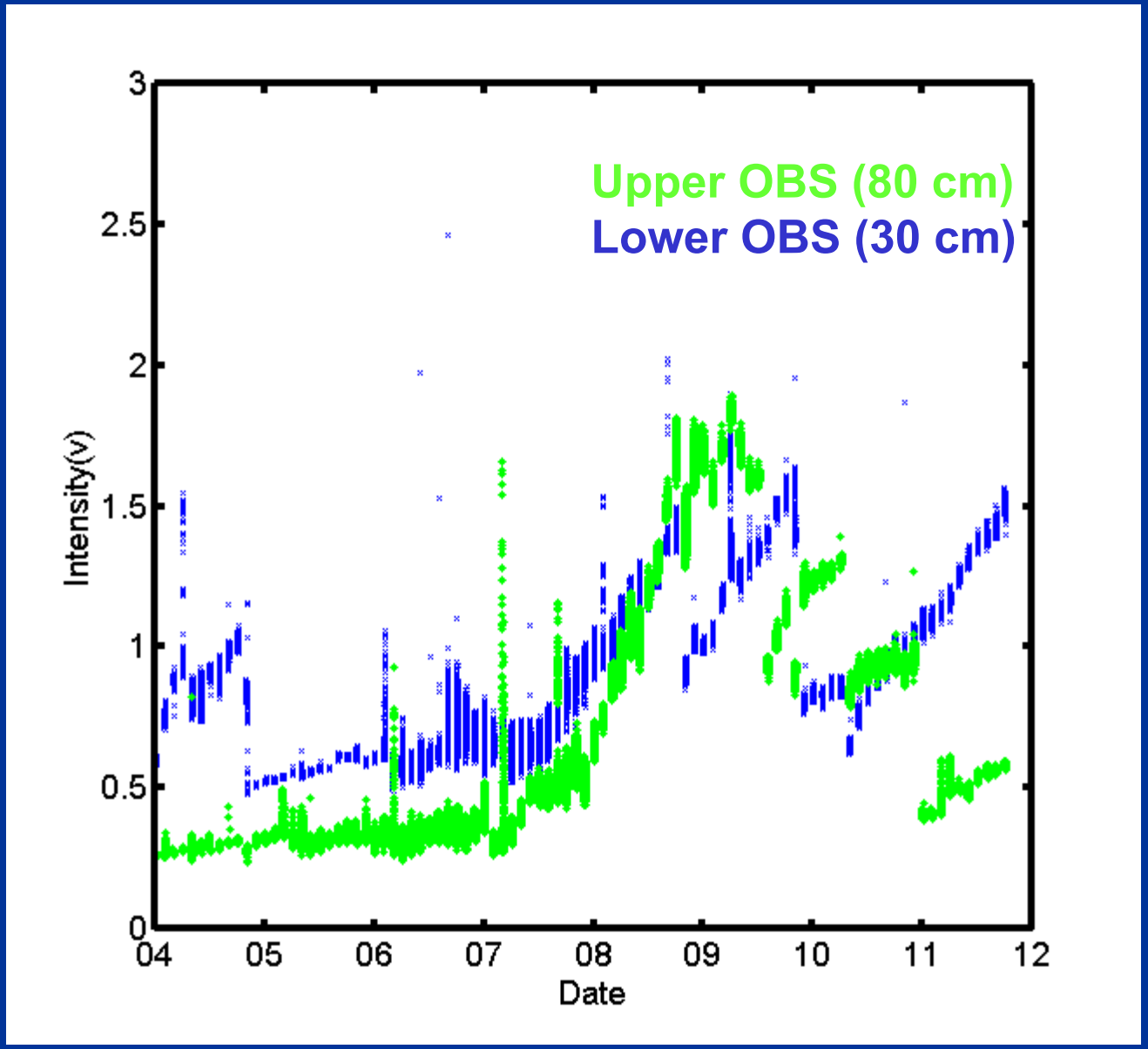

Northeaster
East
North
surface
15 m
25 m
velocity (cm/s)
50
0
-50
09/03
09/05
09/07
09/09
09/11
09/13
Date

Typical PCADP Raw Data of Flows During September Storm and Tides

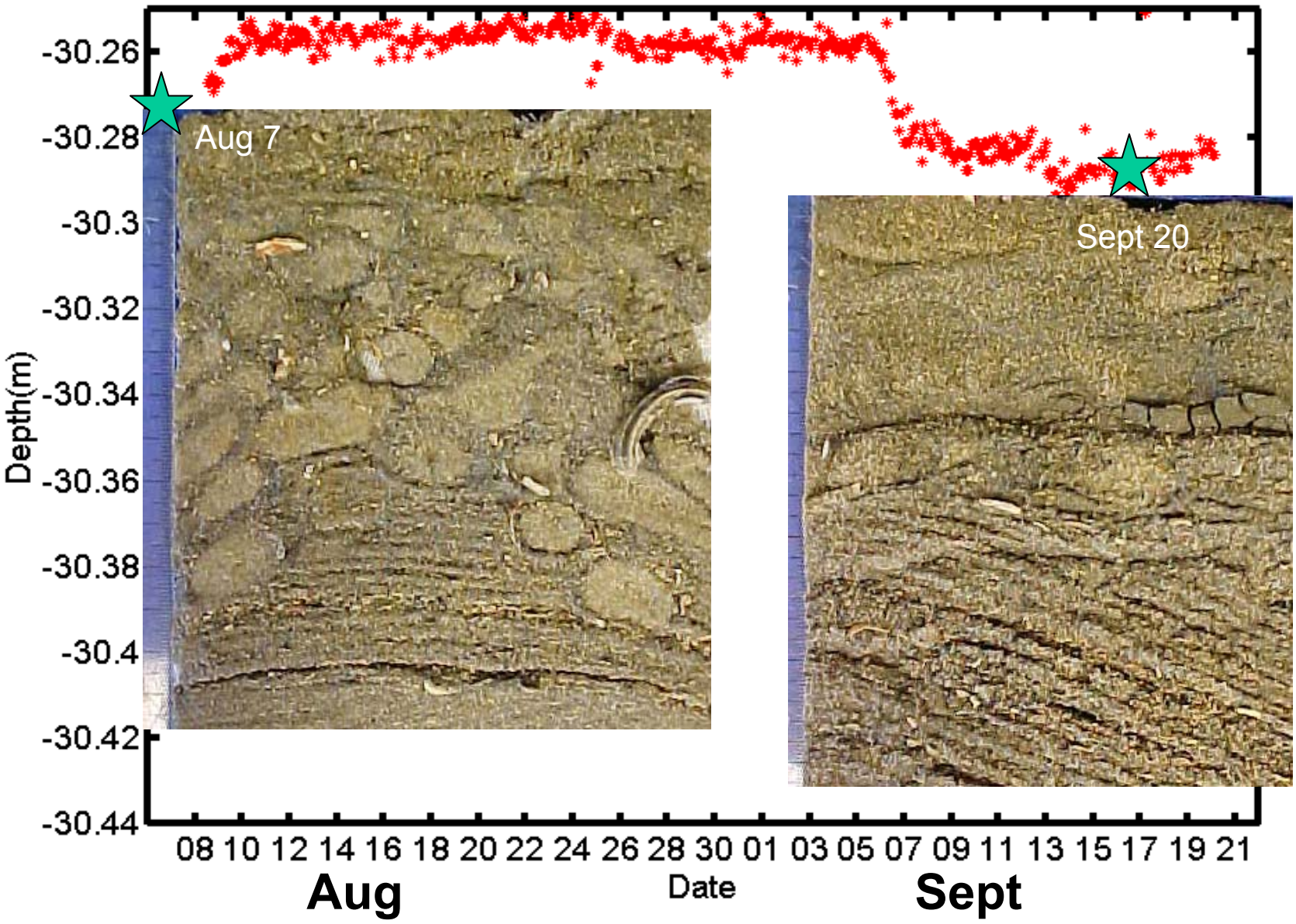



Pre-Event
Storm Event
Post-Event
Sept 4
Sept 7
Sept 11
ADCP
PCADP
Seabed
Depth (m)
Mean Flow Magnitude (cm s-1)
Boundary Layer -- PCADP Data

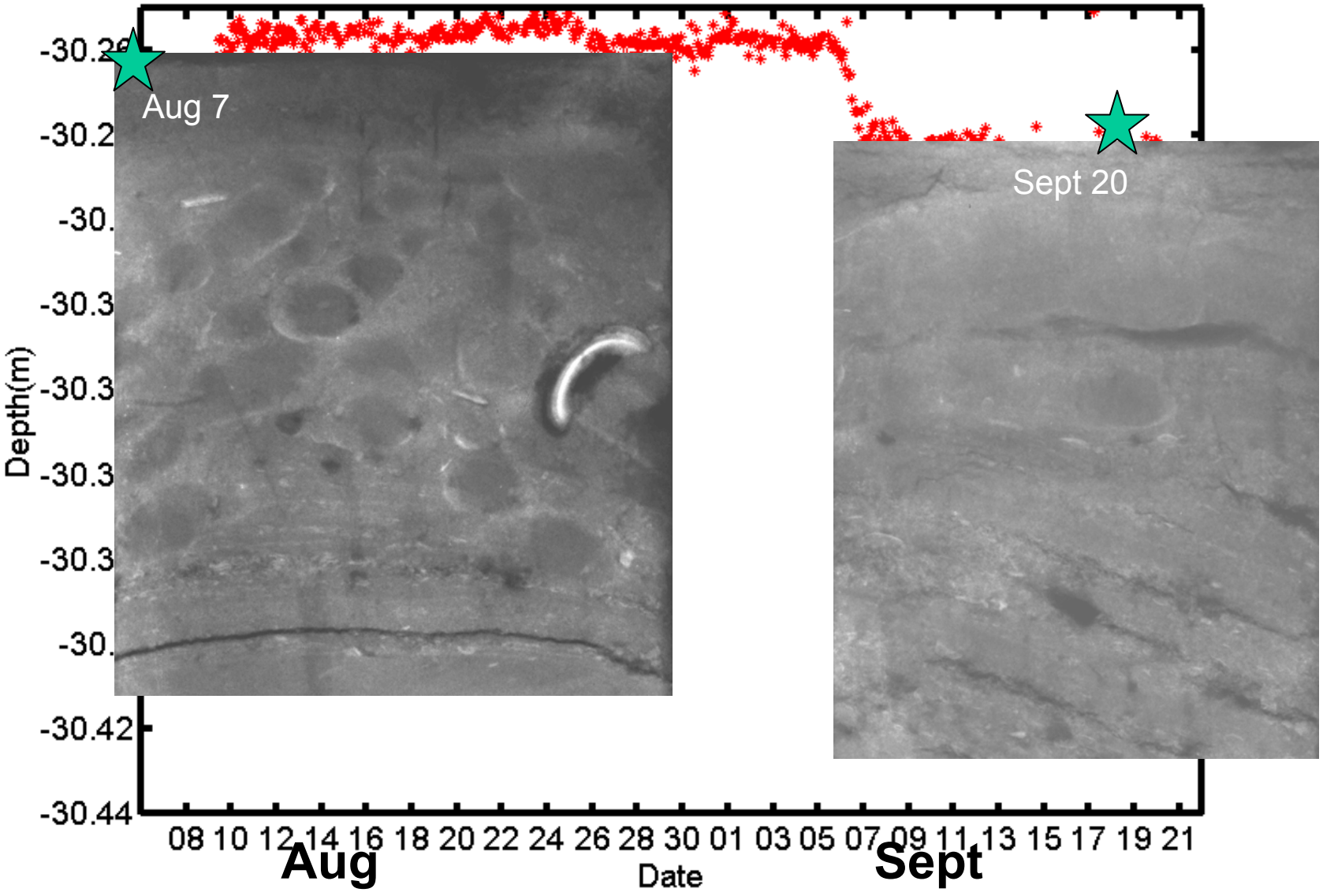
OBS MEASUREMENTS

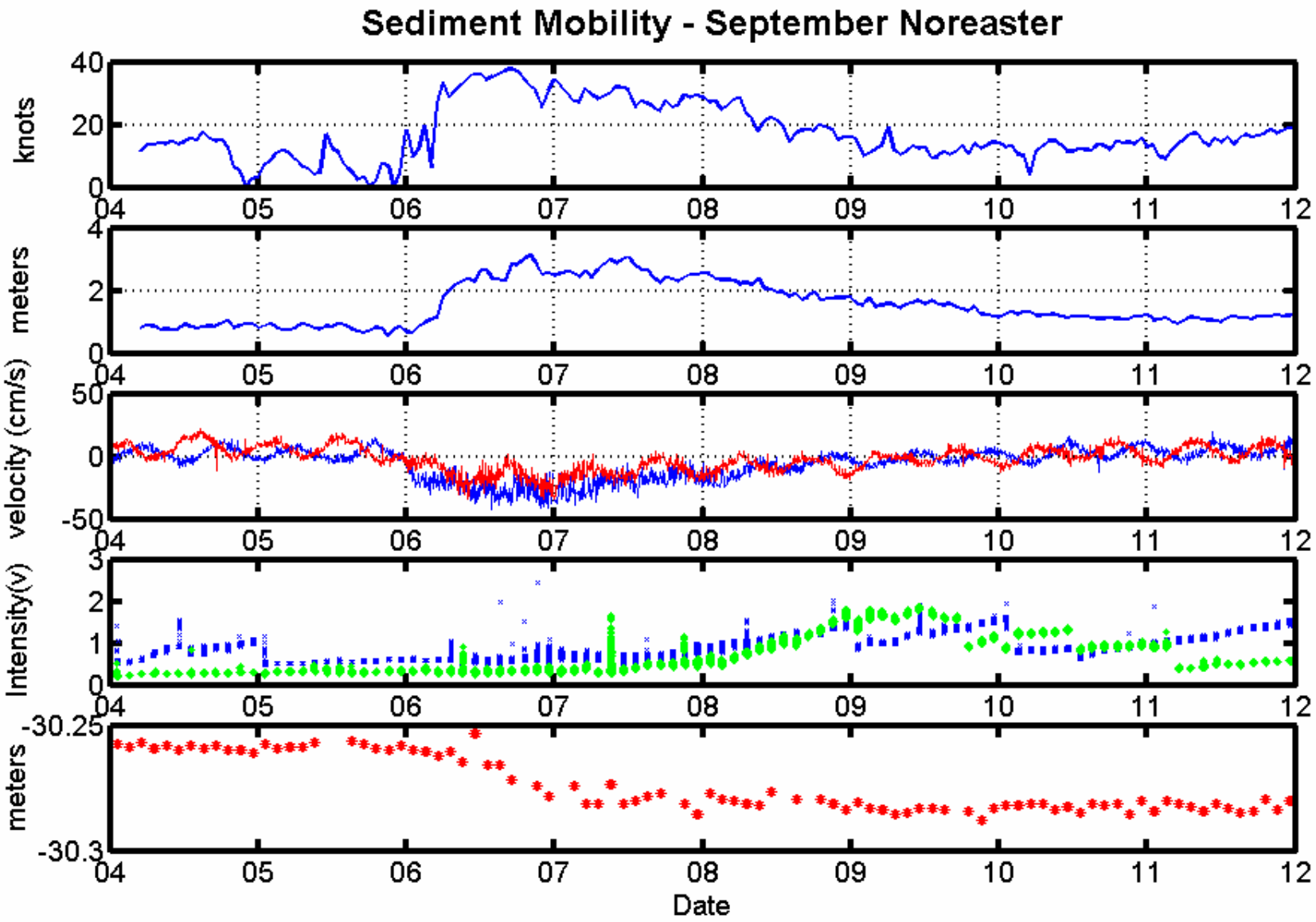


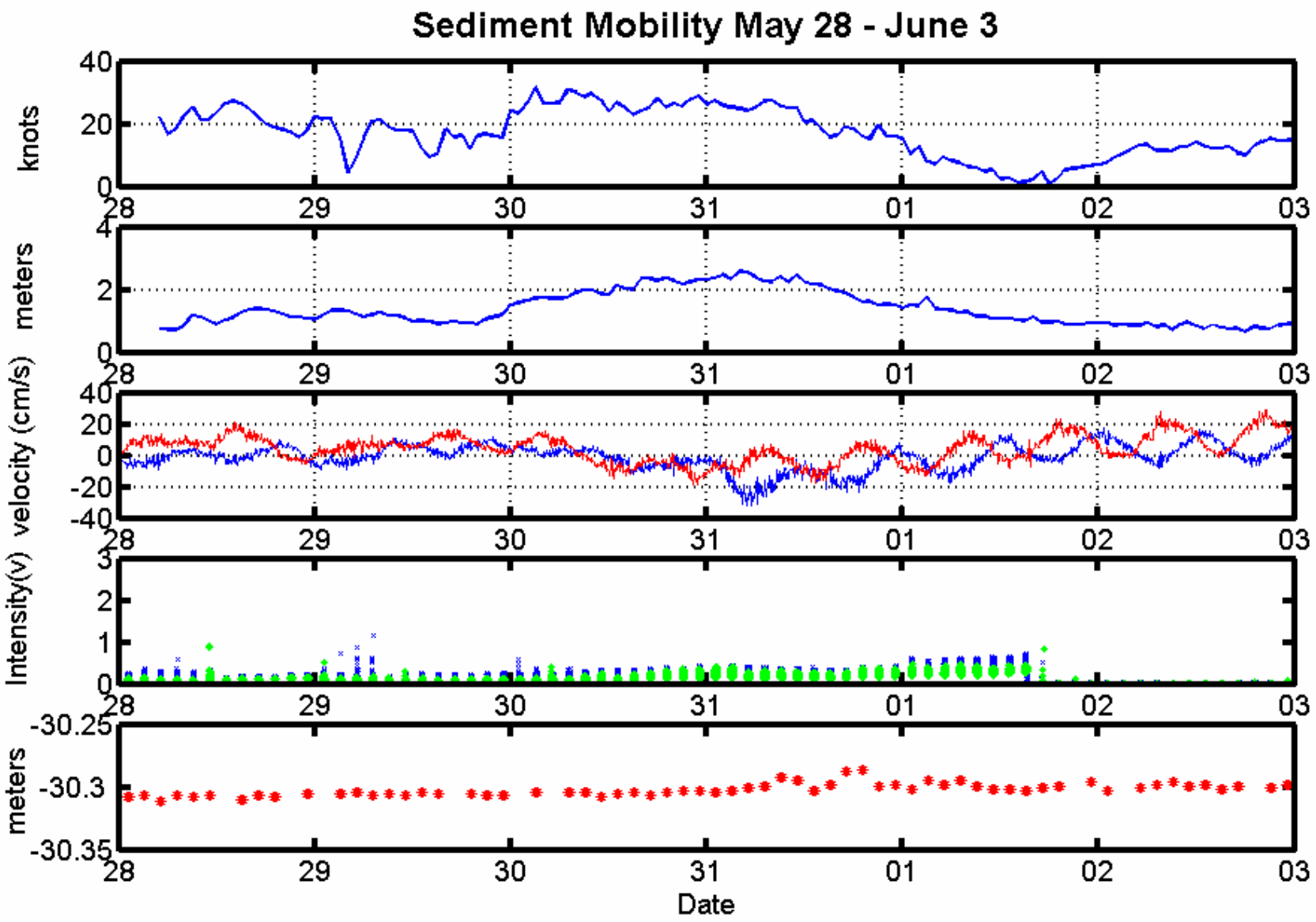
SEABED ELEVATION CHANGES

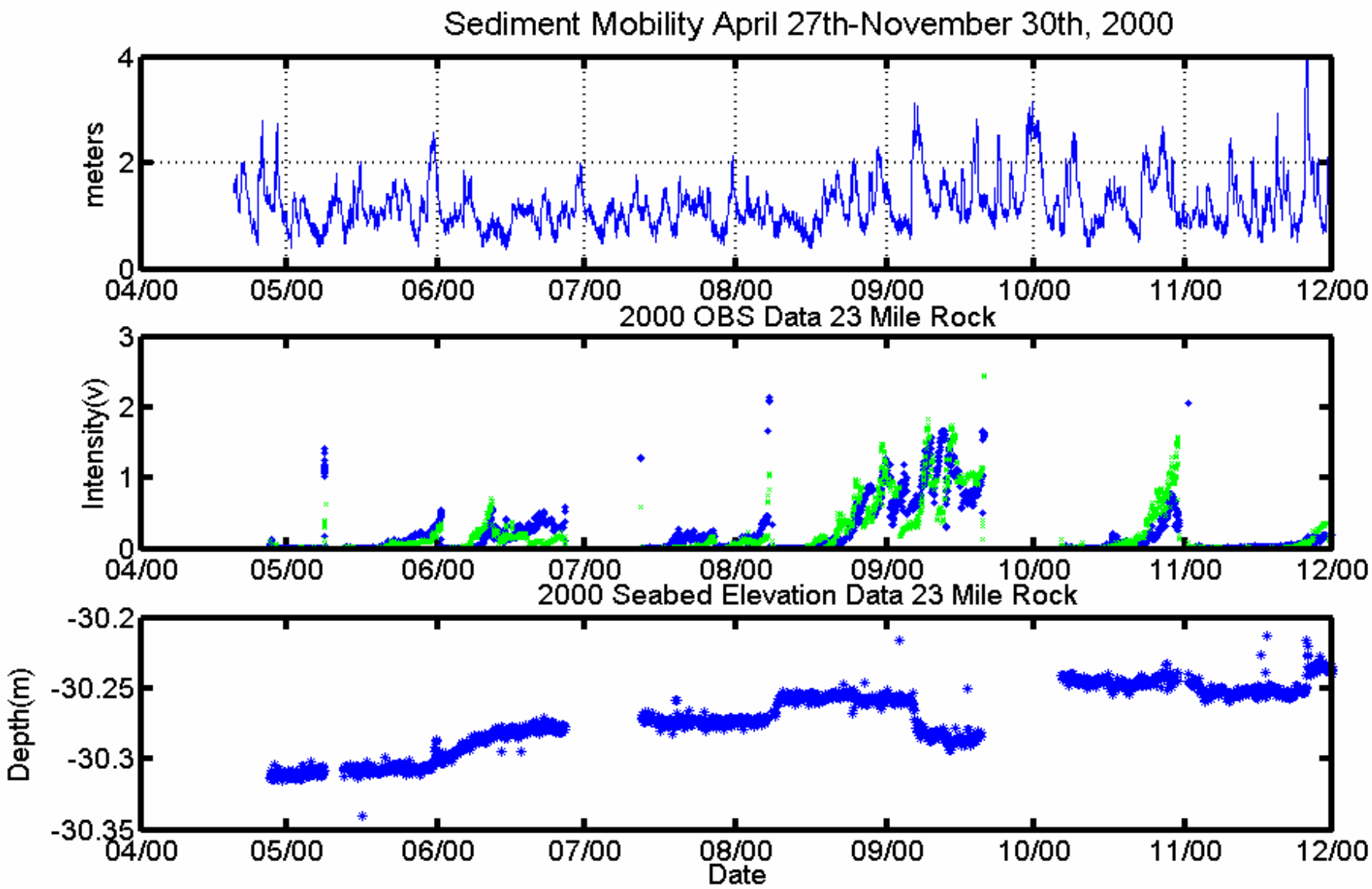


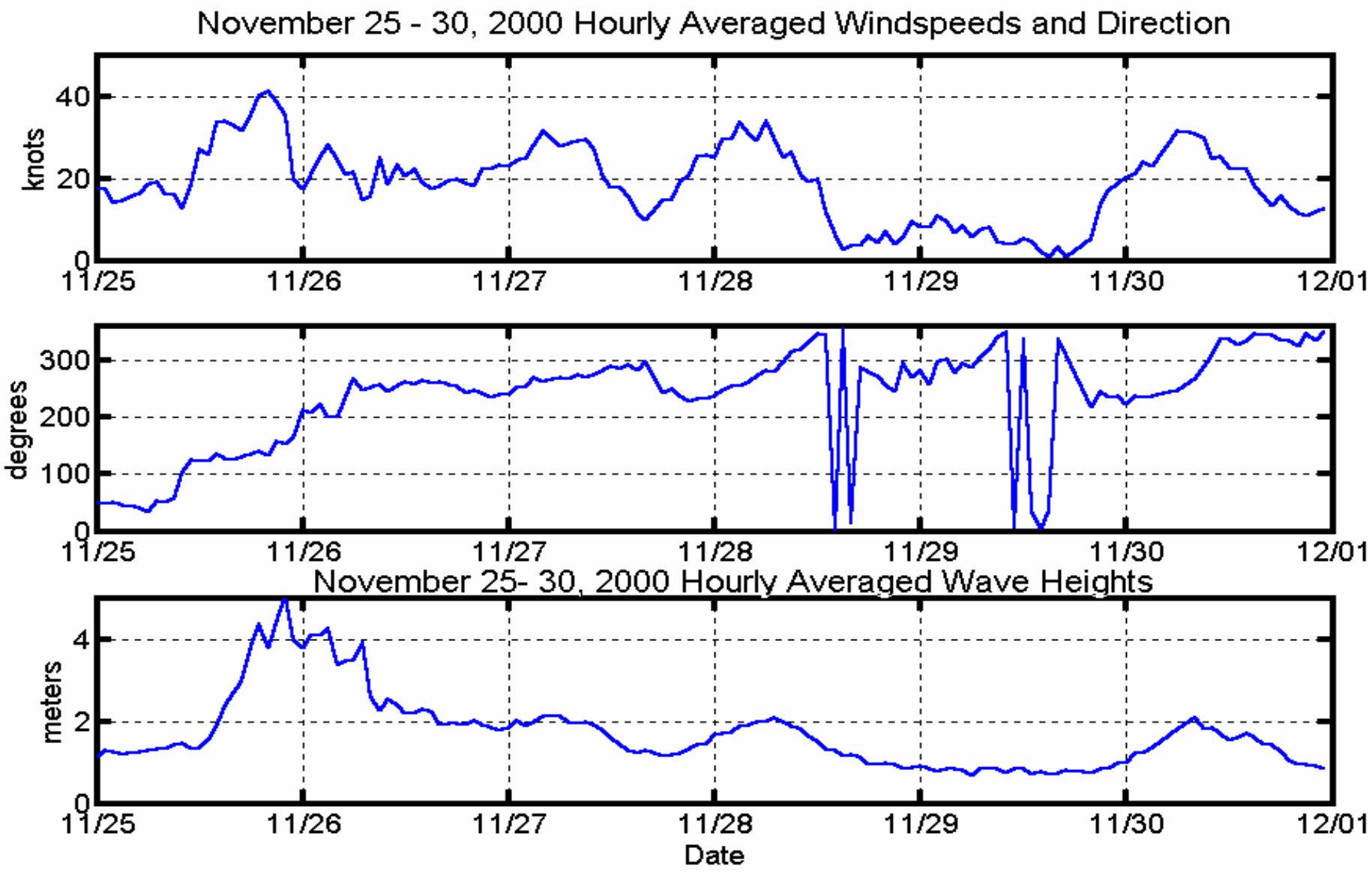
SEABED ELEVATION CHANGES

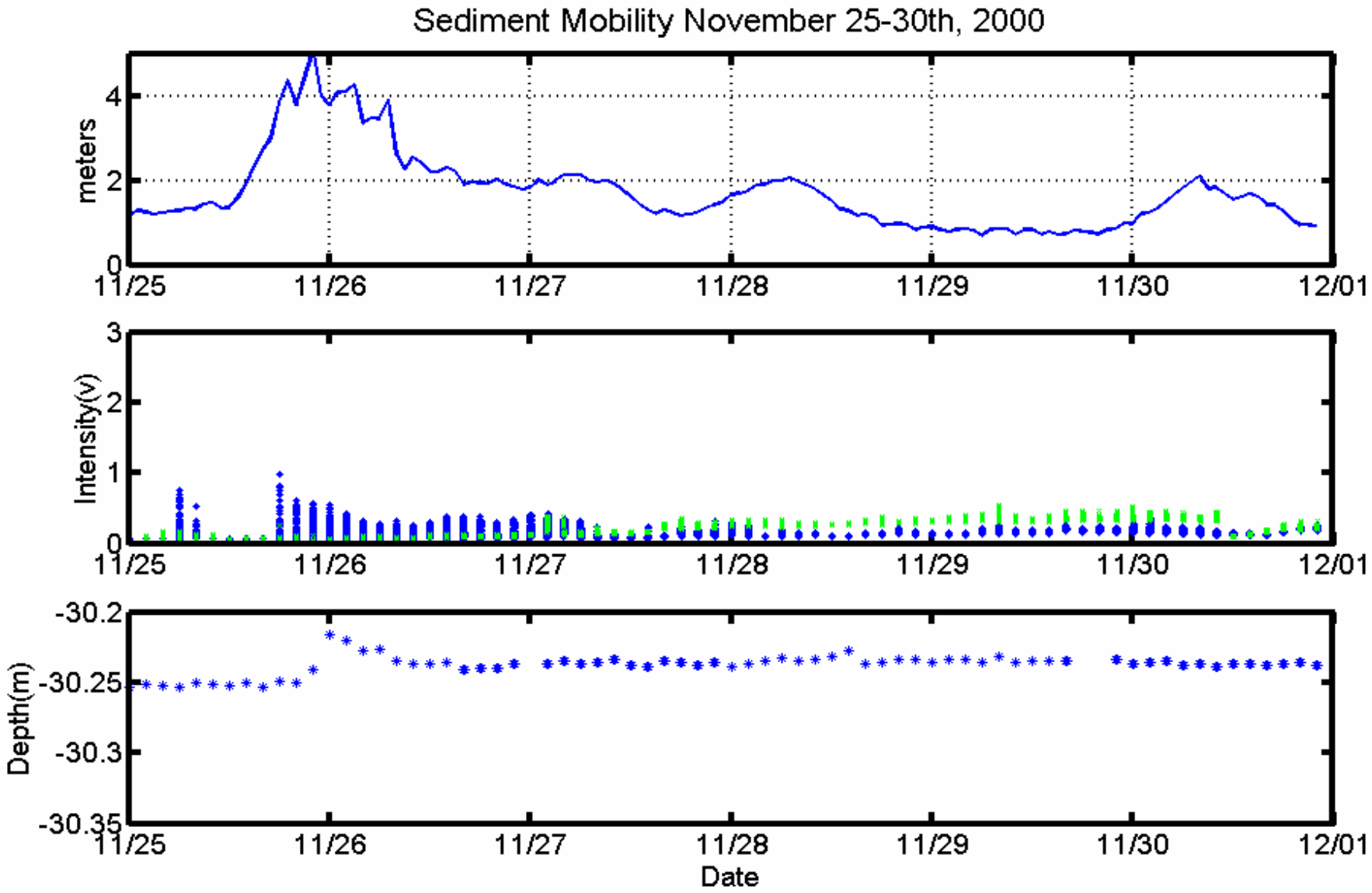



Sediment Mobility - September Noreaster
knots
meters
velocity (cm/s)
Intensity(v)
meters
-30.25
-30.3
04
05
06
07
08
09
10
11
12
Date


Sediment Mobility May 28 - June 3
knots
meters
velocity (cm/s)
Intensity(v)
meters
-30.25
-30.3
-30.35
28
29
30
31
01
02
03
Date


Sediment Mobility April 27th-November 30th, 2000
meters
4
2
0
04/00
05/00
06/00
07/00
08/00
09/00
10/00
11/00
12/00
2000 OBS Data 23 Mile Rock
Intensity(v)
3
2
1
0
2000 Seabed Elevation Data 23 Mile Rock
Depth(m)
-30.2
-30.25
-30.3
-30.35
Date


November 25 - 30, 2000 Hourly Averaged Windspeeds and Direction
knots
40
20
0
11/25
11/26
11/27
11/28
11/29
11/30
12/01
degrees
300
200
100
0
11/25
11/26
11/27
11/28
11/29
11/30
12/01
November 25- 30, 2000 Hourly Averaged Wave Heights
meters
4
2
0
11/25
11/26
11/27
11/28
11/29
11/30
12/01
Date


Sediment Mobility November 25-30th, 2000
meters
0
2
4
Intensity(v)
0
1
2
3
Depth(m)
-30.2
-30.25
-30.3
-30.35
11/25
11/26
11/27
11/28
11/29
11/30
12/01
Date

SUMMARY

- Small northeaster storms with winds upwards of 30 knots for 48 hours can mobilize the upper 4-6 cm of the seabed at mid continental shelf depths (30m).

- Northeast winds of 30 knots for 36 hours showed little sediment mobilization at 30m depth.

- Strong southerly winds of 35-40 knots for 12 hours suspended little sediment and brought sand into reef area.

CONCLUSIONS

- Although waves and currents respond rapidly to local winds, sediment transport processes depend strongly on wind duration.
- Geologic disturbances (Northeaster storms) directly impact mid continental shelf benthic communities near hardbottoms.