Impact of Hurricane Isabel on Nearshore and Offshore Onslow Bay

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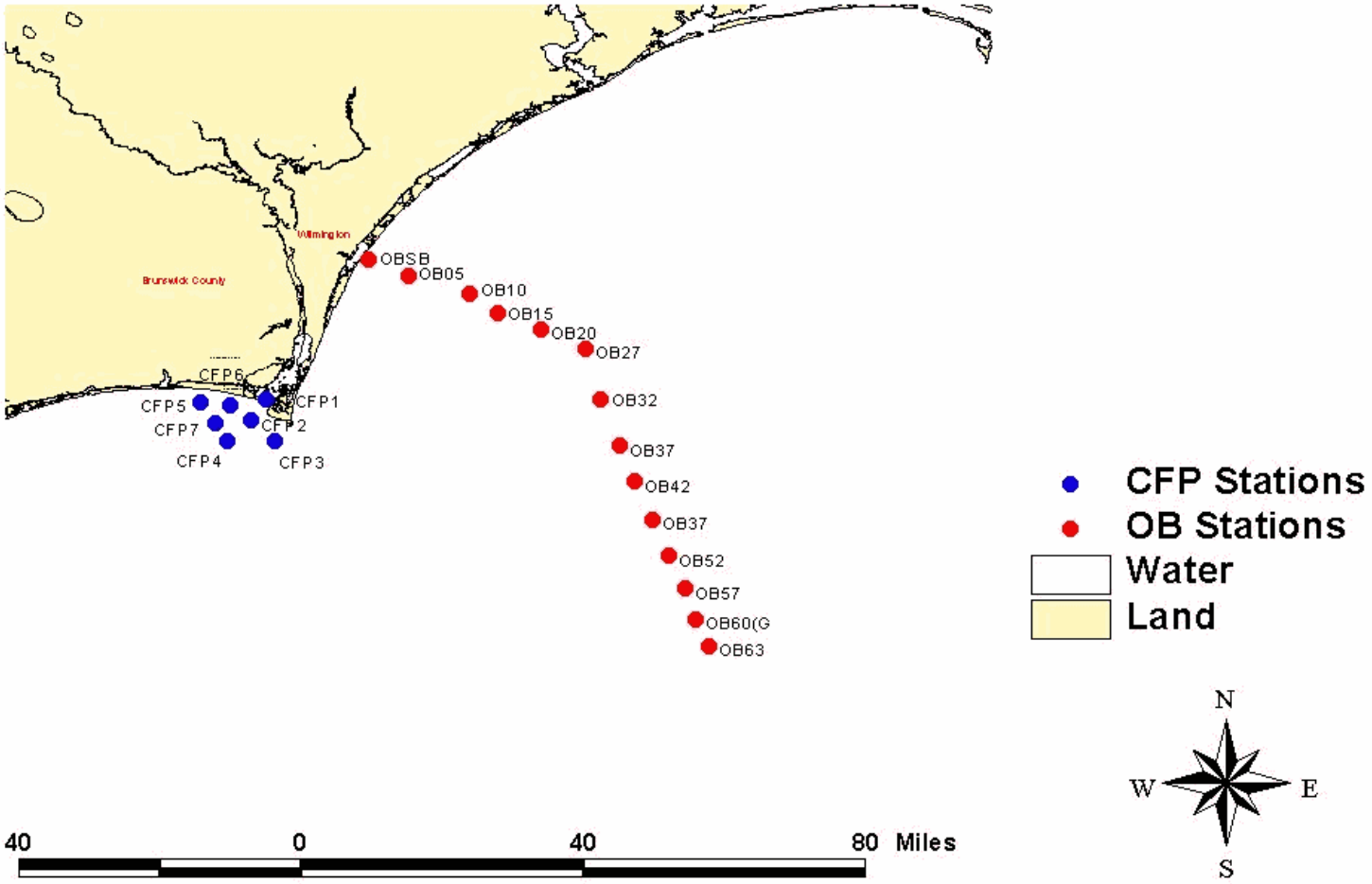


Sampling station characteristics

STATION	DEPTH	DISTANCE OFFSHORE
OB5	15 m	8 km
OB15	21 m	28 km
OB27	27 m	45 km

METHODS

- Water column sampled monthly at several sites by ship, samples collected at surface, mid-depth, and just above bottom
- Parameters include temperature, salinity, dissolved oxygen, secchi depth, nitrate-N, ammonium-N, orthophosphate-P, TN, TP, Si and chlorophyll *a*
- Physical data also collected from in-situ quads located at 23 mile reef; downward looking ADCP and sea bed altimeter; wave height and period data acquired from Frying Pan Shoals tower for computation of bottom wave orbital velocities

EFFECT OF HURRICANE ISABEL ON NUTRIENT CONCENTRATIONS IN ONSLOW BAY

- **Total phosphorus – no change**
- **Orthophosphate – no change**
- **Nitrate – no change**
- **Total nitrogen – 20-30% increase at mid-depth and bottom, but no change at surface**

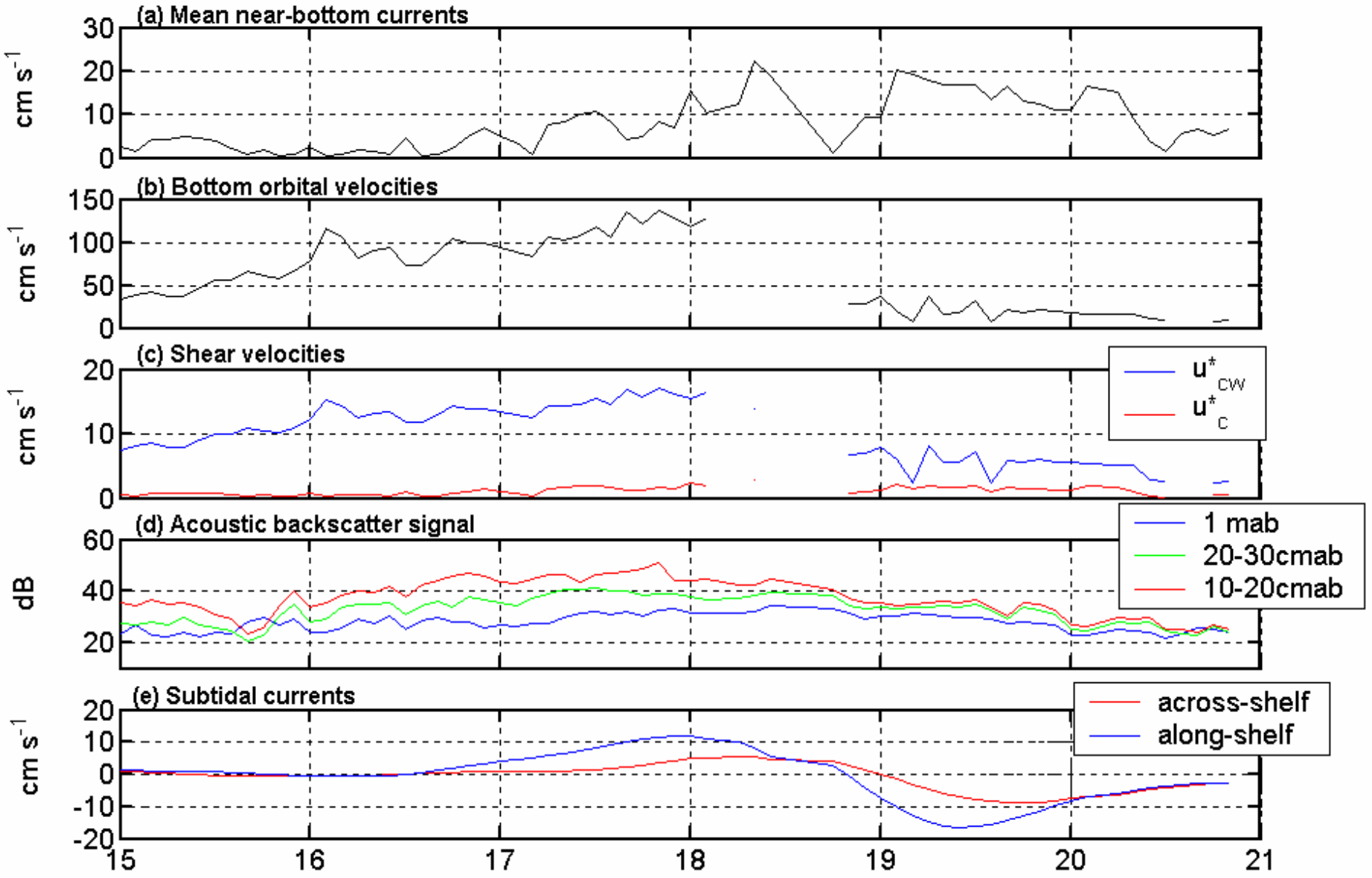
EFFECT OF HURRICANE ISABEL ON AMMONIUM IN ONSLOW BAY

AS MEAN OF SURFACE, MID-DEPTH AND BOTTOM

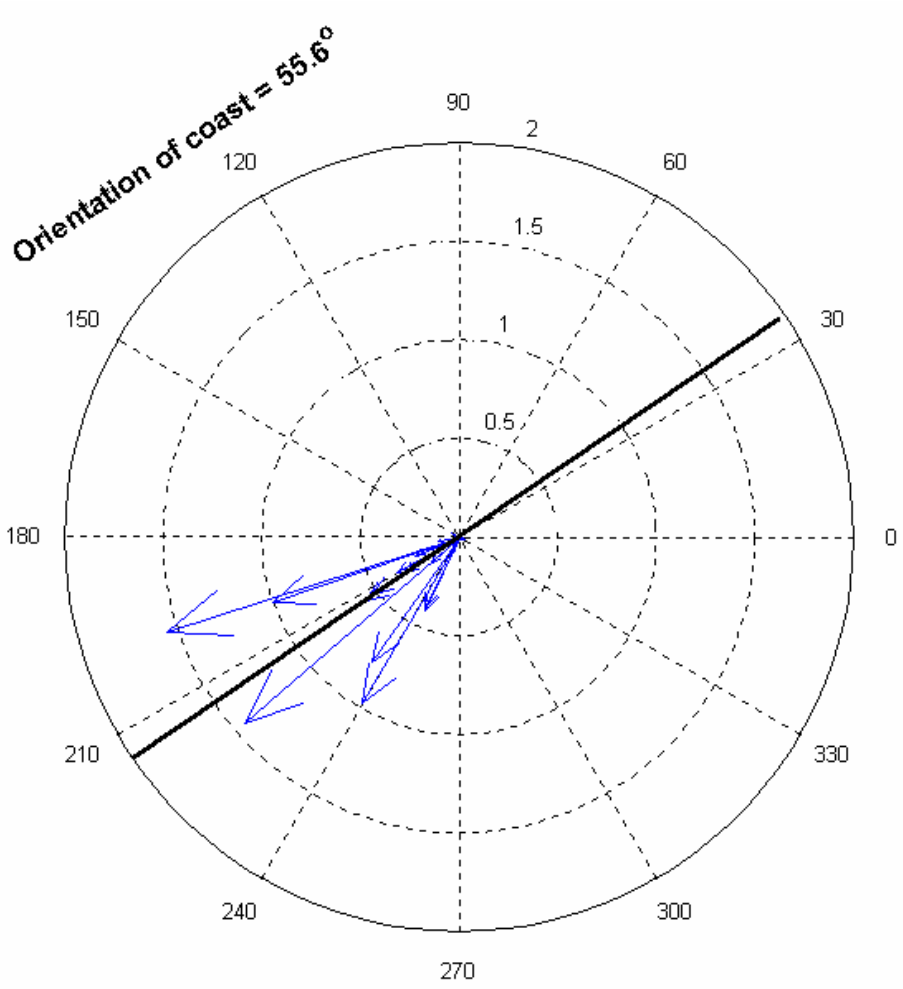
STATION	3 DAYS BEFORE THE STORM	5 DAYS AFTER THE STORM
OB5	0.33 + 0.19 mg/L	0.87 + 0.51 mg/L
OB15	0.29 + 0.17 mg/L	0.83 + 0.55 mg/L
OB27	0.45 + 0.22 mg/L	0.64 + 0.14 mg/L

EFFECT OF HURICANE ISABEL ON WATER COLUNM CHLOROPHYLL *a*

- **Surface chlorophyll *a* at OB5 decreased from 2.5 to 0.5 μg/L following Isabel's passage**
- **Chlorophyll *a* concentrations showed no change at the other stations and depths**
- **Bottom chlorophyll *a* was not increased; thus, resuspended benthic chlorophyll *a* either had resettled, was degraded, or transported elsewhere (contrary to local stirring events where it was increased in the water column).**

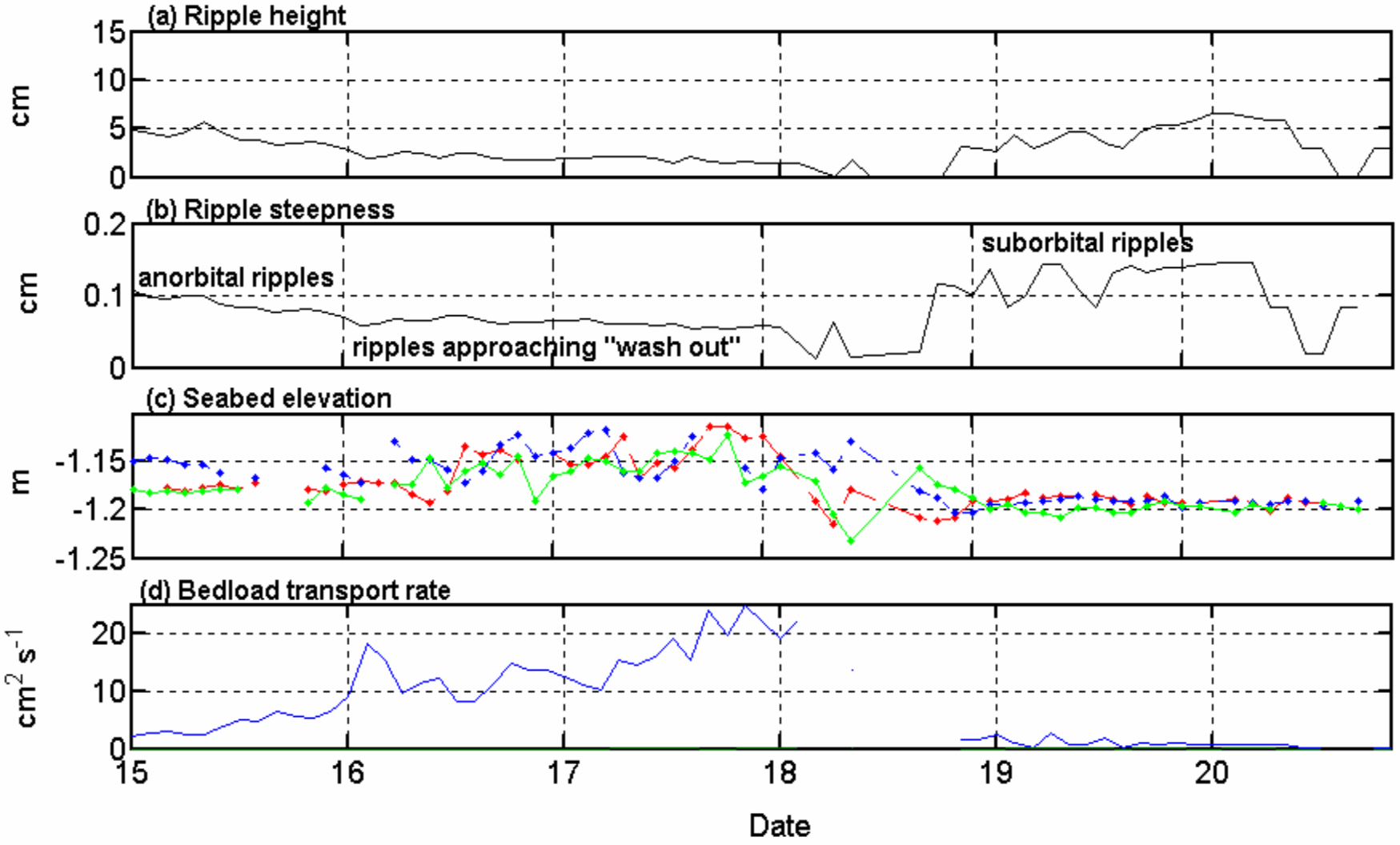

(a) Mean near-bottom currents
cm s-1
30
20
10
0
(b) Bottom orbital velocities
cm s-1
150
100
50
0
(c) Shear velocities
cm s-1
20
10
0
u*CW
u*C
(d) Acoustic backscatter signal
dB
60
40
20
1 mab
20-30cmab
10-20cmab
(e) Subtidal currents
cm s-1
20
10
0
-10
-20
across-shelf
along-shelf
15
16
17
18
19
20
21

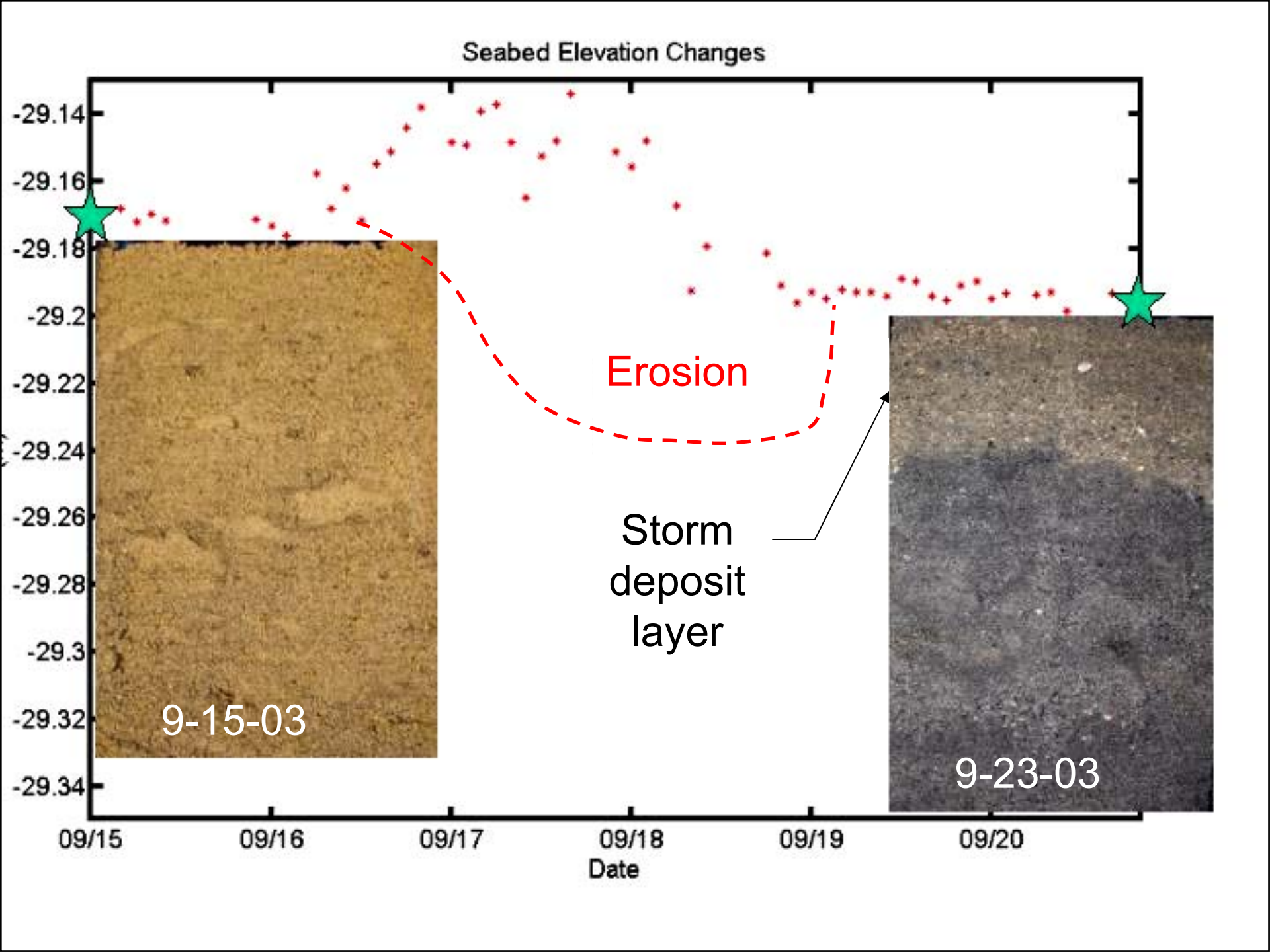
Suspended sediment transport during Isabel…



Total sediment transport = 240.95 kg cm^{-2}

Hurricane Isabel seabed response




Seabed Elevation Changes
-29.14
-29.16
-29.18
-29.2
-29.22
-29.24
-29.26
-29.28
-29.3
-29.32
-29.34
09/15
09/16
09/17
09/18
09/19
09/20
Date
Erosion
Storm deposit layer
9-15-03
9-23-03

Effect of Hurricane Isabel on Sediment Transport

- The close passage of a hurricane resulted in an order of magnitude more suspended sediment transport than a moderate nor'easter storm and the net sediment flux associated with the hurricane was to the southwest and shoreward.

- Due to the hurricane swells from the southeast as early as 72 hours prior to storm passage, ripple migration resulted in extensive bedload transport in the shoreward direction

- The maximum subtidal flows in the along-shelf direction coincided with maximum orbital velocities due to local wind forcing. The synergy between these two processes resulted in increased suspended sediment transport in the positive along-shelf direction.

- The presence of high levels of suspended sediments within the wave boundary layer caused the 1.5 MHz seabed altimeter to not detect the bottom (and 5 cm of erosion) during periods of large swell-dominated bottom conditions.

EFFECT OF HURRICANE ISABEL ON SECCHI DEPTH IN ONSLOW BAY

STATION	3 DAYS BEFORE THE STORM	5 DAYS AFTER THE STORM
OB5	12.0 m	4.5 m
OB15	13.0 m	6.0 m
OB27	11.0 m	7.0 m

CONCLUSIONS – WATER COLUMN EFFECTS OF HURRICANE ISABEL

- **Nitrate, orthophosphate, and TP did not increase in Onslow Bay as a result of the hurricane**
- **Ammonium increased 2-7X over pre-storm conditions at all sites and depths; TN increased slightly at mid depth and bottom**
- **Chlorophyll *a* did not increase at any depth**
- **Secchi depth decreased 37-63%, depending on station, due to bottom sediment displacement**
- **The storm suppressed rather than enhanced phytoplankton primary productivity in Onslow Bay**

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