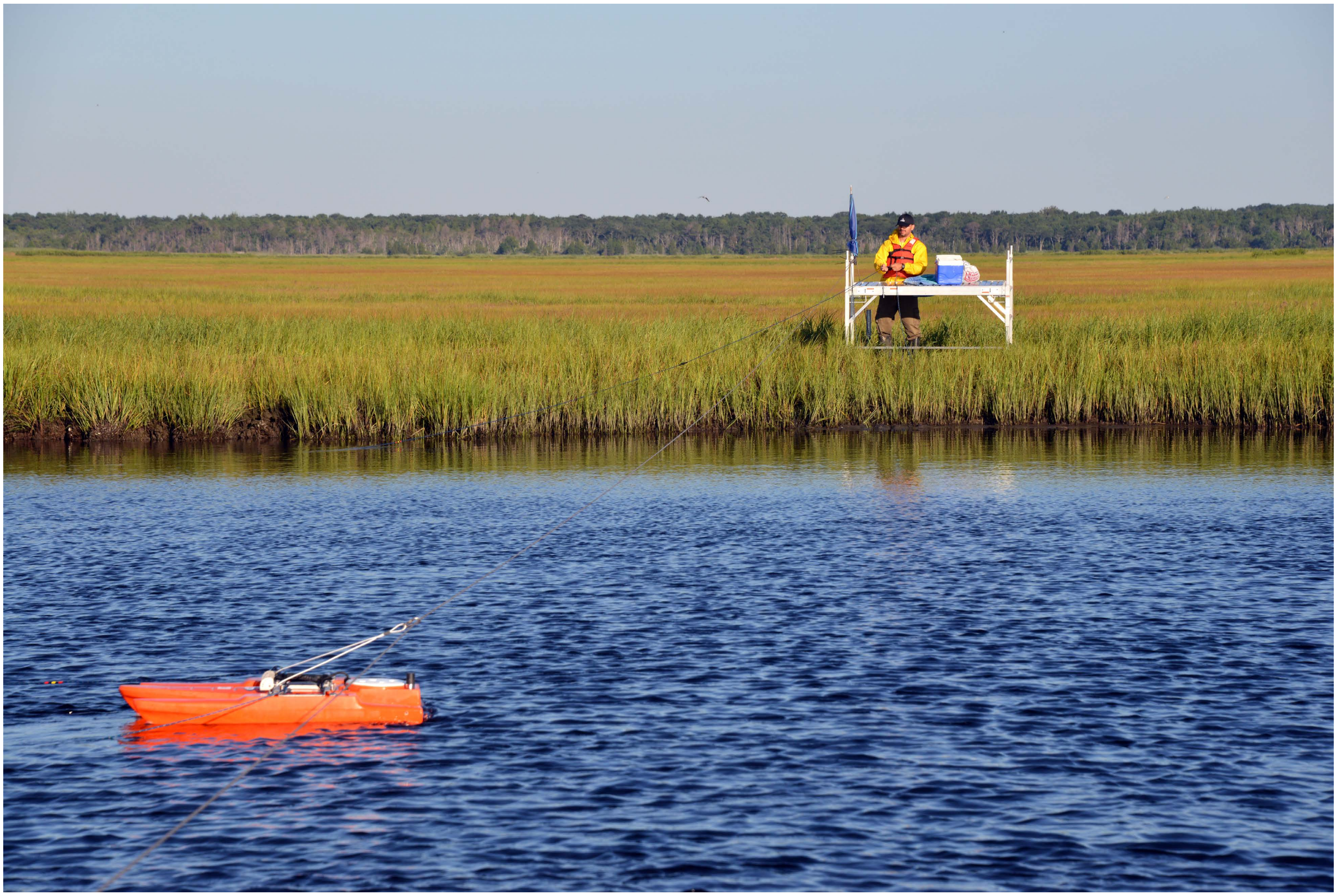
Summary of Oceanographic and Water-Quality Measurements in Barnegat Bay, New Jersey, 2014–15



Open-File Report 2016–1149

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Cover. Field operations to collect tidal cycle discharge data at the Dinner Creek site in Barnegat Bay, New Jersey, soon after deployment of time series instruments in August 2014. Photograph by Sandra Brosnahan, U.S. Geological Survey.

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Field and analytical support were provided by Zafer Defne, Christine Sabens, Kate McMullen, and Wally Brooks, all of the U.S. Geological Survey.

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Conversion Factors

International System of Units to Inch/Pound

Multiply	By	To obtain
	Length	
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	miles (mi)
kilometer (km)	0.5400	nautical miles (nmi)
	Pressure	
decibar (dbar)	1.450	pounds per square inch (psi)
decibar (dbar)	10	kilopascal (kPa)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as °F = (1.8 × °C) + 32.

Supplemental Information

Pressure measured underwater is given in decibars (dbar).
Current speed is given in centimeters per second (cm/s).
Turbidity is given as nephelometric turbidity units (NTU).

Abbreviations

ADCP	acoustic Doppler current profiler
EPIC	Equatorial Pacific Information Collection
HR	high resolution
MHz	megahertz
NetCDF	Network Common Data Form
SSC	suspended-sediment concentration
THREDDS	thematic real-time distributed data services
USGS	U.S. Geological Survey
UTC	coordinated universal time

Summary of Oceanographic and Water-Quality Measurements in Barnegat Bay, New Jersey, 2014–15

By Steven E. Suttles,[1] Neil K. Ganju,[1] Ellyn T. Montgomery,[1] Patrick J. Dickhudt,[2] Jonathan Borden,[1] Sandra M. Brosnahan,[1] and Marinna A. Martini[1]

Abstract

Scientists and technical support staff from the U.S. Geological Survey measured suspended-sediment concentrations, currents, pressure, and water temperature in two tidal creeks, Reedy Creek and Dinner Creek, in Barnegat Bay, New Jersey, from August 11, 2014, to July 10, 2015 as part of the Estuarine Physical Response to Storms project (GS2–2D). The oceanographic and water-quality data quantify suspended-sediment transport in Reedy Creek and Dinner Creek, which are part of a tidal marsh wetland complex in the Edwin B. Forsythe National Wildlife Refuge. All deployed instruments were removed between January 7, 2015, and April 14, 2015, to avoid damage by ice.

Introduction

Suspended-sediment transport is a critical element governing the geomorphology of tidal marshes (Ganju and others, 2013). As part of the Estuarine Physical Response to Storms project (GS2–2D), the U.S. Geological Survey (USGS) quantified suspended-sediment fluxes in two tidal creeks in the Barnegat Bay estuary, New Jersey, from August 11, 2014, to July 10, 2015. Water column velocity, water pressure, and turbidity were measured at 15-minute intervals at fixed stations in Reedy Creek and Dinner Creek. Water temperature measurements at a 1-minute sample interval were collected at the same sites. For the first deployment, August 11, 2014, to January 6, 2015, the turbidity and water temperature instruments were mounted on a pole to allow servicing during the deployment; thus the pole-mounted sensor data from this deployment are stored in two files. The Aquadopp acoustic Doppler current profiler (ADCP) instrument measuring water column velocity and subsurface pressure was deployed on a bottom platform for the entire deployment. All instruments were removed for the winter to prevent damage from freezing. During the April 15 to July 10, 2015, deployment instruments were mounted on the bottom platforms because instrument servicing was not required during that period. Supplemental data on water samples analyzed for suspended-sediment concentration (SSC) are given in appendix 1, and tidal-cycle cross-sectional discharge measurements are given in appendix 2.

Instruments

Autonomous instruments, with internal power and memory, were deployed at two sites in Barnegat Bay, N.J. (fig. 1), for the purpose of quantifying suspended-sediment fluxes in two tidal creeks

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[1]U.S. Geological Survey
[2]U.S. Army Corps of Engineers

that are part of a salt marsh complex. Deployed instruments measured water velocity, pressure, turbidity, and water temperature to allow suspended-sediment flux calculations at each site. Supplemental measurements of water volume discharge throughout a tidal cycle and water sample collection for analysis also were made in support of the time-series data reported herein.

For the August 11, 2014, to January 6, 2015, deployment, at each site a bottom platform with water velocity and pressure sensors was paired with nearby pole-mounted instruments measuring turbidity and water temperature. Two separate mounts were required for this deployment because the turbidity and water temperature sensors required service midway through the deployment and the ADCP needed to remain undisturbed for the entire deployment to allow for accurate sediment-flux calculations. Because of the shorter duration, the April 15 to July 10, 2015, deployment did not require an intermediate servicing for the turbidity sensors; therefore, all sensors were mounted on the bottom platforms for this deployment.

The bottom platforms consist of a 1-by-0.5-meter (m) fiberglass grate base, with aluminum square tubes and channels to provide the structural framework to support and mount the instruments (fig. 2). Lead weights were used to ballast the platform and a ground line was used to allow for recovery. This low-profile design is well suited for the shallow sites occupied for this experiment. The pole mounts were constructed of two lengths of galvanized sign post and a plastic mounting bracket (fig. 3). A longer length of sign post was driven into the seabed, approximately 1 m, and extends through the water column and above the high-water level. A shorter length of sign post with the mounting bracket and instrument attached to the end is attached to the fixed, longer sign post at the desired elevation and secured with bolts. This pole mount design allows for easy recovery and re-deployment of sensors at the same location.

The following instruments were used to collect data for this study:

- Nortek 1-megahertz (MHz) Aquadopp High Resolution (HR) ADCP (Reedy Creek only)
- Nortek 1 MHz Aquadopp ADCP (Dinner Creek only)
- Wet Labs ECO–NTUSB turbidity sensor (with anti-fouling wiper at Reedy Creek and Dinner Creek)
- RBR Solo T temperature sensor (Reedy Creek and Dinner Creek)

All instruments recorded data every 15 minutes, with the exception of the RBR Solo T, which recorded at a 1-minute interval. The Aquadopp HR ADCP used at Reedy Creek allows data to be collected in finer vertical resolution than the standard (non-pulse-coherent) version of the Aquadopp. Use of the Aquadopp HR ADCP was necessary at the Reedy Creek site because of the shallow depth (at times <1 m). The Wet Labs ECO–NTUSB turbidity sensors are equipped with a mechanical wiper and copper face plate to provide anti-fouling control for the optical sensor.

Site Description

The two tidal creek sites selected for this study are part of salt marsh complexes in Edward B. Forsythe National Wildlife Refuge (fig. 1) in the Barnegat Bay estuarine system of coastal New Jersey. Dinner Creek is a tributary in the southern portion of the system and is located on the western side of Barnegat Bay between the two primary inlets that provide the connection to the Atlantic Ocean (fig. 1). Dinner Creek runs primarily in the north-south direction with a typical spring tide range of approximately 0.75 m near the creek mouth. Typical channel depths in Dinner Creek are generally greater than 2 m. Reedy Creek is located in the northern portion of the estuarine system and the refuge (fig. 1), also on the western side of Barnegat Bay, and is farther away from the major inlets to the ocean. As a result, Reedy Creek has a smaller tidal range (typically <0.25 m) and shallower channel depths (<1.5 m) than Dinner Creek. In general Reedy Creek runs in an east-west direction. Dinner Creek exhibits higher sediment accumulation rates and higher inorganic sediment content on the adjoining marsh plain than Reedy Creek (Unger, 2013).

The time-series deployment site at Dinner Creek was located approximately 2 kilometers (km), from the mouth of the creek as measured along the channel thalweg. The instruments were placed in a relatively straight (north-south) segment of the creek where the deepest part of the channel was greater than or equal to 2 m deep, and the instruments were positioned slightly to the east of the creek centerline. At Reedy Creek, the deployment site was approximately 0.4 km from the mouth of the creek. At the site, the deepest part of the channel was less than 1.5 m and the instruments were located between the south bank and the creek centerline.

On August 11, 2014, a bottom platform with a current profiler was deployed at each site in the channel with pole-mounted turbidity and water temperature sensors deployed on the adjacent channel flank near the bank. Turbidity sensors were located at mid-depth at the time of deployment. The pole-mounted turbidity and water temperature sensors were recovered on October 7, 2014, to allow for downloading data, refreshing batteries, and cleaning sensors. The sensors were redeployed on October 8, 2014. Bottom platforms and pole-mounted sensors were recovered on January 6, 2015, as ice began to form in the creeks (fig. 4).

On April 15, 2015, after ice in the creeks melted, all sensors were redeployed at the two sites in the deepest part of the respective channels. All sensors were mounted to the bottom platforms, as no mid-deployment servicing was required (fig. 5). Details of the site location, depth, and duration for each deployment are listed in table 1.

Table 1. Sensor deployment and location information for platforms deployed in two tidal creeks in the Barnegat Bay estuary, New Jersey.

[ID, identification number; N, north; W, west; m, meter]

Mooring ID	Site name	Latitude (N)	Longitude (W)	Depth (m)	Deployment period
1014	Dinner Creek	39.6371	-74.2627	2.0	August 11, 2014 – January 6, 2015
1015A	Dinner Creek	39.6371	-74.2626	0.6	August 11, 2014 – October 7, 2014
1015B				0.6	October 8, 2014 – January 6, 2015
1016	Reedy Creek	40.0294	-74.0805	1.4	August 11, 2014 – January 6, 2015
1017A	Reedy Creek	40.0295	-74.0811	0.8	August 11, 2014 – October 7, 2014
1017B				1.0	October 8, 2014 – January 6, 2015
1041	Dinner Creek	39.6371	-74.2626	2.3	April 15, 2015 – July 10, 2015
1042	Reedy Creek	40.0294	-74.0806	1.0	April 15, 2015 – July 10, 2015

Results

Time-series data of water velocity, pressure, turbidity, and temperature were collected over two periods in tidal creeks on the west side of Barnegat Bay, N.J., from August 11, 2014, to January 6, 2015, and April 15 to July 10, 2015. The file names associated with the data collected in each deployment are shown in the right-most column of table 2. The deployments resulted in a useable data return of approximately 90 percent (fig. 6), and despite the long deployments in high biological and high sediment fouling environments, the anti-fouling controls were effective in limiting fouling (figs. 7 and 8). The turbidity sensor returned useable data throughout all deployments, except when the pole-mounted sensors were exposed to air during low-water events. The Aquadopp HR ADCP at Reedy Creek was disturbed on September 5, 2014, between 20:00 and 20:15 hours coordinated universal time (UTC), and the Aquadopp HR ADCP was repositioned in such a way as to not provide useable water column velocity data for the rest of the deployment (fig. 9). The source of the disturbance is unknown.

The Aquadopp ADCP at Dinner Creek for the April 15 to July 10, 2015, deployment sustained intermittent sample-timing issues starting on June 20, 2015, and continued until early in the day of July 10th (last day of deployment), when the instrument stopped recording data. The Aquadopp ADCP developed a slow leak, and water intruded into the instrument housing, causing the unit to fail. The full data record was recovered; however, the data from this instrument had data gaps caused by the leak. Plots of the basic time-series data from the two sites are shown in figures 9–16. Water pressure, current speed, and current direction data from the ADCPs are shown in figures 9, 10, 13, and 15. The pressure signals from the ADCPs were corrected for changes in atmospheric pressure by using barometric pressure data from the Jacques Cousteau National Estuarine Research Reserve meteorological station at Nacote Creek (not shown), about 20 kilometers south of the Dinner Creek site. The corrected pressure signal gives a more accurate representation of pressure caused by overlying water. Turbidity and water temperature time-series data from the Wet Labs ECO–NTUSB and from the RBR Solo T sensors, respectively, are shown in figures 11, 12, 14, and 16.

Table 2. Site identification number, instrument type, instrument serial number, instrument elevation, and links to the associated data files for platforms deployed in two tidal creeks in the Barnegat Bay estuary, New Jersey.
[ID, identification number; no., number]

Mooring ID	Instrument	Serial no.	Sensor elevation (meters above bottom)	What was measured	Data file
			1014—Dinner Creek		
10141	Nortek Aquadopp	5378	0.17	Current, pressure	10141aqd-a.nc
			1015A—Dinner Creek		
10151A	RBR Solo T	75565	0.39	Temperature	10151Asolot-a.nc
10152A	Wet Labs ECO–NTUSB	507	0.30	Turbidity	10152Aecn-a.nc
			1015B—Dinner Creek		
10151B	RBR Solo T	75565	0.39	Temperature	10151Bsolot-a.nc
10152B	Wet Labs ECO–NTUSB	507	0.30	Turbidity	10152Becn-a.nc
			1016—Reedy Creek		
10161	Nortek Aquadopp HR	5374	0.17	Burst current, pressure	10161HRaqdb-cal.nc
				Burst averaged current, pressure	10161HRaqds-a.nc
			1017A—Reedy Creek		
10171A	RBR Solo T	75563	0.44	Temperature	10171Asolot-a.nc
10172A	Wet Labs ECO–NTUSB	508	0.35	Turbidity	10172Aecn-a.nc
			1017B—Reedy Creek		
10171B	RBR Solo T	75563	0.44	Temperature	10171Bsolot-a.nc
10172B	Wet Labs ECO–NTUSB	508	0.35	Turbidity	10172Becn-a.nc
			1041—Dinner Creek		
10411	Nortek Aquadopp	5378	0.15	Current, pressure	10411aqd-a.nc
10412	Wet Labs ECO–NTUSB	507	0.13	Turbidity	10412ecn-a.nc
10413	RBR Solo T	75565	0.12	Temperature	10413solot-a.nc
			1042—Reedy Creek		
10421	Nortek Aquadopp HR	5374	0.15	Burst current, pressure	10421HRaqdb-cal.nc
				Burst averaged current, pressure	10421HRaqds-a.nc
10422	Wet Labs ECO–NTUSB	508	0.13	Turbidity	10422ecn-a.nc
10423	RBR Solo T	75563	0.12	Temperature	10423solot-a.nc

The data from all instruments were stored internally. After each recovery, the manufacturers' software was used to download the data, apply calibration coefficients, and convert the data to scientific units. Sensors were above the water surface on several occasions during the August 2014 to January 2015 deployment, and those data have been replaced with the fill value. The output files were then converted by custom, instrument-specific Matlab® programs to Equatorial Pacific Information Collection (EPIC) convention-compliant Network Common Data Form (NetCDF) files for distribution on the U.S. Geological Survey Oceanographic Time-Series Data Collection Web site. Files listed in this report are linked to their locations on the distribution site from which they may be accessed. Additional information on data processing, quality assurance and control protocols, file formats, nomenclature, and access methods used is provided in Montgomery and others (2016).

The landing page for these data (Suttles and others, 2015) contains details of all field activities associated with this project, Google Earth visualizations of deployment locations, and sampling interval information. The edited, final data can be downloaded from the catalog of data Web page or accessed directly at the "Data access via THREDDS" link on the landing page. File naming conventions for time-series observations are described in appendix 1 of Montgomery and others (2016).

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Figures

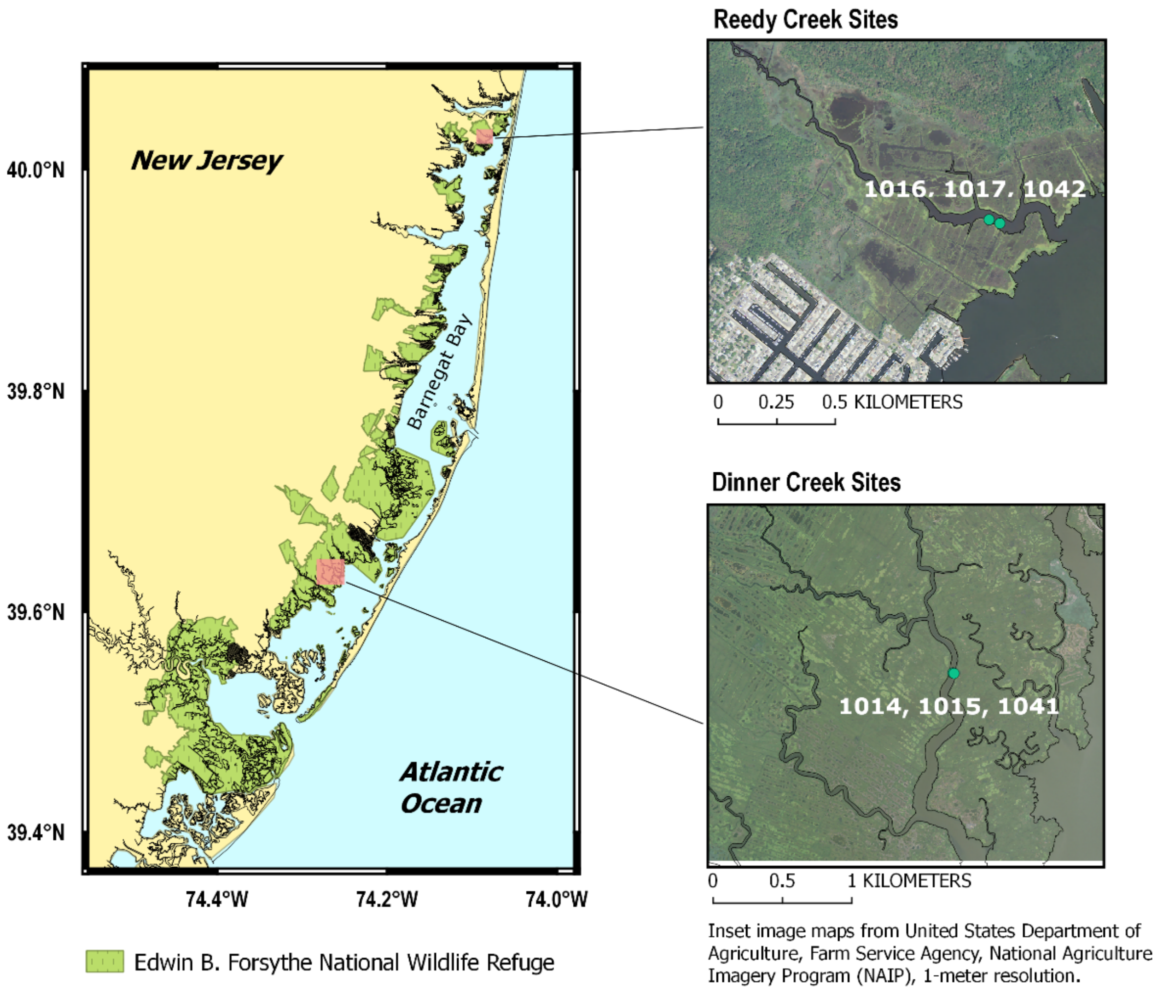

Figure 1. Map showing sampling locations at Dinner Creek and Reedy Creek sites in Barnegat Bay estuary, New Jersey. For site names, coordinates, sensor depths, and deployment periods, organized by the four-digit mooring identification numbers (IDs) shown, see table 1. On inset maps, green dots (●) indicate locations of time-series measurements. For instrumentation information, sensor elevation, and associated data files, by mooring numbers, see table 2. °, degrees; N, north; W, west.

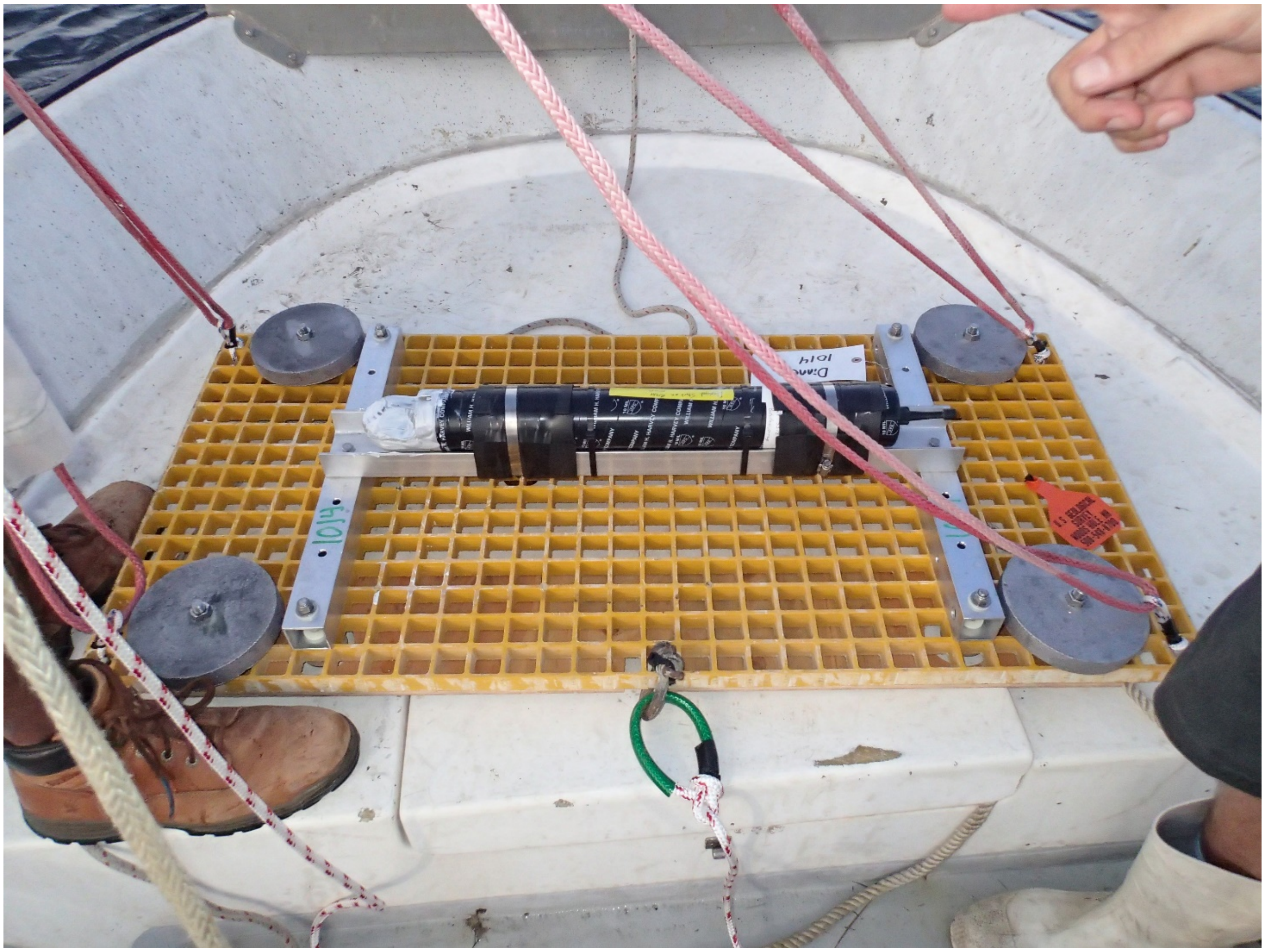

Figure 2. Photograph of the bottom platform with Aquadopp acoustic Doppler current profiler (ADCP) ready for deployment at Dinner Creek site in Barnegat Bay estuary, New Jersey, on August 11, 2014. The bridle deployment lines were attached at the corners of the platform and were removed once the platform was on the seabed.

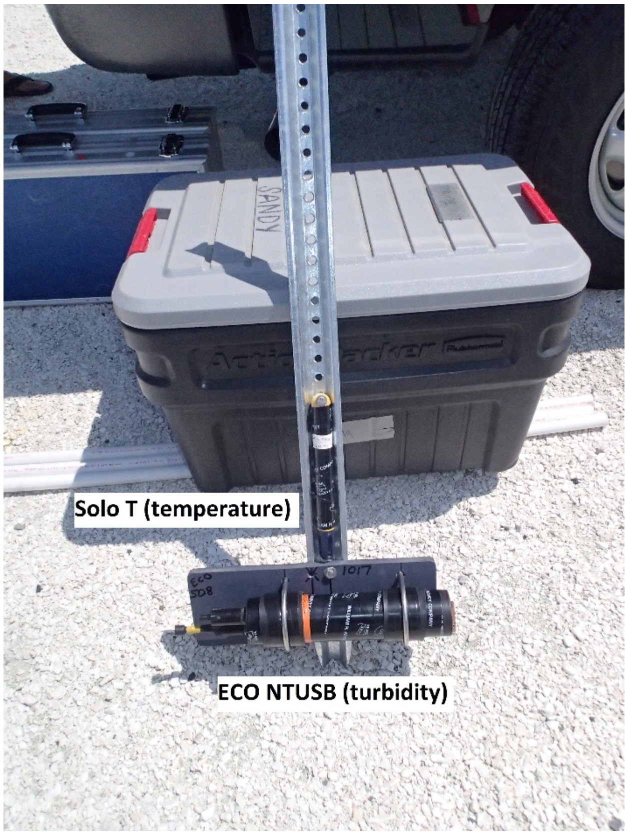

Figure 3. Photograph of pole-mounted turbidity and temperature sensors before deployment at Reedy Creek site on August 11, 2014. This section of sign post with instruments is attached to a longer section of sign post that is driven securely into the seabed.

Figure 4. Pole-mounted sensors at Reedy Creek on January 6, 2015, just before recovery. Icing conditions are just beginning, and low-water event is exposing sensors to air. Water level got low enough to expose turbidity and temperature sensors on numerous occasions during the August 11, 2014, to January 6, 2015, deployment.

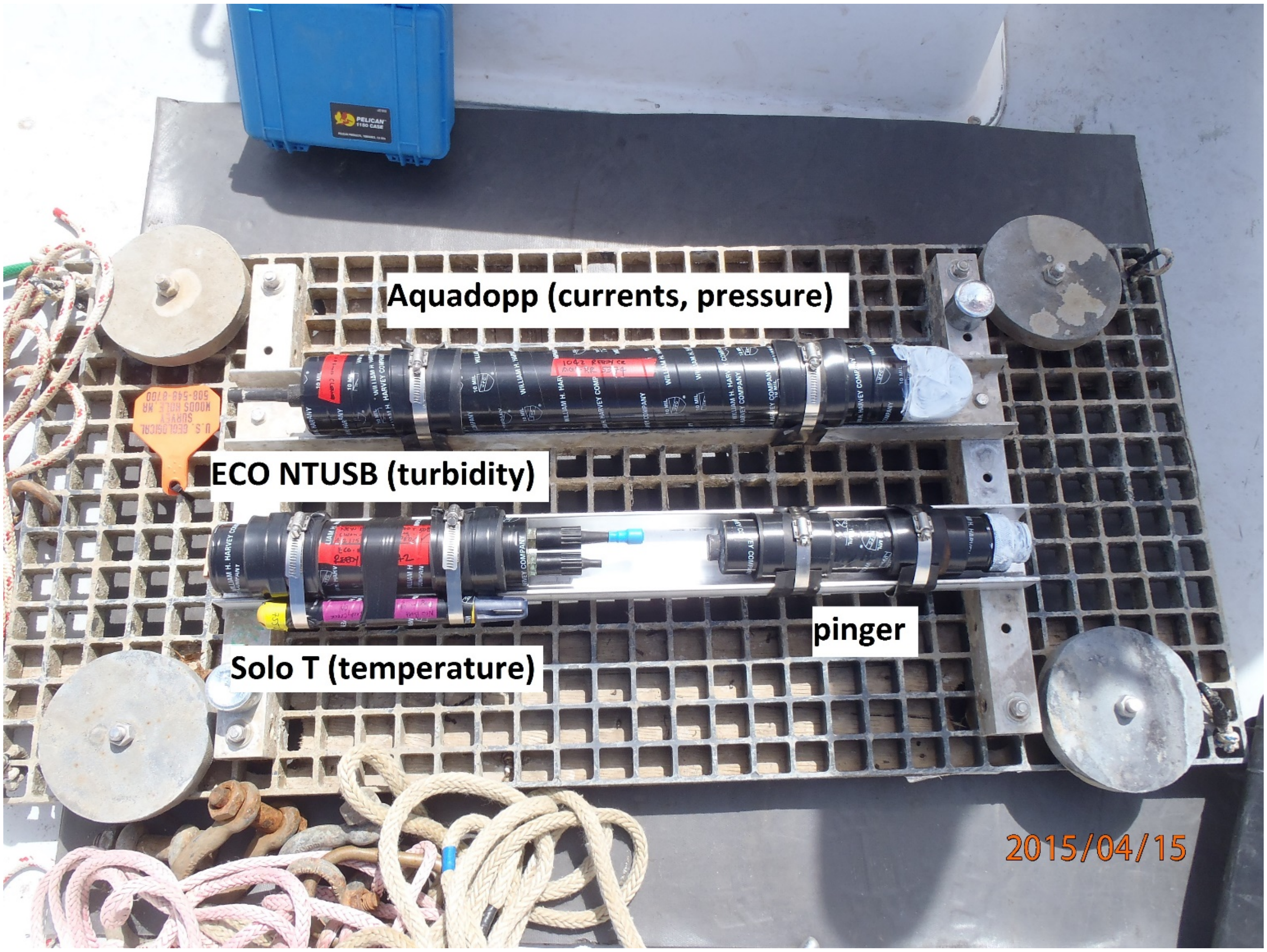

Figure 5. Instrument package with Aquadopp acoustic Doppler current profiler (ADCP), turbidity sensor, temperature sensor, and acoustic pinger all on bottom landing platform for deployment on April 15, 2015. No servicing of the turbidity and temperature sensors was required for this deployment; therefore all sensors could be mounted on the same platform.

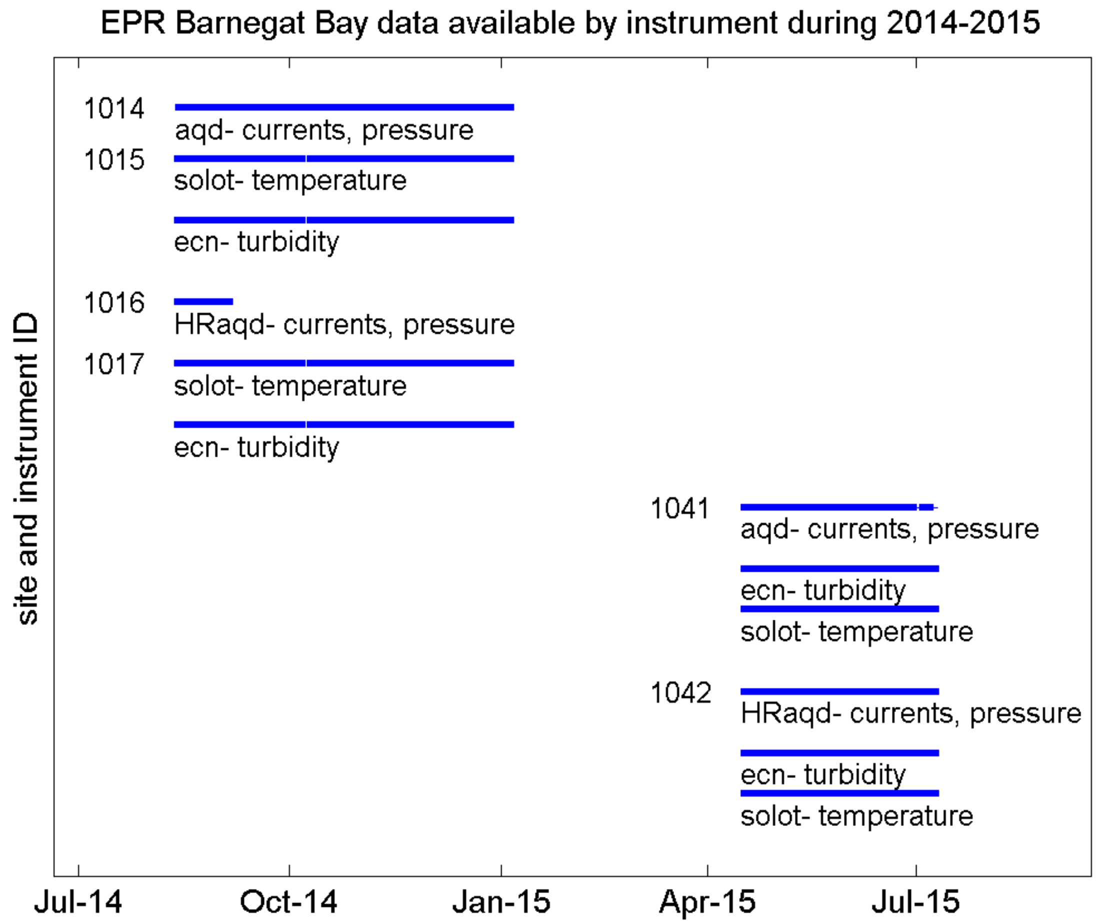

Figure 6. Chart showing the data available over time, by sensor and site, for Dinner and Reedy Creek sites in Barnegat Bay estuary, New Jersey, in 2014–15. ID, identification; EPR, Estuarine Physical Response; aqd, Nortek Aquadopp; solot, RBR Solo T; ecn, Wet Labs ECO NTUSB; HRaqd, Nortek Aquadopp High Resolution.

Figure 7. Sensor face of turbidity sensor upon recovery at Dinner Creek site on October 7, 2014, during turnaround of pole-mounted sensors. Anti-fouling wiper control kept optics area of the turbidity sensor relatively clean compared to rest of instrument body and mount.

Figure 8. Recovered Aquadopp acoustic Doppler current profiler (ADCP) platform from Dinner Creek site on January 6, 2015. Light fouling, primarily from sediment, is present on instrument.

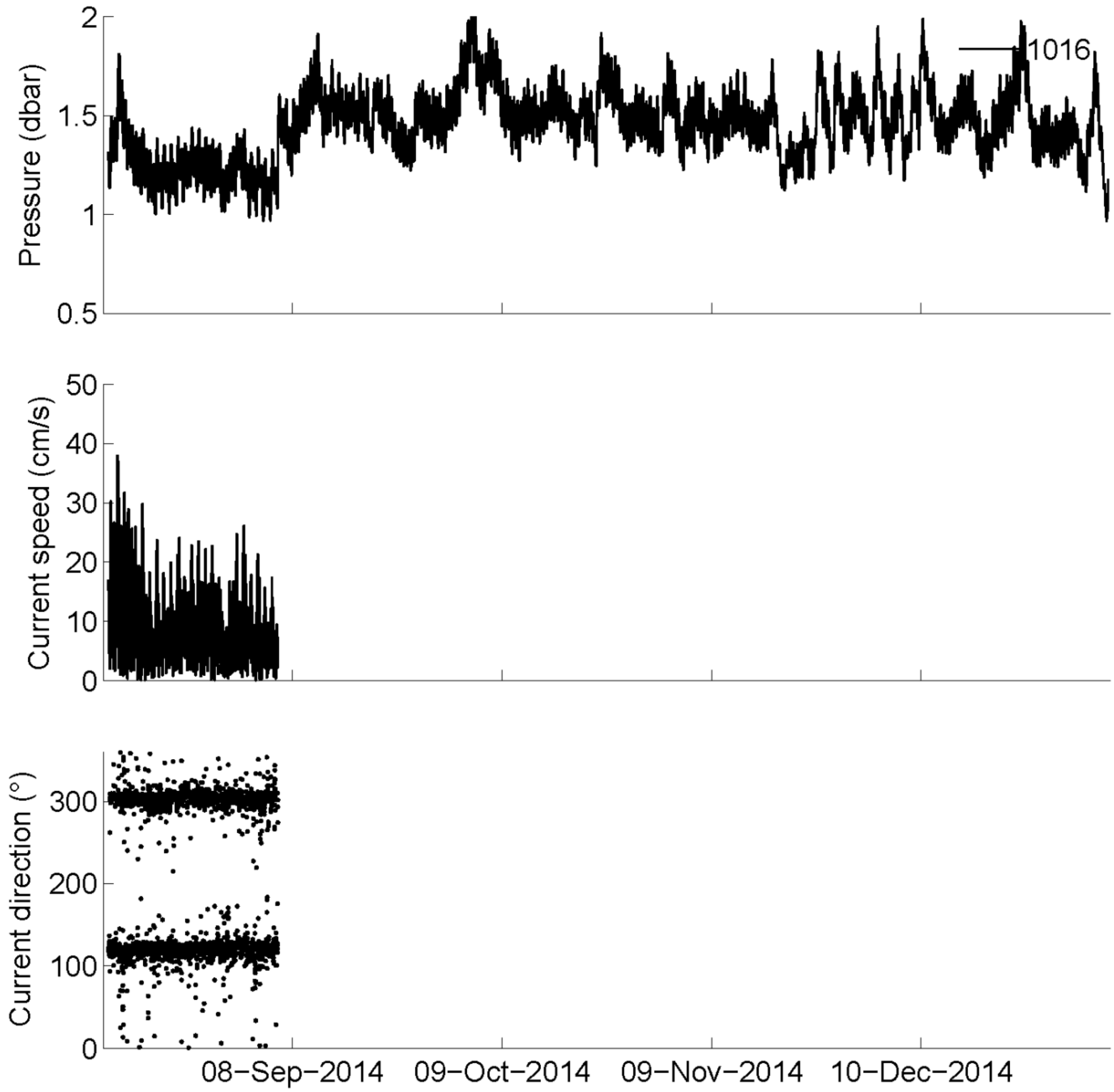

Figure 9. Pressure (atmospherically corrected), current speed, and current direction (traveling towards convention) from the Aquadopp High Resolution (HR) acoustic Doppler current profiler (ADCP), bin 4, at Reedy Creek site (mooring 1016) from August 11, 2014, to January 6, 2015. Platform was disturbed sometime after September 5, 2014, 20:00 coordinated universal time (UTC), and velocity profile data after that time were not useable. An abrupt change in pressure was observed at the time of disturbance, which was caused by the platform being repositioned. dbar, decibars; cm/s, centimeters per second; °, degrees true.

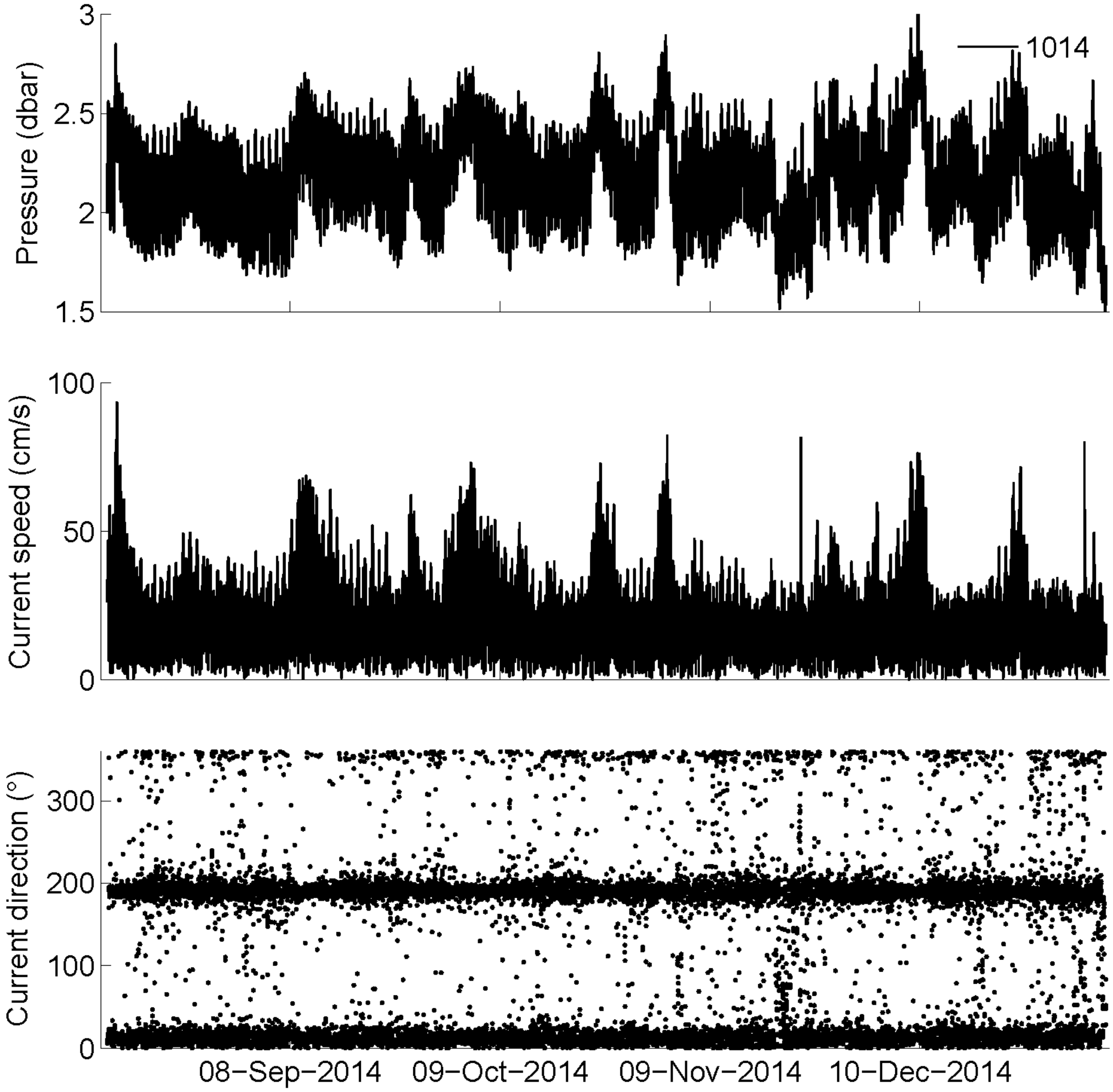

Figure 10. Pressure (atmospherically corrected), current speed, and current direction (traveling towards convention) from Aquadopp acoustic Doppler current profiler (ADCP), bin 2, at Dinner Creek site (mooring 1014) from August 11, 2014, to January 6, 2015. dbar, decibar; cm/s, centimeters per second; °, degrees true.

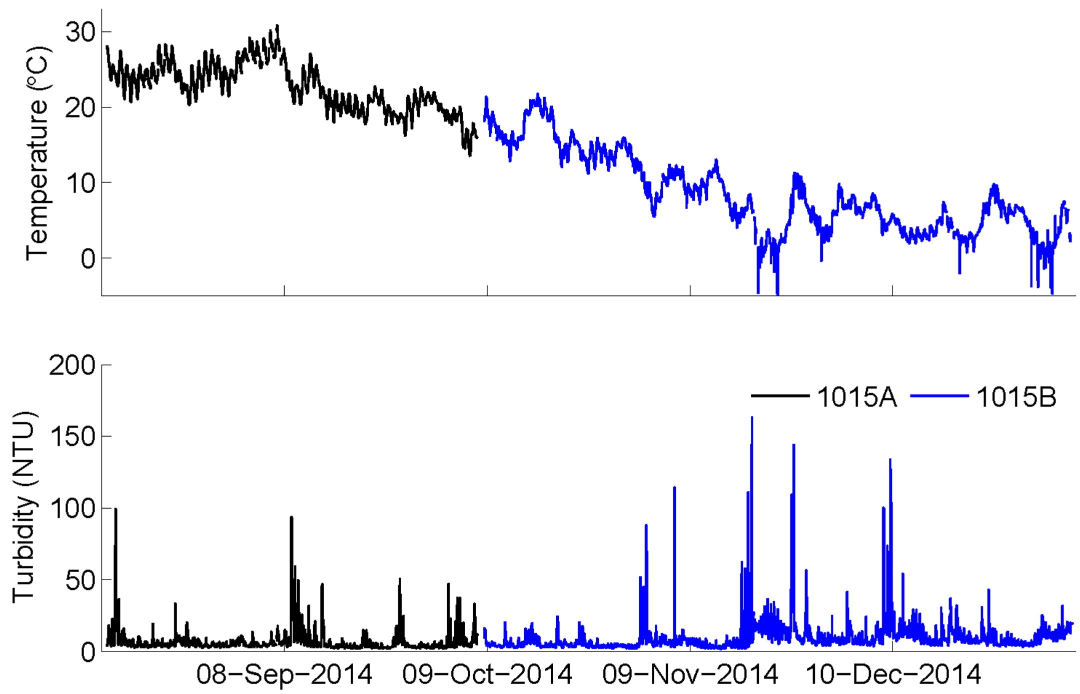

Figure 11. Water temperature and turbidity time series from pole-mounted Solo T and ECO–NTUSB instruments, respectively, deployed at Dinner Creek site (mooring 1015) in Barnegat Bay estuary, New Jersey, from August 11, 2014, to January 6, 2015. Instruments were recovered on October 7, 2014, and redeployed on October 8, 2014, to refresh batteries, download data, and clear memory to continue sampling; segmentation of data caused by this turnaround is indicated by 1015A and 1015B segments. °C, degrees Celsius; NTU, nephelometric turbidity units.

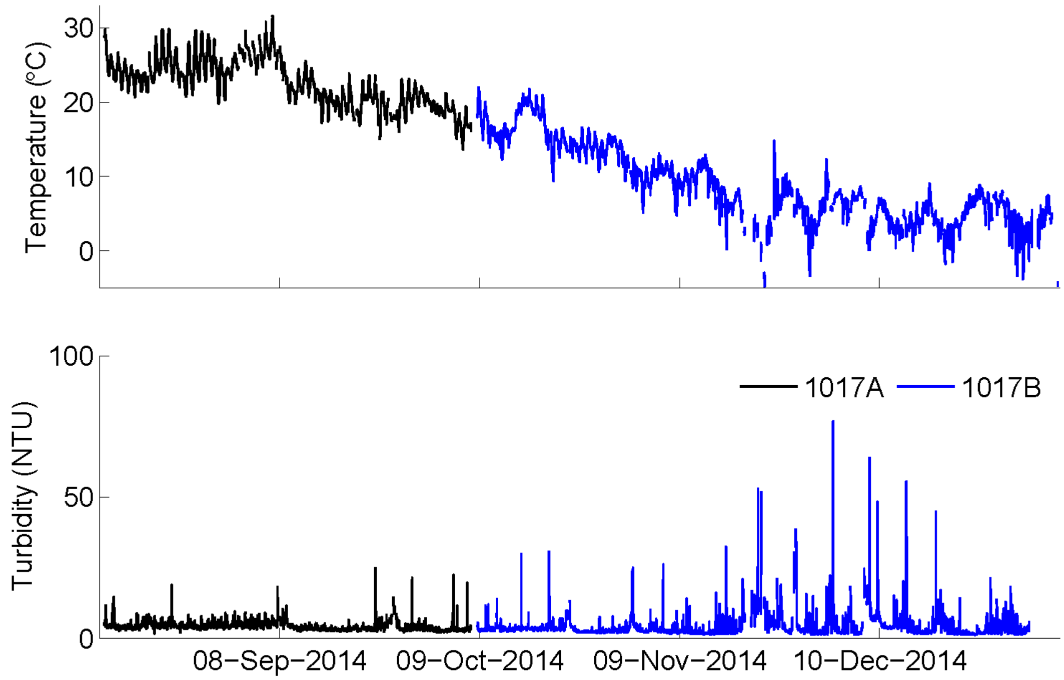

Figure 12. Water temperature and turbidity time series from pole-mounted Solo T and ECO–NTUSB instruments, respectively, deployed at Reedy Creek site (mooring 1017) in Barnegat Bay estuary, New Jersey, from August 11, 2014, to January 6, 2015. Instruments were recovered on October 7, 2014, and redeployed on October 8, 2014, to refresh batteries, download data, and clear memory to continue sampling; segmentation of data caused by this turnaround is indicated by 1017A and 1017B segments. °C, degrees Celsius; NTU, nephelometric turbidity units.

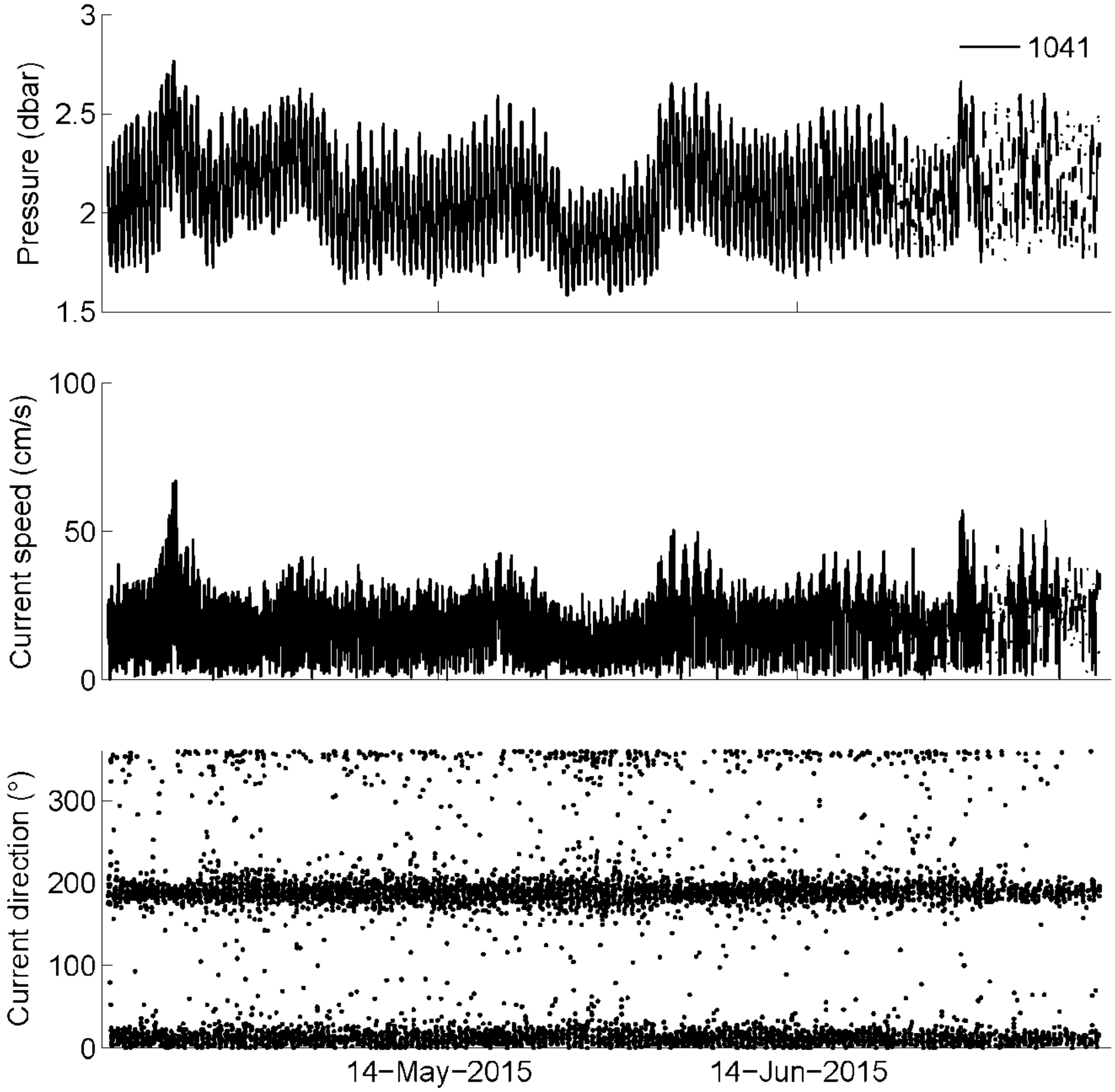

Figure 13. Pressure (atmospherically corrected), current speed, and current direction (traveling towards convention) from Aquadopp acoustic Doppler current profiler (ADCP), bin 2, at Dinner Creek site (mooring 1041) from April 15 to July 10, 2015. During the final month of this deployment, the ADCP began to intermittently miss sample times, and it stopped sampling 20 hours before being recovered on July 10, 2015, because of a small instrument housing leak. dbar, decibar; cm/s, centimeters per second; °, degrees true.

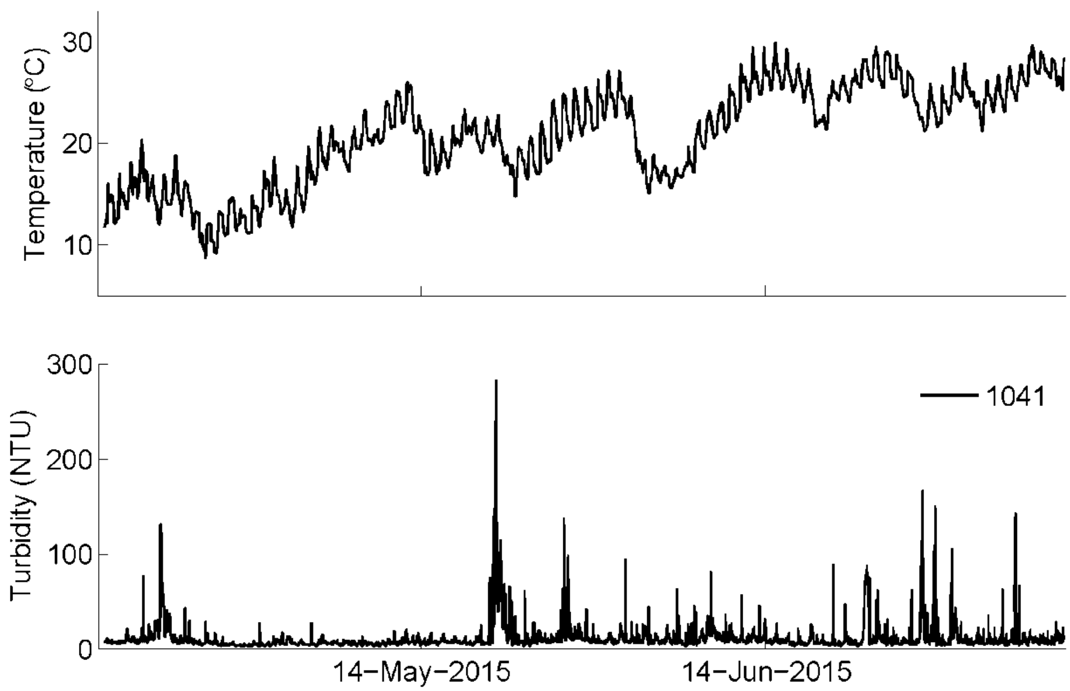

Figure 14. Water temperature and turbidity time series from RBR Solo T and Wet Labs ECO–NTUSB instruments, respectively, deployed at Dinner Creek site (mooring 1041) in Barnegat Bay estuary, New Jersey, from April 15 to July 10, 2015. These instruments were mounted on the bottom landing platform for this deployment. °C, degrees Celsius; NTU, nephelometric turbidity units.

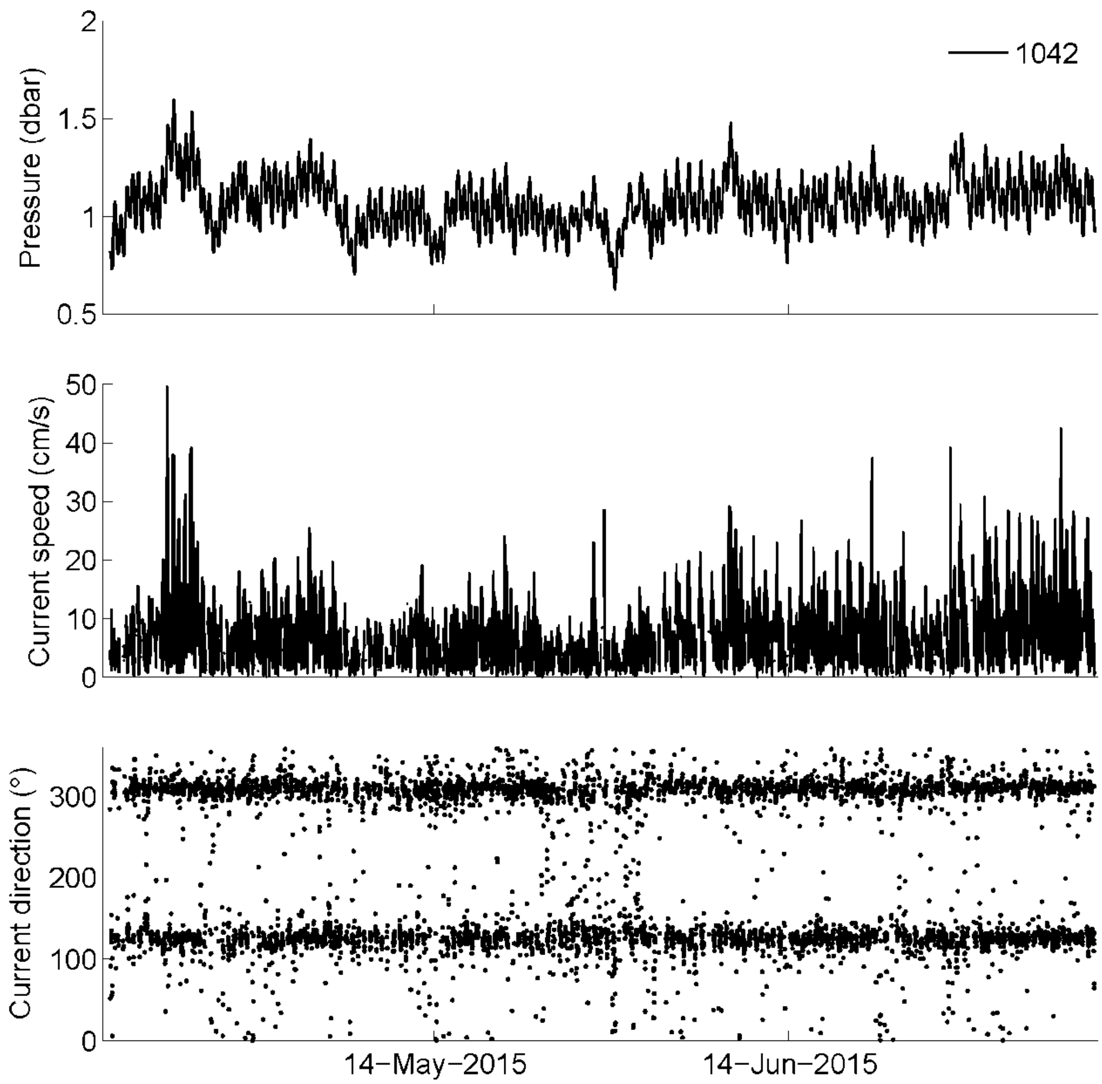

Figure 15. Pressure (atmospherically corrected), current speed, and current direction (traveling towards convention) from Aquadopp High Resolution (HR) acoustic Doppler current profiler (ADCP), bin 4, at Reedy Creek site (mooring 1042) from April 15 to July 10, 2015. dbar, decibar; cm/s, centimeters per second; °, degrees true.

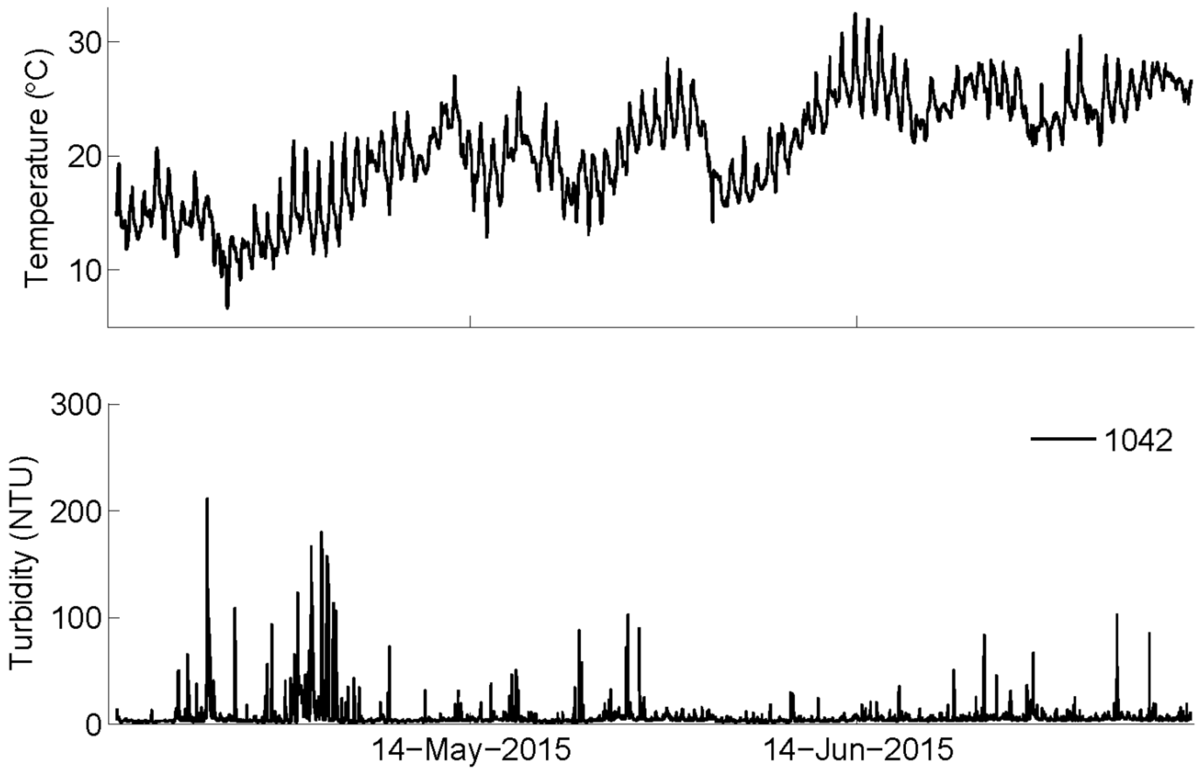

Figure 16. Water temperature and turbidity time series from RBR Solo T and Wet Labs ECO–NTUSB instruments, respectively, deployed at Reedy Creek site (mooring 1042) in Barnegat Bay estuary, New Jersey, from April 15 to July 10, 2015. These instruments were mounted on the bottom landing platform for this deployment. °C, degrees Celsius; NTU, nephelometric turbidity units.

Appendixes

These appendixes provide access to (1) water sample information and (2) acoustic Doppler current profiler (ADCP) tidal cycle transect data collected during this study. Water samples were collected by using a van Dorn sampler and processed for suspended-sediment concentration and loss-on-ignition by following U.S. Geological Survey methods (Fishman and Friedman, 1989). The samples were used to calibrate turbidity sensors at the Reedy Creek and Dinner Creek sites. ADCP tidal cycle transect data were collected to estimate lateral variability in channel conditions and to correlate water discharge to measured ADCP velocity in the creeks.

Appendix 1. Water Sample Data, Reedy Creek and Dinner Creek Sites, Barnegat Bay, New Jersey, 2014–15

[Appendix 1 tables (two *.xlsx files within a *.zip file) can be downloaded at http://dx.doi.org/10.3133/ofr20161149.]

Table 1–1. Water sample data from the Reedy Creek and Dinner Creek sites, Barnegat Bay, New Jersey, August 2014 to January 2015.

Table 1–2. Water sample data from the Reedy Creek and Dinner Creek sites, Barnegat Bay, New Jersey, April to July 2015.

Appendix 2. Acoustic Doppler Current Profiler Transect Measurements, Reedy Creek and Dinner Creek Sites, Barnegat Bay, New Jersey, August 2014 and May 2015

[Appendix 2 files (*mmt files, with logs) can be downloaded at http://dx.doi.org/10.3133/ofr20161149.]

Transect data for the Reedy Creek site are for August 2014, adjacent to mooring 1016, and May 2015, adjacent to mooring 1042. Data for the Dinner Creek site are for August 2014, adjacent to mooring 1014, and May 2015, adjacent to mooring 1041.

For more information concerning this report, contact:
Director, Woods Hole Coastal and Marine
Science Center
U.S. Geological Survey
384 Woods Hole Road
Quissett Campus
Woods Hole, MA 02543-1598
WHSC_science_director@usgs.gov
508-548-8700 or 508-457-2200
or visit our Web site at:
http://woodshole.er.usgs.gov/

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