Velocity data collection in the Corpus Christi Bay ship channel

Laura C. Gundlach, B.S.
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Center for Research in Water Resources
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CRWR Online Report 11-XX
Submitted to the Texas Water Development Board
TWDB Contract No. 1004831013
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Acknowledgments

This field study was partially supported by TWDB research grant 1004831013 to Prof. Ben R. Hodges at the University of Texas at Austin. Additional contributions were made by TWDB staff with TWDB instruments and equipment. Prof. Paul Montagna at the Harte Research Institute of Texas A&M Corpus Christi and Prof. Scott Socolofsky at Texas A&M College Station provided additional equipment and staff to make this project possible.

Executive Summary

This report documents the data collection and archiving for a field study conducted in Corpus Christi Bay during the summer of 2010. The study collected velocity data in both the main shipping channel and in non-channelized portions of the bay. The study was designed to provide data that can be used to better understand the how wind-driven flow through the main basin is coupled or de-coupled from the tidally-driven flow in the ship channel.

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1 Introduction

A field study was conducted during July and August of 2010 to provide insight into coupling between wind and tidally-driven currents near a deep ship channel in a shallow bay. The project consisted of two principal efforts: 1) deployment of Acoustic Doppler Current Profilers (ADCP) and conductivity-temperature-depth-dissolved oxygen (CTD+DO) sondes for several weeks in Corpus Christi Bay (CCB), and 2) a boat survey of transects across and along the ship channel over two days using a downward-looking ADCP, profiling casts with a CTD+DO sonde and Lagrangian drifters.

This project was the collaboration between the Texas Water Development Board (TWDB), The University of Texas at Austin, Texas A&M University at College Station and the Harte Research Institute (HRI) at Texas A&M University Corpus Christi.

This report is intended as a historical reference for the data collected during this study. It provides a data summary, including overview maps and tables, an outline of available data files on DVD, an outline of instruments and methods, and a field study narrative. The appendix includes a short paper of design considerations when installing an ADCP in the ship channel, a plan for the installation, a table of the latitudes and longitudes of significant locations, the drogue sensors report, and a copy of the sampling trip logbook.

2 Study site

The study was conducted in the CCB environs as shown in Figure 1, with details in Figures 2 and 3. Four upward-looking ADCPs were deployed from July 13 – August 11, 2010 in a southeast to northwest line along the direction of the typical afternoon summer seabreeze. During the boat surveys of July 17 – 19, 2010, transect surveys were conducted between target pairs S1:N1 and Buoy49:Buoy61. Global Positioning System (GPS) waypoints were recorded for locations where transects were started and finished, as well as where CTD drops were made from the survey boat.

Table 1. Abbreviations used for study locations

CCHYP	first southeast ADCP
CCOBS	second southeast ADCP
CCBSC/Buoy55	ship channel ADCP
CCOBN	northwest ADCP
CCOBM	western ADCP
WPT	waypoint recorded in boat GPS
S1	southern transect target
N1	northern transect target
Buoy49	western transect target
Buoy61	eastern transect target

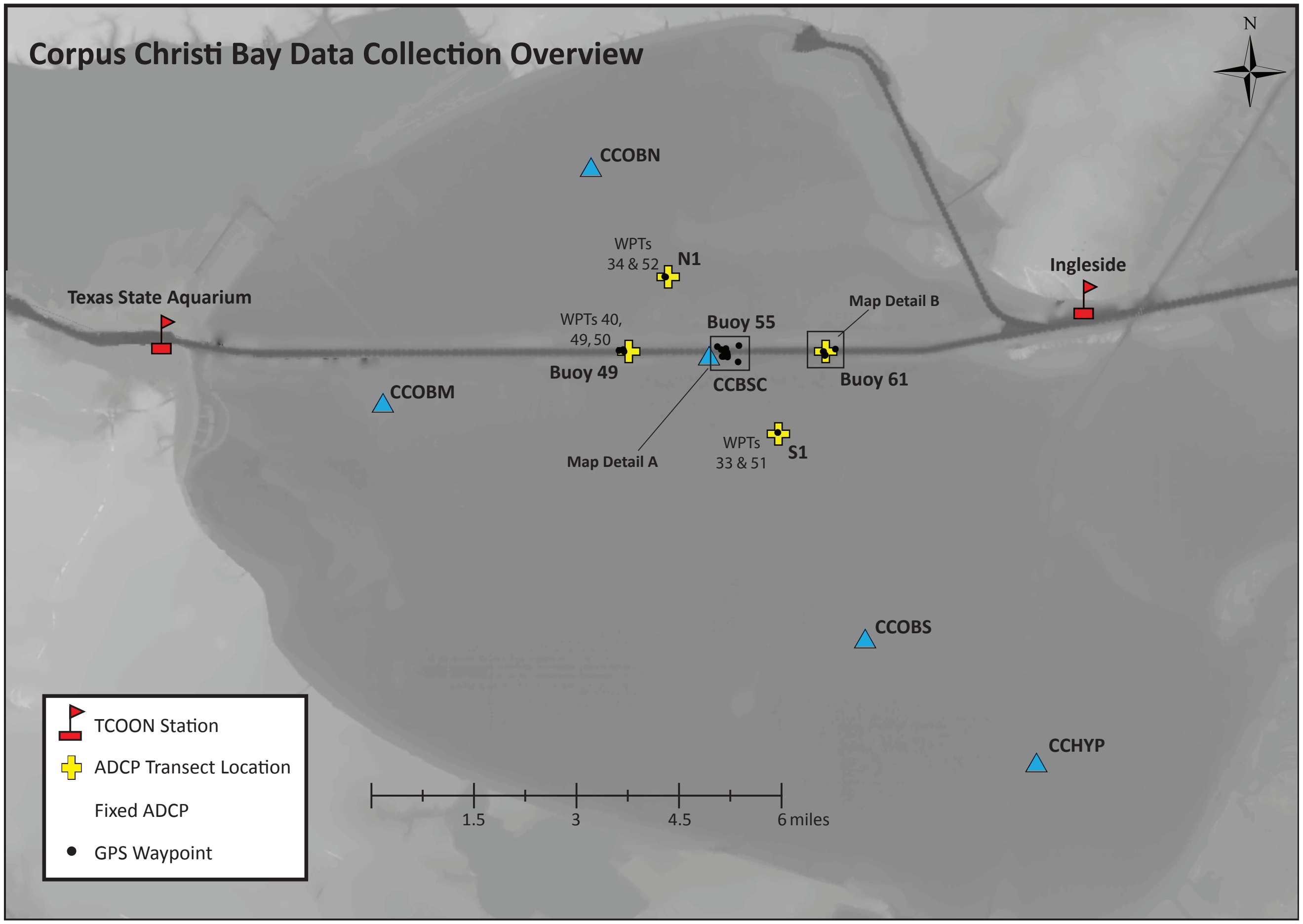

Figure 1. Corpus Christi Bay study site. See Table 1 for abbreviations.

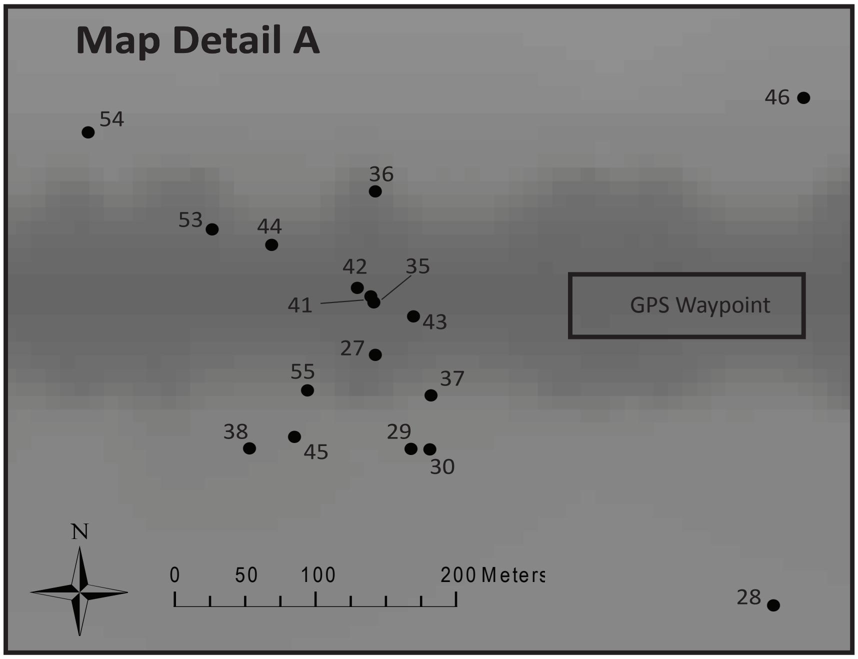

Figure 2. GPS waypoints in the vicinity of Buoy55. Detail A from Figure 1. Numbers represent waypoint indexes.

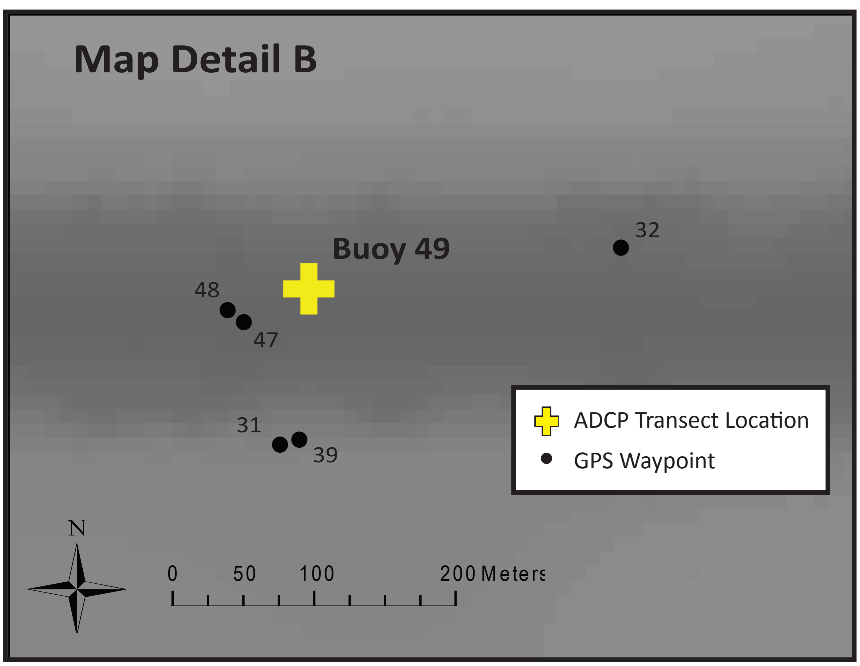

Figure 3. GPS waypoints in the vicinity of Buoy61. Detail B from Figure 1. Numbers represent waypoint indexes.

The Corpus Christi ship channel is dredged to 45 ft over a 400 ft breadth through the northern portion of Corpus Christi Bay (CCB), which is otherwise about 12 ft deep (Figure 4). This study was designed to gather data in this area with an upward-looking ADCP, a challenging prospect due to wakes developed by the deep-draft ships using the channel and shrimp trawlers scraping the bottom.

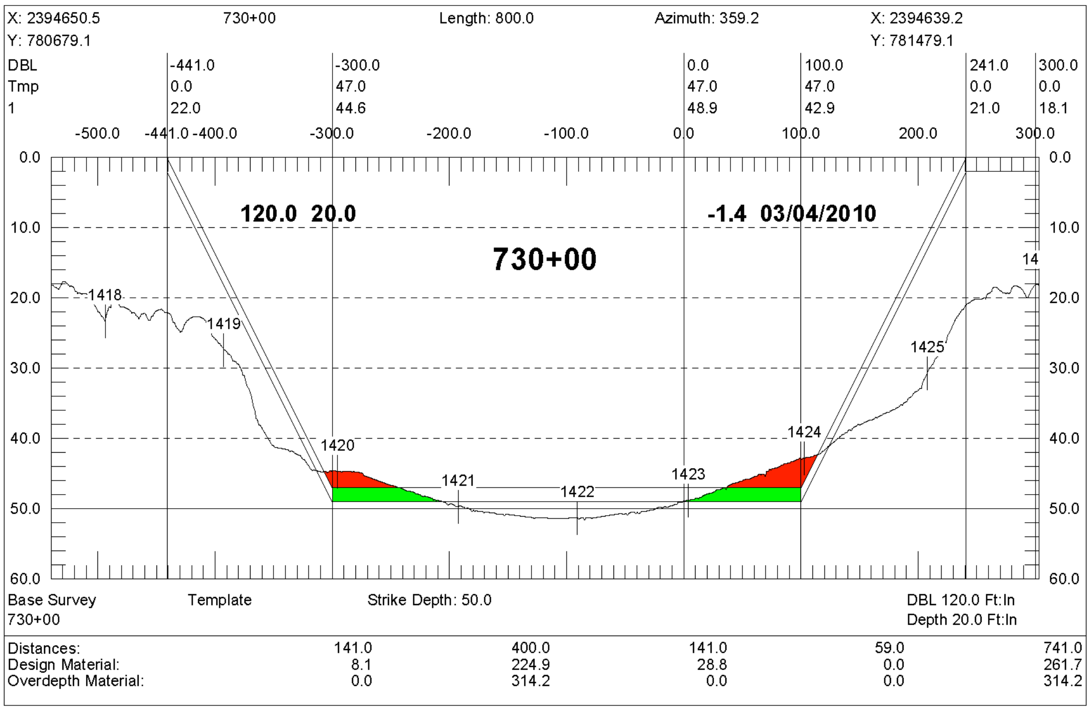

Figure 4. Typical surveyed cross-section of Corpus Christi ship channel (courtesy of TWDB)

3 Project planning and execution

Personnel involved in the planning and execution of the study are listed in Table 2. The study was planned around the expected wind and tide conditions expected in July and August for CCB. The mean summertime daily wind evolution at different locations around CCB is shown in Figure 5. The predicted harmonic tides for the ADCP deployment are shown in Figure 6, with a detail of tides during the boat survey shown in Figure 7. The wind in CCB follows a summer seabreeze pattern, which is out of phase with the tide during the boat survey (Figure 8). Figure 9 shows five different wind/tide regimes expected during the survey: ebbing current/strong wind; reversing current/strong wind; flooding current/dying wind; flooding current/no wind; reversing current/rising wind. Note that in this time period it is impossible to get a data set predicted to have an increasing to strong wind with a strong flooding current.

Table 2. Project personnel

Organization	Name	Role
TWDB	Dharhas Pothina Robert Burgess	Project lead Field lead
U. Texas – Austin	Ben Hodges Laura Gundlach	UT lead graduate student
Texas A&M – College Station	Scott Socolofsky Kerri Whilden	TAMU – College Station lead graduate student
Texas A&M – Corpus Christi, Harte Research Institute	Paul Montagna Kevin Nelson Terry Palmer Rick Kalke	HRI lead ADCP, CTD+DO deployment ADCP, CTD+DO deployment ADCP, CTD+DO deployment

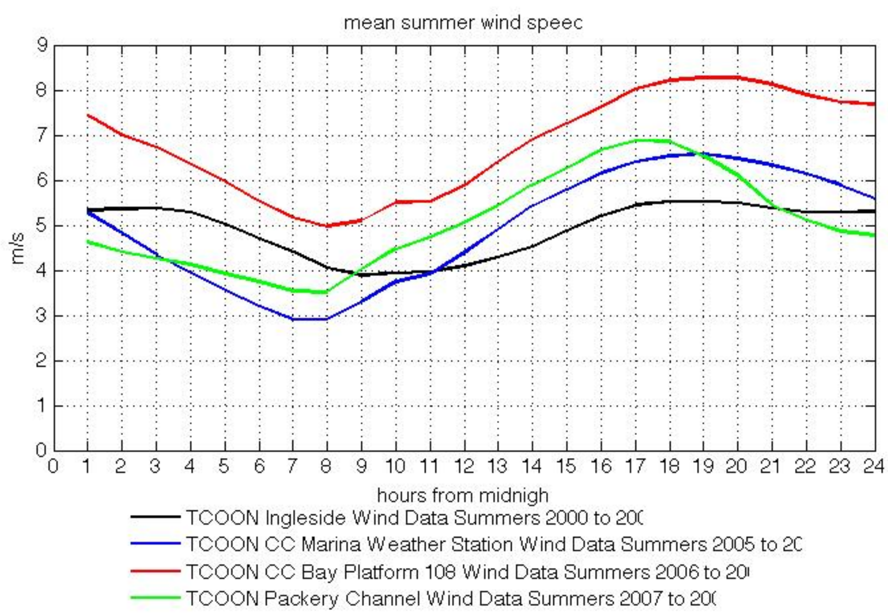

Figure 5. Daily evolution of mean wind speed during summer in Corpus Christi Bay.

Fixed ADCPs and CTD+DO sondes (see §4.1) in Corpus Christi Bay were deployed beginning July 13, 2010. A boat survey from July 17, 2010 to July 19, 2010 used a 26 ft boat with a rotating three person crew. The boat survey collected downward-looking ADCP transects, profiles of CTD+DO, and several Lagrangian drifter tracks. A total of 23 ADCP transects were completed, providing spatially-distributed velocity profiles over a two-day time frame to complement the longer data sets from the fixed ADCPs deployed in the bay.

The boat survey was originally planned to obtain ADCP transects, CTD+DO profiles and additional profiles with a Self-Contained Autonomous MicroProfiler (SCAMP) as outlined in the sampling plan shown in Figure 10. However, the instrument was stolen from the boat dock before it could be deployed.

The boat survey plan required two boats and two crews so as to minimize transit downtime between crew changes. Unfortunately, one of the boats had an engine malfunction before it could be used. The survey was accomplished using a single boat with the timeline shown in Figure 11 with 23 ADCP transects, 15 CTD+DO profiles and 4 Lagrangian drifter releases. Tidal data recorded at TCOON stations during the boat survey is provided in Figure 12.

Waypoints and locations from the boat survey and fixed ADCP emplacement are provided in Table 3.

An annotated transcription of the logbook from the boat survey is provided as Appendix A.

Table 3. Waypoints and locations

CCBay Significant Locations and Waypoints			
Latitude	Longitude	Location	Time Measured (CST)
27.81082993	-97.25832993	BUOY-49	Entered Manually
27.81082993	-97.27916994	BUOY-55	Entered Manually
27.81082993	-97.29999998	BUOY-61	Entered Manually
27.80883	97.276	CCBSC	Entered Manually
27.72367	-97.21375	CCHYP	Entered Manually
27.8	-97.352	CCOBM	Entered Manually
27.85	-97.308	CCOBN	Entered Manually
27.75	-97.25	CCOBS	Entered Manually
29.34722901	-96.19354249	Glen Flora	Entered Manually
27.83332997	-97.37082999	HOME	Entered Manually
27.82666996	-97.29166996	N1	Entered Manually
27.85034993	-97.30839998	N-ADP	Entered Manually
27.79332994	-97.26832996	S1	Entered Manually
27.75015995	-97.25115997	S-ADP	Entered Manually
30.39196015	-97.74536134	US 183	Entered Manually
30.51068545	-97.82327414	US 183	Entered Manually
29.3170166	-96.1001587	Wharton	Entered Manually
27.81015041	-97.27941503	WPT 27	17-JUL-10 5:19:05PM
27.80842725	-97.27686525	WPT 28	17-JUL-10 5:44:50PM
27.80950374	-97.27918696	WPT 29	17-JUL-10 6:29:01PM
27.8094993	-97.27906626	WPT 30	17-JUL-10 8:12:47PM
27.80982661	-97.25851735	WPT 31	17-JUL-10 8:38:31PM
27.81110301	-97.25630092	WPT 32	17-JUL-10 8:57:27PM
27.79348073	-97.26845519	WPT 33	17-JUL-10 10:17:52PM
27.8264009	-97.29215519	WPT 34	17-JUL-10 10:56:13PM
27.81051317	-97.27942467	WPT 35	18-JUL-10 4:01:18AM
27.81127618	-97.2794157	WPT 36	18-JUL-10 8:22:32AM
27.80987322	-97.27905922	WPT 37	18-JUL-10 12:03:29PM
27.80950953	-97.28022254	WPT 38	18-JUL-10 12:28:26PM
27.80985545	-97.25839062	WPT 39	18-JUL-10 1:00:16PM
27.81081886	-97.30205522	WPT 40	18-JUL-10 1:41:13PM
27.81055383	-97.27944529	WPT 41	18-JUL-10 1:48:03PM
27.81061015	-97.27953154	WPT 42	18-JUL-10 2:14:38PM
27.8104172	-97.27917078	WPT 43	18-JUL-10 2:30:03PM
27.81090956	-97.28007846	WPT 44	18-JUL-10 2:43:45PM
27.80958572	-97.27993362	WPT 45	18-JUL-10 4:02:48PM
27.8119215	-97.27667239	WPT 46	18-JUL-10 4:16:18PM
27.81061786	-97.25875129	WPT 47	18-JUL-10 4:35:04PM
27.81069942	-97.25885782	WPT 48	18-JUL-10 4:35:16PM
27.81106739	-97.30113547	WPT 49	18-JUL-10 5:19:12PM
27.81059942	-97.30099365	WPT 50	18-JUL-10 5:21:25PM
27.79346086	-97.26847555	WPT 51	18-JUL-10 6:09:58PM
27.82656192	-97.29242508	WPT 52	18-JUL-10 6:47:45PM
27.811015	-97.28046126	WPT 53	18-JUL-10 10:16:51PM
27.81168245	-97.28125519	WPT 54	18-JUL-10 11:49:56PM
27.80990641	-97.27985055	WPT 55	18-JUL-10 11:57:27PM

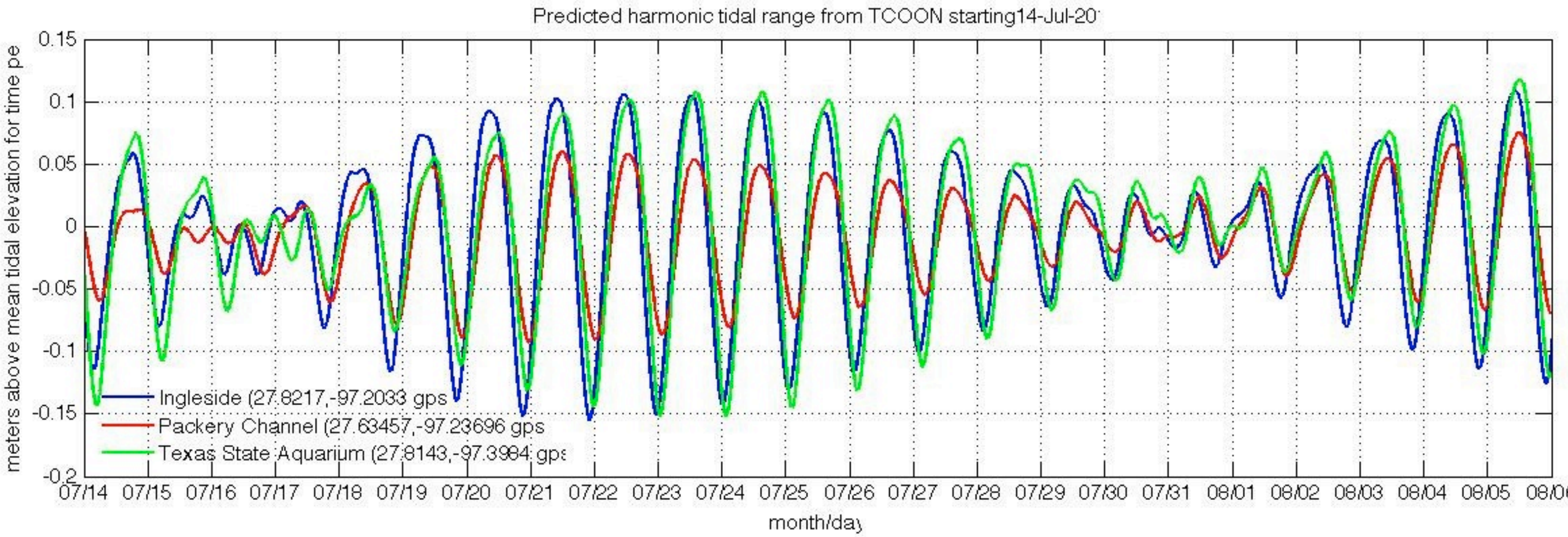

Figure 6. TCOON predicted harmonic tides in Corpus Christi Bay for mid-July through early August, 2010.

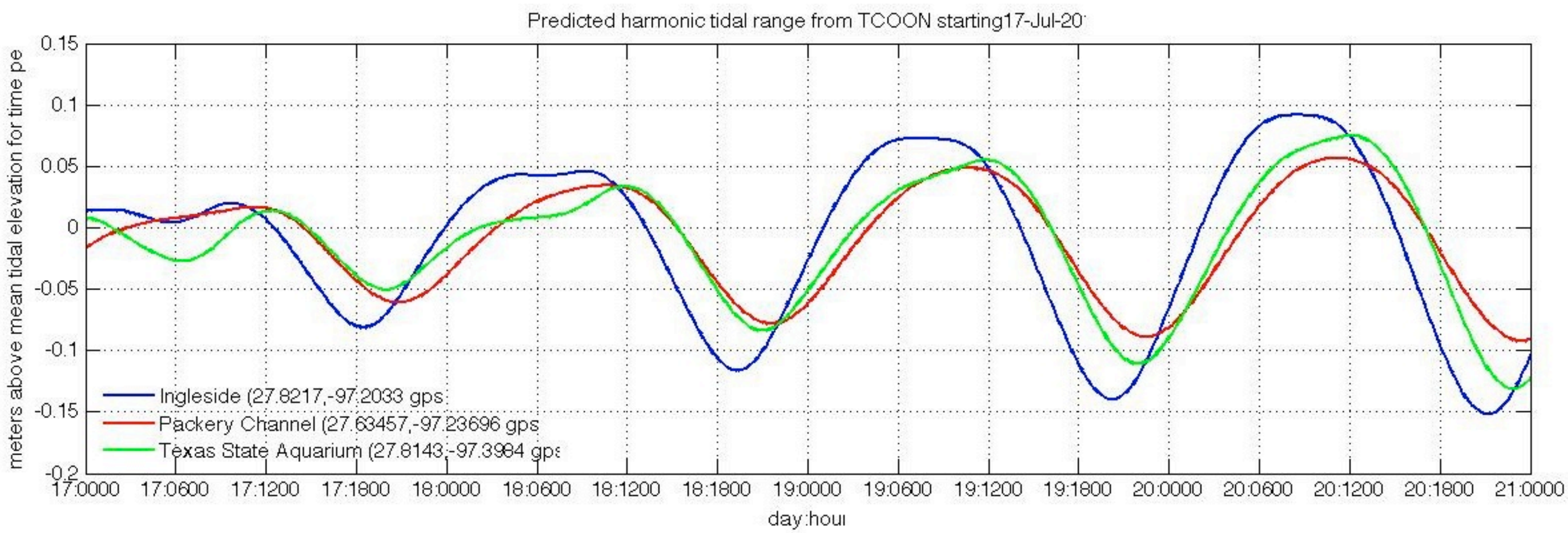

Figure 7. TCOON predicted harmonic tides in Corpus Christi Bay used for planning boat survey from July 17-19 2010.

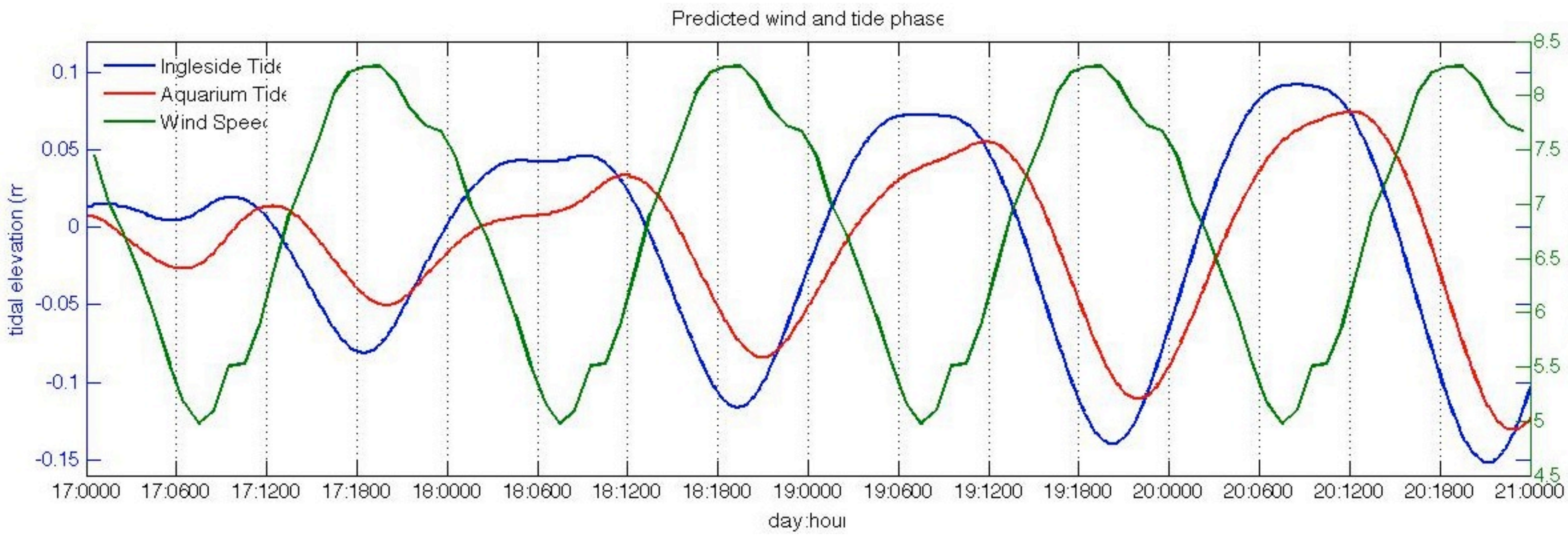

Figure 8. Predicted phase relationship between wind and tide during boat survey from July 17-19, 2010

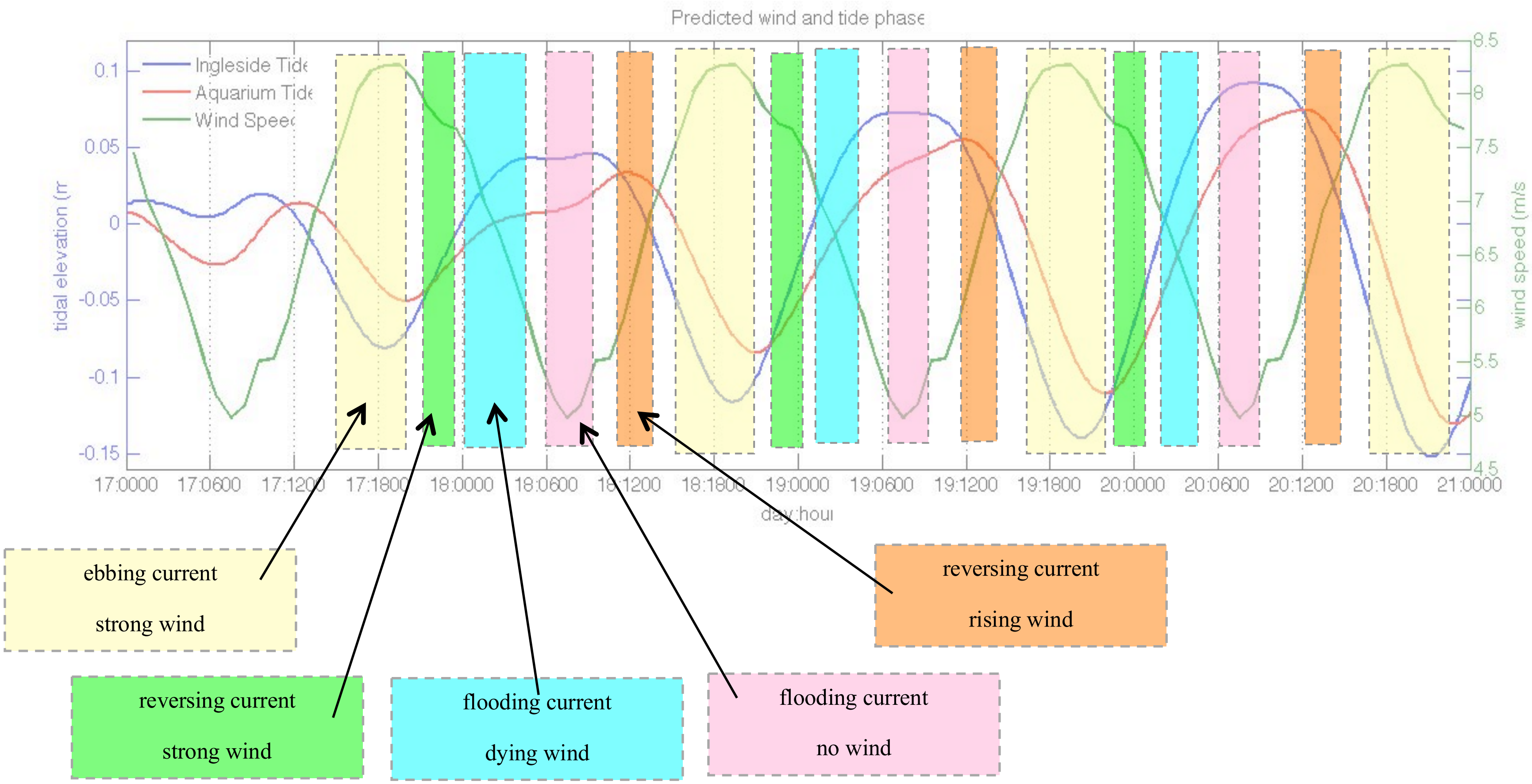

Figure 9. Predicted wind/tide regimes during boat survey.

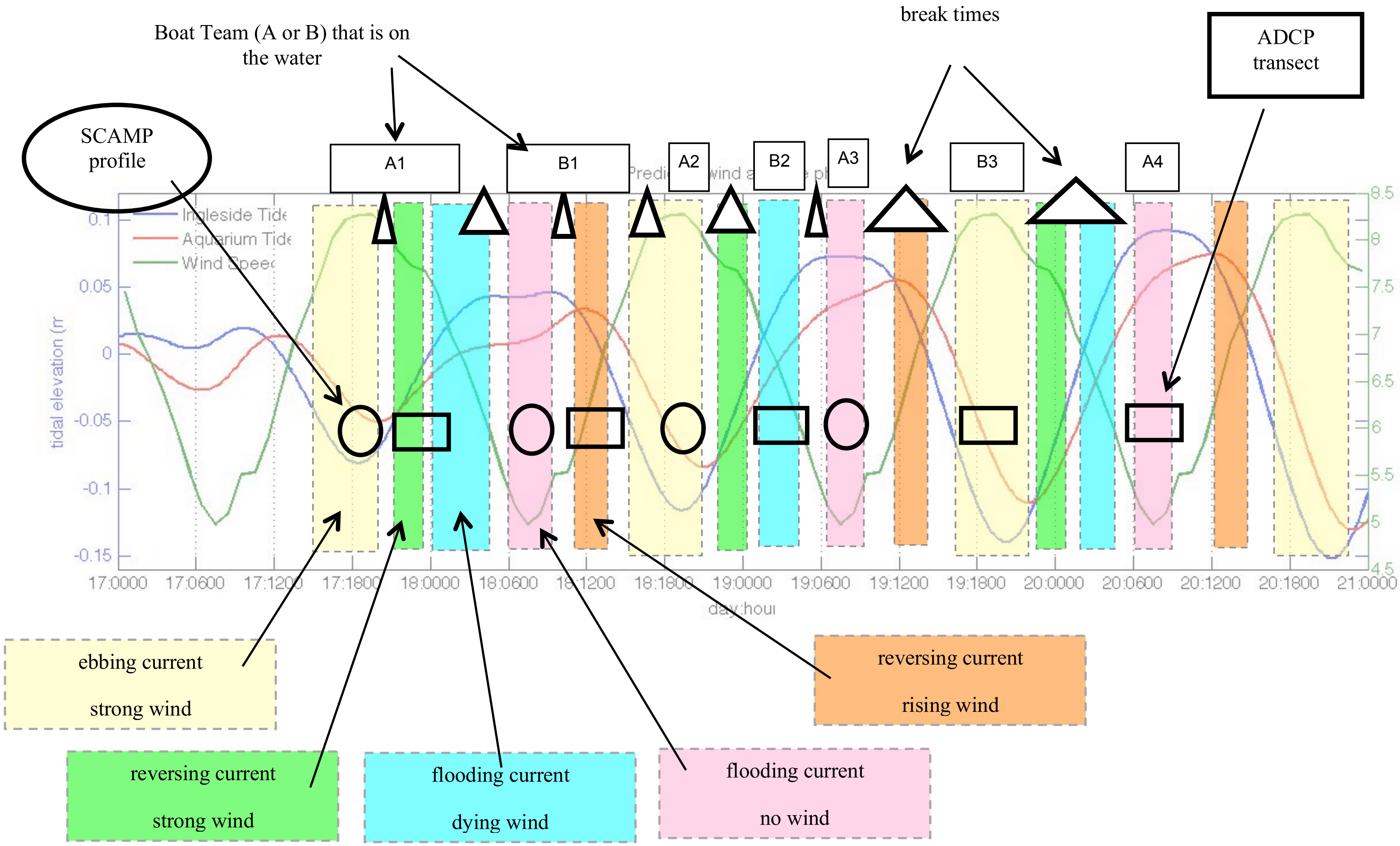

Figure 10. Boat survey planned sampling schedule

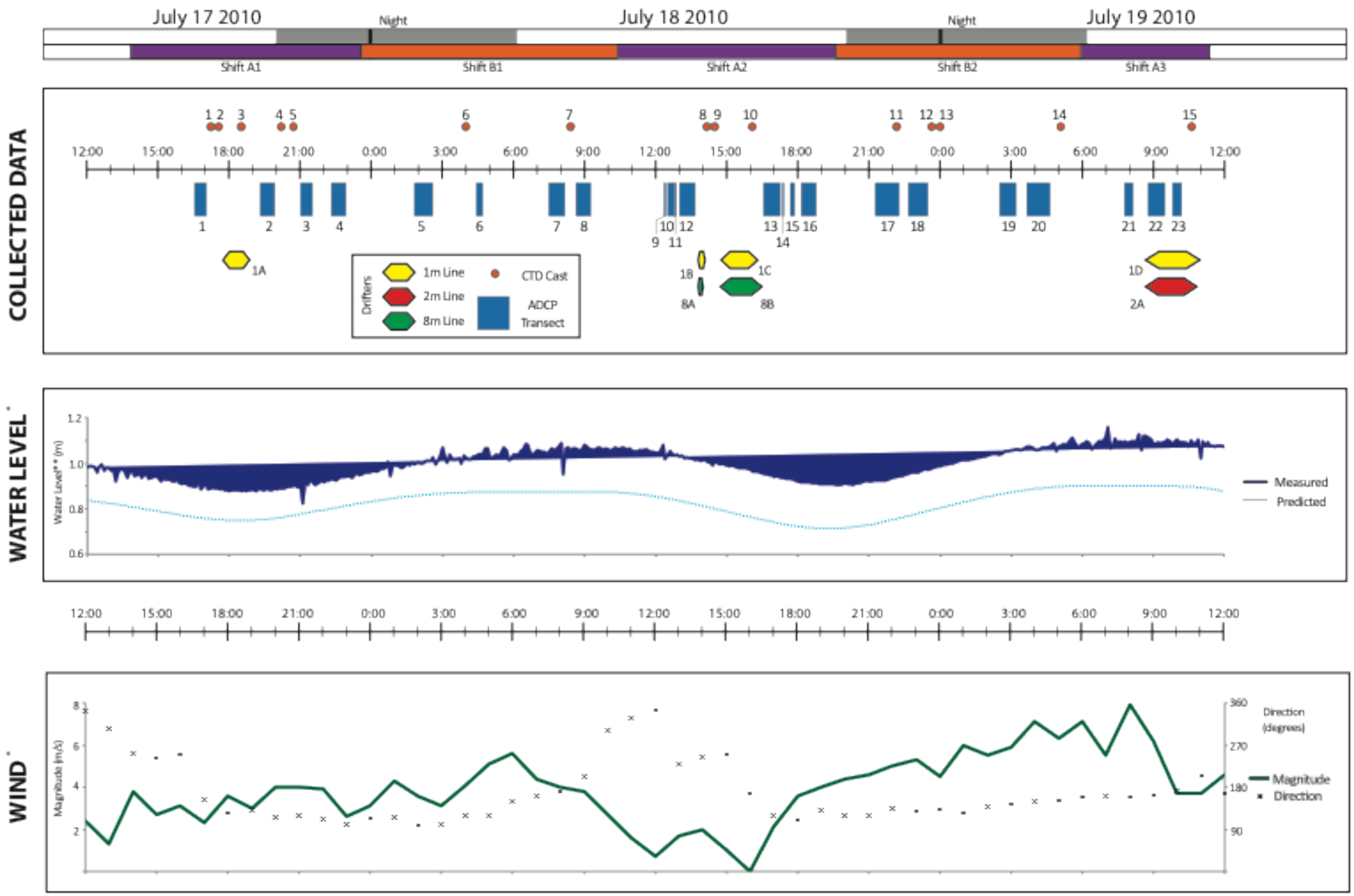

Figure 11. Data collection timeline for completed boat survey. Wind speed and water level from TCOON Ingleside Station. Water level elevation is relative to station datum.

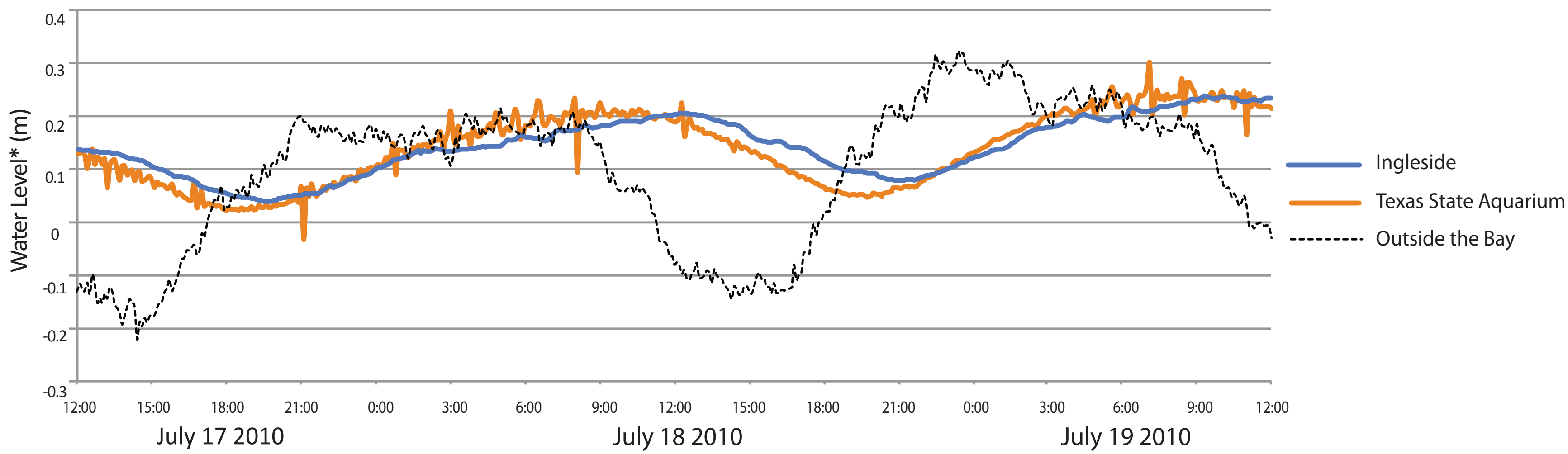

Figure 12. Tides near the ship channel (Ingleside, Texas State Aquarium) and outside Corpus Christi Bay during the boat survey. Water levels are referenced to station datum.

4 Instrument deployment

4.1 Fixed ADCP and CTD+DO sondes

The fixed ADCPs and CTD+DO sondes listed in Table 4 were placed in six locations (*q.v.* Figure 1). Downward-looking Nortek Aquadopp ADCPs were deployed with a CTD+DO sonde on a PVC pole driven into the sediment. Both the sonde and ADCP were attached by hose clamps. The sonde was located slightly above the sediment surface, whereas the downward-looking ADCP was located about 3 m above the bottom, less than 1 m below the water surface. Upward-looking SonTek Argonaut ADCPs at CCOBN, CCOBS and CCOBS, were deployed directly on the bottom near the downward-looking poles. These instruments were deployed by a combined effort of the TWDB and Harte Research Institute staff. The ADCP deployment locations and times are provided in Table 5.

Table 4. Fixed ADCP deployments

Site Code	Site Description	Instrument
CCSCT	ship channel (top)	Nortek downward-looking ADCP CTD + DO sonde
CCSCB	ship channel (bottom)	SonTek upward-looking ADCP (0.5 MHz) CTD + DO sonde
CCOBN	open bay north	Nortek downward-looking ADCP SonTek upward-looking ADCP CTD + DO sonde at surface CTD + DO sonde at bottom
CCOBS	open bay south	Nortek downward-looking ADCP SonTek upward-looking ADCP CTD + DO sonde at surface CTD + DO sonde at bottom
CCOBM	open bay middle	SonTek side-looking ADCP CTD + DO sonde
CCHYP	hypoxic zone	Nortek downward-looking ADCP Nortek upward-looking ADCP CTD + DO sonde at surface CTD + DO sonde at bottom

Table 5. ADCP deployment sites

Site Code	Latitude (N)	Longitude (W)	Start Date	Stop Date
CCBSC	27.80883	97.276	7/13/2010	8/11/2010
CCOBN	27.85	97.308	7/19/2010	8/18/2010
CCOBM	27.8	97.352	7/13/2010	8/20/2010
CCOBS	27.75	97.25	7/15/2010	8/20/2010
CCHYP	27.72367	97.21375	7/19/2010	8/23/2010

The ADCP at the ship channel bottom was deployed in a custom mounting (Figure 13) developed by R. Burgess at TWDB. The unit was designed to be hammered approximately 2 ft into the sediment. This mounting base provided the necessary stability to prevent the wake from a deep-draft vessel from overturning the ADCP. Because of the complexity of the installation and the depth, the instrument was installed by a commercial dive firm contracted by TWDB. The complete records of that installation, including pictures and sketches, were lost in a computer crash. A TWDB planning document that was recovered provides some of the design considerations (see Appendix). Although the ship channel ADCP survived numerous ship wakes, it was overturned on August 11, 2010, most likely caught by a shrimp trawl from one of the fishing boats that routinely worked the ship channel.

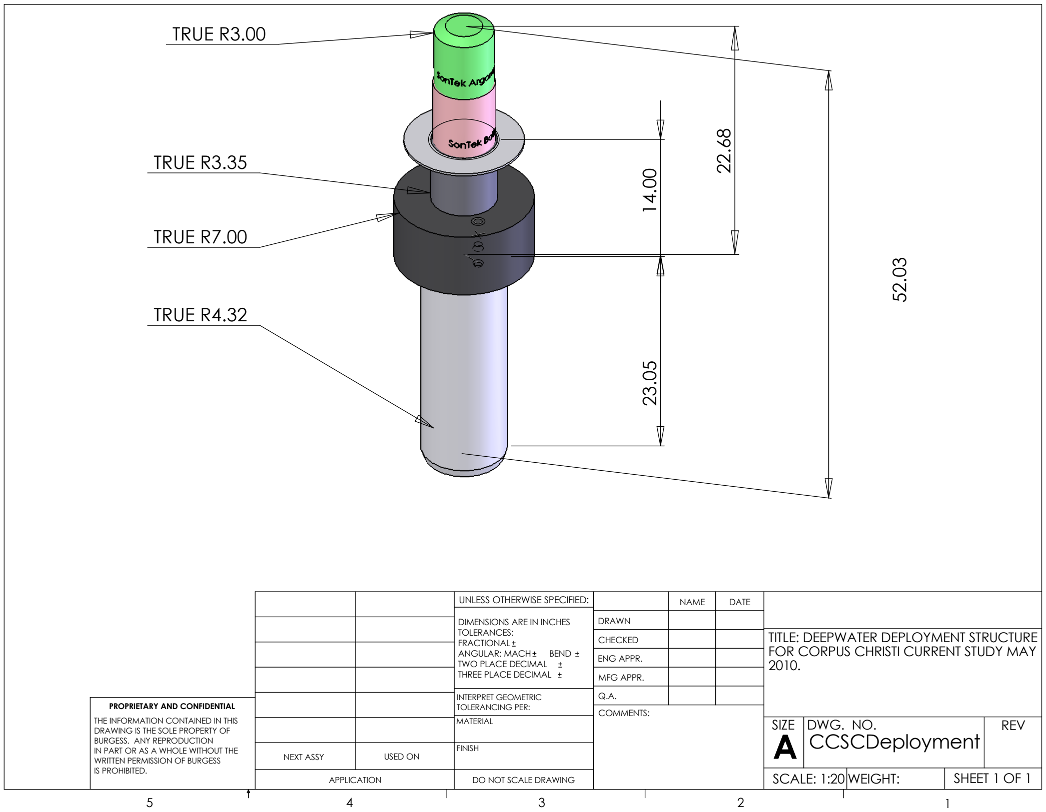

Figure 13. Ship channel ADCP mounting preliminary design.

4.2 ADCP transects

Data collection during the July 17-19, 2010 sampling trip was from a 26 foot TWDB survey boat. ADCP transects used a 1200kHz Teledyne RD Instruments Workhorse Sentinel ADCP mounted in an Oceanscience Riverboat ADCP tow carriage with a Trimble SPS351 GPS, as shown in Figure 14. The Riverboat was towed to the side of the survey boat so that it would be outside of the strern wake. The towing line that attached to the edge of a pole extending 5 ft over the left side of the boat about 8 ft back from the bow. A second safety line was tied to the side of the survey boat. The ADCP and GPS on the Riverboat were connected to a laptop computer on the survey boat by a waterproof data line. ADCP data was collected at nine second intervals, while GPS data was collected at half second intervals.

The Riverboat was deployed over the side by two people with the survey boat moving less than 1 knot. Once the Riverboat was in the water, the towing and safety lines were adjusted so that the data line was slack and the safety line did not jerk the Riverboat towards the sampling boat. The Riverboat traveled well in calm water. In choppy water, the riverboat would occasionally flip over if the safety line did not have enough slack. ADCP data would still be recording when the riverboat flipped, but the GPS data would stop. The ADCP used 0.25 m deep bins sampled at nine second intervals. Transect deployments are summarized in Table 6.

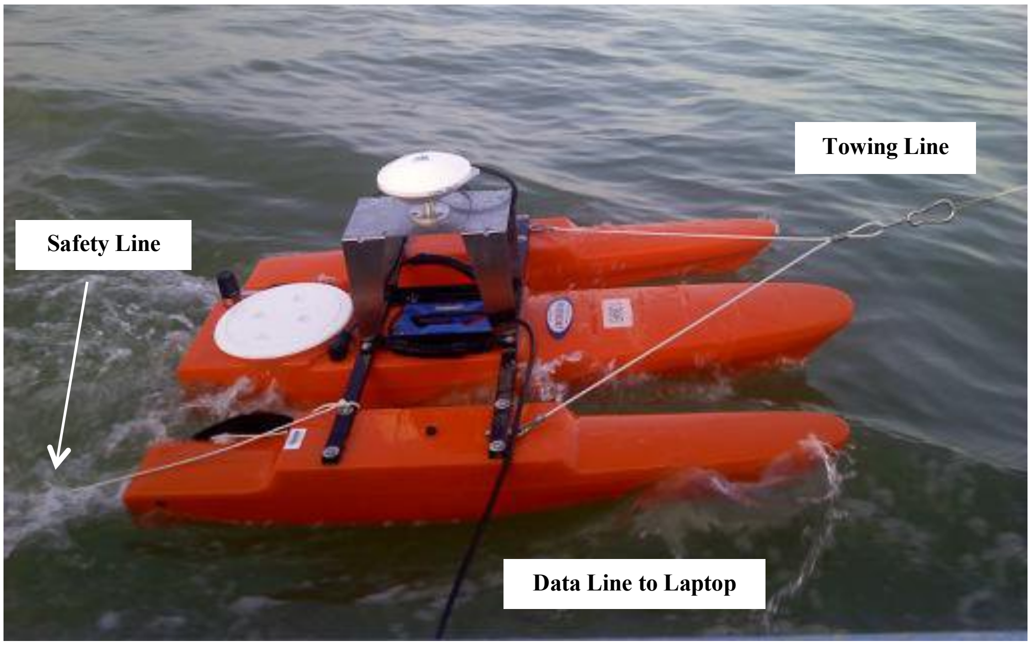

Figure 14. Riverboat ADCP tow carriage.

Table 6. ADCP transects

Transect	Date	Start		End		Key Observations / Performance Issues	Folder Name
		Time	Location	Time	Location		
1	7/17/10	16:30	Buoy 49	17:04	Buoy 55	Transect began at 16:30, but recording did not begin until 16:45. Cruise speed was 4 mph.	7-17_Transect_1
2	7/17/10	19:18	Buoy 55, WPT 32	19:54	Buoy 49		7-17_Transect_2
3	7/17/10	21:00	Buoy 49			Error opening file	7-17_Transect_3
4	7/17/10	22:20	S1, WPT 33	22:56	N1, WPT 34		7-17_Transect_4
5	7/18/10	1:48	Buoy 49	2:34	Buoy 61	Sampling boat detoured twice due to ships passing through the channel.	7-18_Transect_5
6	7/18/10	4:25	S1	4:41	on route to N1	The boat had to end the intended S1-N1 transect early due to incoming bad weather.	7-18_Transect_6
7	7/18/10	7:28	S1	8:12	N1	A ship passed through the channel just five minutes before the sampling boat boat. Unfortunately, the collection was started and stopped several times during collection. Most breaks were 1-2 minutes in duration. All velocity data is compiled into a single file.	7-18_Transect_7
8	7/18/10	8:37		9:12		As above, collection was started and stopped during the sampling period. Most breaks were short, 1-2 minutes in duration and the velocity data has been compiled into a single file.	7-18_Transect_8
9	7/18/10	12:19	Buoy 56	12:24	Buoy 55	The sampling boat traveled in the channel between two barges.	7-18_Transect_9
10	7/18/10	12:27	Buoy 55	12:44	Buoy 55	Error opening file - Not enough valid ensembles. The sampling boat began at Buoy 55, then traveled to 56. At 12:32 the group traveled back from Buoy 56 to Buoy 55, then back again to Buoy 56. The final transect from Buoy 56 to 55 began at 12:42.	7-18_Transect_10
11	7/18/10	12:44	Buoy 55	12:49	Buoy 56		7-18_Transect_11
12	7/18/10	13:00	Buoy 49, WPT 39	13:40	Buoy 61, WPT 40		7-18_Transect_12
13	7/18/10	16:37	Buoy 49, WPT 48	17:19	Buoy 61, WPT 49		7-18_Transect_13
14	7/18/10	17:21	WPT 50	17:25	Buoy 61	Test Transect to see how the Riverboat handled with different orientations to the waves.	7-18_Transect_14
15	7/18/10	17:45	Buoy 55	17:55	Buoy 55	Transect began at Buoy 55, traveled to Buoy 56, and then headed back to the original location.	7-18_Transect_15
16	7/18/10	18:10	S1, WPT 51	18:48	N1, WPT 52		7-18_Transect_16
17	7/18/10	21:22	Buoy 49	22:02	Buoy 61	The riverboat flipped between 18:37-18:39 because the safety line was too short. Velocity data was compiled into a single file since recording stopped during that time.	7-18_Transect_17
18	7/18/10	22:42		23:33			7-18_Transect_18
19	7/19/10	2:30	Buoy 49	3:11	Buoy 61	A tugboat and barge passed the sampling boat at 2:58	7-19_Transect_19
20	7/19/10	3:46	S1, WPT 51	4:46	N1		7-19_Transect_20
21	7/19/10	7:47	Buoy 50	8:09	Buoy 61	Riverboat flipped upside down near Buoy 55 and GPS signal was lost.	7-19_Transect_21
22	7/19/10	8:52	S1	9:34	N1	A barge passed ahead of the boat through the shipping channel.	7-19_Transect_22
23	7/19/10	9:45	Buoy 55	10:09	Buoy 61	A barge passed the boat during this transect at 9:55.	7-19_Transect_23

4.3 CTD+DO profiles

A Hach Hydrolab DS5 sonde was used to collect 15 profiles of water temperature, conductivity, salinity, depth, and DO. The automatic data recording interval was two seconds. The sonde was stored on the boat with its sensors submerged in bucket of water between casts. Before each profiling cast, the waterproof sonde cable was connected to the laptop to initialize the sonde and monitor the data during the profile. The sonde was lowered slowly over the side while the boat driver attempted to maintain a relatively fixed position. At 1 m intervals, the sonde would be held steady until the DO readings stabilized. This process was repeated until the sonde reached the bottom of the shipping channel. Locations of CTD+DO casts were noted with a handheld GPS by saving a waypoint. Summary of the CTD+DO casts is provided in Table 7.

Table 7. CTD+DO profiling casts.

Cast	Date	Location	Time		Key Observations / Performance Issues	File Name
			Start	End		
1	7/17/10	WPT 27	17:20:46	17:27:54	Cast ended up in the bank of the ship channel.	wpt-27_CTD_1
2	7/17/10	WPT 27	17:31:44	17:40:52		wpt-27_CTD_2
3	7/17/10	WPT 29	18:30:42	18:32:30		wpt-29_CTD_3
4	7/17/10	WPT 30	20:14:58	20:25:12		wpt-30_CTD_4
5	7/17/10	WPT 31	20:40:14	20:48:22		wpt-31_CTD_5
6	7/18/10	WPT 35	4:01:40	4:10:22		wpt-35_CTD_6
7	7/18/11	WPT 36	8:22:30	8:31:16	Water was very calm, only one wake.	wpt-36_CTD_7
8	7/18/11	WPT 42	14:15:42	14:25:44	CTD was pulled out of the water and into the holding bucket before it stopped measuring.	wpt-42_CTD_8
9	7/18/10	WPT 43	14:30:52	14:36:36	Same as above.	wpt-43_CTD_9
10	7/18/11	WPT 45	16:03:46	16:13:42		wpt-45_CTD_10
11	7/18/11	WPT 53	22:16:50	22:26:54	Between the recorded depths of six and seven meters at around 22:20, the pull on the line changed direction from NW to W. This was most likely due to the drift of the boat.	wpt-53_CTD_11
12	7/18/11	WPT 54	23:50:32	23:55:46	It was very windy and the CTD never reached the bottom because the boat was drifting too close the edge of the ship channel.	wpt-54_CTD_12
13	7/18/11 - 7/19/11	WPT 55	23:58:00	0:09:18	Even though all the cable was let out, the wind caused the line to be diagonal enough that the CTD never reached the bottom.	wpt-55_CTD_13
14	7/19/11	Midway between 55 and 56	5:05:52	5:12:22	The GPS battery died, so the exact location is unknown. The cast was made midway between Buoys 55 and 56.	midway55-56_CTD_14
15	7/19/11	Midway between 55 and 56	10:25:04	10:30:32	Same as above.	midway55-56_CTD_15

4.4 Lagrangian Drifters

Prof. Socolofsky from TAMU- College Station provided a set of five Pacific Gyre Microstar surface drifters (Figure 15) with Iridium satellite telemetry for use in this study. The drifter's electronics are housed inside an ABS plastic ball that floats on the water surface, which is attached to collapsible nylon and plastic drogue. Drogue tethers of varying lengths can be selected to track water motion at different depths. Tether of 1m, 2m, and 8m were used in this study. The 1m tether shows the effects of the wind on the surface currents and is shallow enough to be unaffected by the possible currents that exist deep in the shipping channel. The 8m tether was selected for drifters deployed in the deep channel.

The 2m tether was used to evaluate whether there was a significant difference between near surface currents and mid-depth in the shallower sections of CCB.

Before leaving the dock, the internal battery in each drifter unit was connected within the surface float. To prevent false GPS readings, the surface floats were kept upside down on the boat until deployment. The drifters were placed overboard, making sure the equipment did not run into the boat motor. Once in the water, the drifters are supposed to send their GPS locations to the Pacific Gyre server so that they can be easily recovered. However, we were not able to complete the communication loop from the drifters to the server to the boat, so the drifters were recovered by spotting the orange surface float. Summary of drifter deployments are provided in Tables 8a – g.

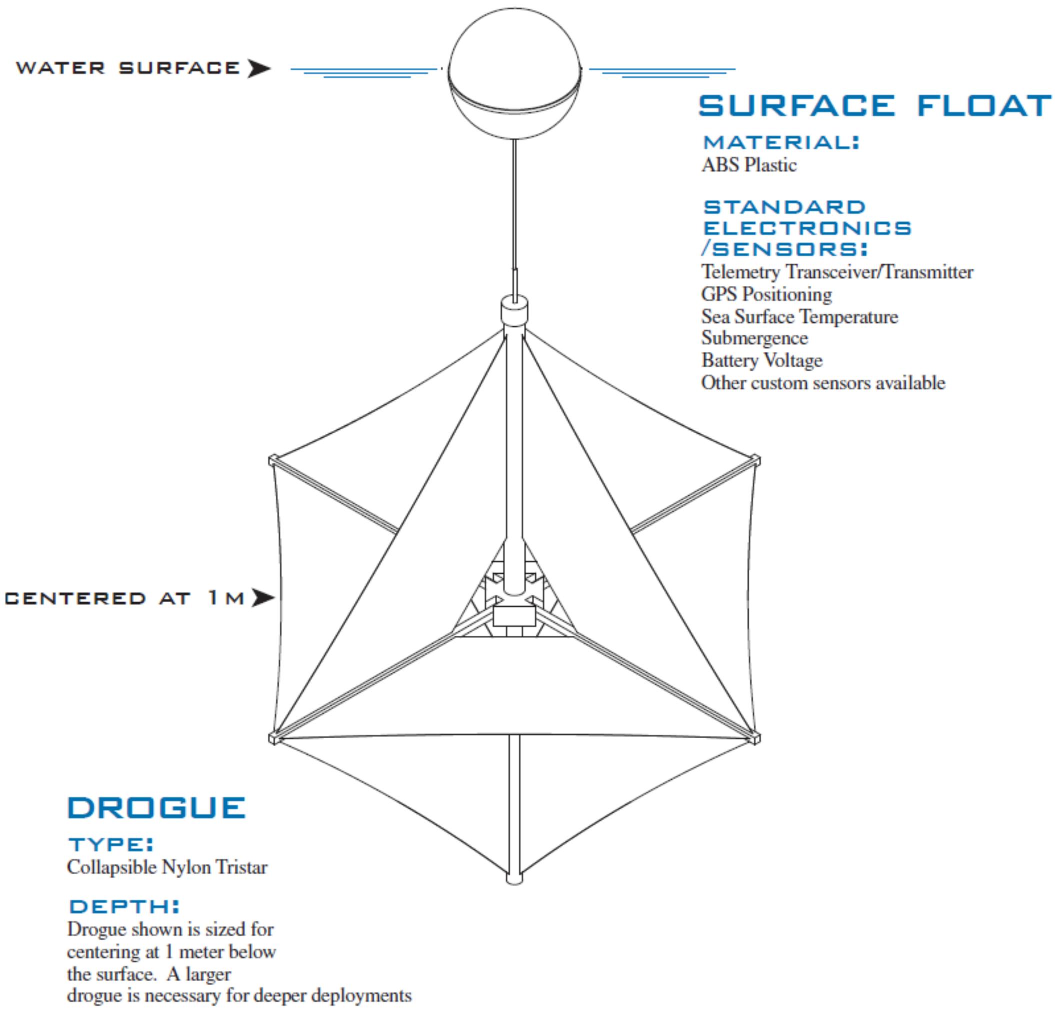

Figure 15: Schematic of Pacific Gyre drifter. From http://www.pacificgyre.com/files/microstar.pdf

Table 8a. Lagrangian drifter deployment 1A

Deployment 1A		Unit: TAM-I-00004			
Local Time	**GPS**	**Latitude**	**Longitude**	**Batt V**	**Submerged**
7/17/10 17:53	3	27.8084090	-97.2762430	5	FALSE
7/17/10 18:00	3	27.8086230	-97.2762710	12.5	TRUE
7/17/10 18:07	3	27.8090110	-97.2762230	12.5	TRUE
7/17/10 18:11	2	27.8091730	-97.2762070	12.5	TRUE
7/17/10 18:17	3	27.8094310	-97.2761840	12.5	TRUE
7/17/10 18:21	3	27.8099780	-97.2749840	12.5	TRUE
7/17/10 18:26	3	27.8098170	-97.2761290	12.5	TRUE
7/17/10 18:34	3	27.8101780	-97.2760710	12.5	TRUE
7/17/10 18:39	3	27.8103700	-97.2760590	12.5	TRUE
7/17/10 18:41	3	27.8104500	-97.2760370	12.5	TRUE
7/17/10 18:46	3	27.8106110	-97.2759980	12.5	TRUE
7/17/10 18:51	3	27.8108090	-97.2759210	12.5	TRUE

Table 8b. Lagrangian drifter deployment 1B

Deployment 1B		Unit: TAM-I-00001			
Local Time	**GPS**	**Latitude**	**Longitude**	**Batt V**	**Submerged**
7/18/10 13:54	3	27.8106140	-97.2792960	5	FALSE
7/18/10 13:55	3	27.8106140	-97.2792820	5	FALSE
7/18/10 14:00	3	27.8106450	-97.2791010	12.5	TRUE

Table 8c. Lagrangian drifter deployment 1C

Deployment 1C		Unit: TAM-I-00001			
Local Time	**GPS**	**Latitude**	**Longitude**	**Batt V**	**Submerged**
7/18/10 14:52	3	27.8109110	-97.2793510	5	FALSE
7/18/10 14:55	3	27.8109480	-97.2793430	5	FALSE
7/18/10 15:00	3	27.8109340	-97.2791370	12.5	TRUE
7/18/10 15:05	3	27.8109340	-97.2789680	12.5	TRUE
7/18/10 15:10	3	27.8109590	-97.2787230	12.5	TRUE
7/18/10 15:15	3	27.8109950	-97.2785010	12.5	TRUE
7/18/10 15:20	3	27.8110200	-97.2783870	12.5	TRUE
7/18/10 15:25	3	27.8110530	-97.2782210	12.5	TRUE
7/18/10 15:30	3	27.8111280	-97.2780960	12.5	TRUE
7/18/10 15:35	3	27.8112170	-97.2779340	12.5	TRUE
7/18/10 15:40	3	27.8112530	-97.2777570	12.5	TRUE
7/18/10 15:45	3	27.8113670	-97.2776680	12.5	TRUE
7/18/10 15:50	3	27.8115230	-97.2775290	12.5	TRUE
7/18/10 15:55	3	27.8115340	-97.2773590	12.5	TRUE
7/18/10 16:00	3	27.8116060	-97.2771790	12.5	TRUE
7/18/10 16:05	3	27.8117110	-97.2770930	12.5	TRUE
7/18/10 16:10	3	27.8117780	-97.2769730	12.5	TRUE
7/18/10 16:15	3	27.8119030	-97.2767340	12.5	TRUE

Table 8d. Lagrangian drifter deployment 1D

Deployment 1D		Unit: TAM-I-00001			
Local Time	GPS	Latitude	Longitude	Batt V	Submerged
7/19/10 8:49	3	27.7938230	-97.2687570	5	FALSE
7/19/10 8:50	3	27.7938610	-97.2687590	5	FALSE
7/19/10 8:55	3	27.7940700	-97.2688260	5	FALSE
7/19/10 9:00	3	27.7942700	-97.2689230	12.5	TRUE
7/19/10 9:05	3	27.7944230	-97.2689340	12.5	TRUE
7/19/10 9:10	3	27.7946230	-97.2689650	12.5	TRUE
7/19/10 9:15	3	27.7948780	-97.2689790	12.5	TRUE
7/19/10 9:20	3	27.7950920	-97.2689430	12.5	TRUE
7/19/10 9:25	3	27.7952420	-97.2689370	12.5	TRUE
7/19/10 9:30	3	27.7955090	-97.2689540	12.5	TRUE
7/19/10 9:35	3	27.7956840	-97.2689960	12.5	TRUE
7/19/10 9:41	3	27.7959230	-97.2690210	12.5	TRUE
7/19/10 9:46	3	27.7961700	-97.2690680	12.5	TRUE
7/19/10 9:51	3	27.7963750	-97.2690980	12.5	TRUE
7/19/10 9:56	3	27.7965840	-97.2691510	12.5	TRUE
7/19/10 10:00	3	27.7968060	-97.2691930	12.5	TRUE
7/19/10 10:05	3	27.7970450	-97.2692400	12.5	TRUE
7/19/10 10:10	3	27.7971340	-97.2692480	12.5	TRUE
7/19/10 10:15	3	27.7972360	-97.2693590	12.5	TRUE
7/19/10 10:20	3	27.7974060	-97.2694340	12.5	TRUE
7/19/10 10:26	3	27.7975280	-97.2694210	12.5	TRUE
7/19/10 10:31	3	27.7977200	-97.2694480	12.5	TRUE
7/19/10 10:36	3	27.7978530	-97.2694400	12.5	TRUE
7/19/10 10:41	3	27.7980030	-97.2694590	12.5	TRUE
7/19/10 10:46	3	27.7981310	-97.2694460	12.5	TRUE
7/19/10 10:51	3	27.7983530	-97.2695340	12.5	TRUE
7/19/10 10:58	3	27.7985000	-97.2694210	12.5	TRUE

Table 8e. Lagrangian drifter deployment 8A

Deployment 8A		Unit: TAM-I-00004			
Local Time	GPS	Latitude	Longitude	Batt V	Submerged
7/18/10 13:51	3	27.8104670	-97.2794230	5	FALSE
7/18/10 13:55	3	27.8104810	-97.2800070	5	FALSE

Table 8f. Lagrangian drifter deployment 8B

Deployment 8B		Unit: TAM-I-00004			
Local Time	**GPS**	**Latitude**	**Longitude**	**Batt V**	**Submerged**
7/18/10 14:47	3	27.8107780	-97.2797540	5	FALSE
7/18/10 14:50	3	27.8107700	-97.2800430	5	FALSE
7/18/10 14:55	3	27.8108140	-97.2804620	5	FALSE
7/18/10 15:00	3	27.8108230	-97.2808840	12.5	TRUE
7/18/10 15:05	3	27.8108110	-97.2812980	12.5	TRUE
7/18/10 15:10	3	27.8108700	-97.2817400	12.5	TRUE
7/18/10 15:15	3	27.8109200	-97.2821570	12.5	TRUE
7/18/10 15:20	3	27.8109340	-97.2825510	12.5	TRUE
7/18/10 15:25	3	27.8109560	-97.2829370	12.5	TRUE
7/18/10 15:30	3	27.8109450	-97.2833460	12.5	TRUE
7/18/10 15:35	3	27.8109340	-97.2836730	12.5	TRUE
7/18/10 15:40	3	27.8109340	-97.2840120	12.5	TRUE
7/18/10 15:45	3	27.8109750	-97.2843180	12.5	TRUE
7/18/10 15:50	3	27.8109700	-97.2846230	12.5	TRUE
7/18/10 15:55	3	27.8110090	-97.2850320	12.5	TRUE
7/18/10 16:00	3	27.8110340	-97.2853370	12.5	TRUE
7/18/10 16:05	3	27.8110420	-97.2856180	12.5	TRUE
7/18/10 16:10	3	27.8110450	-97.2859790	12.5	TRUE
7/18/10 16:15	3	27.8110590	-97.2862460	12.5	TRUE
7/18/10 16:20	3	27.8110810	-97.2865430	12.5	TRUE

Table 8g. Lagrangian drifter deployment 2A

Deployment 2A		Unit: TAM-I-00002			
Local Time	**GPS**	**Latitude**	**Longitude**	**Batt V**	**Submerged**
7/19/10 8:50	2	27.7942810	-97.2686840	5	FALSE
7/19/10 8:55	3	27.7937500	-97.2688120	11.5	TRUE
7/19/10 9:00	3	27.7937060	-97.2688870	11.5	TRUE
7/19/10 9:05	3	27.7937450	-97.2689840	11.5	TRUE
7/19/10 9:10	3	27.7937560	-97.2690340	12	TRUE
7/19/10 9:15	3	27.7937500	-97.2690730	12	TRUE
7/19/10 9:20	3	27.7937860	-97.2690180	12	TRUE
7/19/10 9:25	3	27.7937750	-97.2690960	12	TRUE
7/19/10 9:30	3	27.7938390	-97.2690680	12	TRUE
7/19/10 9:35	3	27.7938530	-97.2690930	12	TRUE
7/19/10 9:40	3	27.7939110	-97.2691430	12	TRUE
7/19/10 9:45	3	27.7938920	-97.2691980	12	TRUE
7/19/10 9:50	3	27.7939450	-97.2692400	12	TRUE
7/19/10 9:56	3	27.7940000	-97.2692710	12	TRUE
7/19/10 10:00	3	27.7940500	-97.2693120	12	TRUE
7/19/10 10:05	3	27.7940840	-97.2693430	12	TRUE
7/19/10 10:10	3	27.7941610	-97.2693870	12	TRUE
7/19/10 10:15	3	27.7941200	-97.2694510	12	TRUE
7/19/10 10:20	3	27.7941170	-97.2694820	12	TRUE
7/19/10 10:25	3	27.7941530	-97.2695120	12	TRUE
7/19/10 10:30	3	27.7941110	-97.2695340	12	TRUE
7/19/10 10:35	3	27.7942230	-97.2695480	12	TRUE
7/19/10 10:40	3	27.7941110	-97.2695260	12	TRUE
7/19/10 10:45	3	27.7940840	-97.2695260	12	TRUE

5 Data Archive

The data collected by the research teams has been archived on a DVD as illustrated in Figure 16. The "Documents" folder contains supporting document files while the "Data" folder contains both the prepared and raw data files organized by data type. The subfolders in the data archive contain folders and files as described in Tables 9 – 16. The original data as provided to UT by the different research teams is in folder Raw Data (Table 15).

Water level and meteorlogical data can be obtained from TCOON stations at: http://lighthouse.tamucc.edu/pq.

Data for NOAA stations is obtained through the IOOS Data Portal available on the NOAA Tides and Currents homepage, at: http://tidesandcurrents.noaa.gov/index.shtml. For the NOAA data provided in the *Weather and Water Levels* folder, dat can be found at: http://tidesandcurrents.noaa.gov/geo.shtml?location=8775870,

Data for available for Ingleside and the Texas State Aquarium, respectively at: http://lighthouse.tamucc.edu/overview/006, http://lighthouse.tamucc.edu/overview/008

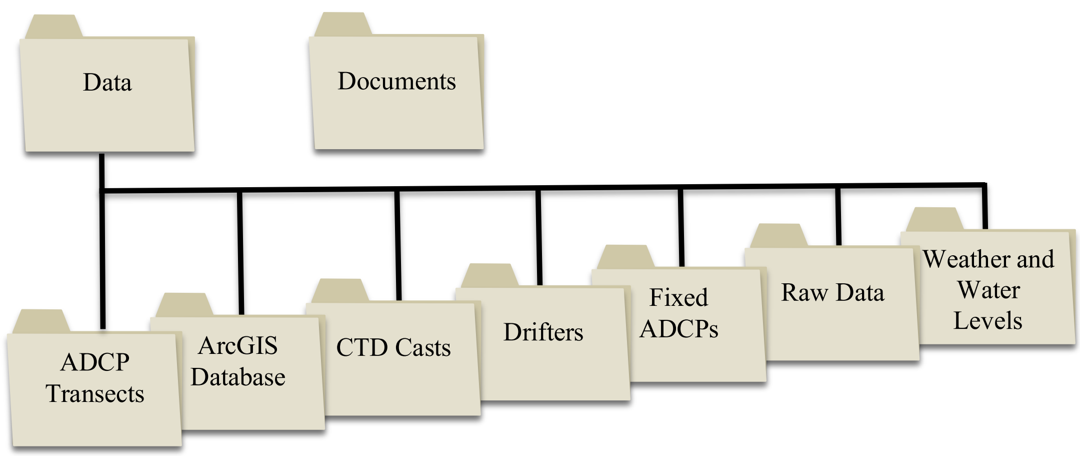

Figure 16. File structure of archive

Table 9. Documents folder

File or Folder	Description	File Format
Wave Data Processing Toolbox Manual.docx	USGS Instructions for setting up open source toolbox for processing of ADCP data. Useful as a general reference on ADCP processing	MS Word 2010
AquaPro_Manual.pdf	Manual for Nortek Aquadopp ADCP	Adobe Acrobat PDF
Logbook.pdf	Scan of logbook used during boat survey	Adobe Acrobat PDF
Personnel_Information.pdf	Contact information on survey participants	Adobe Acrobat PDF
WinADCP (FOLDER)	Windows Executable and instruction manual for Windows ADCP software used for extracting ADCP data in Data/ADCP Transects/ folders.	MS-Windows executable Adobe Acrobat PDF

Table 10a. ADCP Transects folder

File or Folder	Description	File Format
GPS Data Interpretation	Explanation of headers for *_GPS.TXT files in *_Transect_* folders.	Adobe Acrobat PDF MS Excel
Transect Overview	Date, time and logbook notes on ADCP transects.	Adobe Acrobat PDF MS Excel
Configuration Files	Configuration files from ADCP processing	ASCII text (xml)
7-DD_Transect_XX (FOLDER)	Data files from transect XX on July DD, 2010	See Table 10b.

Table 10b. m-dd_Transect_XX subfolders of ADCP Transect folder

File or Folder	Description	File Format
DD_Transect_XX_ADCP.csv	Processed ADCP data files for transect XX on day DD of July 2010. Output from WinADCP software processing *.PD0 file.	ASCII text (csv)
DD_Transect_XX_GPS.txt	GPS files for transect XX on day DD of July 2010	ASCII text (see *GPS Data Interpretation.pdf* in Table 10a)
CCBayTransect_*.PD0	ADCP raw data	Binary used RDI's PD0 standard. Read using WinADCP.exe (see Table 9) and converted to *.csv. May be converted to *.mat using Export function in WinADCP

Table 11. ArcGIS Database folder

File or Folder	Description	File Format
CCbay.gdb (FOLDER)	Files with latitudes and longitudes of waypoints, buoys and sampling locations.	ArcGIS - compatible files
Significant Locations and Waypoints	Summary of waypoints in CCbay.gdb folder	Adobe Acrobat PDF

Table 12. CTD Casts folder

File or Folder	Description	File Format
CTD Overview.pdf CTD Overview.xlsx	Summary of CTD profiling casts	Adobe Acrobat PDF MS Excel
***_CTD_XX_julyDD.csv	CTD+DO data for *** location of cast XX on July DD, 2010.	ASCII text

Table 13. Drifters folder

File or Folder	Description	File Format
Drogue Sensors Report.csv Drogue Sensors Report.pdf	Data downloaded from Lagrangian drifters	ASCII text Adobe Acrobat PDF

Table 14a. Fixed ADCPs folder

File or Folder	Description	File Format
Figures (FOLDER)	Figures of fixed ADCP results	jpg image
CCBSC (FOLDER)	ADCP data from bottom of ship channel	see Table 14b
CCHYP (FOLDER)	ADCP data from CC Bay hypoxic zone	see Table 14b
CCOBN (FOLDER)	ADCP data from open bay north site	see Table 14b
CCOBS (FOLDER)	ADCP data from open bay south site	see Table 14b

Table 14b. CC* subfolders of Fixed ADCPs folder**

File or Folder	Description	File Format
*.hdr	Instrument setup for ADCP#### at ***. Describes profiling interval (900s), number of cells, cell size and other configuration data. Provides headers for the *.v1, *.a1, *.sen files	ASCII text
*.v1, *.v2, *.v3	ADCP velocity data in ENU (East, North, Up are positive) coordinate system. *.v1 = East, *.v2 = North, *.v3 = Up	ASCII text see *.hdr for header row
*.a1, *.a2, *.a3	ADCP measured amplitudes for each of three beams, a1, a2, a3.	ASCII text see *.hdr for header row
*.sen	ADCP sensor log with roll, pitch, battery voltage and other data. No	ASCII text see *.hdr for header row
*.prf	Raw data collected in beam coordinates. Can be converted with AquaPro software.	Binary (Nortek)
*.log	Log data from ADCP	ASCII text
*.dep	Deployment file	Binary (see AquaPro_manual.pdf)
CC***.xlsx	Velocities in East, North, Up coordinates by ADCP cell and date:time	MS-Excel 2010
CC***_vE.dat CC***_vN.dat CC***_vU.dat	Velocity in East, North, or Up coordinate	ASCII text Column order: Cell, Cell number, Observation number, Date, Time, Value.
CC***_vel.dat CC***_speed.dat	Velocity magnitude	ASCII text Column order: Cell, Cell number, Observation number, Date, Time, Value.
CC***.dat CC***_dir.dat	Velocity direction (compass heading)	ASCII text Column order: Cell, Cell number, Observation number, Date, Time, Value.

Table 15. Raw Data folder

File or Folder	Description	File Format
TAMU Data (FOLDER)	Data provided by Socolofsky's group at Texas A&M College Station	
TAMU-CC Data (FOLDER)	Data provided by Montagna's group at Texas A&M Corpus Christi	
TWDB – CCBay_2010FieldData (FOLDER)	Data provided by TWDB (including UT-Austin ADCP downloaded by TWDB)	

Table 16. Weather and Water Levels folder

File or Folder	Description	File Format
Ingleside Station -TCOON	Weather, water levels, and station datum for TCOON recorded data at Ingleside, 27.82167 N, 97.20306 W	ASCII text (csv) gif image (datum files)
Texas State Aquarium - TCOON	Weather, water levels, and station datum for TCOON recorded data at the Texas State Aquarium in Corpus Christi, 27.81430 N, 97.39840 W	ASCII text (csv) gif image (datum files)
Station ID 87758780, Outside the bay - NOAA	Wind, weather and water levels for NOAA observations at 27.58 N, 97.21667 W	ASCII text (csv)

A Appendix: Survey trip narrative

A.1 Overview

The boat survey trip took place in the summer of 2010 from July 17 to July 19. The work was continuous from 14:00 CST on July 17 to 11:30 CST on July 19. The logbook kept during this survey has been transcribed and annotated in this appendix. A scanned an unedited copy of the logbook is available in the data archive (q.v. Table 9). The narrative below is organized by working shifts for each 3 person team. All data was collected in the TWDB 26' survey boat. All GPS waypoints were taken using the Garmin 76CS. All times listed are local (CST).

Exact coordinates are available for many of the fixed target locations, e.g. the Buoys, S1, and N1. In general, the boat was maneuvered close to a target fixed location and a waypoint of the actual location was recorded with the GPS. Thus, may fixed target locations are associated with multiple nearby waypoints.

A.2 Shift A1. 7/17/2010 14:00 – 23:30 CST

<u>Crew:</u> Robert Burgess, Scott Socolofsky, Kerri Whilden

<u>Summary</u>: ADCP transects 1-4, CTD casts 1-5, Drogue deployment 1A, TWDB laptop broke

<u>Computer</u>: The group began using the 580-017674 computer and experienced COM-port problems. The serial to USB was not cooperating, so a new configuration file *CCBayGroup1_0.mmt* was run. After further use, around 19:00, the TWDB computer gave itself up to the blue screen of death and was replaced by the TAMU computer. The group used the ADCP prefix "CCBayTransect."

The A group traveled to Buoy 49 and began the first transect towards Buoy 55, *7-17_Transect_1*, at 16:30. However, data collection did not begin until 16:45. The transect ended at 17:04.

Then they took two CTD casts at WPT 27 beginning at 17:20. The first cast, *wpt-27_CTD_1_july17.csv*, ended in the ship channel. The second cast, *wpt-27_CTD_2_july17.csv*, ended at 17:40.

The #4 drogue, 1A, was deployed from the 1 m line at 17:53 from WPT 28. A CTD cast, *wpt-29_CTD_3_july17.csv*, cast was taken in the shipping channel at WPT 29 at 18:30 and ended just two minutes later because it gave poor readings. The #4 drogue was recovered at 18:55.

The second transect, *7-17_Transect_2*, began at 19:18 near Buoy 55 at WPT 32. It ended at Buoy 49 at 19:54. The CTD was then cast near Buoy 55 at WPT 30, *wpt-30_CTD_4_july17.csv*. The second, *wpt-31_CTD_5_july17.csv*, is near Buoy 49. A transect, *7-17_Transect_3*, was made beginning in this area at Buoy 49 and traveled inside the shipping channel to Buoy 55. Unfortunately, the corresponding ADCP (.pD0) file shows an error when opening.

The final transect of this shift, *7-17_Transect_4*, crossed the shipping channel. It began at WPT 33, near S1 at 22:20. It traveled towards N1 and ended at WPT 34 at 22:56. The boat then headed to the dock.

A.3 Shift B1. 7/17/2010 23:30 – 7/18/2010 10:30 CST

Crew: Dharhas Pothina, Ben Hodges, Laura Gundlach

Summary: ADCP transects 5-8, CTD casts 6-7, bad weather drove the boat to the dock

Computer: The group began using the TAMU computer and then switched to the TWDB Semi-Rugged around 6:00. The prefix used with the Semi-Rugged was "CCSCDay2."

The B group began a transect, *7-18_Transect_5*, at Buoy 49 at 1:48 and ended at Buoy 61 at 2:34. The sampling boat detoured out of the channel twice due to passing ships.

A CTD cast, *wpt-35_CTD_6_july18.csv*, was made near Buoy 55 at WPT 35 at 4:01.

They began the next transect, *7-18_Transect_6*, at location S1 at 4:25. They recorded data until 4:41 on route to location N1, but were forced to return to the dock due to an incoming storm. After the team docked and the storm passed, they attempted to take a CTD cast at Buoy 55, but could not due to the presence of several fishing boats.

The group returned to location S1 at 7:28 at to complete a transect, *7-18_Transect_7*, across the shipping channel. A ship passed through the channel just five minutes before the sampling boat. The transect had to be started and stopped several times because bad data was collected, but has since been compiled into a single file. The transect ended at 8:12.

A CTD cast, *wpt-35_CTD_7_july18.csv*, was made at WPT 36 near Buoy 55 at 8:22. The water was very calm and there was only one wake. Then the group made one final transect, *7-18_Transect_8*, from 8:37-9:12. The velocity data from this transect is also compiled into a single file.

A.4 Shift A2. 7/18/2010 10:30 – 7/18/2010 19:30 CST

Crew: Robert Burgess, Scott Socolofsky, Kerri Whilden

Summary: ADCP transects 9-16, CTD casts 8-10, drogue deployments 1B-1C & 8A-8B

Computer: TAMU computer

The #4 drifter was deployed at 12:04, but cancelled due to a large barge. The group traveled between two barges to complete an ADCP transect between Buoys 55 and 56, *7-18_Transect_9*, beginning at 12:19.

Then the group completed several transects between the Buoys 55 and 56 which are all contained in a single file, *7-18_Transect_10*, beginning at 12:27. The group began at WPT 37, near Buoy 55, and traveled to Buoy 56. Then at 12:32, the group traveled back to Buoy 55. After reaching this point, they traveled back to Buoy 56. During this trip, at 12:41, a ship passed. The final trip from Buoys 56 to Buoy 55 began at 12:42 and ended at 12:44. (Note: The ADCP raw data has one or more ensemble resets. The raw data will have to be resequenced using BBSub.exe.)

At 12:44, the group began a transect, 7-*18_Transect_11*, from Buoy 55. They arrived at Buoy 56 at 12:49.

The group completed a transect, *7-18_Transect_12*, beginning at 13:00 at WPT 39 near Buoy 49 and ending at 13:40 at WPT 40 near Buoy 61.

Two drifters, *1B* and *8A*, were then deployed from 1m and 8m lines, respectively, from WPT 41 near Buoy 55 at 13:47. Since a tug was approaching, the drogues were recovered prematurely. The #4 drifter on the 8m line, *8A*, was recovered at 14:00. The #1 drifter on the 1m line, *1B*, was recovered at 14:05.

The CTD was cast, *wpt-42_CTD_8_july18.csv*, at WPT 42 near Buoy 55 at 14:15. Unfortunately, the sensor was pulled out of the water and placed into the holding bucket before measurement was turned off. Another CTD cast, *wpt-43_CTD_9_july18.csv*, at WPT 43 near Buoy 55 at 14:30. In this cast, the sensor also was pulled out of the water and placed into the holding bucket before measurement was turned off.

The drifters, *1C* and *8B*, were then deployed from WPT 44 near Buoy 55 again from the 1m and 8m lines, respectively. While the drifters were drifting, the CTD was cast, *wpt-45_CTD_10_july18.csv*, at WPT 45 near Buoy 55 at 16:03. The drifter on the 1m line, *1C*, was recovered at WPT 46 at 16:19. The drifter on the 8m line, *8B*, was recovered very near WPT 46 minutes later at 16:26.

The group began an ADCP transect, *7-18_Transect_13*, at WPT 48 near Buoy 49 at 16:37. During this trip, at 17:03, a barge passed through the channel. This transect ended at WPT 49 near Buoy 61 at 17:19.

The group then completed an ADCP transect, *7-18_Transect_14*, tested how the riverboat handled with different orientations to the waves. It began at WPT 50 near Buoy 61 at 17:21 and ended just four minutes later in a similar location.

Another ADCP transect, *7-18_Transect_15*, began near Buoy 55 at 17:45. The group traveled to Buoy 56 and then arrived back at Buoy 55 at 17:55.

This shift's final ADCP transect, *7-18_Transect_16*, began at WPT 51 near location S1 at 18:11. The group crossed the shipping channel and the transect ended at WPT 52 near location N1 at 18:48. They then headed to the dock.

A.5 Shift B2. 7/18/2010 19:30 – 7/19/2010 6:00 CST

Crew: Dharhas Pothina, Ben Hodges, Laura Gundlach

Summary: ADCP transects 17-20, CTD casts 11-14, strong winds from 23:00-3:30, handheld GPS battery died

Computer: TAMU Computer

The group began an ADCP transect, *7-18_Transect_17*, near Buoy 49 at 21:22. During the transect, from 18:37-18:39, the riverboat was upside down. It flipped over because the safety line was too short. The transect ended at 22:02 near Buoy 61.

The CTD was cast at WPT 53 near Buoy 55 at 22:16, *wpt-53_CTD_11_july18.csv*. When the sensor was between the recorded depths of six and seven meters, around 22:20, the pull of the line changed direction from NW to W. This was probably due the turning of the boat. Then the team completed an ADCP transect, *7-18_Transect_18*, between 22:42 and 23:33.

At 23:51, the group cast the CTD, *wpt-54_CTD_12_july18.csv*, at WPT 54 near Buoy 55. The cast was abandoned at 23:55 before the sensor reached the bottom due to strong winds that caused the boat to drift too close to the channel's edge. At 23:58, the CTD was recast at WPT 55, *wpt-55_CTD_13_july18.csv*. Again, due to strong winds, though all of the cable was let out, the sensor never reached the bottom.

The group waited for the wind to die down a bit before completing another ADCP transect. A transect, *7-19_Transect_19*, began near Buoy 49 at 2:30. Early in this run, at 2:35, the riverboat flipped and the GPS signal was lost. A tugboat and barge passed the team's boat at 2:58. The transect ended at 3:13 at Buoy 61.

The group began a transect, *7-19_Transect_20*, near S1 at 3:46. The riverboat traveled without incident and ended at N1 at 4:46.

The group completed a CTD cast, *midway55-56_CTD_14_july19.csv*, at 5:05 about midway between Buoys 55-56. The GPS battery died, so the exact location is unknown. Similar to the last couple CTD casts, though all the line was let out, the sensor did not reach the bottom.

A.6 Shift A3. 7/19/2010 6:00 – 11:30 CST

Crew: Robert Burgess, Ben Hodges, Kerri Whilden

Summary: ADCP transects 21-23, CTD cast 15, drogue deployments 1D & 2A

Computer: TAMU Computer

The group began an ADCP transect, *7-19_Transect_21*, near Buoy 50 at 7:47. This run ended at 8:09 near Buoy 61. Unfortunately, the GPS stopped collecting data just one minute into the run at 7:48.

The drifters, *1C* and *8B*, were then deployed from WPT 44 near Buoy 55 again from the 1m and 8m lines, respectively. While the drifters were drifting, the CTD was cast, *wpt-45_CTD_10_july18.csv*, at WPT 45 near Buoy 55 at 16:03. The drifter on the 1m line, *1C*, was recovered at WPT 46 at 16:19. The drifter on the 8m line, *8B*, was recovered very near WPT 46 minutes later at 16:26.

Two drifters, *1D* and *2A*, were then deployed on 1m and 2m lines, respectively, at 8:42. The handheld GPS battery died, but the boat's GPS recorded the deployment location as 27.79367° N and 97.2689° W. *Note: The drifter on the 1m line, 1D, was not completely sunk at the start of the run.*

An ADCP transect, *7-19_Transect_22*, began near location S1 at 8:52. This run ended at 9:36 near location N1. A barge passed through the shipping channel just before the sampling boat.

The group began a transect, *7-19_Transect_23*, near Buoy 55 at 9:45 and headed towards Buoy 61. At 9:55 a barge passed the sampling boat in the shipping channel. The run ended at 10:09.

Finally, the drifters, *1D* and *2A*, were recovered. *2A* was recovered at 10:52 and *1D* was recovered at 11:00.

B Appendix: Ship channel ADCP deployment

Document provided by TWDB staff (D. Pothina)

Design Considerations on Channel Instrument Platform Design

Introduction and Background

Essentially system design is a solution to a complex problem. In system design, a design constraint refers to some limitation on the conditions under which a system is developed, or requirements of the system. The design constraint could be on the system form, materials to be incorporated, time taken to develop the system, or overall budget. During system design it is important to identify each design constraint since they place an overall boundary around the system design process.

Several physical constraints due to the deployment area as well as specified constraints forced by stakeholders were factored into possible designs. The constraints are as follows:

- High current velocities and high dynamic impulse loading due to shipping.
- Narrow clearance between channel bottom and fully loaded tankers.
- Plastic soft muddy bottom.
- Local shoaling or erosion due to the instrument itself.
- Unit would be self powered, and would contain an onboard data recorder.
- Stakeholders indicated that we would want a data link to the surface, with a solid state data recorder that will serve as a backup of the data collection.
- Due to bathymetry the data link would approach the maximum transmission link limits for the communication protocol RS232.
- Stakeholders didn’t want to absolutely have to rely on divers.
- Platform should minimize ferrite iron near instrument due to onboard fluxgate compass.

Evaluation of designs

Several designs for a structure that could be mounted along edge of the ship channel without the explicit need for divers were considered. However, almost all design structure shared a flaw or problem in that as the currents changed direction due to a heavy displacement vessel, there was the potential for the current to act on an aspect of a surface or face. With the right current direction and object orientation it can result in the flow not only being a lateral force but also producing lift much as a wing and these forces can then roll the structure. Several designs of this class were considered, but rejected due to this flaw. The best design of this class was basically a tetrahedron with a weighted base. A tetrahedron would be a good design, but would rely exclusively on its weight to stabilize the structure, and there is still the potential for currents to gain purchase and utilize the bottom to flip the structure if the areas near the edge of the structure erode. In addition, a solid tetrahedron would require that it be built of non-magnetic materials like stainless sheet.

Two design structures would minimize the aspect ratio presented to currents. A pipe tetrahedron would not have major problems with varied current directions, and would be resistant to high currents with proper ballast loading. However, the favored design utilized a cylindrical suction caisson. The draft design sheet of the proposed caisson is attached as a PDF file. All dimensions are given in inches. The reason that this platform design would outperform the other structures in the chosen deployment is due to the minimized aspect ratio, and the high breakout capacities of a suction caisson. The surface seen by a current of any direction is minimized in the cylinder as it provides no face or edge that a current could act on differentially due to direction, and has a smooth radius. Suction anchors have desirable properties for this type of environment as the breakout capacity is not due to their weight. The ultimate pullout load of a caisson is in addition due to the surface friction of the caisson, the induced suction during pullout over the area of the casson, the weight of the sediment plug, and the reversed end bearing strength imparted by the sediments. Preliminary calculations utilizing the caisson dimensions in the drawing suggest that the instrument platform could have between 1/2 to 2 tons of breakout capacity from a caisson that only weighs in the range of 300 pounds. The caission has an integrated slide hammer to aid in penetration during installation with a tension member from the surface, which after installation also acts as a properly placed ballast.

The data link would be deployed in the same high current area as the platform with the platform forming the lower endpoint of the data link, and another structure forming the upper endpoint. To perform and not be damaged by the changing currents, this link is required to be a weighted cable. There are armored cables that were used in wireline logging in the oilfield. Some wireline logging cables were multiconductor emf shielded cables, which would be needed due to the very long data link. Unfortunately, we were unable to locate a source of cable that met our needs, and if we were to have used this type of cable, the data link ends would have to be waterproof and spliced into the unit. Production of a prototype cable would most likely be expensive. Another design solution with these properties could be weighting the cable that the manufacturer provides. Securing weights along the cable would be difficult, and would slide under differential loading if part of the cable was lofted between two weights in a current. Thus it was thought that a better solution would be a chain continuously secured to the manufacturer's recommended data cable. A grade 30 3/8 steel chain could be basically sewed along the data cable with cord or zip ties, and would provide approximately 1.4 pound per foot to the data link (in water). The weight of this should keep the data cable down into the sediments where it would be protected from currents. This design could incorporate a soft attachment or an anchor such as a 50 pound sounding weight attached to the chain and dropped into the sediment near the ATON as the upper endpoint. Upon retrieval, the chain would also provide a mechanical link to the caisson to aid in retrieval, and could act as the tension member during installation.

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