Georgia Tech - Savannah
Civil and Environmental Engineering

Post-Dredging Hydrodynamics and Bathymetry, Brunswick, GA

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Introduction

The U.S. Army Corps of Engineers maintains navigable depths within the Brunswick Harbor Entrance Channel (Figure 1) via periodic dredging. An ongoing study related to beneficial uses of dredge spoil involves collection of data defining bathymetry, waves, and currents near the entrance channel.

The authors spent two days (September 4-5, 2003) collecting data defining bathymetry and tidal hydrodynamics in and near the Brunswick Harbor entrance channel (Figures 1 and 2). This period corresponded to the neap portion of the tidal cycle; Brunswick features semi-diurnal tides. Predicted high and low tidal stages for the measurement period are provided in Table 1. Winds were light and there was a moderate swell from Hurricane Fabian evident in the area during the measurement period. This report describes the methodologies employed for data collection and analysis, and presents selected results in graphical format. The entire digital dataset is also provided.

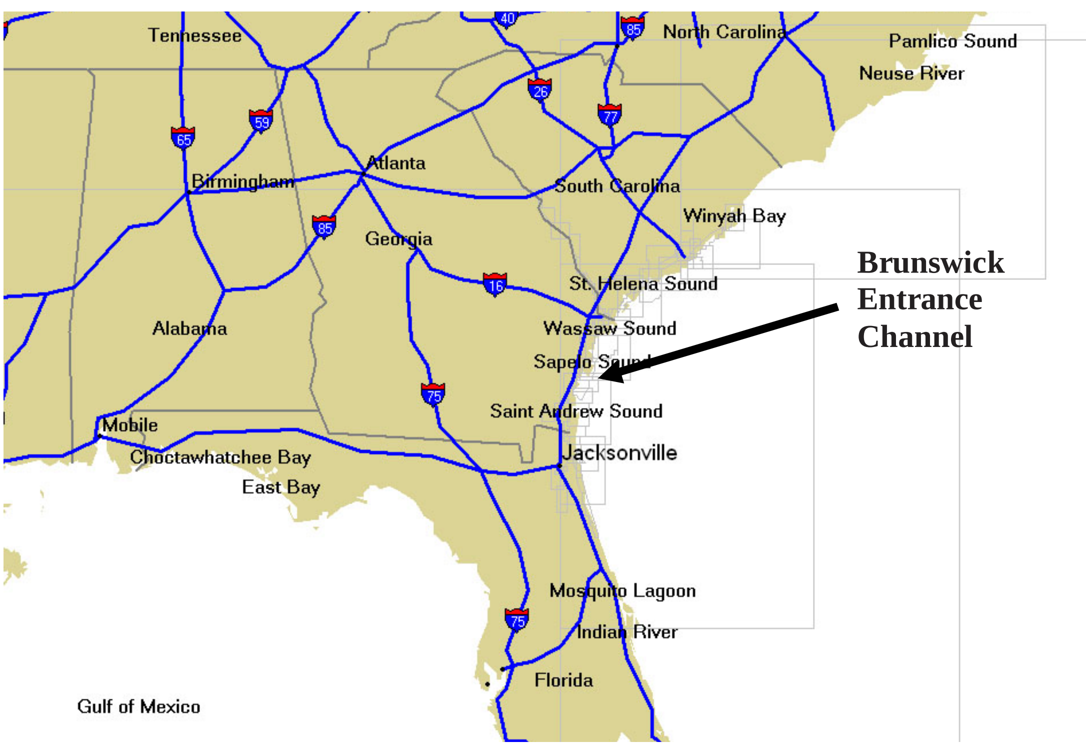

Figure 1. Locator map.

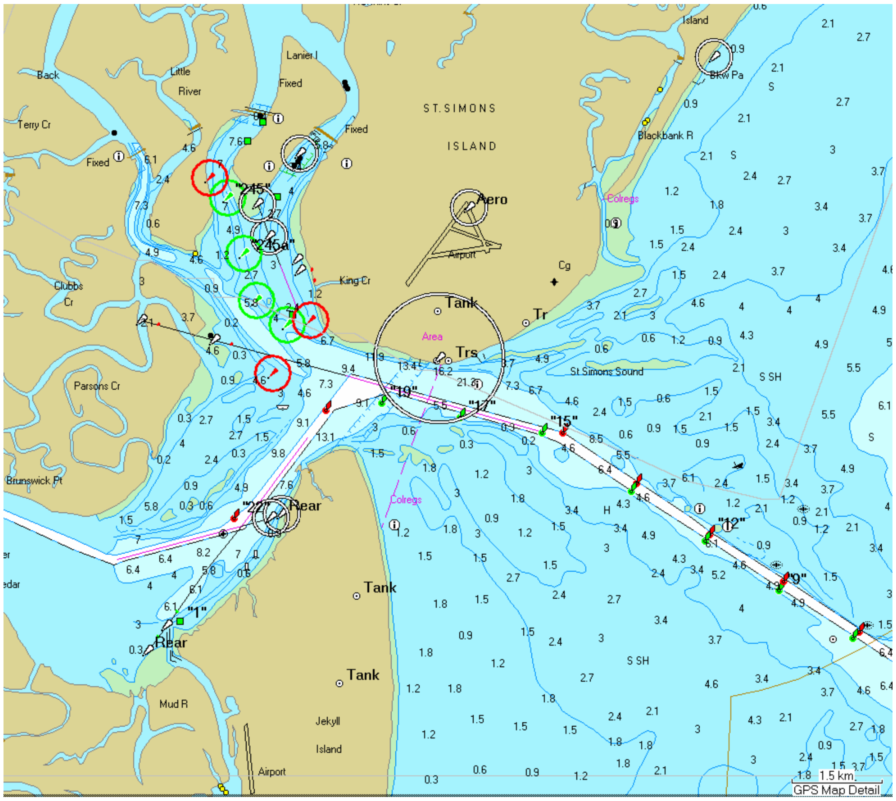

Figure 2. Brunswick Harbor entrance channel, Jekyll Island to the south, and St. Simons Island to the north. Depths are labeled in meters.

	Thursday, September 4, 2003		Friday, September 5, 2003	
Parameter	Time (EDT)	Stage (m)	Time (EDT)	Stage (m)
	3:07 AM	2.00	4:09 AM	1.96
	9:29 AM	0.16	10:37 AM	0.18
	3:54 PM	2.30	4:57 PM	2.29
	10:33 PM	0.32	11:38 PM	0.28
Measurement Period (approx)	10AM-8PM		7AM-1PM	

Table 1. Predicted tides for measurement period.

Data Collection Procedure

A 10.5-m jet-drive powerboat with 1 m draft, owned by Brunswick SeaTow, served as the survey platform (Figure 3). The data collection equipment employed for this project included:

- A 1200 kHz RD Instruments Acoustic Doppler Current Profiler (ADCP).
- A Ceeducer survey depth sounder (200 kHz).
- A Garmin 188 GPS Sounder, with WAAS differential corrections.
- VmDas and Hypack data collection software running on two separate computers.

Figure 3. Boat used for data collection.

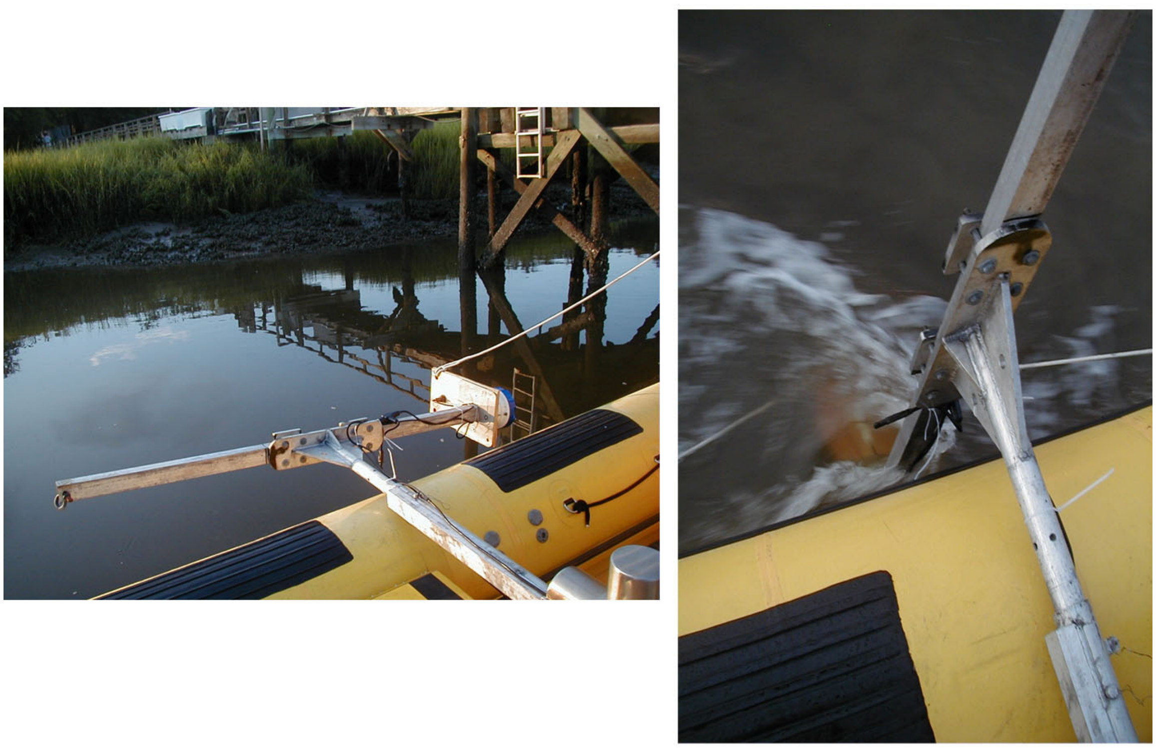

Figure 4. ADCP and fathometer transducers mounted on boat at dock (left) and underway (right).

The ADCP and fathometer transducers were mounted on the side of the boat, to place them away from the vessel wake and jet propulsion systems (Figure 4). The ADCP was placed such that its draft (distance from transducers to water surface) was 41 cm. The minimum blanking distance for the instrument of 0.5 m was also specified, so that the top of the first bin in the measurement profile was at an elevation that was close to that of the bottom of the boat (the survey boat has a draft of slightly less than 1 m). The draft for the fathometer was 30 cm, and it was placed outboard of the ADCP so that neither instrument would be in the wake of the other.

Both the ADCP and fathometer transducer have integral temperature sensors that are used to assign speed of sound values based on water temperature, with the assumption that the salinity of the water corresponded to that of seawater. Both instruments adjusted speed of sound while underway to correspond to local water temperature. A bar check was not performed, as the boat was not equipped for this, but reported depths were compared to the onboard depth sounder and were in general agreement.

The ADCP has an internal compass that was calibrated prior to deployment. The predicted magnetic deviation (-5.7 degrees) for the site was recorded in the instrument software so that all reported directions would be referenced to true north.

The ADCP records a 3-dimensional velocity profile beneath the boat. The recorded data define the speed of the flow past the instrument; this represents the vector sum of the water velocity and the opposite of the boat’s velocity vector. Thus it is necessary to remove the contribution due to the vessel motion. There are several ways to do this. If bottom tracking is possible, the instrument can determine its own velocity vector across the bottom, assuming that the bottom is immobile. If this is not feasible, GPS position or velocity data can be used to define the boat’s velocity vector.

The instrument used for this project can “see” the bottom in up to 10-16 m of water, depending on conditions. This depth range is exceeded in the Brunswick entrance channel. Because of this, and the fact that bottom tracking was not operational during data collection, due to an instrument software problem, the data presented in this report have been corrected using GPS position data.

The GPS receiver used here employs a form of differential corrections, called WAAS (Wide Area Augmentation System). This system involves broadcast of differential corrections from fixed locations to improve the accuracy of the GPS position fixes. During data collection, the instrument’s estimated horizontal position error was typically between 2 and 3 m. The authors have also determined that the error in position *change* (as opposed to absolute position) is typically much smaller than this value (Elci and Work 2003). This means that the error in the computed boat velocity vector should be up to an order of magnitude less than the estimated position error (2-3 m) divided by the time between fixes. The use of longer averaging times also tends to reduce errors in computed boat velocities.

The ADCP "ping" rate exceeded 1 Hz. Every ensemble (velocity profile) was stored, without averaging, so that the maximum amount of information would be retained in the raw data files. Drafts for each transducer were recorded within the data collection software (RDI's VmDas program) prior to data collection so that all stored digital data would be correctly referenced to the instantaneous water surface. All recorded depths are referenced to the local water surface at the time of measurement.

As noted above, the ADCP requires a blanking distance immediately below the transducer. In this case, the blanking distance was set at 0.5 m. The transducer was 41 cm below the still water surface, and each measurement bin was 25 cm thick. Thus the top measurement corresponds to a layer of water that is centered roughly one meter (50 + 41 + 25/2 cm) below the water surface. This represents the instrument's measurement limitation, and closely matched the vessel draft.

The vessel's throttles were set to yield a speed of 3-4 knots (up to 2 m/s) in still water, and the throttle position was held constant. Although boat speed varied as the boat encountered opposing or following currents, the speed of the flow past the transducer head thus remained relatively constant. This speed also minimized heave, pitch, and roll motions of the transducers. The software used to log velocity data does include compensation for pitch and roll motions. The depth data logged with the fathometer have not been compensated to account for this motion. This could be done either by combining the ADCP pitch and roll data with the depth data, or in a more simplistic way by applying some kind of smoothing function to the depth data, such as a moving average.

An RD Instruments program called VmDas was used to record velocity data. GPS position data were sent to this program via a serial port. The program then logged every "ping" from the ADCP, along with GPS position data. It was assumed that latency (delay between measurement and reporting) of the GPS data was zero. The slight horizontal offset between the GPS antenna and the measurement transducers is neglected here because it is less than the GPS position errors.

The Hypack survey program was used on a separate computer to simultaneously log GPS position and depth data from the fathometer. The program recorded NMEA strings defining depth and position, among other things, as fast as they were reported by the fathometer and GPS, typically faster than 1 Hz for both GPS and depth data.

Clocks on the two computers were synchronized to within 1 second of each other so that depth and velocity data were reference to the same time and could later be merged. The difference between the time on the two computer clocks and the GPS time was later found to be 10 seconds (this difference is unimportant as long as the two data streams are synchronized, which they were). All times were recorded as Eastern Daylight Time (EDT).

Data collection commenced at roughly 10AM on Thursday, September 4, 2003, and continued until 8PM that evening (field notes are attached to this report as an appendix). Data collection resumed on Friday, September 5, 2003, at 7AM, and continued until

1PM, yielding roughly 16 hours (total) of data. The goal was to follow a pre-designed survey track, covering at least some areas during both ebb and flood tides. Modifications to the planned track were made in the field, as necessary and appropriate. The weather was very cooperative, particularly on the second day, when winds were negligible. A modest swell from Hurricane Fabian in the Atlantic was the primary source of vertical motion of the boat.

Figures 5 and 6 show the boat tracks for each day, superimposed on the planned boat track.

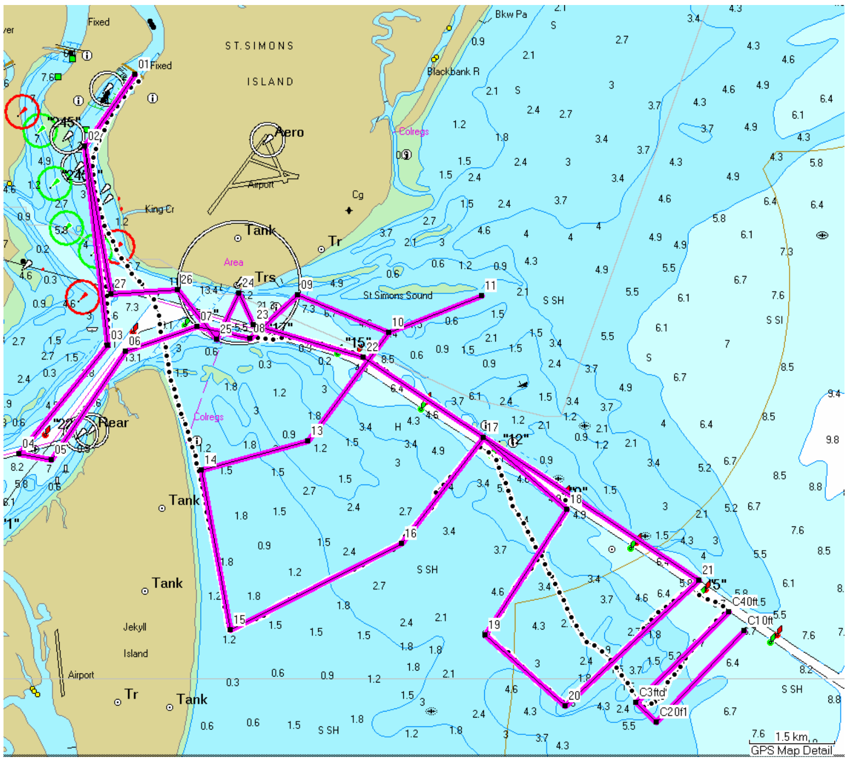

Figure 5. Boat track for Thursday, September 4, 2003. Solid line shows pre-planned survey track; dotted line shows actual vessel track.

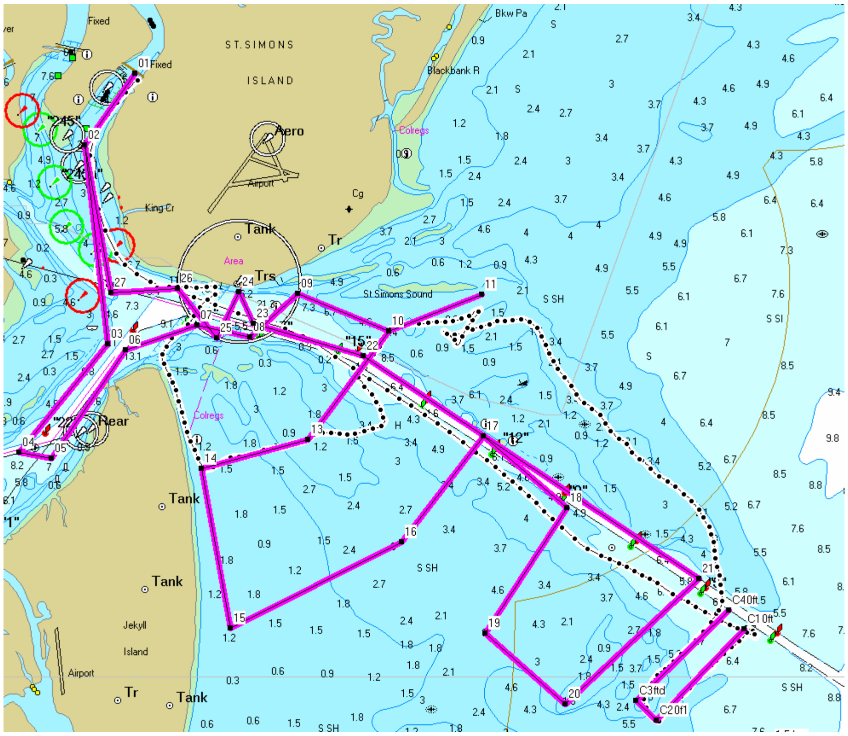

Figure 6. Boat track for Friday, September 5, 2003. See Figure 5 for explanation. Some data points were collected near two fixed, bottom-mounted ADCPs that were logging data during the field campaign. The data from the bottom-mounted instruments were not available at the time this report was being prepared. Six minutes of data (7:57-8:03AM) were also collected while anchored at a fixed point (N31 04.715 W81 17.903; at the extreme eastern limit of boat track) early on the second day of surveying (9/5/03).

Data Analysis

The field work yielded roughly 250 Mb of data that had to be processed. The raw velocity data were first averaged. This improves the quality of the velocity estimates by removing much of the noise associated with single-ping data. A 10-second averaging period was chosen. With a 2 m/s boat speed, this represents a distance of 20 m over which the velocity is averaged. This represents a tradeoff between noise level and resolution. For the region considered, both depth and velocity should be reasonably constant over a 20 m distance. As the averaging period (and distance) increase, the influence of boat speed errors are reduced. Two-meter errors on each end of a 20 m transect represent, potentially, a 20% error in distance, and thus boat speed. But the position errors are not truly random (Elci and Work 2003) and change slowly. For example, if the current estimate of position is east of the true position, it is likely that the same will be true for the next fix. This reduces the magnitude of boat speed errors arising from position errors.

The raw velocity data (e.g. BRUNS0904001_000000.ENR, BRUNS0905001_000000.ENR) were averaged over a ten second period and saved to “long-term average” files (e.g. BRUNS0904001_000000.LTA). The raw data include “beam velocities” (i.e. velocity along each acoustic beam) and a time series from the internal compass. When averaging, the user can specify a magnetic variation to correct magnetic north to true north. All directions referred to in this report are reference to true north, where

$$\theta_{true} = \theta_{mag} + MV$$

and *MV* is the magnetic variation, which for Brunswick during the measurement period was -5.7 degrees.

All averaged data were saved to the long-term average files. A number of plots generated to investigate data quality are presented below.

Each long-term average file was read into RDI's WinADCP program, and most available parameters (temperature, navigation info, all velocity data) were exported in Matlab format (e.g. bruns0904.mat). The resulting files could then be loaded into Matlab for manipulation and plotting. A Matlab script (vmplot.m) was written to automate much of this process.

The velocity data were recorded as water speed past the transducer head as a function of time and depth. The first step was to remove the component of the velocity that corresponds to the motion of the transducer itself, as follows:

$$\vec{u}_{water} = \vec{u}_{recorded} + \vec{u}_{boat}$$

This was done using the east and north components of the velocity:

$$u_{water} = u_{recorded} + u_{boat}$$

$$v_{water} = v_{recorded} + v_{boat}$$

A number of plots generated to investigate the quality of the data set are shown below. Additional results may be found in the next section of the report.

Including the new data, two sources of depth data are available. The GEODAS data set, available from the National Geodetic Data Center, was used to create a bathymetric grid for plotting purposes, referenced to Mean Sea Level (MSL). The new depth data, sampled at more than 1 Hz, were interpolated to determine a water depth for each velocity measurement. These are recorded and reported as instantaneous water depth, i.e. distance from water surface to seafloor at the time of measurement.

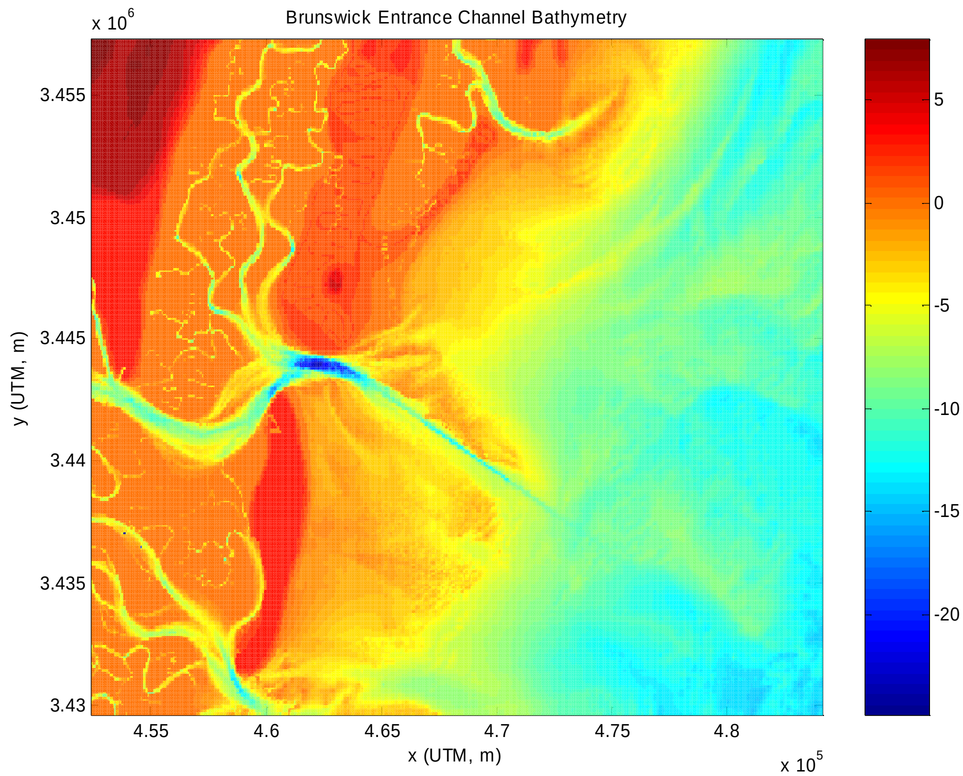

Figure 7. Bathymetry derived from 3-minute GEODAS data. Shade indicates elevation in meters relative to MSL.

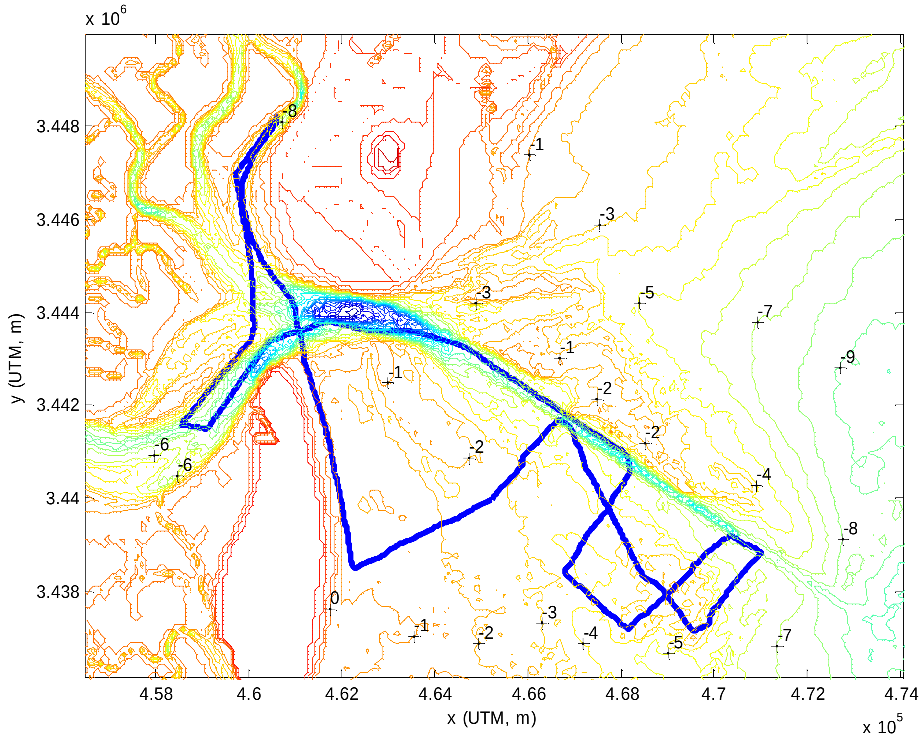

Figure 8. Boat track for 9/4/03 superimposed on bathymetry derived from NGDC GEODAS dataset. Depth contours in meters, datum is mean sea level.

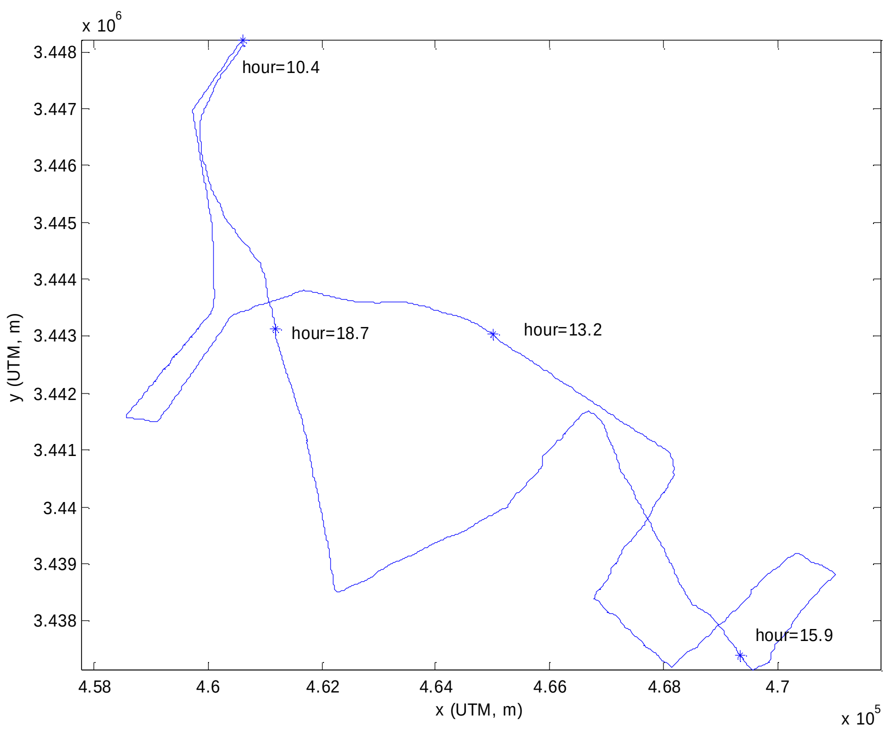

Figure 9. Detail of boat track for 9/4/03, showing position as a function of time (EDT).

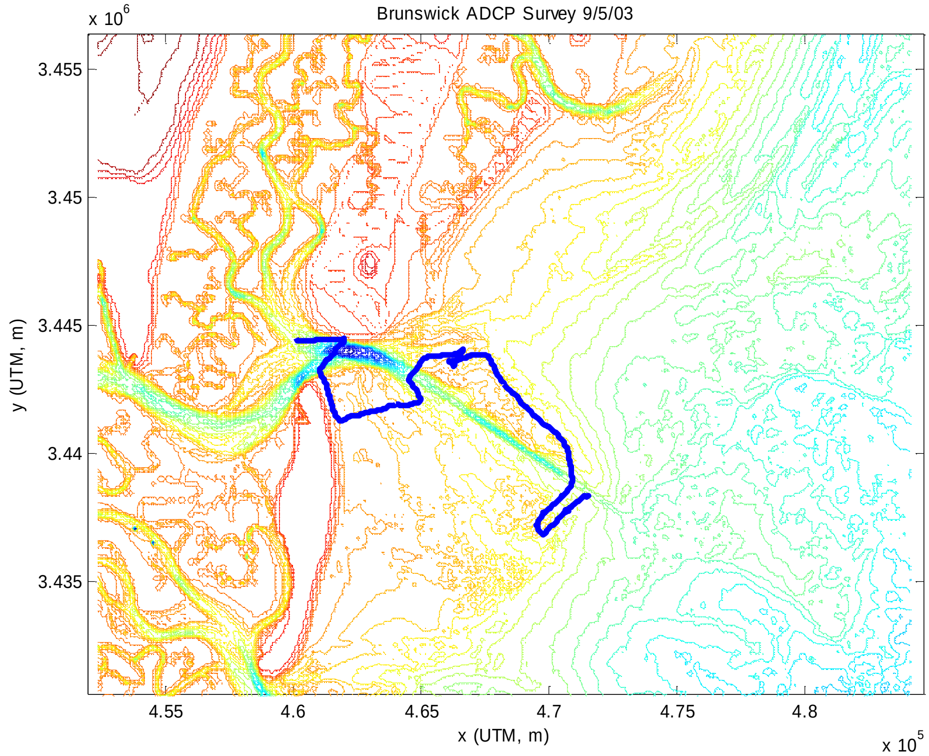

Figure 10. Boat track for 9/5/03 superimposed on bathymetry derived from NGDC GEODAS dataset. Depth contours in meters, datum is mean sea level.

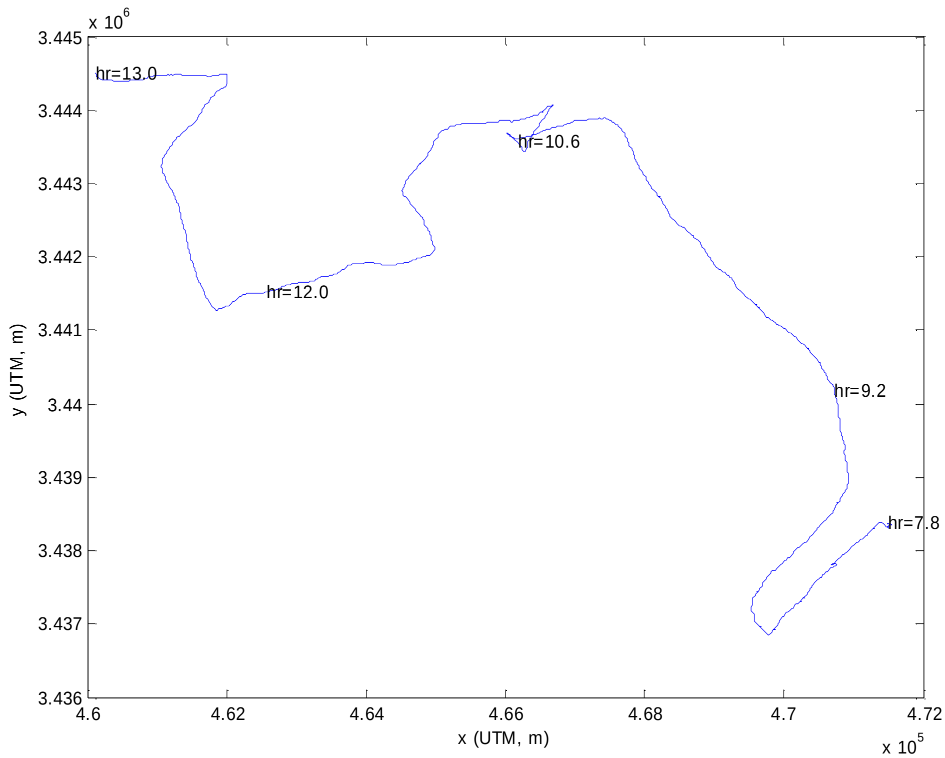

Figure 11. Detail of boat track for 9/5/03, showing position as a function of time (EDT).

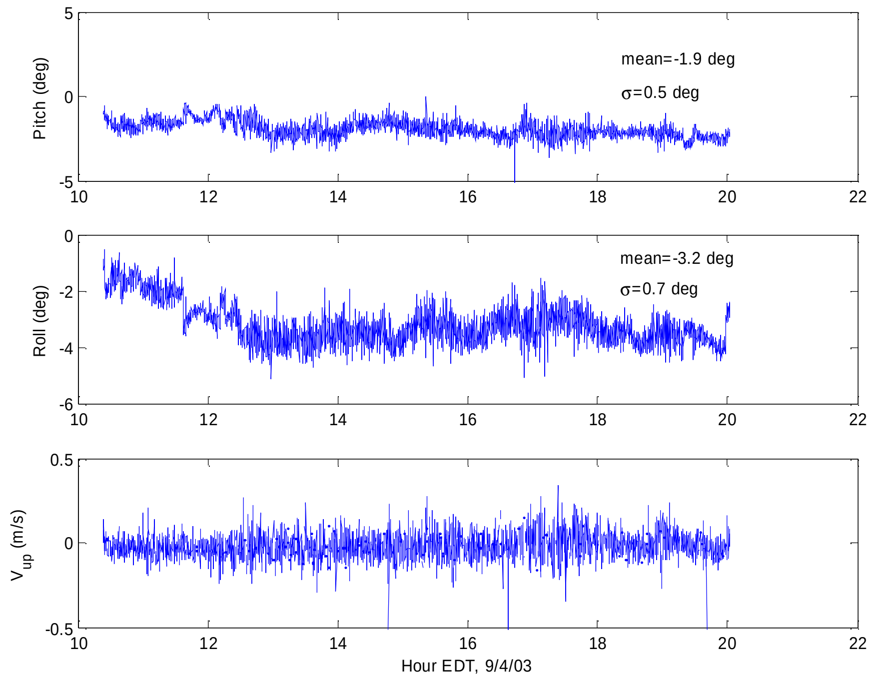

Figure 12. Time series of pitch, roll, and vertical velocity (top bin) for Thursday 9/4/03.

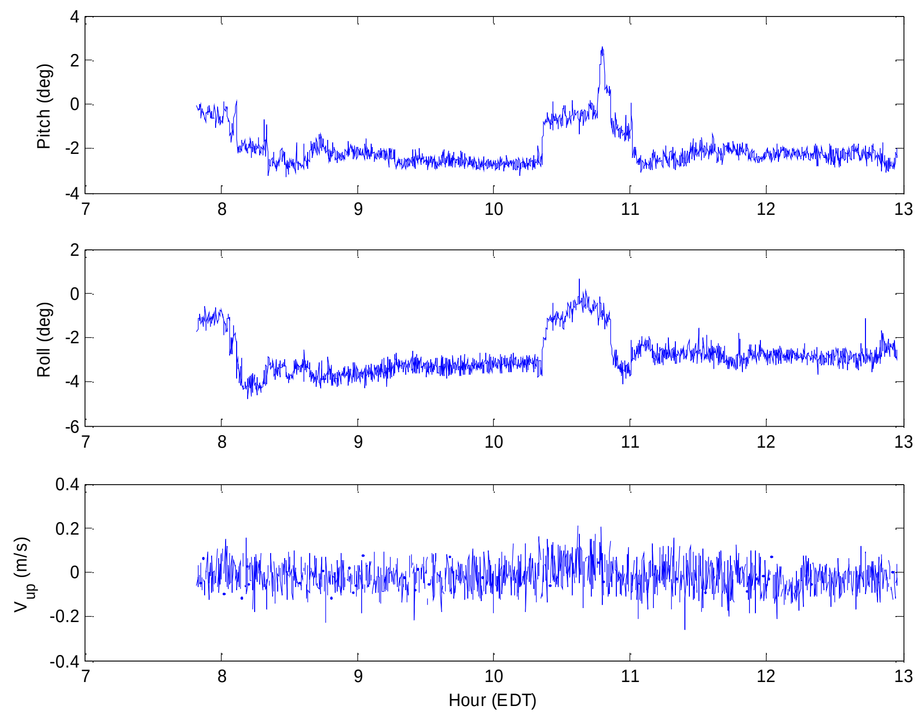

Figure 13. Time series of pitch, roll, and vertical velocity (top bin) for Friday 9/5/03.

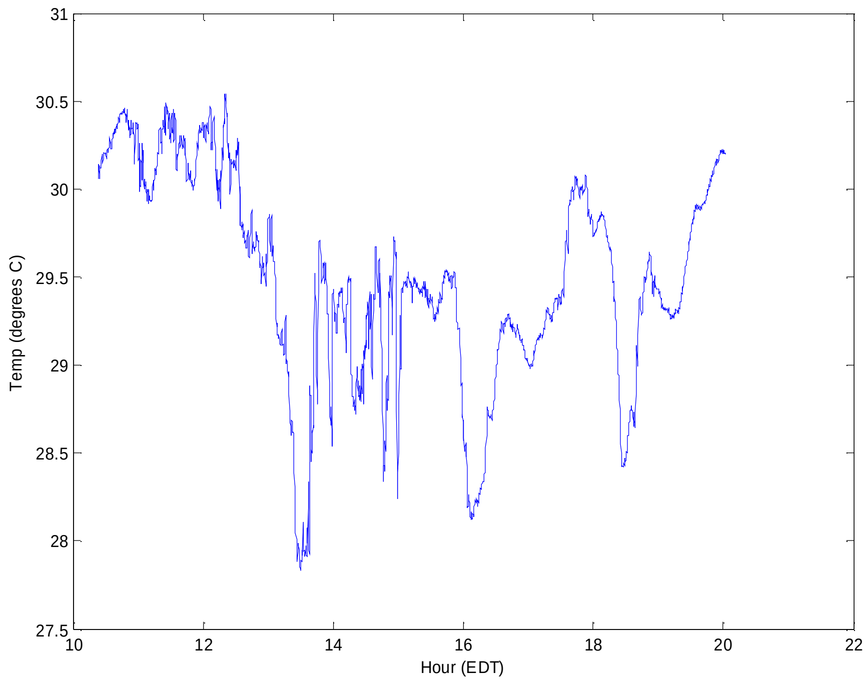

Figure 14. Surface water temperature time series for survey of 9/4/03.

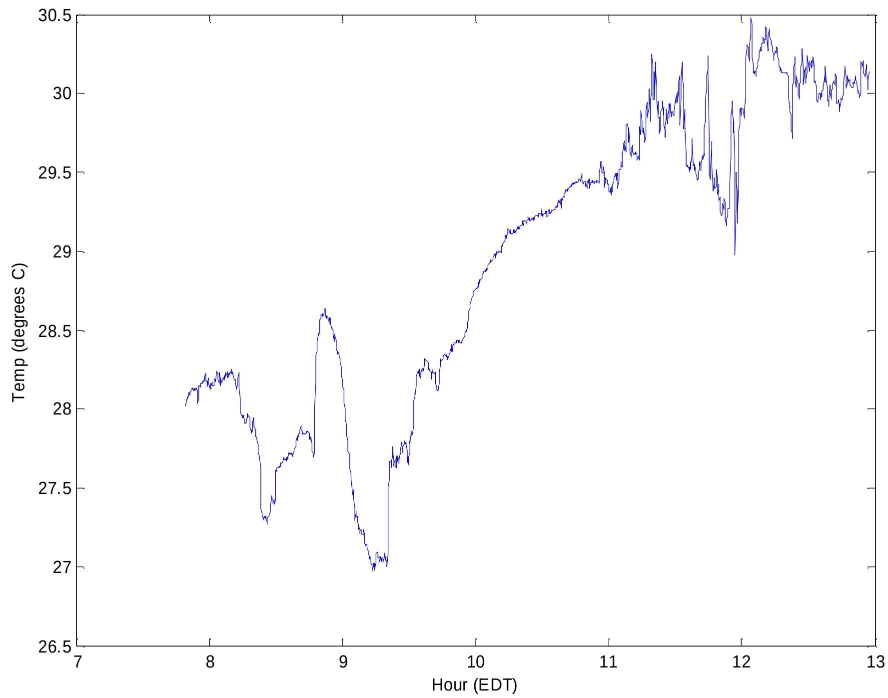

Figure 15. Surface water temperature time series for survey of 9/5/03.

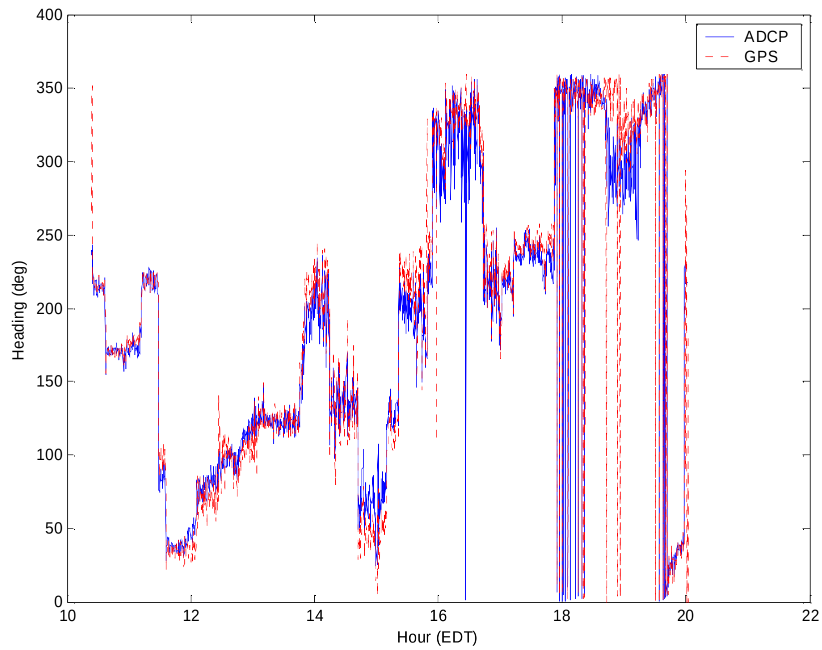

Figure 16. Boat heading (w.r.t. True North), as reported by ADCP and GPS, 9/4/03. Assumes magnetic variation of -5.7 degrees and 45 degree rotation of beam 3 of ADCP (which serves as angle reference) w.r.t. bow of boat. For a constant-heading section of boat track, mean difference in heading is roughly 1 degree, which is less than compass error.

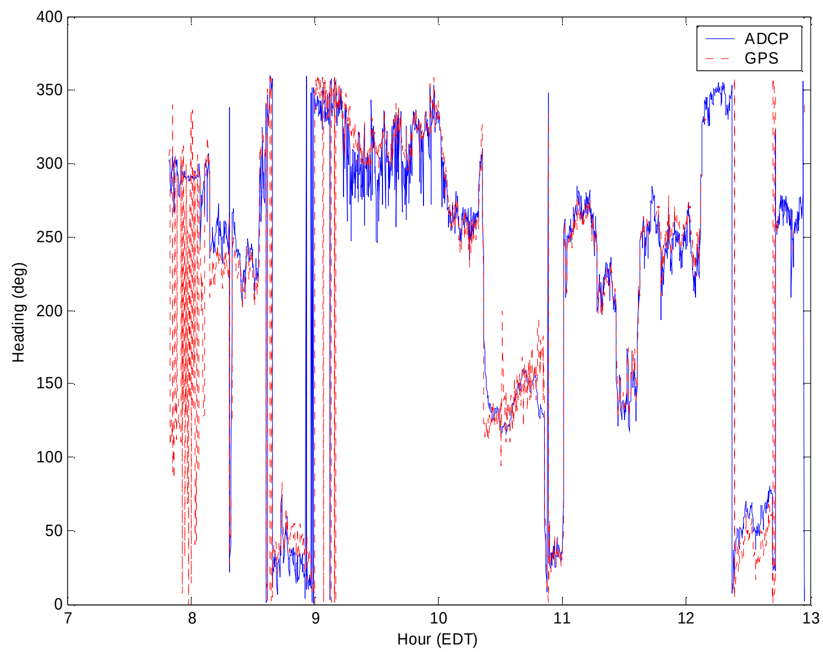

Figure 17. Boat heading (w.r.t. True North), as reported by ADCP and GPS, 9/5/03. See Figure 16 for explanation.

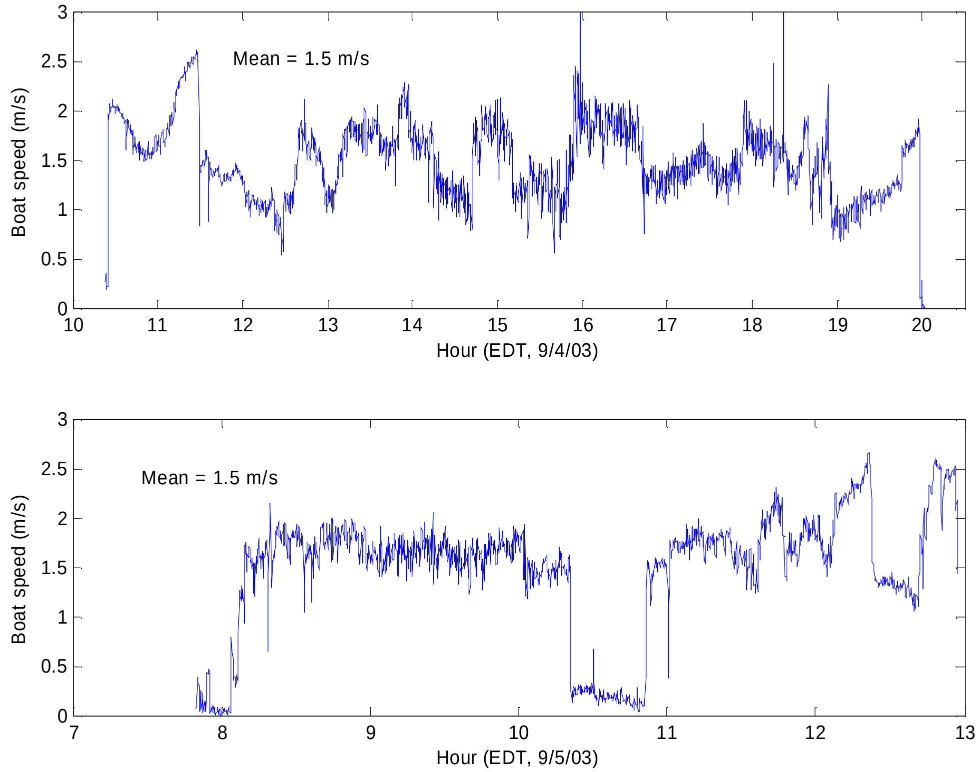

Figure 18. Boat speed data for both days, derived from GPS position fixes. On second day, beginning of record shows near-zero velocities while anchored (8:00AM), and again while boat drifted during slack tide (10:20-10:50AM).

Results

Presentation of the velocity data is complicated by the fact that every ensemble (velocity profile) defines a 3-D velocity profile, and each ensemble was measured at a unique location and time. Plots of the surface velocity, and selected velocity profiles, are shown below. Prior to plotting, any water velocity vectors for which either component of the velocity exceeded 2 m/s were discarded, on the assumption that these were erroneous values. The GPS data were not filtered; no obviously erroneous values were observed. Depth data were also not filtered, other than removing erroneous zero values. Depths were simply interpolated to determine a depth corresponding to each velocity measurement. If desired, a filter could be applied to the depth data prior to interpolation. This would likely improve the realism of the depth data slightly, but for interpretation of the velocity measurements, small depth errors are not important.

If bottom tracking is not active, the ADCP does not “know” which bins are beneath the bottom, and will report meaningless velocities even for regions below the seafloor. After interpolating to determine a depth for every velocity record, the velocity data were filtered to remove all such erroneous measurements. Depth-averaged currents could then be computed and velocity profiles plotted.

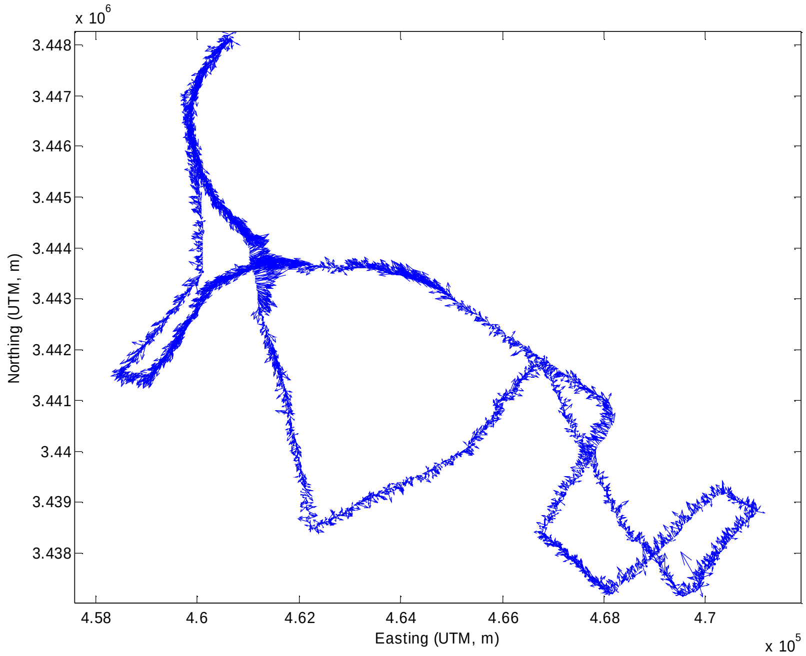

Figure 19. Plan view of September 4, 2003 survey, showing surface (water) velocity vectors w.r.t. fixed coordinate system. Each vector was recorded at a unique time.

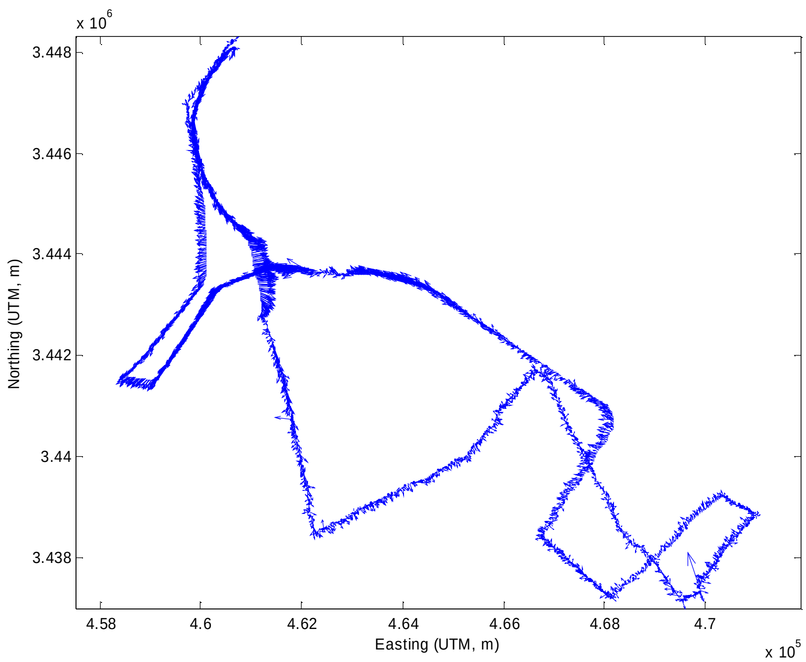

Figure 20. Depth-averaged water velocities for September 4, 2003.

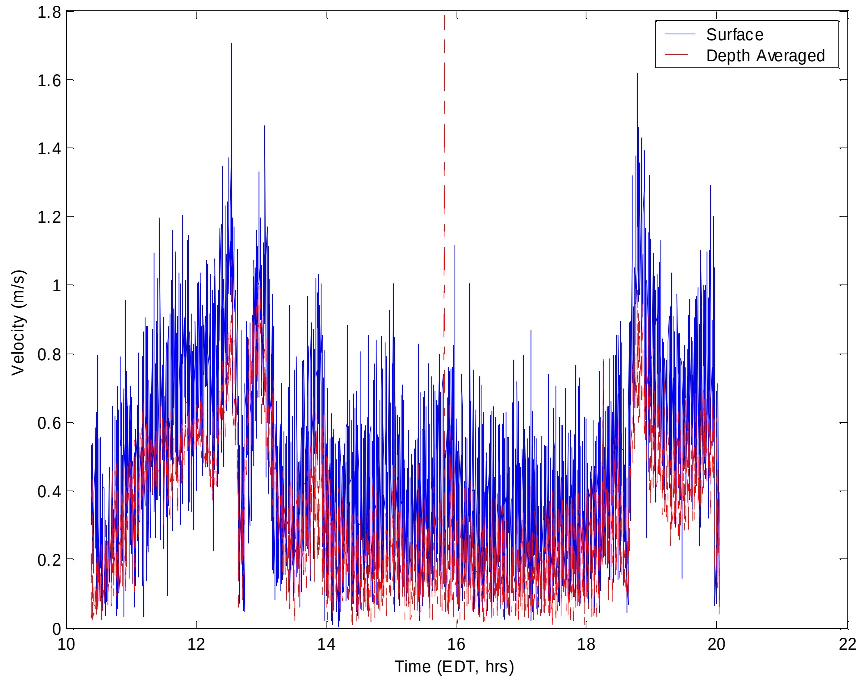

Figure 21. Time series of water velocity magnitude (i.e. speed) for top bin (1 m below surface) and entire water column for September 4, 2003 survey.

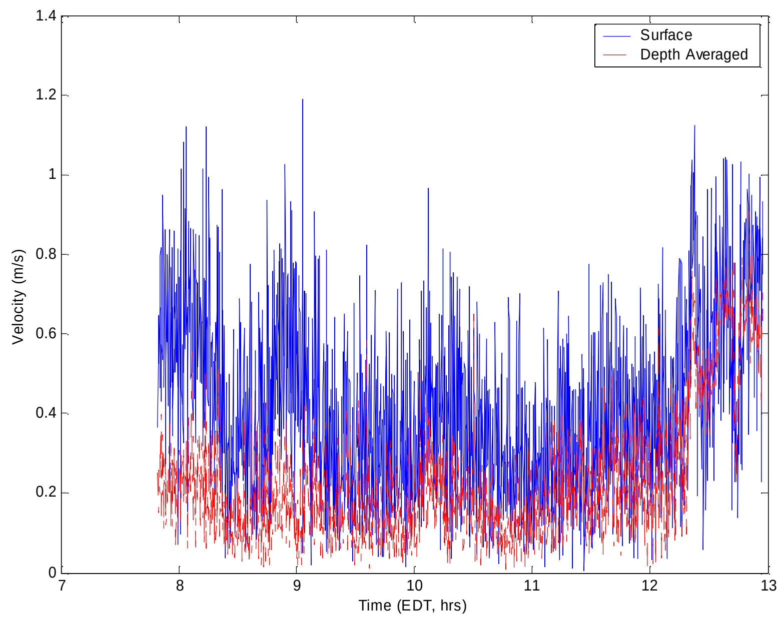

Figure 22. Time series of water velocity magnitude for top bin (1 m below surface) and entire water column for September 5, 2003 survey.

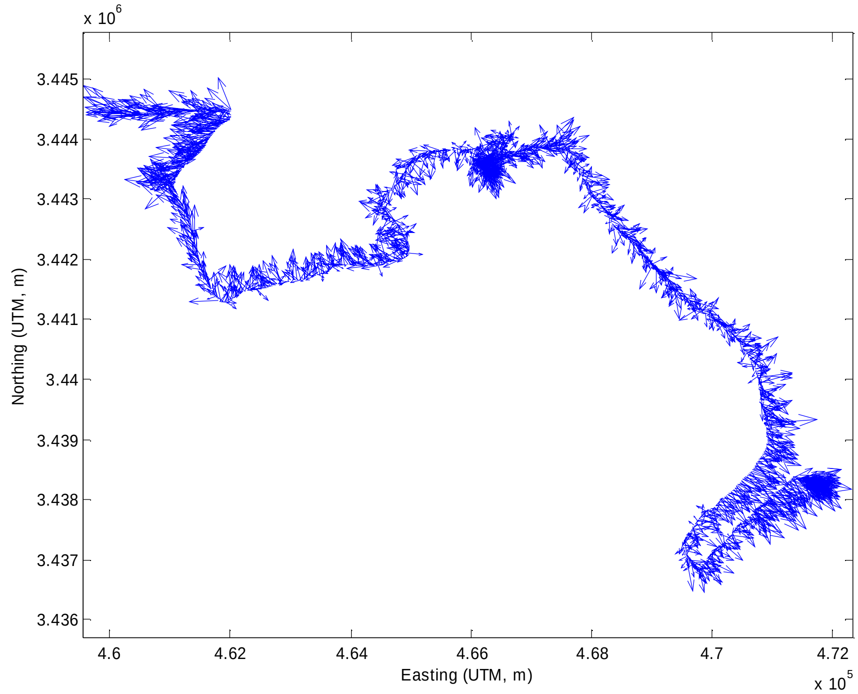

Figure 23. Plan view of September 5, 2003 survey, showing surface (water) velocity vectors (speed over ground). Each vector was recorded at a unique time. Beginning of day corresponds to lower right in figure, when tide was ebbing. End of day corresponds to upper left, when tide was flooding.

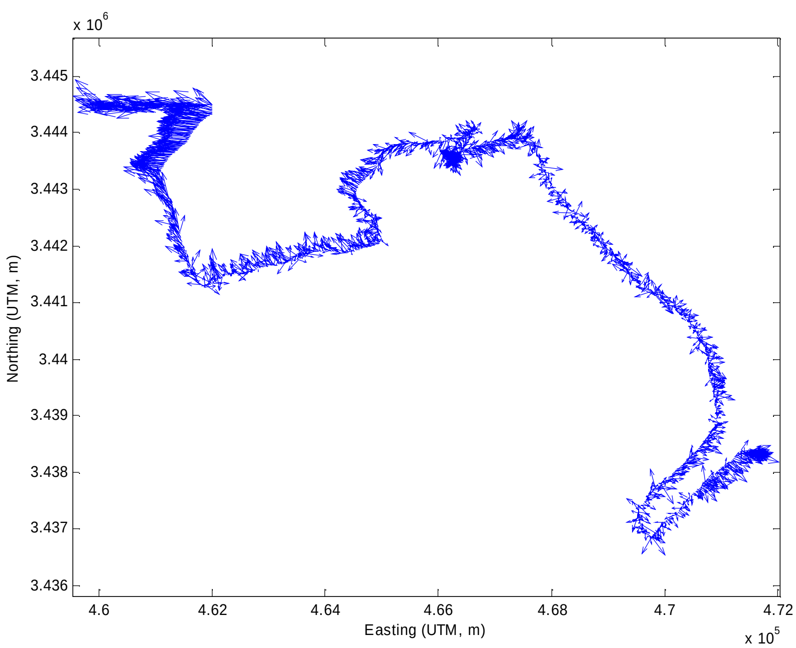

Figure 24. Depth-averaged water velocities for 9/5/03.

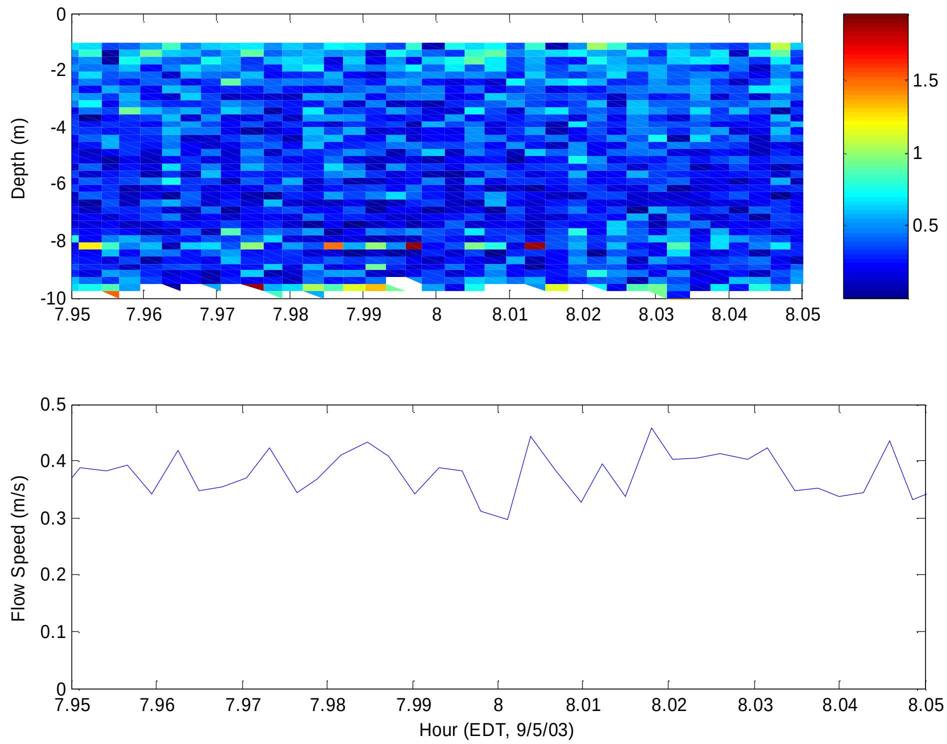

Figure 25. Velocity measurements while boat was anchored at (x,y) = (471538 m, 3438349 m) (or (Lat, Long) = (31.0785, -81.2983)) for six minutes on 9/5/03. Top plot shows time series of velocity profiles; color indicates speed in m/s. Lower plot shows depth-averaged velocity vs. time for this location. Each measurement represents a 10-second average velocity.

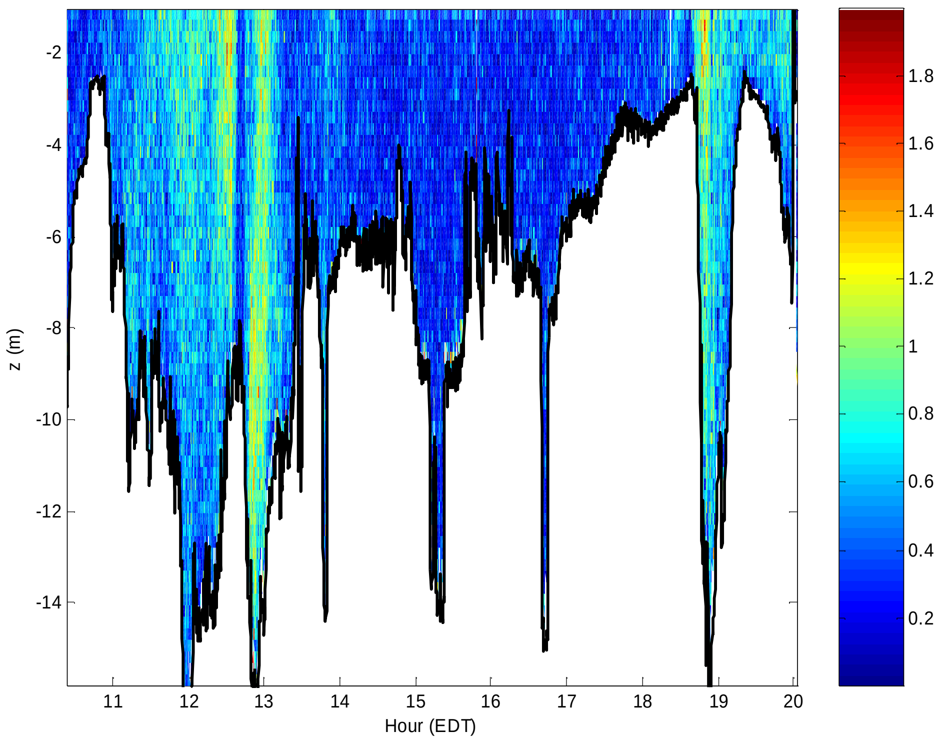

Figure 26. Velocity profile time series for 9/4/03. Color indicates magnitude of velocity in m/s. Thick line at bottom indicates seafloor elevation (with respect to instantaneous water surface) as reported by fathometer. Maximum magnitudes (near 13:00 and 19:00) correspond to passes across inlet.

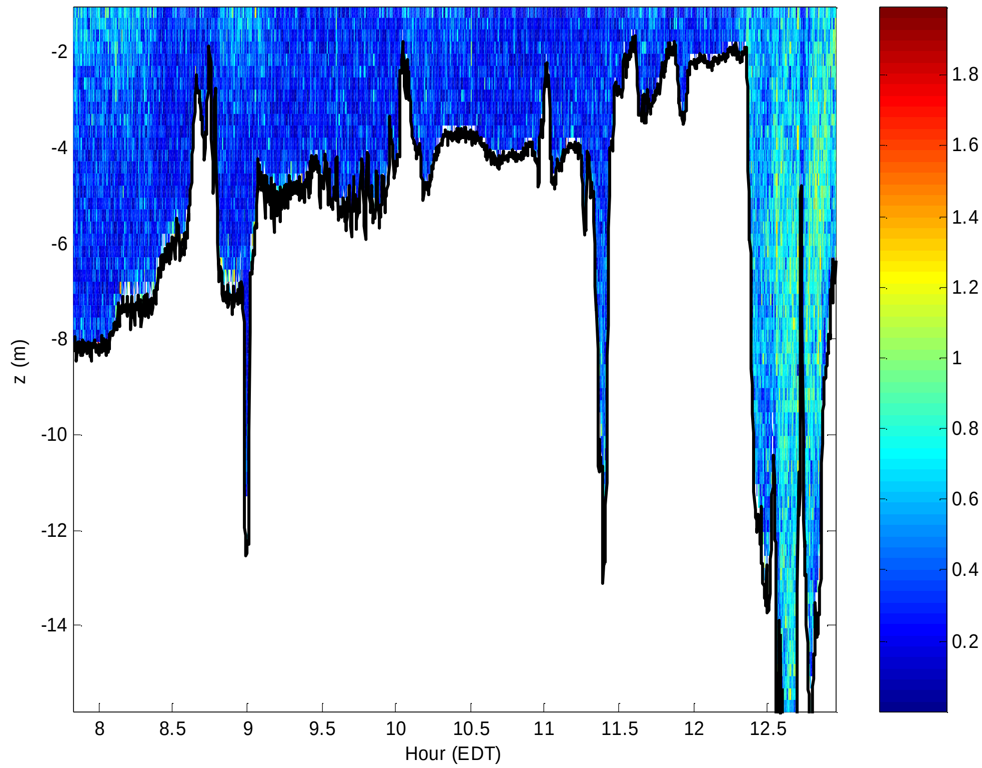

Figure 27. Velocity profile time series for 9/5/03. Color indicates magnitude of velocity in m/s. Maximum magnitude (near 12:30) corresponds to pass across inlet. Thick line at bottom indicates seafloor as reported by fathometer. Maximum measured depth for this transect is 21.4 m; the ADCP was able to "see" to 15.8 m at this location.

Conclusion

This report described a two-day effort to measure mean flows and depths in the vicinity of Jekyll and St. Simons Islands, including the Brunswick Harbor entrance channel. A total of 16 hours of data were collected. Equipment included a WAAS (differential)-corrected GPS receiver, a survey fathometer, and a 1200 kHz Acoustic Doppler Current Profiler (ADCP), all deployed from a moving boat. Velocity information derived from the GPS data was used to remove the boat velocity vector from the measured water velocity to reference all water velocities to the fixed seafloor (i.e. speed over ground). The field trip occurred during a period of neap tides. Maximum currents were on the order of 1 m/s.

The data sets discussed and presented in this report are only a few weeks old, but a variety of means have been employed to visualize the data and search for erroneous results. In general the magnitudes and trends observed in the data set appear to be reasonable. Additional comparisons may be made later once data from two fixed ADCPs that were deployed during the measurement campaign become available.

The full data set containing both raw and processed data is being provided with this report. Filenames and variables are defined in an appendix to this report.

References

Elci, Ş., and Work, P.A., 2003. Field observations for definition of reservoir shoreline erosion and sedimentation, Lake Hartwell, SC/GA. Report to Georgia Water Resources Institute, Georgia Tech – Savannah, Civil and Environmental Engineering, 47 pp. plus CD.

Appendix I: Raw and Processed Data and File Formats

Raw Velocity Data

The following contain the raw data collected on September 4-5, 2003:
All of the following are contained in \brunswick\vmdas\sep04

```
09/04/2003  08:02p          29,483,456 brun0904001_000000.ENR
09/04/2003  08:02p          31,233,216 brun0904001_000000.ENS
09/04/2003  08:02p          31,233,216 brun0904001_000000.ENX
09/04/2003  08:02p               3,683 brun0904001_000000.LOG
09/04/2003  08:02p          31,210,368 brun0904001_000000.LTA
09/04/2003  08:02p          10,594,520 brun0904001_000000.N1R
09/04/2003  08:02p           1,833,384 brun0904001_000000.NMS
09/04/2003  08:02p          31,210,368 brun0904001_000000.STA
09/04/2003  02:23p               7,077 brun0904001_000000.VMO
09/18/2003  07:45p          31,233,216 brun0904001_000_000000.ENS
09/18/2003  07:45p          31,233,216 brun0904001_000_000000.ENX
09/18/2003  07:45p           4,963,728 brun0904001_000_000000.LTA
09/18/2003  07:45p           1,833,384 brun0904001_000_000000.NMS
09/18/2003  07:45p          31,210,368 brun0904001_000_000000.STA
09/18/2003  06:27p               7,099 brun0904001_000_000000.VMP
```

.ENR represents raw data file (beam velocities), in binary format. Can be read in and reprocessed (e.g. averaged) by VmDas or read in for exporting by WinADCP.
.ENS, .ENX, and .NMS are binary data files.
.LOG shows the commands given to the ADCP and its response.
.LTA is the long-term average file, and .STA is the short-term average file. During deployment, both short- and long-term averaging periods were set to 1-sec.
.N1R contains navigation data, in NMEA format (GPS data, but no depth data).
.VMO shows the instrument configuration.

Running VmDas to compute velocities representing 10-second averages resulted in the files shown above named brun0904001_000_000000.*. Within this group of files, the .LTA file includes 10-second averaged data. All other files are the same as described above.

Data from the second day of data collection may be found in the directory \brunswick\vmdas\sep05. The file naming conventions are the same; simply substitute “5” for “4” in the filenames.

Raw Depth and Position Data

The raw depth and GPS position data, as logged by Hypack, may be found in the following files:

```
\brunswick\hypack\bruns090403d

09/04/2003  02:11p           286,628 000_0945.RAW
09/04/2003  08:01p         6,639,358 000_1012.RAW
09/04/2003  01:38p             4,768 brun.ini
09/04/2003  11:17p            72,206 bruns090403.mps
```

The third file in this list represents the Hypack initialization file, showing options used when logging data. The last file is a Mapsource map; this can be read in by Garmin's Mapsource program and will show both the pre-planned boat track and the actual boat track.

The first two files in the list above represent the actual raw data. The smaller file was collected prior to logging any velocity data. Each file contains a series of strings, explained briefly below. For additional details, see the Hypack user manual.

```
DEV 1 16 "cstar" 512 C:\Hypack\devices\nmea.dll
Says that device named cstar is using nmea protocol

EC1 1 35128.551 1.910
Says that echosounder reports depth of 1.910 m at time 35128.551
(seconds since midnight)

POS 0 35129.753 1032856.355 3461496.327
Gives time followed by easting and northing, based on reported GPS
coordinates. Note: the UTM zone was incorrectly specified as 16 instead
of 17, so these coordinates are not correct for Brunswick. These data
were not used however; correct GPS position data are available in the
VmDas files.

QUA 0 35129.753 4 9.100 0.900 12.000 2.000
Gives GPS quality information.

RAW 0 35129.753 4 310997.35000 -812476.72000 3.90000 134520.00000
Gives raw GPS position information. 310997.35 represents 31 degrees,
09.9735 minutes of latitude. The subsequent values represents
longitude.
```

The Hypack raw data files were converted to ASCII files containing, in four columns, time (since start of day), easting (UTM Zone 17, m), northing (UTM Zone 17, m), and measured depth (relative to instantaneous free surface, m). Filenames are as follows:
Converteddepth0904.txt
Converteddepth0905.txt

Processed Data

All of the processed data may be found in two Matlab files:
\Brunswick\vmdas\sep04\export\bruns0904.mat (3476 records x 60 bins)
\Brunswick\vmdas\sep05\export\bruns0905.mat

Each of these files contains processed velocity data (10-second averages), and depths and positions interpolated to correspond to the measurement time. All velocities are referenced to speed over ground. All coordinates are in UTM Zone 17, and depths are relative to the instantaneous free surface. Variables within each file are defined as follows:

AnBatt: Time series of battery voltages
AnDepthmm: Time series of depths of the ADCP pressure transducer, in mm
AnFLatDeg: Time series of latitude of the GPS, in degrees
AnFLonDeg: Time series of longitude of GPS, in degrees
AnH100thDeg: Time series of heading of GPS, in Degrees*100. Note: Heading of boat and GPS differ by 45 degrees because of the way the ADCP was mounted on the boat. This does not affect directions of reported velocities, however.
AnLLatDeg: time series of latitude of GPS, in degrees
AnLLonDeg: time series of longitude of GPS, in degrees
AnNVDir10thDeg: time series of boat heading (from GPS), in Degrees*10
AnNVEmmpersec: time series of East component of boat speed, from GPS, in mm/sec
AnNVMagmmpersec: time series of magnitude of boat speed, from GPS, in mm/sec
AnNVNmmpersec: time series of North component of boat speed, from GPS, in mm/sec
AnP100thDeg: time series of pitch, in degrees*100
AnR100thDeg: time series of roll, in degrees*100
AnT100thDeg: time series of temperature, in degrees Celsius*100
RDIBin1Mid: gives depth to midpoint of Bin 1 (nearest water surface) in m
RDIBinSize: give vertical size of each bin in m
RDIEnsDate, RDIEnsInterval, RDIEnsTime, RDIFileName, RDIPingsPerEns, RDISecPerPing, RDISystem: self-explanatory
SerBins: gives number of bins
SerDay: time series of day (all the same, in this case)
SerDir10thDeg: gives direction (in degrees*10) of each velocity measurement as a time series. Each time series includes 60 records since 60 bins were used.
SerEmmpersec: time series of east component of water velocity (speed over ground) in mm/sec
SerEnsembles: time series of ensemble number
SerErrmmpersec: time series of error velocity in mm/sec
SerHour: time series of hour (only)
SerMagmmpersec: time series of magnitude of water velocity vector (speed over ground) in mm/sec
SerMin: time series of minute since hour last changed
SerMon: time series of month
SerNmmpersec: time series of north component of water velocity vector, mm/sec
SerSec: time series of seconds since minute last changed
SerVmmpersec: time series of vertical component of velocity
SerYear: time series of year
Adcp.hour = hours since beginning of day, i.e. 12.5000 = 12:30PM EDT
Adcp.x = time series of easting (m) for velocity measurements
Adcp.y = time series of northing (m) for velocity measurements

Adcp.z = z-coord (datum = instantaneous water surface) for velocity measurements
Depth.hour = times since midnight at which depths were recorded (EDT)
Depth.h = time series of depths (m)
Depth.inth = time series of depths (m), interpolated to match up in time with adcp.hour
Emean = time series of east component of depth-averaged velocity (m/s)
Nmean = time series of north component of depth-averaged (m/s)
Umag = time series of magnitude of depth-averaged velocity
Geodas.x = easting of GEODAS data point (m)
Geodas.y = northing of GEODAS data point (m)
Geodas.z = elevation of GEODAS data point (m MSL)
V = values of depth contours to be plotted (m)
Vcut = cutoff velocity; velocity data discarded if above this threshold

If desired, all depths/elevations could be computed to a common datum. One would need to determine water level as a function of time (and position, if this level of detail is desired), and then remove the difference between the actual water level and the datum from the measured depth.

Appendix II: Field Notes

Brunswick, GA field trip to measure currents and depths
9/3-9/5/03

All times are EDT, per PAW's watch. Laptop computer synchronized roughly to this watch; other computer within 1 sec of laptop, so times agree with each other, although may not match watch or GPS time exactly.

Personnel:
Paul Work
Huseyin Demir
Charley Johnson

Equipment:
RDI 1200kHz Workhorse Monitor ADCP. Set in low-res mode (i.e. Mode 1), looking down. Compass calibrated in downward looking mode while in lab. Mounted to aluminum pole on aluminum boat (not far from iron engines, however). Power supplied by AC power supply from 600W DC-AC inverter (modified sine wave). This instrument logged using VmDas software.

Ceeducer depth sounder with 200kHz transducer. Powered independently by small 12V battery.

Garmin GPS Sounder 188. Antenna mounted on top of boat cabin. Powered independently by small 12V battery. This unit has two serial outputs; one was directed to laptop computer so that VmDas would have position data. The second serial output went to a small desktop computer that was running Hypack to log depth and position data.

Wednesday 9/3/03
15:00 Left office for Wal-Mart to get deep-cycle battery
16:30 Arrived SeaTow boat dock in Brunswick
Spent most of next 4 hours mounting equipment on boat.
ADCP power cable not long enough; remainder of equipment mounted up ok.
Checked into Best Western for evening.

Thursday 9/4/03
6:30AM arrived at SeaTow dock to prepare for measurements
Met by Jamie who would serve as captain. Tide low on arrival.

Transducer drafts:
8" from top of aluminum mounting plate to bottom of ADCP
3" from top of plywood down to face of transducer
8" from water surface to top of aluminum plate.
Therefore draft of ADCP is 16"

9” from water surface to top of plywood
Therefore draft of fathometer is 12”

ADCP is mounted such that beam 3 is 45 degrees away from bow (clockwise; therefore ADCP headings will be 45 degrees greater than GPS headings, after accounting for magnetic variation).

9:30 slack tide, still messing around with software
GPS antenna is 102” forward of the transducers and 72” inboard of the transducers

10:07 on PAW’s watch; laptop clock set to match this. Other computer clock not yet set. Fathometer set to output corrected data, i.e. depth below surface as output from fathometer should be correct depth. No draft correction put into Hypack, but position of GPS antenna put into Hypack. Hypack used to log position and depth only.

WinRiver running on laptop with GPS and ADCP. Draft correction for ADCP put into WinRiver. Draft also put into VmDas.

10:11 Clocks synchronized; little desktop computer is 1 sec behind laptop.
Filename for Hypack data = 000_1012.RAW in hypack\bruns

10:30 on PAW’s watch; laptop says 10:29.
Headed out channel; logging depth and position with Hypack on small desktop, and VmDas logging velocity and position. Saving every second. Bottom track not functional.

10:57 Checked data; looks good. Two things that we might use to improve our system: longer cable to hook battery pack to ADCP, and better software. Laptop for 2nd computer might also be easier.

11:18 Passed mark #27, passed #3, headed for #4 (1/3 of the way between 3 and 4), headed behind Jekyll Island (these are waypoints, not channel markers).

11:38 Checked Hypack computer; working fine, almost 1Mb of depth data so far. Other computer also working. Just passed point #5, heading for 6.

12:12PM Headed out into channel, offshore. ADCP shows ~5Mb in several of the files, and 1.3Mb in the raw data file for hypack

1:06 passed station 22, headed for 21, right out the channel, going against very strong flood current. Both computers still working, 1.9Mb on Hypack computer.

2:30 12Mb of velocity data, 3Mb of depth and position data. Between 19 and 20, headed offshore. Doing a box that extends south of channel, then heading for C1, 2, 3, and 4 (additional lines suggested by Trap Puckette).

3:33 Passed point C1, headed for C2. Near max high tide, so velocity small. Close to 12,000 ensembles of velocity data and 3.5 Mb of position/depth data. Everything working. Pretty good swell coming in (Hurricane Fabian headed for Bermuda), wind is from south-southeast.

4:52 Went from C2 straight to 17; skipped C3-C4 leg since it is high tide and not much flow. Now headed south to 16, towards Jekyll Island. 20 Mb velocity data, 4.5 Mb position data.

6:47 Coming into inlet, tide is ebbing. 26Mb of velocity data, 19000 records. 5.5 Mb of depth/position data. Fathometer dropping out once in a while, mostly in shallow water.

8:05 arrived at dock, stopped logging data.

11:25PM back from dinner at 11PM. Finished copying files onto PAW's laptop and dumped to CDRW.

Friday September 5
6:25AM Loading truck at hotel.

7:20 Left dock with computers running, headed offshore

7:48 At point near mound C, at point furthest offshore, closest to channel (C1). Hypack file name: 000_0747.RAW in c:\hypack\bruns.

7:54 Everything running, weather great. Low tide at 10:10 on the bar (predicted). Throwing out anchor for about five minutes to get measurements at a fixed location (tried to hold boat in place with engine for several minutes before this).

7:57 Anchored

8:12 Waited five minutes at anchor spot. Now doing transect C1-C2, headed south. Weather perfect, no wind at all. Some swell.

8:50 Moving northeast from C3 to C4. Passed over some shallow areas (6-7 ft), swell refracting around mounds. Almost low tide now.

9:48 Headed on north side of channel, towards shore, towards waypoint 11. Will follow from 11 south across channel. Low tide coming up.

10:24 Stopped near point number 10. Between 11 and 10. Near slack low tide, hanging out and drifting for a few minutes to wait for flow to start, will then head south across channel.

10:52 Started moving again, towards point 11. Low tide at St. Simons light predicted at 10:35.

12:23 Took line in to Jekyll Island, then went along coast of Jekyll toward inlet. Now heading up towards pier and then to SeaTow dock.

12:58 Just passed waypoint 27. Shut down computers (still working), hauled in gear.

2:00 Leaving for Savannah after loading truck

3:45 Arrived at office and unpacked. 180 miles.