Mound Study Project
Cape Fear, North Carolina
Water Column Profiles
July 2001
EHI Project No. 6000.21

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Final VIMS Report CHSD-2002-03
Prepared for Evans-Hamilton, Inc
By

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1. SUMMARY

This work was conducted in support of an ongoing investigation on sediment dispersal and evolution of a mixed-sediment disposal mound off Cape Fear, NC, by the US Army Corps of Engineers (USACE) and Evans-Hamilton, Inc. (EHI), project number 6000.21. This is the second of three surveys performed by the Virginia Institute of Marine Science (VIMS), College of William and Mary, under the direction of Grace Battisto. In this Survey repetitive water column profiles and suspended sediment concentration samples were collected for calibration of Acoustic Doppler Current Profilers (ADCP) and Optical Backscatter Sensors (OBS) deployed by USACE and EHI personnel under the direction of Herman Carl Miller on the site of the disposal mound and immediate vicinity. The pump samples collected for this survey will be used by John Land and EHI personnel to calibrate the SEDIVIEW software program designed to convert ADCP backscatter to suspended sediment concentrations. Laser in-situ Scattering Transmissometer (LISST 100) and calibrated OBS backscatter data collected during this survey will be used by John Land for comparison purposes with the SEDIVIEW suspended sediment concentration results.

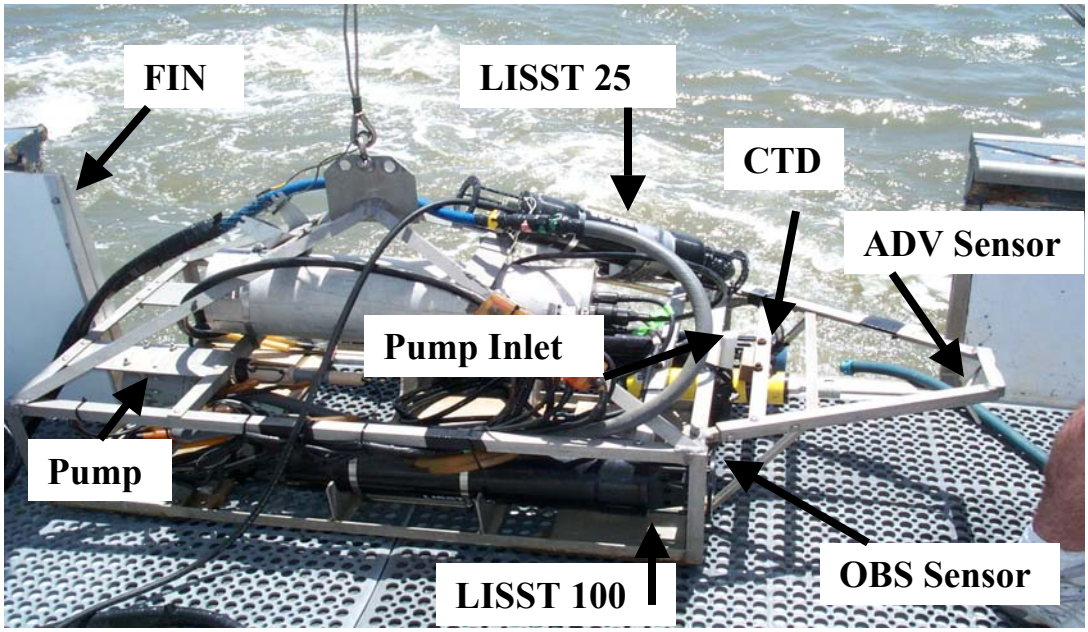


Figure 1. Profiler ready for deployment

2. METHOD

2.1 Profiler Deployment

For this survey the R/V Langley was anchored at four sites between July 24 to July 26, 2001: two in the mouth of the Cape Fear River, one on the mixed-sediment dredge spoil mound located offshore, and one off the beach of Bald Head Island. These sites correspond to bottom mounted ADCP long-term deployment stations maintained by the USACE. At each anchor site a series of "stations" were performed. At each of these stations a profiler (Figure 1) equipped with a conductivity, temperature and depth sensor (CTD), an Optical Backscatter Sensor (OBS), a Laser *in-situ* Scattering Transmissomer (LISST-100), an Acoustic Doppler Velocimeter (ADV), a compass and a submersible pump was deployed in real-time mode for the data collection. Also mounted on the profiler was a LISST-25 provided by Chuck Pottsmith of Sequoia Scientific Inc., Redmond WA using an internal data collection mode. Table 1 lists the sensor heights relative to the bottom of the profiler. Differential GPS was used to document the location of the vessel during each station.

Table 1. Sensor Heights Relative to Bottom of Profiler

Sensor	Height (cm)
Conductivity Sensor	10
Pressure Sensor	10
OBS (center of window)	8
Pump Intake	33
ADV (oriented so sampling volume is same height)	19
LISST 100	10
LISST 25	35

Table 2. Sample Identification.

Station	Date	LAT (W)	LONG (N)	Location	Sample	Depth Mean	Depth StdDev	PUMP Start time EST	PUMP Stop time EST	CTD and LISST Start Time EST	CTD and LISST Stop Time EST	N
S636	24-Jul-01	33^{O} 53.803	78^{O} 00.925	River2	A	14.09	0.05	12:14:29	12:15:32	12:14:01	12:15:04	320
					B	13.06	0.06	12:20:58	12:22:20	12:20:30	12:21:52	415
					C	12.06	0.05	12:24:21	12:25:30	12:23:53	12:25:02	349
					D	11.06	0.06	12:28:26	12:29:32	12:27:58	12:29:04	335
					E	10.08	0.06	12:32:17	12:33:24	12:31:49	12:32:56	340
					F	9.05	0.04	12:36:20	12:37:23	12:35:52	12:36:55	320
					G	8.00	0.04	12:40:00	12:41:05	12:39:32	12:40:37	330
					H	7.05	0.05	12:44:16	12:45:22	12:43:48	12:44:54	335
					I	6.08	0.04	12:48:37	12:49:34	12:48:09	12:49:06	290
					J	5.09	0.05	12:52:47	12:53:52	12:52:19	12:53:24	330
					K	4.04	0.04	12:55:51	12:56:53	12:55:23	12:56:25	316
					L	3.01	0.04	12:59:12	13:00:16	12:58:44	12:59:48	324
S637	24-Jul-01	33^{O} 53.771	78^{O} 00.915	River2	A	10.97	0.11	13:56:32	13:57:40	13:56:04	13:57:12	345
					B	9.83	0.12	13:59:55	14:00:58	13:59:27	14:00:30	320
					C	8.85	0.12	14:03:40	14:05:10	14:03:12	14:04:42	455
S638	24-Jul-01	33^{O} 53.762	78^{O} 00.915	River2	A	11.12	0.10	14:39:58	14:41:02	14:39:30	14:40:34	325
					B	9.91	0.22	14:43:56	14:45:05	14:43:28	14:44:37	300
					C	9.28	0.13	14:47:19	14:48:21	14:46:51	14:47:53	315
					D	8.20	0.25	14:51:12	14:52:39	14:50:44	14:52:11	400
					E	6.99	0.10	14:54:36	14:55:39	14:54:08	14:55:11	318
					F	6.17	0.12	14:58:07	14:59:12	14:57:39	14:58:44	331
					G	5.14	0.13	15:01:00	15:02:15	15:00:32	15:01:47	380
					H	3.97	0.10	15:07:29	15:08:32	15:07:01	15:08:04	320
					I	3.13	0.14	15:10:19	15:11:32	15:09:51	15:11:04	370
S639	24-Jul-01	33^{O} 53.763	78^{O} 00.917	River2	A	11.09	0.26	15:28:10	15:29:22	15:27:42	15:28:54	365
					B	9.67	0.16	15:31:31	15:32:36	15:31:03	15:32:08	330
					C	8.89	0.08	15:34:05	15:35:14	15:33:37	15:34:46	350
					D	7.65	0.14	15:36:47	15:37:49	15:36:19	15:37:21	313
					E	7.09	0.12	15:39:37	15:40:44	15:39:09	15:40:16	340
					F	6.20	0.10	15:42:06	15:43:11	15:41:38	15:42:43	331

Table 2. Sample Identification

Station	Date	LAT (W)	LONG (N)	Location	Sample	Depth Mean	Depth StdDev	PUMP Start time EST	PUMP Stop time EST	CTD and LISST Start Time EST	CTD and LISST Stop Time EST	
S639	24-Jul-01	33^{O} 53.763	78^{O} 00.917	River2	G	4.90	0.11	15:45:28	15:46:38	15:45:00	15:46:10	354
					H	4.14	0.08	15:48:49	15:49:59	15:48:21	15:49:31	351
S639	24-Jul-01	33^{O} 53.763	78^{O} 00.917	River2	I	3.09	0.06	15:51:30	15:52:38	15:51:02	15:52:10	345
S640	24-Jul-01	33^{O} 53.761	78^{O} 00.917	River2	A	11.21	0.17	16:23:01	16:24:15	16:22:33	16:23:47	371
					B	12.22	0.08	16:26:01	16:27:11	16:25:33	16:26:43	351
					C	8.96	0.12	16:28:31	16:29:44	16:28:03	16:29:16	366
					D	8.16	0.08	16:31:41	16:32:49	16:31:13	16:32:21	341
					E	6.65	0.14	16:34:20	16:35:32	16:33:52	16:35:04	361
					F	6.04	0.09	16:37:13	16:38:26	16:36:45	16:37:58	366
					G	5.08	0.10	16:43:11	16:44:24	16:42:43	16:43:56	366
					H	4.19	0.06	16:46:13	16:47:31	16:45:45	16:47:03	391
					I	3.06	0.08	16:49:02	16:50:31	16:48:34	16:50:03	446
S641	24-Jul-01	33^{O} 53.762	78^{O} 00.914	River2	A	9.85	0.12	17:03:01	17:04:14	17:02:33	17:03:46	366
					B	8.84	0.13	17:06:01	17:07:22	17:05:33	17:06:54	406
					C	7.91	0.09	17:09:31	17:10:42	17:09:03	17:10:14	355
					D	6.92	0.10	17:12:43	17:14:04	17:12:15	17:13:36	406
					E	6.06	0.08	17:15:27	17:16:44	17:14:59	17:16:16	386
					F	4.95	0.12	17:18:01	17:19:14	17:17:33	17:18:46	366
					G	4.12	0.09	17:20:29	17:21:46	17:20:01	17:21:18	386
					H	3.10	0.09	17:23:19	17:24:31	17:22:51	17:24:03	361
S643	25-Jul-01	33^{O} 08.188	78^{O} 01.990	Mound	A	7.00	0.25	NO PUMP SAMPLES		11:04:43	11:05:41	291
					B	6.01	0.20	NO PUMP SAMPLES		11:05:48	11:06:43	275
					C	4.89	0.19	NO PUMP SAMPLES		11:06:56	11:08:10	371
					D	3.97	0.22	NO PUMP SAMPLES		11:08:21	11:09:16	275
					E	3.05	0.16	NO PUMP SAMPLES		11:09:24	11:10:17	267
					F	2.20	0.22	NO PUMP SAMPLES		11:10:33	11:12:36	613
S644	25-Jul-01	33^{O} 08.188	78^{O} 01.990	Mound	A	6.88	0.20	NO PUMP SAMPLES		11:17:01	11:17:38	187
					B	6.09	0.21	NO PUMP SAMPLES		11:17:52	11:18:40	242
					C	5.01	0.22	NO PUMP SAMPLES		11:19:05	11:20:07	312
					D	3.90	0.20	NO PUMP SAMPLES		11:20:24	11:21:18	270

Table 2. Sample Identification.

Station	Date	LAT (W)	LONG (N)	Location	Sample	Depth Mean	Depth StdDev	PUMP Start time EST	PUMP Stop time EST	CTD and LISST Start Time EST	CTD and LISST Stop Time EST	
S644	25-Jul-01	33^{O} 08.188	78^{O} 01.990	Mound	E	2.98	0.20	NO PUMP SAMPLES		11:21:33	11:22:28	277
					F	2.25	0.16	NO PUMP SAMPLES		11:22:48	11:24:45	588
S645	25-Jul-01	33^{O} 08.188	78^{O} 01.990	Mound	A	6.97	0.25	NO PUMP SAMPLES		11:29:41	11:30:43	312
					B	6.02	0.21	NO PUMP SAMPLES		11:30:58	11:31:59	305
S645	25-Jul-01	33^{O} 08.188	78^{O} 01.990	Mound	C	5.23	0.20	NO PUMP SAMPLES		11:32:11	11:33:00	242
					D	3.97	0.19	NO PUMP SAMPLES		11:33:23	11:34:27	318
					E	3.13	0.14	NO PUMP SAMPLES		11:34:41	11:35:35	270
					F	2.35	0.22	NO PUMP SAMPLES		11:35:53	11:36:44	256
S646	25-Jul-01	33^{O} 08.188	78^{O} 01.990	Mound	A	7.00	0.19	NO PUMP SAMPLES		11:44:07	11:45:11	325
					B	6.08	0.28	NO PUMP SAMPLES		11:45:32	11:46:28	277
					C	5.04	0.18	NO PUMP SAMPLES		11:46:48	11:48:08	401
					D	4.06	0.19	NO PUMP SAMPLES		11:48:44	11:49:27	215
					E	3.08	0.17	NO PUMP SAMPLES		11:49:41	11:50:25	222
					F	2.32	0.16	NO PUMP SAMPLES		11:50:45	11:51:47	312
S647	25-Jul-01	33^{O} 08.188	78^{O} 01.990	Mound	A	7.14	0.19	NO PUMP SAMPLES		12:32:55	12:33:55	299
					B	5.98	0.19	NO PUMP SAMPLES		12:34:11	12:35:12	307
					C	4.89	0.20	NO PUMP SAMPLES		12:35:29	12:36:10	210
					D	3.86	0.18	NO PUMP SAMPLES		12:36:24	12:37:08	226
					E	3.02	0.15	12:37:45	12:38:10	12:37:42	12:38:07	194
					F	3.11	0.21	12:40:06	12:40:30	12:40:03	12:40:27	347
S648	25-Jul-01	33^{O} 50.758	78^{O} 00.637	Bald Head	A	4.95	0.21	10:39:22	10:40:32	10:38:54	10:40:04	351
					B	4.16	0.19	10:44:01	10:45:11	10:43:33	10:44:43	350
					C	3.12	0.19	10:48:00	10:49:19	10:47:32	10:48:51	396
					D	2.29	0.18	10:51:22	10:52:29	10:50:54	10:52:01	336
S649	25-Jul-01	33^{O} 50.758	78^{O} 00.637	Bald Head	A	5.15	0.26	11:06:20	11:07:41	11:05:52	11:07:13	407
					B	4.12	0.21	11:10:00	11:11:11	11:09:32	11:10:43	357
					C	3.14	0.20	11:13:40	11:14:41	11:13:12	11:14:13	306
					D	2.39	0.19	11:16:30	11:17:40	11:16:02	11:17:12	351
S650	25-Jul-01	33^{O} 50.758	78^{O} 00.637	Bald Head	A	5.13	0.22	11:25:31	11:26:42	11:25:03	11:26:14	356
					B	4.06	0.23	11:28:33	11:29:44	11:28:05	11:29:16	357

Table 2. Sample Identification.

Station	Date	LAT (W)	LONG (N)	Location	Sample	Mean	StdDev	PUMP Start time EST	PUMP Stop time EST	CTD and LISST Start Time EST	CTD and LISST Stop Time EST	
S650	25-Jul-01	33^{O} 50.758	78^{O} 00.637	Bald Head	C	3.12	0.19	11:31:30	11:32:43	11:31:02	11:32:15	366
					D	2.15	0.16	11:36:25	11:37:36	11:35:57	11:37:08	356
S651	25-Jul-01	33^{O} 50.758	78^{O} 00.637	Bald Head	A	4.95	0.23	11:42:33	11:43:46	11:42:05	11:43:18	366
					B	4.04	0.22	11:46:30	11:47:40	11:46:02	11:47:12	351
					C	3.11	0.23	11:48:55	11:50:20	11:48:27	11:49:52	426
					D	2.09	0.22	11:52:25	11:53:31	11:51:57	11:53:03	331
S652	25-Jul-01	33^{O} 52.322	78^{O} 00.435	River2	A	7.91	0.09	13:29:21	13:30:34	13:28:53	13:30:06	366
					B	6.98	0.09	13:31:50	13:33:01	13:31:22	13:32:33	356
					C	6.05	0.11	13:34:33	13:35:43	13:34:05	13:35:15	351
					D	5.03	0.09	13:38:00	13:39:11	13:37:32	13:38:43	356
					E	4.02	0.11	13:41:59	13:43:10	13:41:31	13:42:42	357
					F	3.05	0.06	13:44:31	13:45:41	13:44:03	13:45:13	351
					G	2.17	0.07	13:46:58	13:48:14	13:46:30	13:47:46	381
S653	25-Jul-01	33^{O} 52.322	78^{O} 00.435	River2	A	7.98	0.10	14:04:50	14:06:02	14:04:22	14:05:34	365
					B	7.00	0.10	14:07:23	14:08:36	14:06:55	14:08:08	370
					C	6.04	0.11	14:10:37	14:11:48	14:10:09	14:11:20	360
					D	5.07	0.08	14:14:19	14:15:27	14:13:51	14:14:59	345
					E	4.06	0.08	14:19:58	14:21:09	14:19:30	14:20:41	282
					F	3.08	0.07	14:22:16	14:23:27	14:21:48	14:22:59	359
					G	2.02	0.07	14:26:35	14:27:46	14:26:07	14:27:18	360
S654	25-Jul-01	33^{O} 52.314	78^{O} 00.433	River2	A	7.99	0.09	14:37:17	14:38:28	14:36:49	14:38:00	355
					B	7.08	0.08	14:39:52	14:41:08	14:39:24	14:40:40	385
					C	6.11	0.07	14:42:40	14:43:51	14:42:12	14:43:23	322
					D	5.07	0.11	14:45:05	14:46:15	14:44:37	14:45:47	356
					E	3.98	0.08	14:48:20	14:49:43	14:47:52	14:49:15	389
					F	3.02	0.07	14:51:09	14:52:23	14:50:41	14:51:55	375
					G	2.31	0.06	14:53:50	14:55:01	14:53:22	14:54:33	360
S655	25-Jul-01	33^{O} 53.807	78^{O} 00.923	River2	A	11.99	0.07	15:46:00	15:47:14	15:45:32	15:46:46	375
					B	11.12	0.08	15:49:39	15:50:49	15:49:11	15:50:21	355
					C	10.09	0.07	15:52:48	15:54:00	15:52:20	15:53:32	365

Table 2. Sample Identification.

Station	Date	LAT (W)	LONG (N)	Location	Sample	Depth Mean	Depth StdDev	PUMP Start time EST	PUMP Stop time EST	CTD and LISST Start Time EST	CTD and LISST Stop Time EST	
S655	25-Jul-01	33^{O} 53.807	78^{O} 00.923	River2	D	9.05	0.09	15:55:10	15:56:25	15:54:42	15:55:57	381
					E	8.09	0.07	15:57:31	15:58:41	15:57:03	15:58:13	355
					F	7.05	0.08	16:03:54	16:05:04	16:03:26	16:04:36	355
					G	6.13	0.08	16:07:07	16:08:17	16:06:39	16:07:49	354
					H	4.96	0.08	16:09:35	16:10:45	16:09:07	16:10:17	350
					I	3.97	0.10	16:11:50	16:13:00	16:11:22	16:12:32	355
					J	0.03	0.08	16:14:25	16:15:37	16:13:57	16:15:09	366
S656	25-Jul-01	33^{O} 53.777	78^{O} 00.926	River2	A	11.03	0.07	16:33:20	16:34:30	16:32:52	16:34:02	300
					B	9.16	0.09	16:35:50	16:37:01	16:35:22	16:36:33	365
					C	7.32	0.08	16:38:30	16:39:40	16:38:02	16:39:12	356
					D	5.05	0.07	16:43:45	16:44:56	16:43:17	16:44:28	360

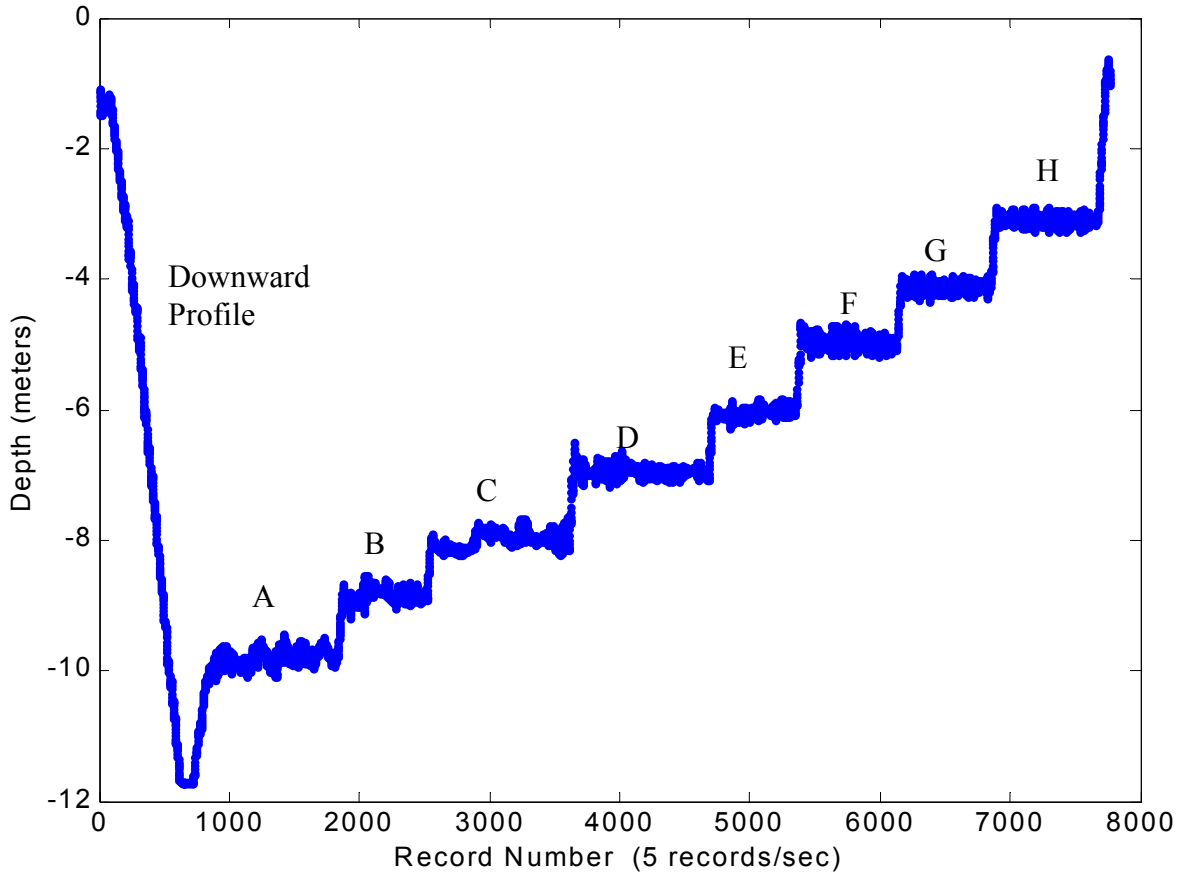


Figure 2. An example, station C641, of the pressure record showing the downward profile and the pump sampling depths (see Table 2).

The profiler with the various instruments was lowered from a near surface depth to a near bottom depth to collect a "profile" of the water column at the beginning of the station (Figure 2). The profiler was then raised from the bottom depth to a depth that corresponded with an ADCP bin depth that would contain good data and kept at that depth while at least 10 liters of water was pumped to the surface and collected in a churn splitter. An aliquot of the sample from the splitter was filtered through a 60 micron mesh filter and the filtrate was filtered through a GF/F glass fiber filter (pore size ~ 0.7 micron) to be dried at 103-105 degrees C for total suspended solids for each fraction and then put in a muffle furnace at 550 degrees C to determine the fixed portion of each fraction. The

difference in the sample weight before being put in the muffle furnace and after being removed is the volatile portion of each fraction. The total concentrations of each fraction before being muffled are added together to get the Total Suspended Solid for each sample. The exact times, to the second, of the start and stop of the water collections were recorded (Table2). Since it takes approximately 28 seconds for the pumped water to clear the hose, the portions of the data records that will be used to compare with the pumped samples will be the bottle fill start and stop times minus 28 seconds. Samples were taken at approximately one-meter intervals, starting at depth and moving the profile upwards to within approximately 2.5 meters from the surface. Figure 2 is an example of the CTD pressure record for Station C641 showing the downward profile and the depths at which each of the pumped samples were taken. John Land collected ADCP data from a shipboard mounted ADCP to correspond with the pumped water samples for calibration of his Sediview program used to convert acoustic backscatter to suspended sediment concentration.

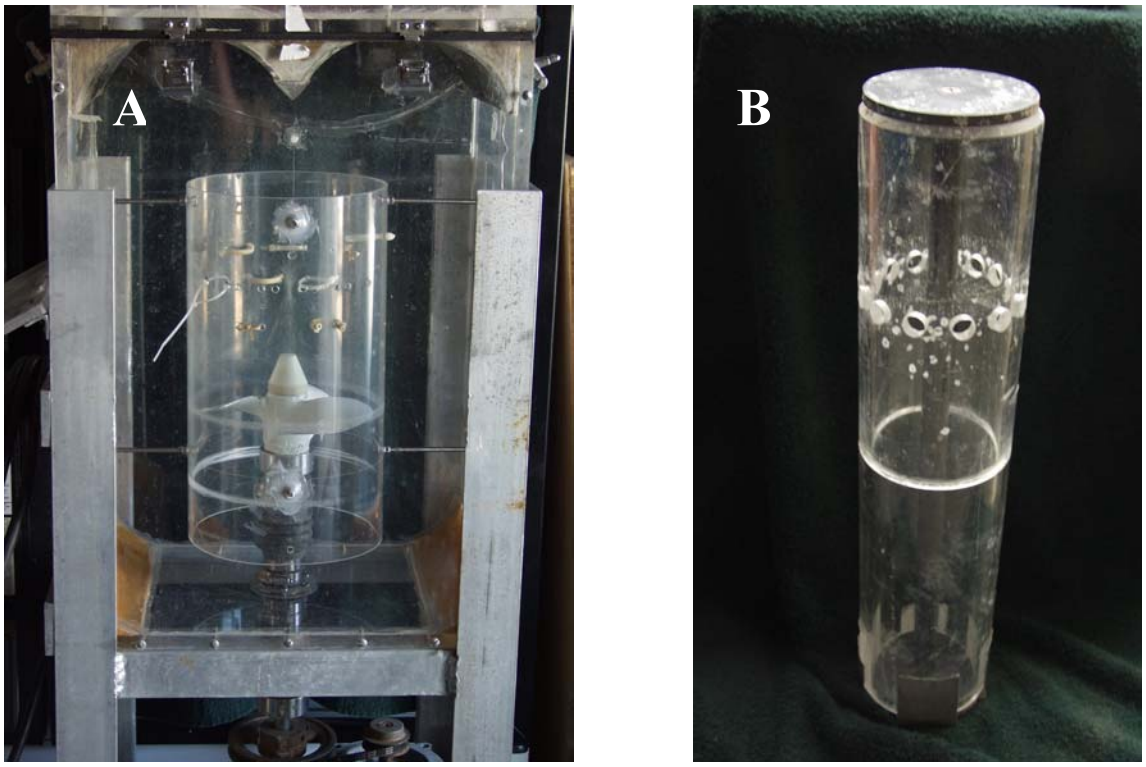


Figure 3. (A) Modified Downing-Beach OBS calibration chamber used to calibrate OBS Sensors. During calibration, sensors are mounted on the inner wall of the inner chamber. (B) Example Sediment Entrainment Device (SED) used to collect suspended sediment for calibration purposes.

2.2 OBS Calibration

A post- deployment calibration of the VIMS' Seapoint OBS sensor (serial number 1075), an auxiliary sensor on the LISST 100, was performed on November 1, 2001. The OBS mounted to the inner wall of the inner chamber of the modified 69-liter Downing-Beach calibration chamber (Figure 3A). Sediment from the bottom Sediment Entrainment Device (SED), sample ID "1B" (see VIMS report CHSD-2002-XX), mounted on the bipod located on the western end of the Mound Crest bipod site (33^o 8.257 N, 78^o 8.1427 W) was used for the calibrations (Example: Figure 3B). The SED deployed by USACE June 29, 2001 and retrieved August 28, 2001, was chosen for the OBS calibration because the deployment bracketed the time period of the profile anchor stations. Sediment in the SED, which had been mounted approximately 150 cm from the bottom, was composed of 5.0, 94.7 and 0.3 percent mud, sand and gravel, respectively. The mud fraction consisted of 72% clay and 28% silt. Rapid Sand Analysis (RSA) results showed a peak sand grain size ranging from 3.25-3.13 phi (105-115 microns).

Table 3. VIMS' Seapoint OBS Sensor 1075 Calibration Data

	Sand		Mixed Sediment	
Concentration (mg/L)	Average (volts)	Stand Deviation (volts)	Average (volts)	Stand Deviation (volts)
0 (w/o stirring)	0.002	0.001	0.002	0.001
0	0.009	0.002	0.010	0.002
20	0.010	0.002	0.020	0.004
40	0.014	0.002	0.029	0.006
60	0.017	0.002	0.039	0.005
80	0.020	0.003	0.048	0.004
100	0.024	0.003	0.057	0.004
200	0.026	0.003	0.101	0.005
300	0.040	0.004	0.147	0.007
400	0.055	0.006	0.191	0.008
500	0.070	0.006	0.237	0.008
600	0.085	0.008	0.280	0.010
700	0.096	0.008	0.323	0.013
800	0.110	0.010	0.371	0.014
900	0.123	0.010	0.412	0.015
1000	0.137	0.011	0.456	0.016

The calibration procedure was performed with two sediment types: the first is a mixed sediment containing both sand and mud together and the second is only sand with the mud and gravel removed by wet sieve methods. The Calibrations done with these two sediment types will be used in Section 2.3 to provide the end user two calibration curves, one for mud (< 63 microns) and the second for sand (63 microns – 2mm), to compensate for the OBS's known sensitivity to grain-size. Addition of the sand to the calibration chamber provided sixteen sand concentrations ranging from 0 to 1000 mg/L (Figure 4 and Table 3). Sixteen mixed sediment concentrations were obtained by adding the mixed sediment solution to the calibration chamber, resulting in a range of 0 to 1000 mg/L (Figure 4 and Table 3). Zero readings were taken for all calibrations first without stirring (0* in Table 3). All the rest of the concentrations were recorded with stirring by the propeller visible in Figure 2.

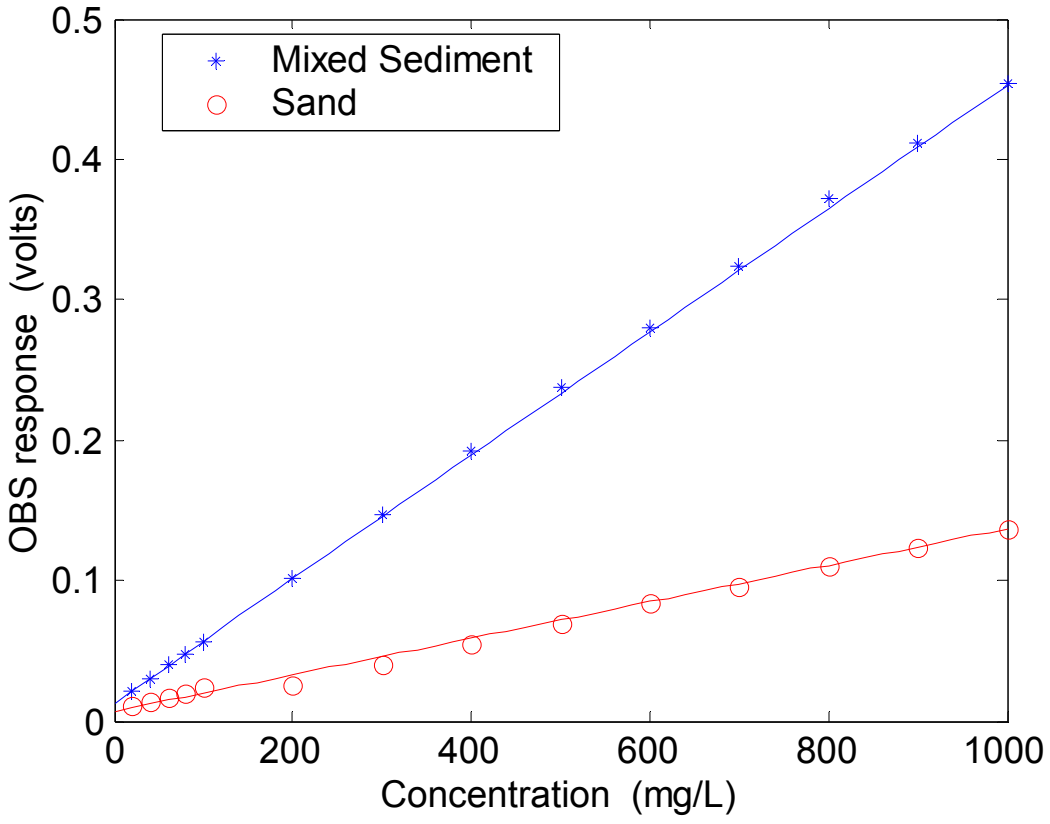


Figure 4. VIMS' Seapoint OBS Sensor 1075 calibration curves.

2.3 Calculation of Mud Calibration Curve

Before the averaged OBS responses (Table 4) that correspond to the pump samples can be converted to suspended sediment concentration the mixed sediment and sand calibration curves must be used to determine the gain and offset for a pure mud calibration curve. The total OBS response (to mixed sediment) is a result of the additive OBS responses to the mud concentration and the sand concentration in suspension by the following formulas:

$$OBS_{mixed} = a_{mixed} + b_{mixed} * Conc \quad \text{(Equation 2.1)}$$

$$a_{mixed} = (f_s * a_s + f_m * a_m) \quad \text{(Equation 2.2)}$$

$$b_{mixed} = (f_s * b_s + f_m * b_m) \quad \text{(Equation 2.3)}$$

Where Conc is the total suspended concentration, $f_s = 0.973$ is the fraction of sand in the mixed concentration, $f_m = 0.05$ is the fraction of mud in the mixed concentration, and b_m and a_m are the gain and offset for a pure mud calibration curve. The OBS response to sand is linear in the range from 0 to 1000 mg/L with a gain of $b_s = (1.44 \pm 0.84)e^{-4}$ and an offset of $a_s = 0.010 \pm 0.044$ (figure 4). The OBS response to the mixed sediment is also linear in the range from 0 to 1000 mg/L with a gain of $b_{mixed} = (4.455 \pm 0.010)\ e^{-4}$ and an offset of $a_{mixed} = 0.01220 \pm 0.00053$ (figure 4).

Rearranging Equation 2.3 the gain of a pure mud calibration can be calculated ($b_m = 0.00618$) because everything else is known. The same can be done for the mud calibration offset (a_m) but for consistency at low concentrations an average of the mixed and sand offsets will be used for all three offsets therefore; $a_{mixed} = a_m = a_s = 0.011$. Figure 5 shows the predicted mud curve using the same concentrations as used for the sand calibrations along with the mud calibration curve. The black star represents the measured OBS response (0.29 volts) of the mud left in suspension after letting the sand in 1000 mg/L mixed sediment settle plotted against the mud concentration in the mixture of 50 mg/L knowing the f_s of the SED sediment to be 0.05. The black star is a validation of

the predicted mud calibration curve. The measured sand calibration curve is included for reference.

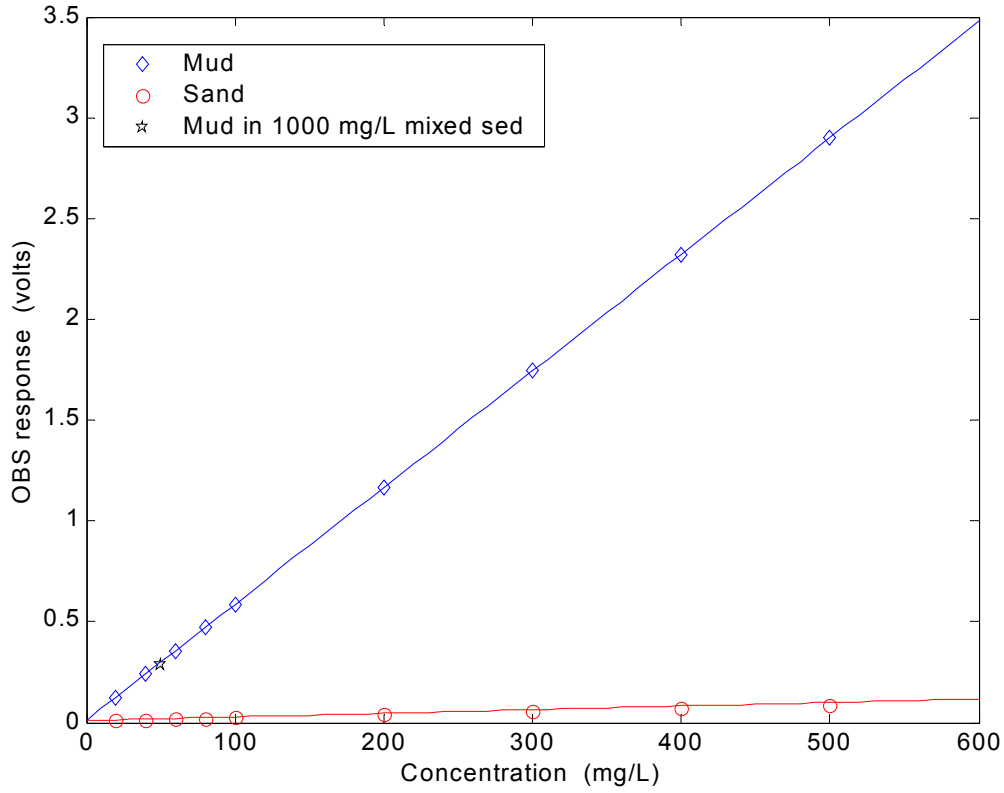


Figure 5. Predicted mud calibration curve and measured sand calibration curve. The black star is the measured mud concentration (50 mg/L) within the mixed sediment of 1000 mg/L concentration plotted vs. the OBS response of the mud portion of this concentration after letting the sand settle out of solution.

2.4 Calculation of OBS Suspended Solids Concentrations

Suspended solids concentrations were calculated from the averaged OBS response, which corresponds with the pumped samples at each station, by two methods. The first method was by using a regression curve between the TSS and the corresponding average OBS response (Figure 6). The River 7/25 data was not used in the development of the coefficients. The best-fit gain was found to be 210 with an offset of –6.5.

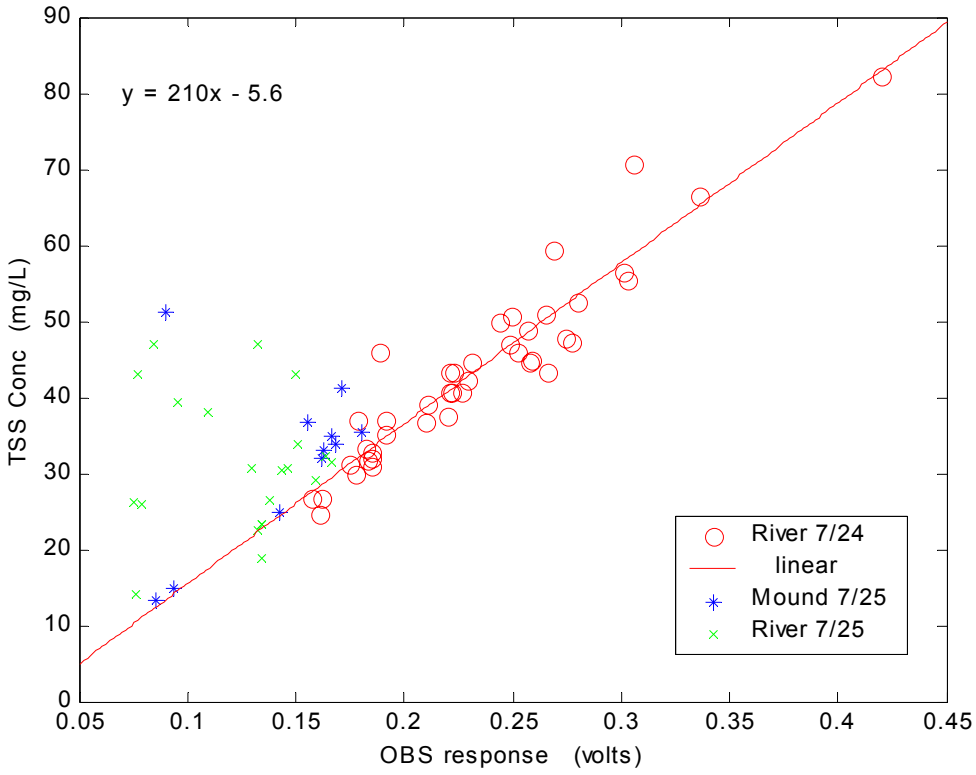


Figure 6. OBS VS. TSS concentration regression curve. River 7/25 data was not used in the calculation of the coefficients.

The second method was to use the sand and mud regression curves using equations 2.1-3. Equation 2.1 was modified to make the OBS response, OBS_{mix}, the independent variable as below:

$$Conc = 1/b_{mix} * OBS_{mix} + a_{mix} /b_{mix} \qquad \text{(Equation 2.4)}$$

The fraction of sand and mud, f_s and f_m respectively, was found using the total mud and sand suspended solids results in Table 4. The percent mud, f_m, calculated is shown in Table 5. When there was not suspended solids taken the average percent mud, $f_m = 0.96$, was used.

2.5 Conversion of LISST100 Volume Concentrations to Weight Concentrations

The volume concentrations for the 32 size class bins (5-500 microns) recorded at a rate of approximately 1 record per second by the LISST was added together for a total volume concentration for each record. The mean and standard deviations of the records corresponding to each sample depth was then calculated. Plotting the TSS concentrations against the corresponding average total volume produced a best-fit regression curve with gain and offset coefficients of 0.28 and –35, respectively (Figure 7).

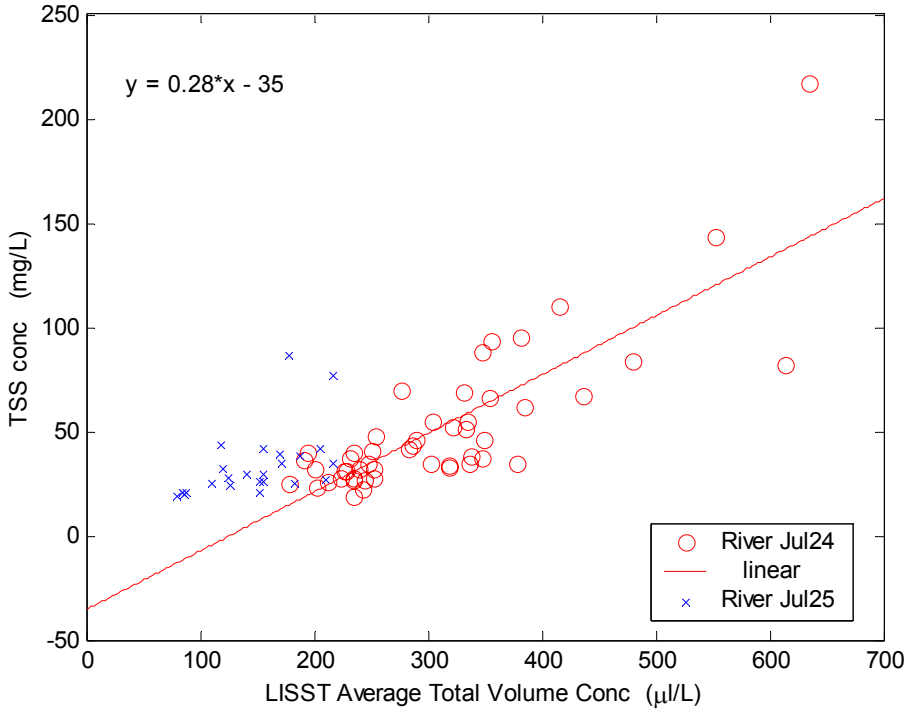


Figure 7. LISST 100 / TSS regression curve used to convert the LISST 100 total volume concentrations to weight concentrations.

3. RESULTS

3.1 Profiler Deployment

Table 1 and Figure 1 document the configuration of the instruments on the profiler deployed during this study.

Table 2 shows the unique station number for each station and the GPS location and name of the site at which that station was taken. Sample names A, B, etc. correspond to the mean and standard deviation of CTD pressure depths for the pump samples (example: Figure 2). The pump start and stop times are the exact time the pump samples were taken. The CTD and LISST start and stop times are corrected for the delay it takes for the water to reach the surface through the pump hose. Figures 8.1- 8.20 display the CTD temperature and salinity downward profiles (Figures A and B, respectively).

3.2 OBS Calibration

Table 3 lists the average and standard deviations of the OBS responses for the sand and mixed sediment calibrations. Figure 4 shows the OBS calibration curves for both the sand and mixed sediment calibration. Figure 5 shows the predicted calibration curve and measured sand calibration curve. The black star is the measured mud concentration (50 mg/L) within the mixed sediment of 1000 mg/L concentration plotted versus the OBS response. The measurement of the mud portion of this concentration was recorded after letting the sand settle out of solution. The OBS responses to both the sand and predicted mud are linear in the range 0-1000 mg/L. The sand and mud regression curve gains are $(1.44 \pm 0.84)\ e^{-4}$ and $6.18\ e^{-4}$, respectively. The offset used for both calibration curves is 0.011 as discussed in Section 2.3.

3.3 Suspended Solids Concentrations

3.3.1 Pump Sample

Table 4 shows the suspended solids concentration results for the pump samples. The Total Solids (TSS) is found by adding the total sand concentrations together. The total mud and sand concentration include both the fixed and volatile fractions for each.

3.3.2 OBS

Table 5 shows the mean and standard deviations of the raw OBS results for each sample depth as well as the calculated concentrations by both the TSS/OBS regression and the mud and sand calibration curves. Figures 9 and 10 show the concentration results of these methods respectively plotted against the corresponding TSS result. The solid lines show the expected 1:1 relationship.

3.3.3 LISST 100

Table 6 shows the mean and standard deviation of the total volume concentrations recorded by the LISST 100 at each sample depth and the corresponding weight concentrations calculated using the LISST 100/TSS regression curve (Figure 7). Figures 11.1-11.14 show the mean and standard deviation distributions for each sample depth recorded by the LISST 100. The D50 grain size is the bin-size that corresponds to 50 percent of the cumulative volume concentration of the mean volume distribution at each sample depth.

Table 4. Suspended Solids Concentration

Station	Sample	TOTAL SOLIDS mg/L	MUD (0.7-60um) Total mg/L	MUD (0.7-60um) Fixed mg/L	MUD (0.7-60um) Volitile mg/L	SAND (>60 um) Total mg/L	SAND (>60 um) Fixed mg/L	SAND (>60 um) Volitile mg/L
S636	A	70.60	67.10	55.70	11.40	3.50	2.45	1.05
	B	59.34	55.20	45.80	9.40	4.14	2.07	2.07
	C	44.70	43.80	36.20	7.60	0.90	0.6	0.30
	D	39.10	38.20	31.40	6.80	0.90	0.50	0.40
	E	30.00	28.80	22.60	6.20	1.20	0.15	1.05
	F	31.20	29.80	24.40	5.40	1.40	0.84	0.56
	G	24.60	24.20	19.40	4.80	0.40		
	H	26.62	25.60	20.60	5.00	1.02	0.68	0.34
	I	26.73	25.00	19.40	5.60	1.73	0.38	1.35
	J	36.95	35.40	28.60	6.80	1.55	1.14	0.41
	K	40.70	38.70	31.10	7.60	2.00	0.84	1.16
	L	52.38	49.60	40.70	8.90	2.78	2.12	0.66
S367	A	82.30	67.00	54.60	12.40	15.30	11.41	3.89
	B	66.40	59.00	48.20	10.80	7.40	5.78	1.62
	C	56.40	50.20	40.80	9.40	6.20	4.58	1.62
S638	A	55.27	45.00	36.70	8.30	10.27	8.95	1.32
	B	47.80	41.80	34.80	7.00	6.00	4.97	1.03
	C	50.80	46.60	39.00	7.60	4.20	2.42	1.78
	D	47.27	41.60	34.60	7.00	5.67	4.77	0.90
	E	44.79	43.40	36.00	7.40	1.39	0.92	0.47
	F	48.71	42.10	34.80	7.30	6.61	5.23	1.38
	G	46.95	40.50	33.70	6.80	6.45	4.89	1.56
	H	50.68	44.80	36.80	8.00	5.88	4.34	1.54
	I	45.93	41.20	33.80	7.40	4.73	3.11	1.62
S639	A	43.20	37.20	31.00	6.20	6.00	3.87	2.13
	B	49.80	43.80	36.20	7.60	6.00	4.67	1.33

Table 4. Suspended Solids Concentration

Station	Sample	TOTAL SOLIDS mg/L	MUD (0.7-60um) Total mg/L	MUD (0.7-60um) Fixed mg/L	MUD (0.7-60um) Volitile mg/L	SAND (>60 um) Total mg/L	SAND (>60 um) Fixed mg/L	SAND (>60 um) Volitile mg/L
	C	44.50	38.40	32.00	6.40	6.10	3.94	2.16
	D	43.30	37.40	30.60	6.80	5.90	4.15	1.75
	E	43.30	39.40	32.60	6.80	3.90	1.53	2.37
	F	40.60	36.60	30.00	6.60	4.00	1.45	2.55
	G	40.59	37.20	30.60	6.60	3.39	2.24	1.15
	H	37.40	35.00	28.60	6.40	2.40	1.49	0.91
	I	42.27	39.60	32.80	6.80	2.67	2.00	0.67
S640	A	36.70	35.00	29.20	5.80	1.70	0.73	0.97
	B	35.25	30.00	24.40	5.60	5.25	4.42	0.83
	C	36.92	31.30	25.50	5.80	5.62	3.80	1.82
	D	30.93	29.10	23.20	5.90	1.83	1.62	0.21
	E	32.73	31.80	26.00	5.80	0.93	0.73	0.20
	F	33.27	32.20	26.20	6.00	1.07	0.77	0.30
	G	31.87	30.40	24.40	6.00	1.47	1.07	0.40
	H	45.80	44.00	36.60	7.40	1.80	1.61	0.19
	I	31.81	30.60	24.40	6.20	1.21	0.76	0.45
S641	A	35.30	34.50	28.80	5.70	0.80	0.62	0.18
	B	41.30	40.40	33.80	6.60	0.90	0.90	0.00
	C	34.90	34.50	28.20	6.30	0.40		
	D	33.00	32.60	26.00	6.60	0.40		
	E	33.70	32.60	27.00	5.60	1.10	0.55	0.55
	F	31.90	31.00	25.20	5.80	0.90	0.60	0.30
	G	36.80	36.80	30.40	6.40	<0.4		
	H	25.00	24.40	19.40	5.00	0.60	0.56	0.04
S647	A	9.12	7.90	6.30	1.60	1.22	1.22	<0.4
	B	5.11	4.40	3.40	1.00	0.71	0.53	0.18
S648	A	19.11	18.40	15.10	3.30	0.71	0.71	<0.4

Table 4. Suspended Solids Concentration

Station	Sample	TOTAL SOLIDS mg/L	MUD (0.7-60um) Total mg/L	MUD (0.7-60um) Fixed mg/L	MUD (0.7-60um) Volitile mg/L	SAND (>60 um) Total mg/L	SAND (>60 um) Fixed mg/L	SAND (>60 um) Volitile mg/L
	B	19.30	19.30	15.50	3.80	<0.4		
	C	18.40	18.40	15.10	3.30	<0.4		
	D	21.98	21.40	17.50	3.90	0.58	0.58	<0.4
S649	A	17.87	17.40	14.10	3.30	0.47		
	B	15.75	15.20	12.00	3.20	0.55	0.44	0.11
	C	16.60	16.60	13.40	3.20	<0.4		
	D	19.60	19.60	15.80	3.80	<0.4		
S650	A	19.30	19.30	15.70	3.60	<0.4		
	B	15.90	15.90	12.00	3.90	<0.4		
	C	22.60	22.60	18.20	4.40	<0.4		
	D	12.90	12.90	9.70	3.20	<0.4		
S651	A	17.70	17.70	14.00	3.70	<0.4		
	B	13.60	13.60	10.90	2.70	<0.4		
	C	17.60	17.60	13.80	3.80	<0.4		
	D	16.60	16.60	12.60	4.00	<0.4		
S652	A	43.15	42.50	34.00	8.50	0.65		
	B	29.19	28.50	22.80	5.70	0.69	0.60	0.09
	C	27.30	27.30	22.00	5.30	<0.4		
	D	24.85	24.40	19.30	5.10	0.45	0.45	<0.4
	E	22.30	22.30	17.60	4.70	<0.4		
	F	18.00	18.00	13.90	4.10	<0.4		
	G	18.10	18.10	14.10	4.00	<0.4		
S653	A	23.70	23.70	18.60	5.10	<0.4		
	B	20.10	20.10	16.10	4.00	<0.4		
	C	22.70	22.70	18.10	4.60	<0.4		
	D	15.40	15.40	12.00	3.40	<0.4		
	E	13.40	13.40	10.10	3.30	<0.4		

Table 4. Suspended Solids Concentration

Station	Sample	TOTAL SOLIDS mg/L	MUD (0.7-60um) Total mg/L	MUD (0.7-60um) Fixed mg/L	MUD (0.7-60um) Volitile mg/L	SAND (>60 um) Total mg/L	SAND (>60 um) Fixed mg/L	SAND (>60 um) Volitile mg/L
	F	14.90	14.90	11.50	3.40	<0.4		
	G	51.30	51.30	43.40	7.90	<0.4		
S654	A	38.00	38.00	31.40	6.60	<0.4		
	B	39.30	39.30	31.90	7.40	<0.4		
	C	47.00	47.00	39.80	7.20	<0.4		
	D	42.96	42.40	36.00	6.40	0.56	0.56	<0.4
	E	14.20	14.20	11.20	3.00	<0.4		
S654	F	26.00	26.00	20.80	5.20	<0.4		
	G	26.20	26.20	20.60	5.60	<0.4		
S655	A	30.60	26.20	20.70	5.50	4.40	2.09	2.31
	B	22.50	21.00	16.40	4.60	1.50	1.00	0.50
	C	23.30	21.60	16.80	4.80	1.70	0.43	1.22
	D	18.70	17.80	11.60	6.20	0.90	0.82	0.08
	E	23.30	22.40	17.20	5.20	0.90	0.90	<0.4
	F	33.80	32.40	26.00	6.40	1.40	1.09	0.31
	G	30.30	28.50	22.30	6.20	1.80	1.05	0.75
	H	29.00	27.80	21.60	6.20	1.20	1.04	0.16
	I	31.50	30.10	24.10	6.00	1.40	0.78	0.62
	J	32.20	28.30	22.40	5.90	3.90	3.64	0.26
S656	A	47.10	43.80	35.90	7.90	3.30	2.12	1.28
	B	30.60	27.40	22.40	5.00	3.20	2.63	0.57
	C	26.32	23.20	18.60	4.60	3.12	2.77	0.35
	D	42.93	39.60	32.80	6.80	3.33	2.84	0.49

Table 5. OBS Raw data and Calculated Concentrations

Date	Station	Sample	Raw OBS Mean volts	Raw OBS StdDev volts	OBS Conc Mean mg/L (calc'd using TSS)	OBS Conc StdDev mg/L (calc'd using TSS)	f_m from Solids	OBS Conc Mean mg/L (calc'd using SED sample)	OBS Conc StdDev mg/L (calc'd using SED sample)	TSS conc mg/L
24-Jul-01	S636	A	0.3060	0.0193	58.66	4.05	0.96	50.50	3.29	70.60
		B	0.2692	0.0186	50.93	3.91	0.96	44.22	3.17	59.34
		C	0.2313	0.0102	42.97	2.14	0.98	37.00	1.71	44.70
		D	0.2108	0.0163	38.67	3.42	0.98	33.57	2.73	39.10
		E	0.1775	0.0104	31.68	2.18	0.99	27.73	1.72	30.00
		F	0.1748	0.0119	31.11	2.50	0.97	27.83	2.01	31.20
		G	0.1615	0.0075	28.32	1.58	1.00	24.84	1.23	24.60
		H	0.1578	0.0068	27.54	1.43	0.97	24.96	1.15	26.62
		I	0.1624	0.0125	28.50	2.63	0.98	25.48	2.09	26.73
		J	0.1783	0.0133	31.84	2.79	0.96	28.71	2.27	36.95
		K	0.2265	0.0187	41.97	3.93	0.97	36.56	3.16	40.70
		L	0.2798	0.0259	53.16	5.44	0.95	46.50	4.46	52.38
24-Jul-01	S637	A	0.4204	0.0346	82.68	7.27	0.83	80.68	6.80	82.30
		B	0.3358	0.0308	64.92	6.47	0.89	59.84	5.66	66.40
		C	0.3016	0.0190	57.74	3.99	0.90	52.98	3.45	56.40
24-Jul-01	S638	A	0.3029	0.0109	58.01	2.29	0.80	59.68	2.22	55.27
		B	0.2740	0.0141	51.94	2.96	0.88	49.03	2.62	47.80
		C	0.2652	0.0105	50.09	2.21	0.94	44.44	1.83	50.80
		D	0.2774	0.0119	52.65	2.50	0.88	49.66	2.21	47.27
		E	0.2583	0.0092	48.64	1.93	0.98	41.52	1.54	44.79
		F	0.2566	0.0081	48.29	1.70	0.87	46.31	1.52	48.71
		G	0.2486	0.0134	46.61	2.81	0.87	44.81	2.52	46.95
		H	0.2499	0.0138	46.88	2.90	0.89	44.07	2.53	50.68
		I	0.2520	0.0121	47.32	2.54	0.92	43.04	2.15	45.93
24-Jul-01	S639	A	0.2664	0.0083	50.34	1.74	0.89	47.10	1.52	43.20
		B	0.2438	0.0115	45.60	2.42	0.89	42.95	2.11	49.80
		C	0.2575	0.01	48.48	2.10	0.89	45.46	1.84	44.50
		D	0.223	0.0119	41.23	2.50	0.88	39.56	2.21	43.30
		E	0.221	0.0082	40.81	1.72	0.96	36.00	1.40	43.30
		F	0.222	0.0096	41.02	2.02	0.95	36.54	1.65	40.60

Table 5. OBS Raw data and Calculated Concentrations

Date	Station	Sample	Raw OBS Mean volts	Raw OBS StdDev volts	OBS Conc Mean mg/L (calc'd using TSS)	OBS Conc StdDev mg/L (calc'd using TSS)	f_m from Solids	OBS Conc Mean mg/L (calc'd using SED sample)	OBS Conc StdDev mg/L (calc'd using SED sample)	TSS conc mg/L
24-Jul-01	S639	G	0.2214	0.0097	40.89	2.04	0.93	37.20	1.71	40.59
		H	0.2196	0.0095	40.52	2.00	0.95	36.13	1.64	37.40
		I	0.2297	0.0081	42.64	1.70	0.94	38.26	1.41	42.27
24-Jul-01	S640	A	0.2102	0.0184	38.54	3.86	0.98	33.47	3.08	36.70
		B	0.1912	0.0042	34.55	0.88	0.85	34.81	0.81	35.25
		C	0.1915	0.0057	34.62	1.20	0.87	34.09	1.07	36.92
		D	0.1846	0.0063	33.17	1.32	0.93	30.73	1.11	30.93
		E	0.1849	0.0059	33.23	1.24	0.97	29.54	1.00	32.73
		F	0.1821	0.0063	32.64	1.32	0.97	29.07	1.06	33.27
		G	0.1846	0.0063	33.17	1.32	0.96	29.79	1.07	31.87
		H	0.1890	0.0080	34.09	1.68	0.96	30.54	1.36	45.80
		I	0.1835	0.0100	32.94	2.10	0.97	29.30	1.69	31.81
24-Jul-01	S641	A	0.1801	0.0074	32.22	1.55	0.98	28.44	1.24	35.30
		B	0.1708	0.0051	30.27	1.07	0.97	27.16	0.86	41.30
		C	0.1668	0.0056	29.43	1.18	1.00	25.70	0.92	34.90
		D	0.1627	0.0079	28.57	1.66	1.00	25.03	1.30	33.00
		E	0.1682	0.0079	29.72	1.66	0.98	26.45	1.32	33.70
		F	0.1620	0.0091	28.42	1.91	0.98	25.42	1.52	31.90
		G	0.1551	0.0074	26.97	1.55	1.00	23.79	1.21	36.80
		H	0.1422	0.0081	24.26	1.70	0.97	22.33	1.37	25.00
25-Jul-01	S643	A	0.0699	0.0095	9.08	2.00	0.96	10.22	1.62	NO DATA
		B	0.0412	0.0022	3.05	0.46	0.96	5.32	0.38	NO DATA
		C	0.0417	0.0032	3.16	0.67	0.96	5.41	0.55	NO DATA
		D	0.0392	0.0026	2.63	0.55	0.96	4.98	0.44	NO DATA
		E	0.0381	0.0034	2.40	0.71	0.96	4.80	0.58	NO DATA
		F	0.0362	0.0025	2.00	0.53	0.96	4.47	0.43	NO DATA
25-Jul-01	S644	A	0.0474	0.0034	4.35	0.71	0.96	6.38	0.58	NO DATA
		B	0.0434	0.0035	3.51	0.74	0.96	5.70	0.60	NO DATA
		C	0.0384	0.0028	2.46	0.59	0.96	4.85	0.48	NO DATA
		D	0.0360	0.0034	1.96	0.71	0.96	4.44	0.58	NO DATA

Table 5. OBS Raw data and Calculated Concentrations

Date	Station	Sample	Raw OBS Mean volts	Raw OBS StdDev volts	OBS Conc Mean mg/L (calc'd using TSS)	OBS Conc StdDev mg/L (calc'd using TSS)	f_m from Solids	OBS Conc Mean mg/L (calc'd using SED sample)	OBS Conc StdDev mg/L (calc'd using SED sample)	TSS conc mg/L
		E	0.0348	0.0023	1.71	0.48	0.96	4.23	0.39	NO DATA
		F	0.0345	0.0023	1.65	0.48	0.96	4.18	0.39	NO DATA
25-Jul-01	S645	A	0.0538	0.0042	5.70	0.88	0.96	7.47	0.72	NO DATA
		B	0.0468	0.0029	4.23	0.61	0.96	6.28	0.49	NO DATA
25-Jul-01		C	0.0463	0.0027	4.12	0.57	0.96	6.19	0.46	NO DATA
		D	0.038	0.0034	2.38	0.71	0.96	4.78	0.58	NO DATA
		E	0.0349	0.0028	1.73	0.59	0.96	4.25	0.48	NO DATA
		F	0.0337	0.0026	1.48	0.55	0.96	4.05	0.44	NO DATA
25-Jul-01	S646	A	0.0670	0.0046	8.47	0.97	0.96	9.73	0.78	NO DATA
		B	0.0569	0.0041	6.35	0.86	0.96	8.00	0.70	NO DATA
		C	0.0496	0.0041	4.82	0.86	0.96	6.76	0.70	NO DATA
		D	0.0434	0.0044	3.51	0.92	0.96	5.70	0.75	NO DATA
		E	0.0355	0.0033	1.86	0.69	0.96	4.35	0.56	NO DATA
		F	0.0332	0.0032	1.37	0.67	0.96	3.96	0.55	NO DATA
25-Jul-01	S647	A	NO DATA	Software conflict with LISST25			0.96			NO DATA
		B	NO DATA	Software conflict with LISST25			0.96			NO DATA
		C	NO DATA	Software conflict with LISST25			0.96			NO DATA
		D	NO DATA	Software conflict with LISST25			0.96			NO DATA
		E	NO DATA	Software conflict with LISST25			0.84			9.12
		F	NO DATA	Software conflict with LISST25			0.87			5.11
25-Jul-01	S648	A	NO DATA	Software conflict with LISST25			0.96			19.11
		B	NO DATA	Software conflict with LISST25			1.00			19.30
		C	NO DATA	Software conflict with LISST25			1.00			18.40
		D	NO DATA	Software conflict with LISST25			0.97			21.98
25-Jul-01	S649	A	NO DATA	Software conflict with LISST25			1.00			17.87
		B	NO DATA	Software conflict with LISST25			0.96			15.75
		C	NO DATA	Software conflict with LISST25			1.00			16.60
		D	NO DATA	Software conflict with LISST25			1.00			19.60
25-Jul-01	S650	A	NO DATA	Software conflict with LISST25			1.00			19.30
		B	NO DATA	Software conflict with LISST25			1.00			15.90

Table 5. OBS Raw data and Calculated Concentrations

Date	Station	Sample	Raw OBS Mean volts	Raw OBS StdDev volts	OBS Conc Mean mg/L (calc'd using TSS)	OBS Conc StdDev mg/L (calc'd using TSS)	f_m from Solids	OBS Conc Mean mg/L (calc'd using SED sample)	OBS Conc StdDev mg/L (calc'd using SED sample)	TSS conc mg/L
		C	NO DATA	Software conflict with LISST25			1.00			22.60
		D	NO DATA	Software conflict with LISST25			1.00			12.90
25-Jul-01	S651	A	NO DATA	Software conflict with LISST25			1.00			17.70
		B	NO DATA	Software conflict with LISST25			1.00			13.60
		C	NO DATA	Software conflict with LISST25			1.00			17.60
		D	NO DATA	Software conflict with LISST25			1.00			16.60
25-Jul-01	S652	A	NO DATA	Software conflict with LISST25			1.00			43.15
		B	NO DATA	Software conflict with LISST25			0.97			29.19
		C	NO DATA	Software conflict with LISST25			1.00			27.30
		D	NO DATA	Software conflict with LISST25			0.98			24.85
		E	NO DATA	Software conflict with LISST25			1.00			22.30
		F	NO DATA	Software conflict with LISST25			1.00			18.00
		G	NO DATA	Software conflict with LISST25			1.00			18.10
25-Jul-01	S653	A	NO DATA	Software conflict with LISST25			1.00			23.70
		B	NO DATA	Software conflict with LISST25			1.00			20.10
		C	NO DATA	Software conflict with LISST25			1.00			22.70
		D	NO DATA	Software conflict with LISST25			1.00			15.40
		E	0.0852	0.0079	12.29	1.66	1.00	12.33	1.30	13.40
		F	0.0936	0.0061	14.06	1.28	1.00	13.70	1.00	14.90
		G	0.0900	0.0082	13.30	1.72	1.00	13.11	1.34	51.30
25-Jul-01	S654	A	0.1095	0.0082	17.40	1.72	1.00	16.31	1.34	38.00
		B	0.0955	0.0062	14.46	1.30	1.00	14.02	1.02	39.30
		C	0.0847	0.0065	12.19	1.37	1.00	12.25	1.07	47.00
		D	0.0768	0.0053	10.53	1.11	0.98	11.17	0.89	42.96
		E	0.0767	0.0064	10.51	1.34	1.00	10.93	1.05	14.20
		F	0.0789	0.0063	10.97	1.32	1.00	11.30	1.03	26.00
		G	0.0751	0.0048	10.17	1.01	1.00	10.67	0.79	26.20
25-Jul-01	S655	A	0.1464	0.0113	25.14	2.37	0.91	24.52	2.03	30.60
		B	0.1327	0.0098	22.27	2.06	0.94	21.37	1.71	22.50
		C	0.1347	0.0106	22.69	2.23	0.98	20.85	1.77	23.30

Table 5. OBS Raw data and Calculated Concentrations

Date	Station	Sample	Raw OBS Mean volts	Raw OBS StdDev volts	OBS Conc Mean mg/L (calc'd using TSS)	OBS Conc StdDev mg/L (calc'd using TSS)	f_m from Solids	OBS Conc Mean mg/L (calc'd using SED sample)	OBS Conc StdDev mg/L (calc'd using SED sample)	TSS conc mg/L
		D	0.1345	0.0107	22.65	2.25	0.93	21.91	1.88	18.70
		E	0.1341	0.0147	22.56	3.09	0.95	21.39	2.53	23.30
		F	0.1510	0.0147	26.11	3.09	0.96	24.06	2.51	33.80
		G	0.1438	0.0171	24.60	3.59	0.96	22.83	2.92	30.30
		H	0.1594	0.0193	27.87	4.05	0.95	25.75	3.33	29.00
		I	0.1665	0.0152	29.37	3.19	0.97	26.43	2.57	31.50
		J	0.1639	0.0142	28.82	2.98	0.86	29.23	2.70	32.20
25-Jul-01	S656	A	0.1328	0.0081	22.29	1.70	0.94	21.39	1.41	47.10
		B	0.1301	0.0059	21.72	1.24	0.89	22.06	1.08	30.60
		C	0.1378	0.0089	23.34	1.87	0.87	24.00	1.67	26.32
		D	0.1503	0.0106	25.96	2.23	0.92	24.95	1.88	42.93

Table 6. Raw and Calculated Concenration LISST 100 data

				Raw LISST100 Total Volume Conc			LISST100 Conc	
Station	Date	Location	Sample	Mean ul/L	StdDev ul/L	D50 microns	Mean mg/L	Std Dev mg/L
S636	24-Jul-01	River2	A	634	217	113	142.52	60.76
			B	553	143	115	119.84	40.04
			C	415	110	103	81.2	30.8
			D	348	88	97	62.44	24.64
			E	276	70	109	42.28	19.6
			F	254	48	99	36.12	13.44
			G	200	32	88	21	8.96
			H	191	36	86	18.48	10.08
			I	194	40	79	19.32	11.2
			J	232	37	77	29.96	10.36
			K	333	51	73	58.24	14.28
			L	480	84	71	99.4	23.52
S637	24-Jul-01	River2	A	613	82	58	136.64	22.96
			B	436	67	57	87.08	18.76
			C	384	62	58	72.52	17.36
S638	24-Jul-01	River2	A	379	35	60	71.12	9.8
			B	338	38	56	59.64	10.64
			C	334	55	58	58.52	15.4
			D	347	37	58	62.16	10.36
			E	319	34	56	54.32	9.52
			F	349	46	62	62.72	12.88
			G	321	52	59	54.88	14.56
			H	354	66	65	64.12	18.48
			I	381	95	71	71.68	26.6
S639	24-Jul-01	River2	A	337	35	62	59.36	9.8
			B	302	35	58	49.56	9.8

Table 6. Raw and Calculated Concenration LISST 100 data

				Raw LISST100 Total Volume Conc			LISST100 Conc	
Station	Date	Location	Sample	Mean ul/L	StdDev ul/L	D50 microns	Mean mg/L	Std Dev mg/L
S639	24-Jul-01	River2	C	319	33	60	54.32	9.24
			D	283	42	61	44.24	11.76
			E	290	46	63	46.2	12.88
			F	287	43	62	45.36	12.04
			G	331	69	72	57.68	19.32
			H	304	55	66	50.12	15.4
S639	24-Jul-01	River2	I	355	93	74	64.4	26.04
S640	24-Jul-01	River2	A	252	28	65	35.56	7.84
			B	235	19	63	30.8	5.32
			C	243	22	66	33.04	6.16
			D	239	32	67	31.92	8.96
			E	235	27	64	30.8	7.56
			F	234	40	65	30.52	11.2
			G	250	41	69	35	11.48
			H	252	32	68	35.56	8.96
			I	247	35	69	34.16	9.8
S641	24-Jul-01	Mound	A	244	27	73	33.32	7.56
			B	235	28	73	30.8	7.84
			C	226	31	72	28.28	8.68
			D	224	28	73	27.72	7.84
			E	228	31	74	28.84	8.68
			F	212	26	71	24.36	7.28
			G	202	23	72	21.56	6.44
			H	178	25	71	14.84	7
S643	25-Jul-01	Mound	A	66	22	80	-16.52	6.16
			B	33	10	92	-25.76	2.8

Table 6. Raw and Calculated Concenration LISST 100 data

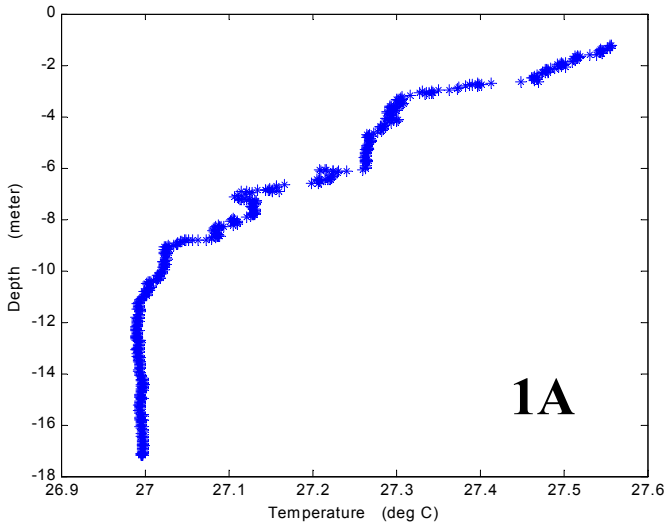
Station	Date	Location	Sample	Raw LISST100 Total Volume Conc Mean ul/L	StdDev ul/L	D50 microns	LISST100 Conc Mean mg/L	Std Dev mg/L
S643	25-Jul-01	Mound	C	30	10	94	-26.6	2.8
			D	30	12	108	-26.6	3.36
			E	25	10	100	-28	2.8
			F	25	8	113	-28	2.24
S644	25-Jul-01	Mound	A	35	10	82	-25.2	2.8
			B	34	12	92	-25.48	3.36
			C	25	9	92	-28	2.52
			D	23	10	99	-28.56	2.8
			E	23	9	111	-28.56	2.52
			F	20	9	110	-29.4	2.52
S645	25-Jul-01	Mound	A	48	16	85	-21.56	4.48
			B	39	13	88	-24.08	3.64
S645	25-Jul-01	Mound	C	38	11	91	-24.36	3.08
			D	27	9	104	-27.44	2.52
			E	22	9	115	-28.84	2.52
			F	23	11	131	-28.56	3.08
S646	25-Jul-01	Mound	A	73	19	93	-14.56	5.32
			B	54	19	86	-19.88	5.32
			C	42	14	101	-23.24	3.92
			D	29	10	95	-26.88	2.8
			E	20	9	92	-29.4	2.52
			F	18	10	103	-29.96	2.8
S647	25-Jul-01	Mound	A	NO DATA	NO DATA	NO DATA		
			B	NO DATA	NO DATA	NO DATA		
			C	NO DATA	NO DATA	NO DATA		
			D	NO DATA	NO DATA	NO DATA		

Table 6. Raw and Calculated Concenration LISST 100 data

				Raw LISST100			LISST100 Conc	
				Total Volume Conc				
Station	Date	Location	Sample	Mean ul/L	StdDev ul/L	D50 microns	Mean mg/L	Std Dev mg/L
S647	25-Jul-01	Mound	E	NO DATA	NO DATA	NO DATA		
			F	NO DATA	NO DATA	NO DATA		
S648	25-Jul-01	Bald Head	A	NO DATA	NO DATA	NO DATA		
			B	NO DATA	NO DATA	NO DATA		
			C	NO DATA	NO DATA	NO DATA		
			D	NO DATA	NO DATA	NO DATA		
S649	25-Jul-01	Bald Head	A	NO DATA	NO DATA	NO DATA		
			B	NO DATA	NO DATA	NO DATA		
			C	NO DATA	NO DATA	NO DATA		
			D	NO DATA	NO DATA	NO DATA		
S650	25-Jul-01	Bald Head	A	NO DATA	NO DATA	NO DATA		
			B	NO DATA	NO DATA	NO DATA		
			C	NO DATA	NO DATA	NO DATA		
			D	NO DATA	NO DATA	NO DATA		
S651	25-Jul-01	Bald Head	A	NO DATA	NO DATA	NO DATA		
			B	NO DATA	NO DATA	NO DATA		
			C	NO DATA	NO DATA	NO DATA		
			D	NO DATA	NO DATA	NO DATA		
S652	25-Jul-01	River2	A	NO DATA	NO DATA	NO DATA		
			B	NO DATA	NO DATA	NO DATA		
			C	NO DATA	NO DATA	NO DATA		
			D	NO DATA	NO DATA	NO DATA		
			E	NO DATA	NO DATA	NO DATA		
			F	NO DATA	NO DATA	NO DATA		
			G	NO DATA	NO DATA	NO DATA		
S653	25-Jul-01	River2	A	NO DATA	NO DATA	NO DATA		

Table 6. Raw and Calculated Concenration LISST 100 data

				Raw LISST100 Total Volume Conc			LISST100 Conc	
Station	Date	Location	Sample	Mean ul/L	StdDev ul/L	D50 microns	Mean mg/L	Std Dev mg/L
S653	25-Jul-01	River2	B	NO DATA	NO DATA	NO DATA		
			C	NO DATA	NO DATA	NO DATA		
			D	NO DATA	NO DATA	NO DATA		
			E	119	43	125	-1.68	12.04
			F	125	28	109	0	7.84
			G	120	32	123	-1.4	8.96
S654	25-Jul-01	River2	A	141	29	98	4.48	8.12
			B	126	24	120	0.28	6.72
			C	110	25	127	-4.2	7
			D	87	20	107	-10.64	5.6
			E	84	21	111	-11.48	5.88
			F	88	21	112	-10.36	5.88
			G	80	19	111	-12.6	5.32
S655	25-Jul-01	River2	A	183	25	74	16.24	7
			B	156	26	70	8.68	7.28
			C	152	21	69	7.56	5.88
			D	156	42	72	8.68	11.76
			E	152	26	70	7.56	7.28
			F	188	38	72	17.64	10.64
			G	172	35	69	13.16	9.8
			H	205	42	71	22.4	11.76
			I	217	35	71	25.76	9.8
			J	211	27	69	24.08	7.56
S656	25-Jul-01	River2	A	179	86	84	15.12	24.08
			B	156	29	72	8.68	8.12
			C	170	39	71	12.6	10.92
			D	217	77	79	25.76	21.56



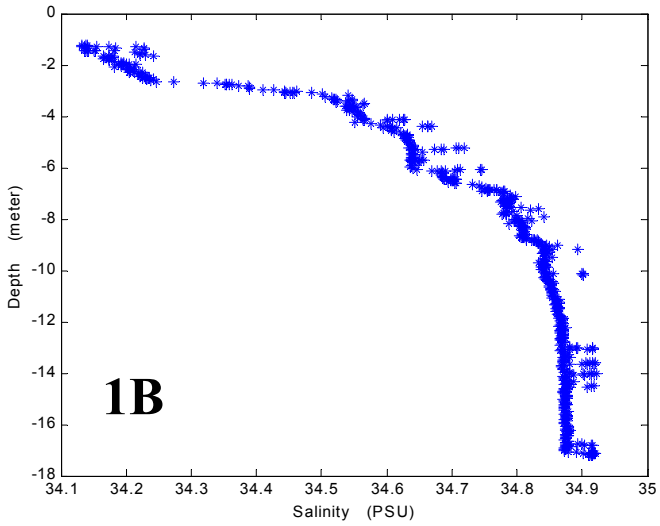
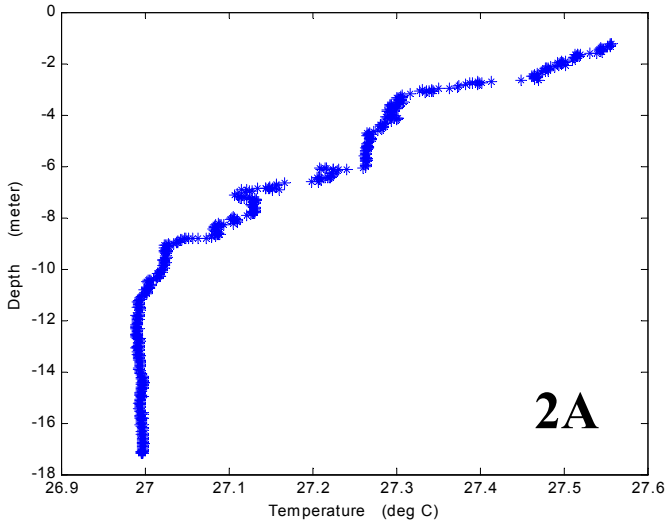


Figure 8.1 Station s636 downward CTD profiles



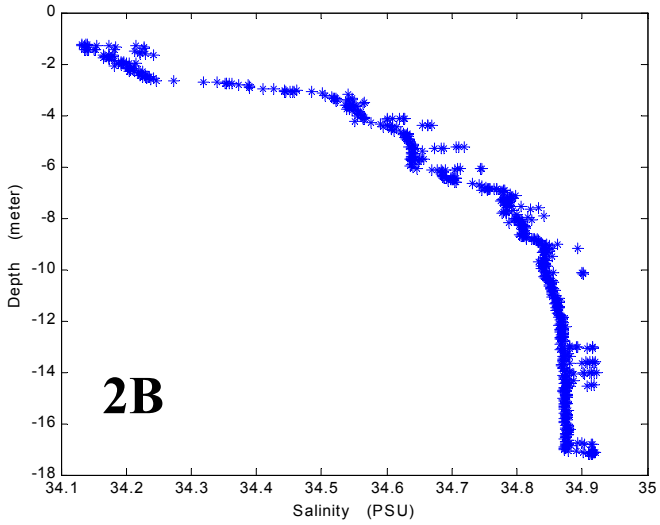
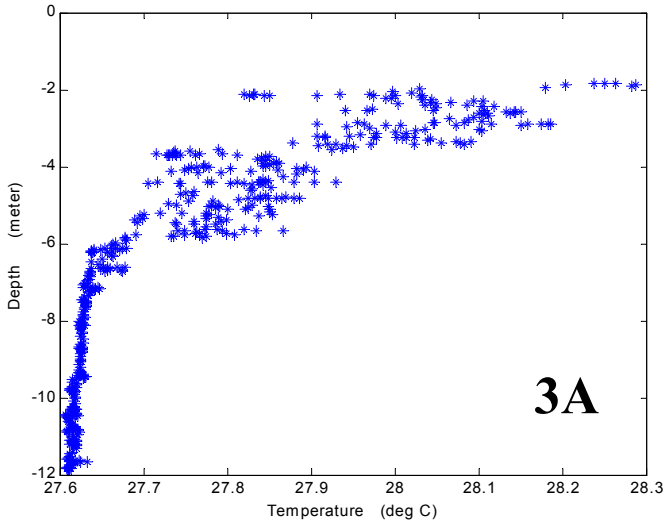


Figure 8.2 Station s637 downward CTD profiles



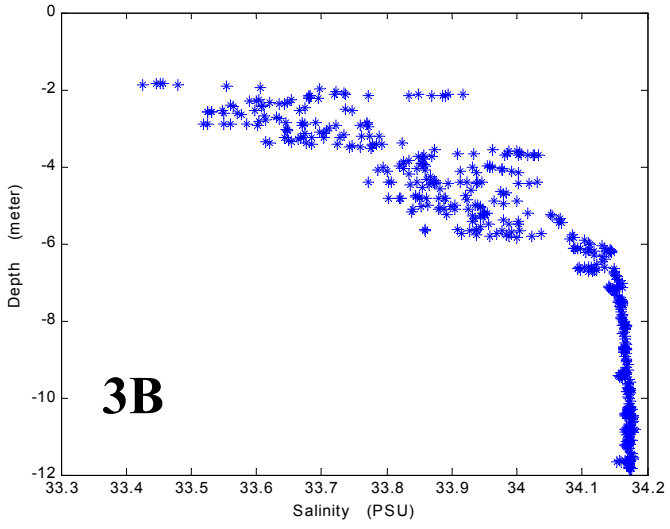
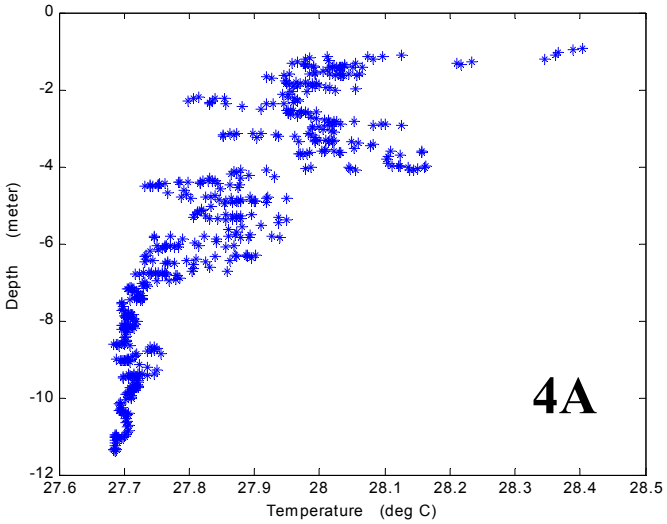


Figure 8.3 Station s638 downward CTD profiles



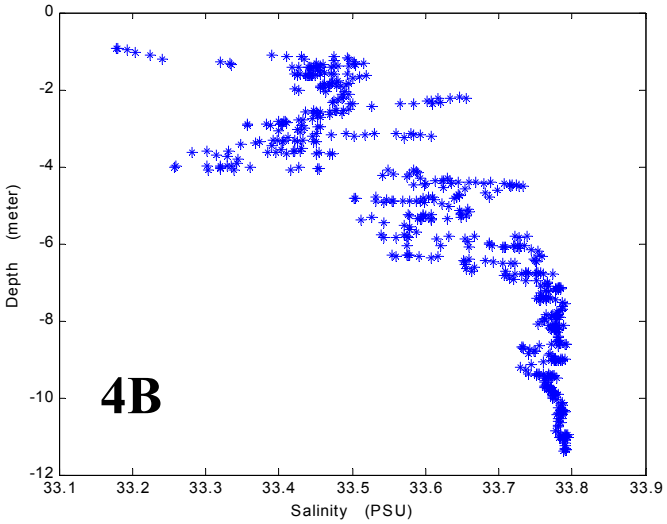
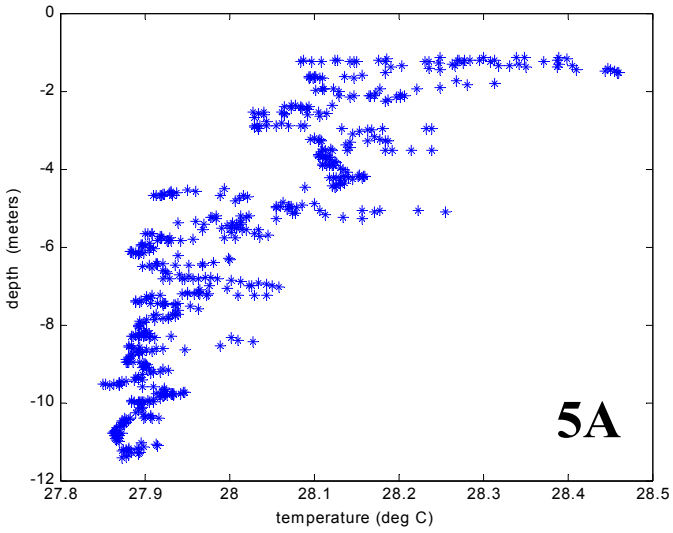


Figure 8.4 Station s639 downward CTD profiles



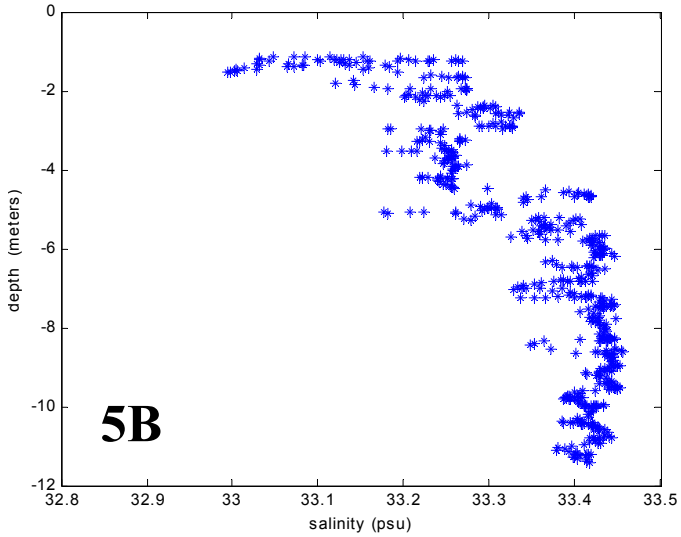
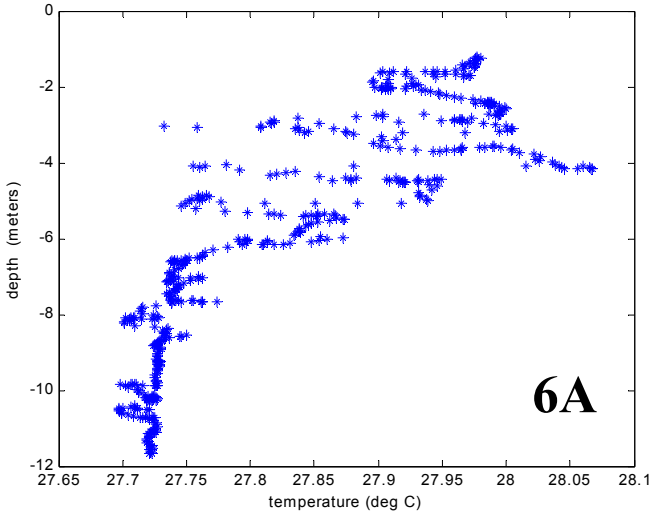


Figure 8.5 Station s640 downward CTD profiles



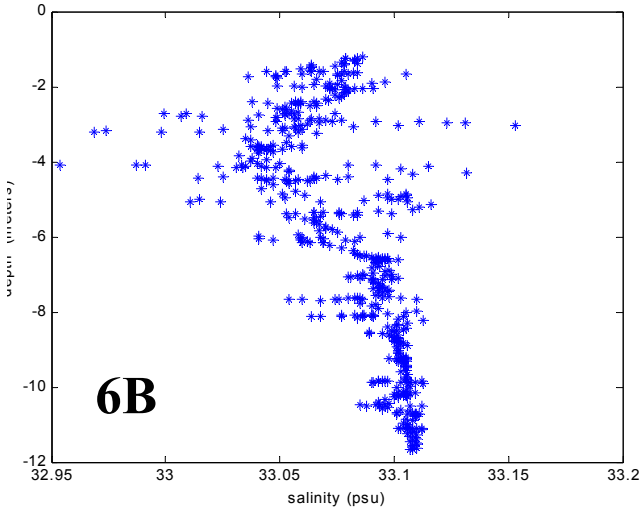


Figure 8.6 Station s641 downward CTD profiles

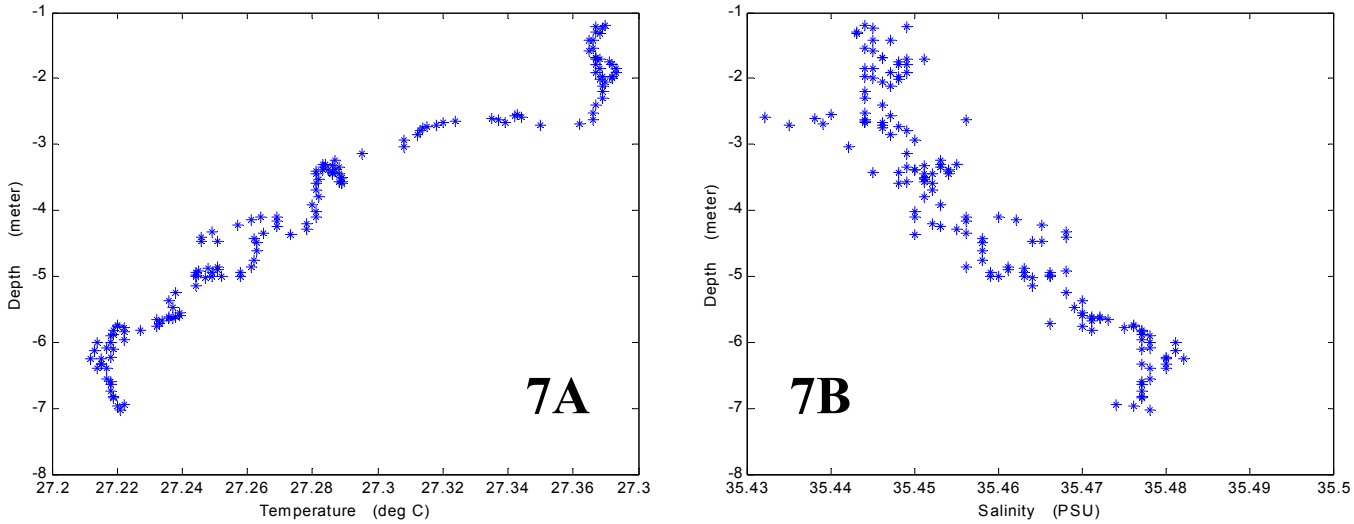


Figure 8.7 Station s643 downward CTD profiles

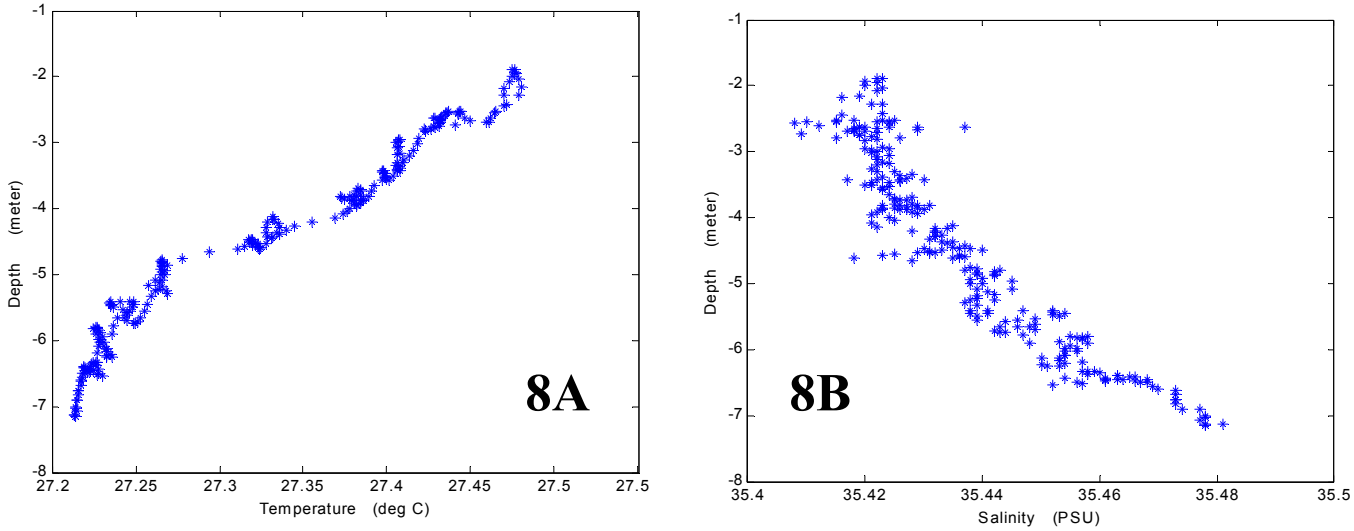


Figure 8.8 Station s644 downward CTD profiles

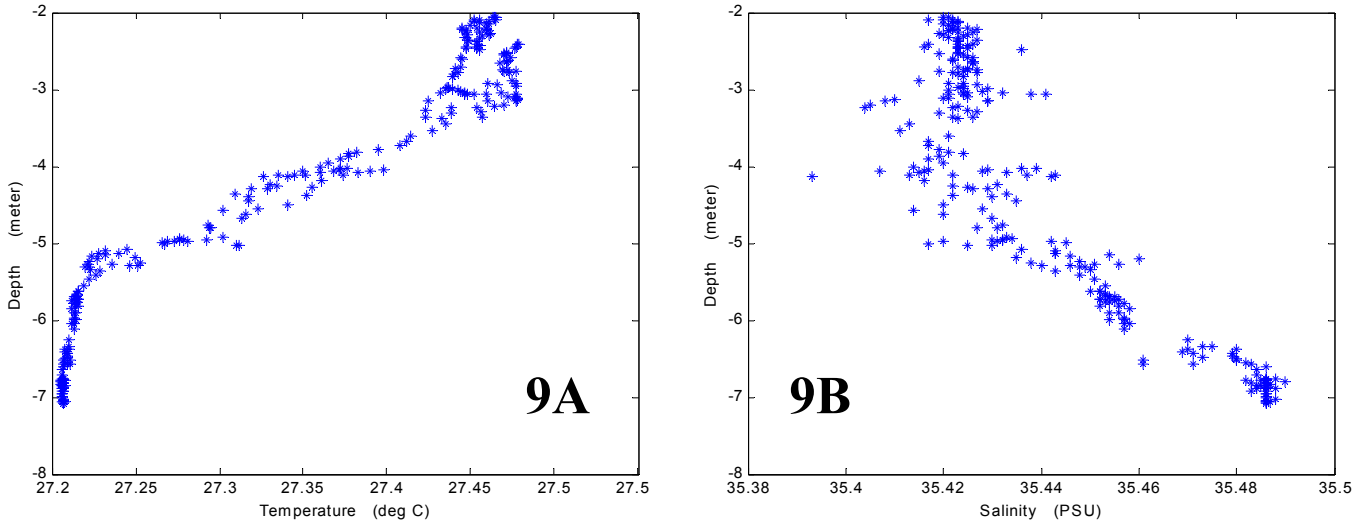


Figure 8.9 Station s645 downward CTD profiles

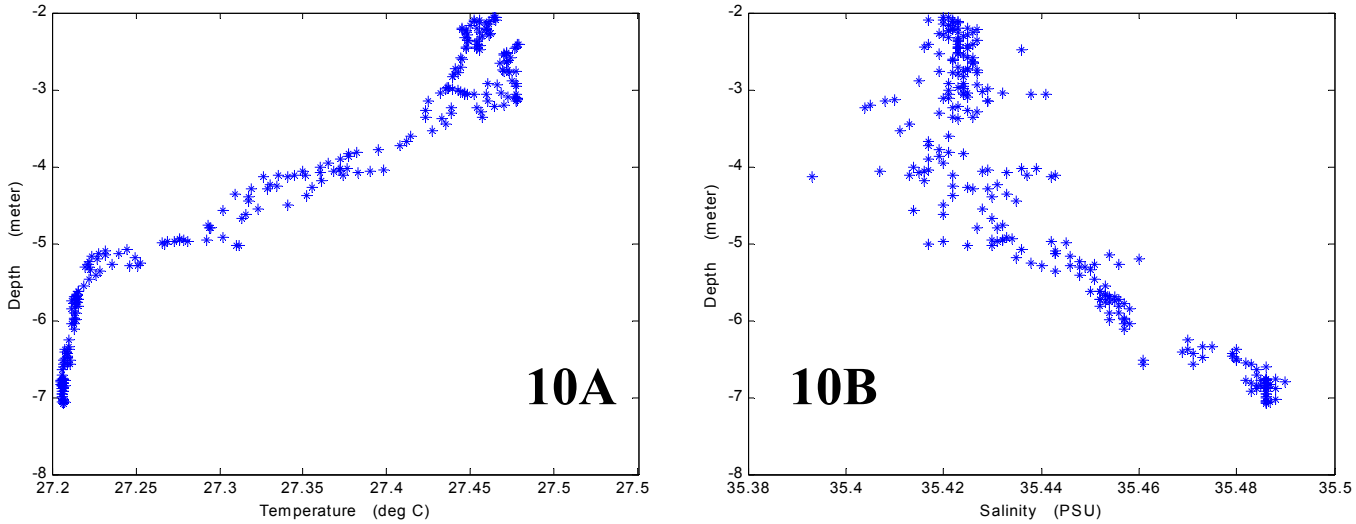


Figure 8.10 Station s646 downward CTD profiles

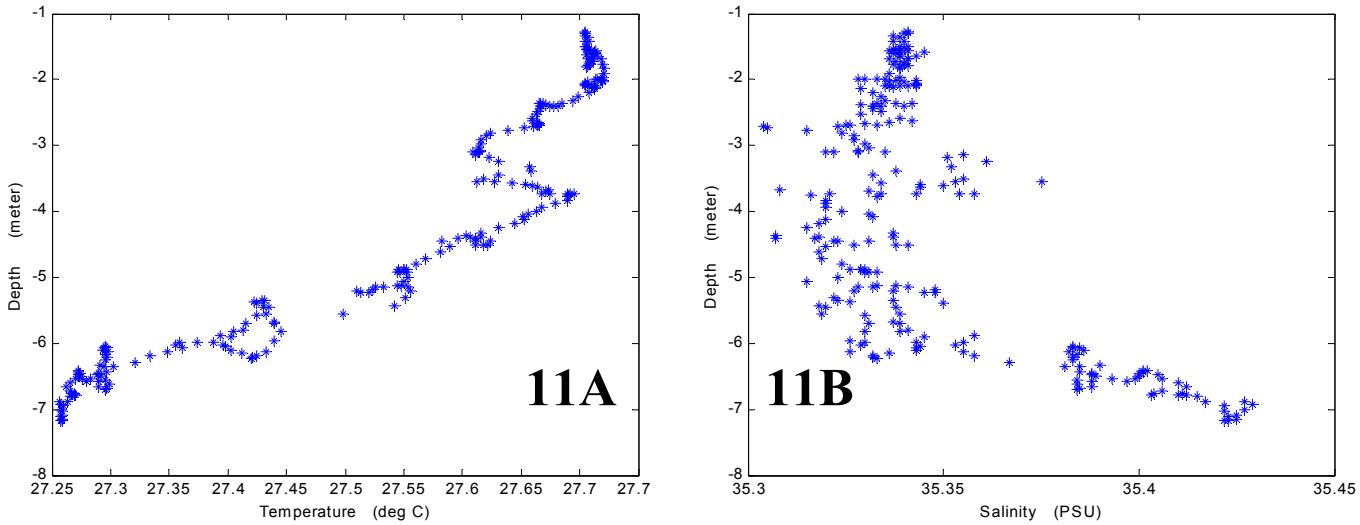


Figure 8.11 Station s647 downward CTD profiles

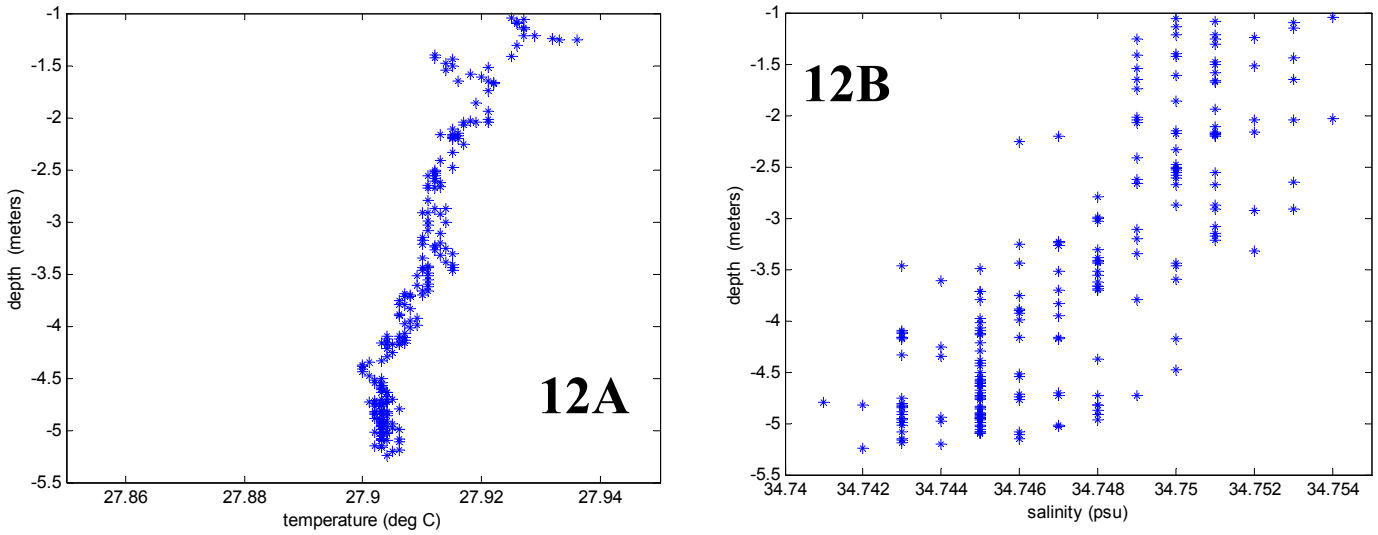
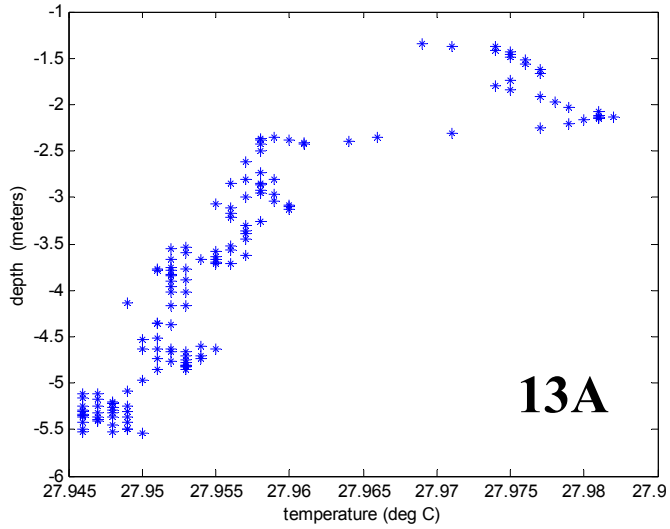


Figure 8.12 Station s648 downward CTD profiles



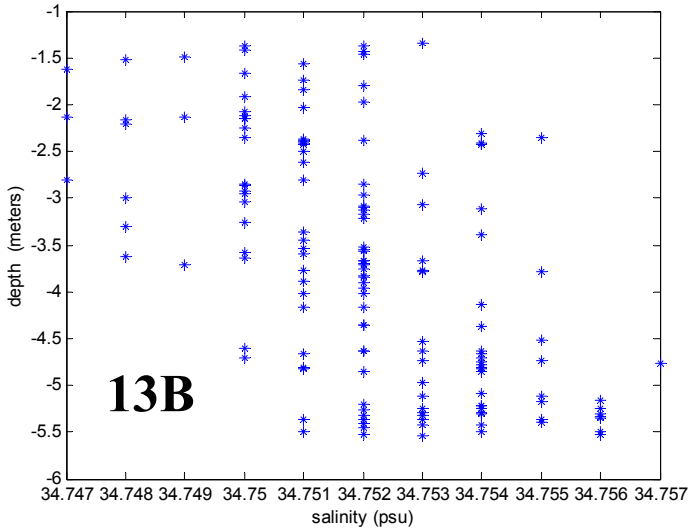
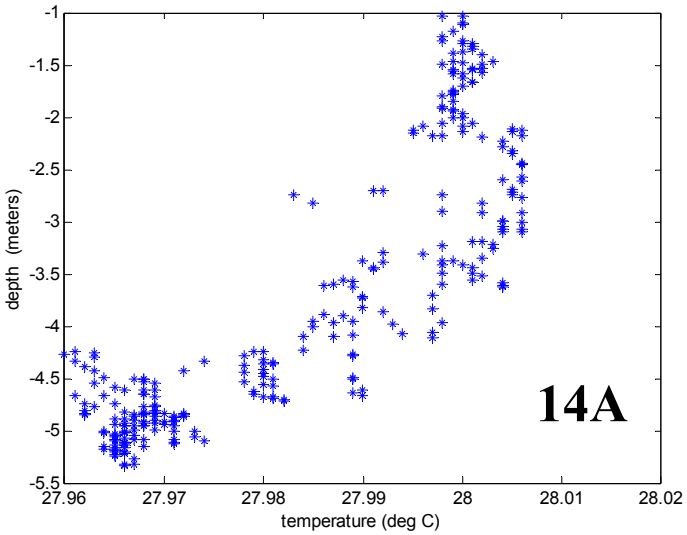


Figure 8.13 Station s649 downward CTD profiles



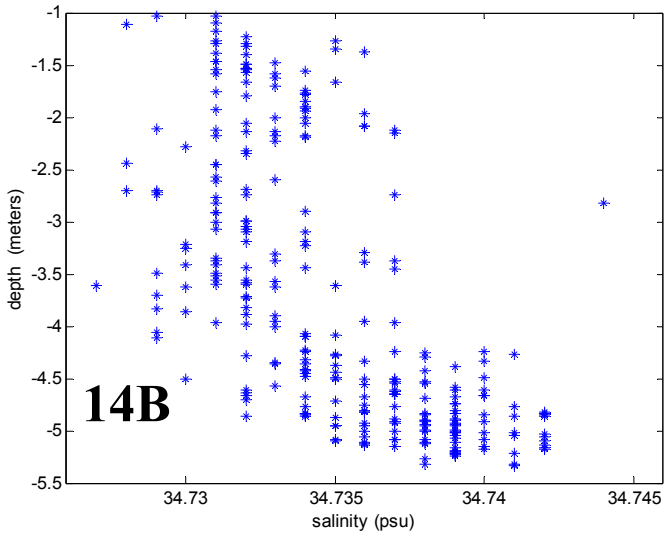
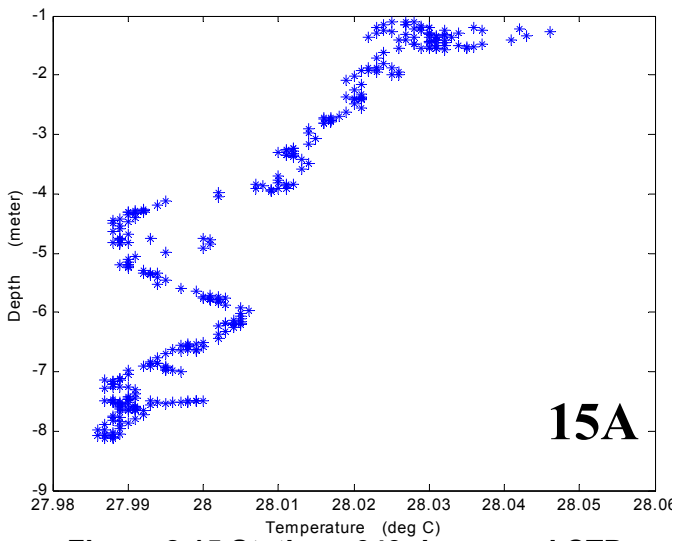


Figure 8.14 Station s649 downward CTD profiles



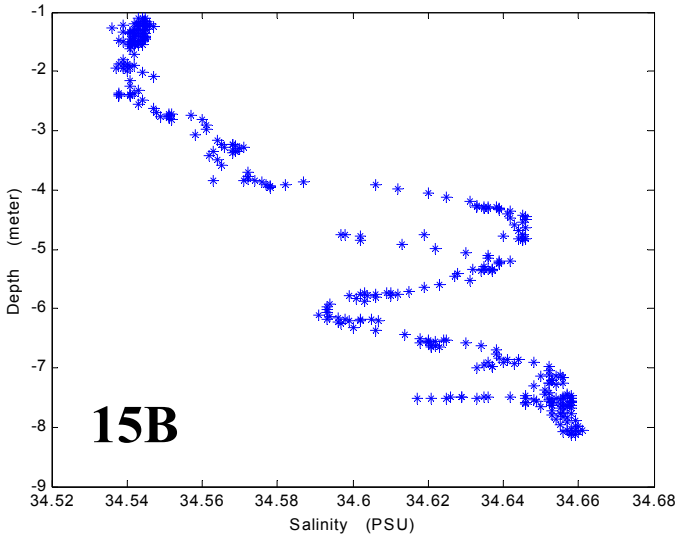


Figure 8.15 Station s649 downward CTD profiles

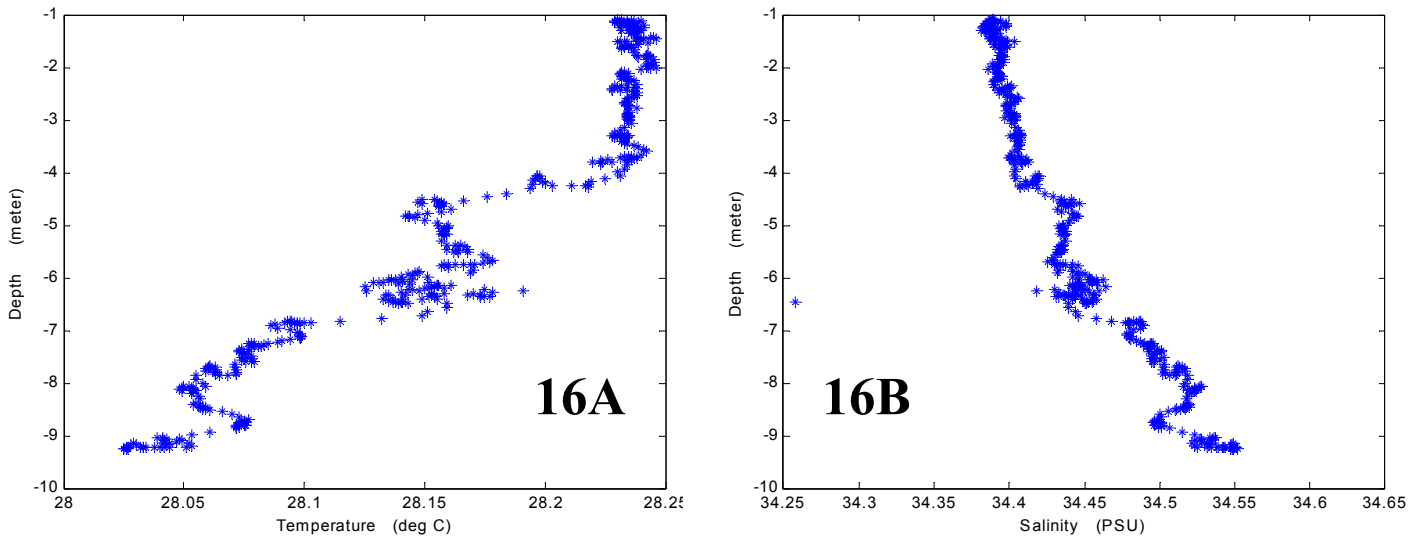


Figure 8.16 Station s649 downward CTD profiles

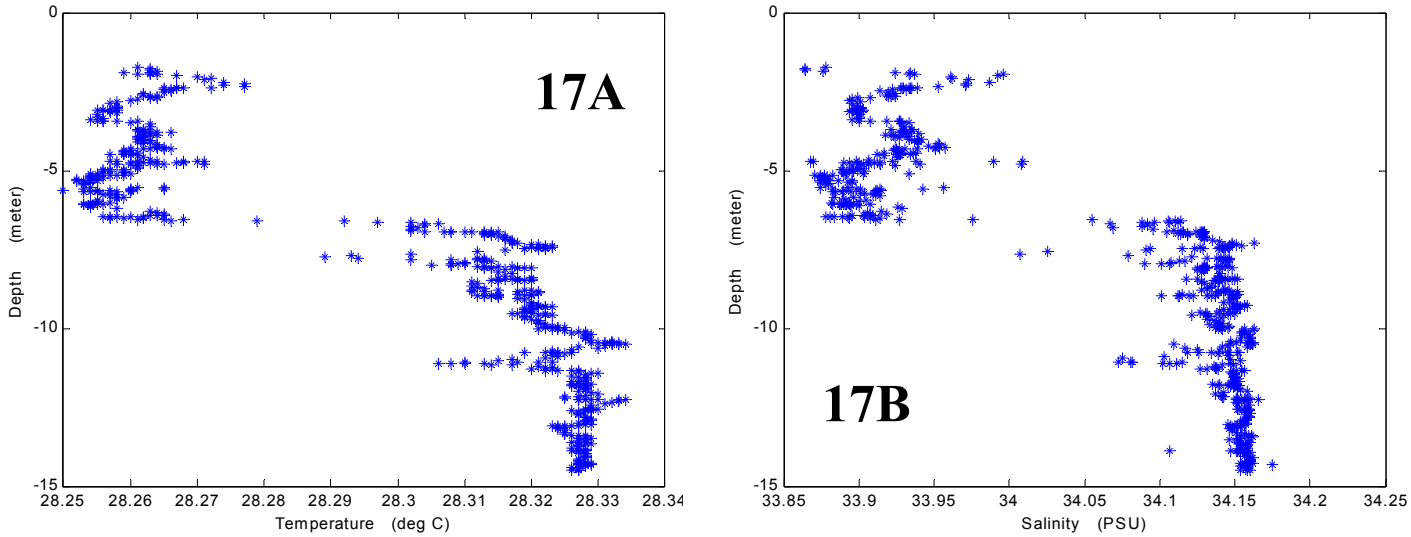


Figure 8.17 Station s649 downward CTD profiles

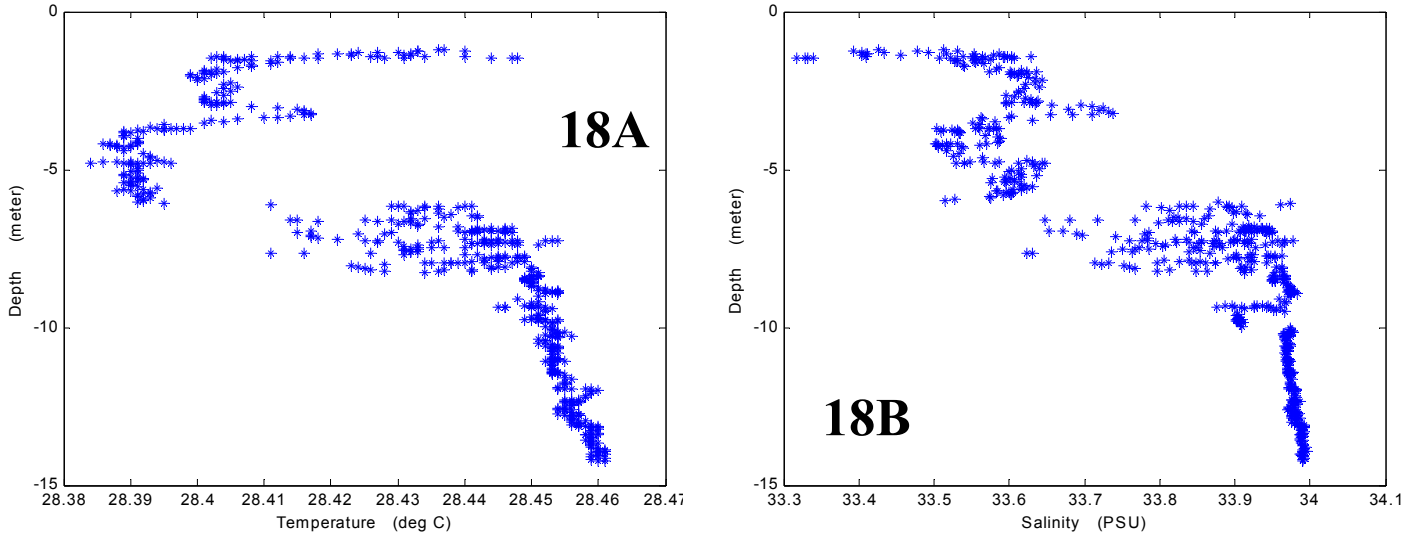


Figure 8.18 Station s649 downward CTD profiles

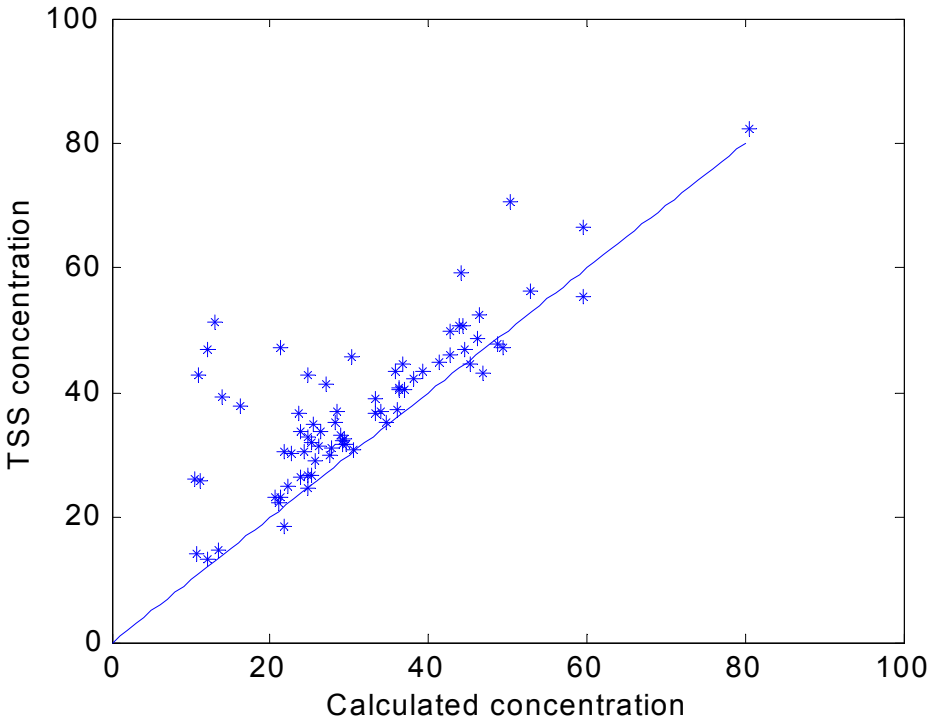


Figure 9. Suspended solids concentrations calculated using TSS/OBS regression in Figure 6 plotted against the TSS concentration.

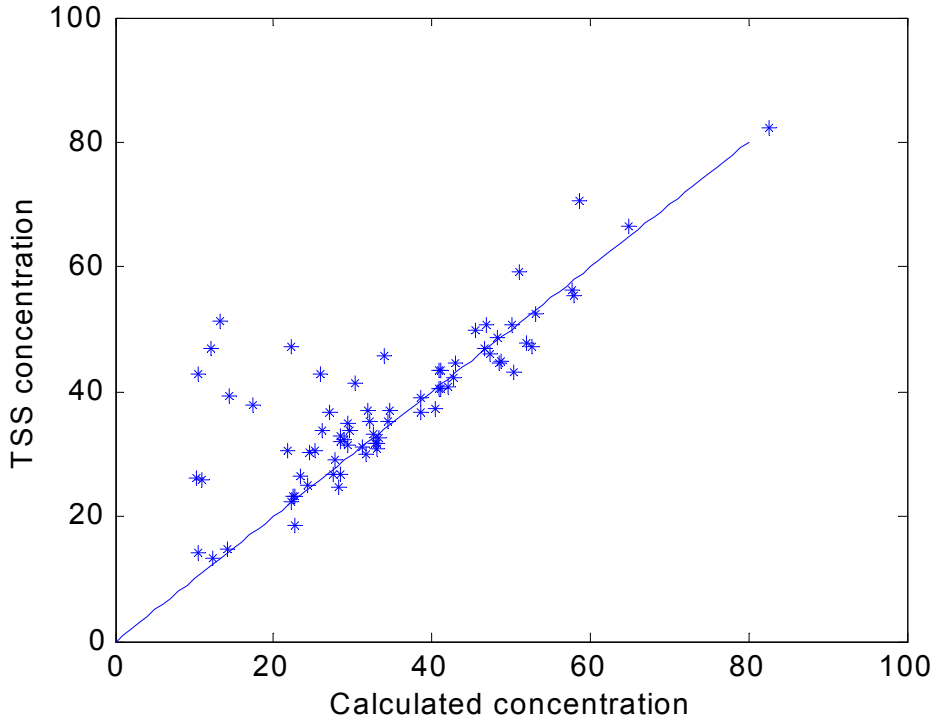


Figure 10. TSS concentration plotted against Suspended solids concentration calculated using Equation 2.4 with sand and mud regressions in Sections 2.3 and 2.4 and fm in Table 5.

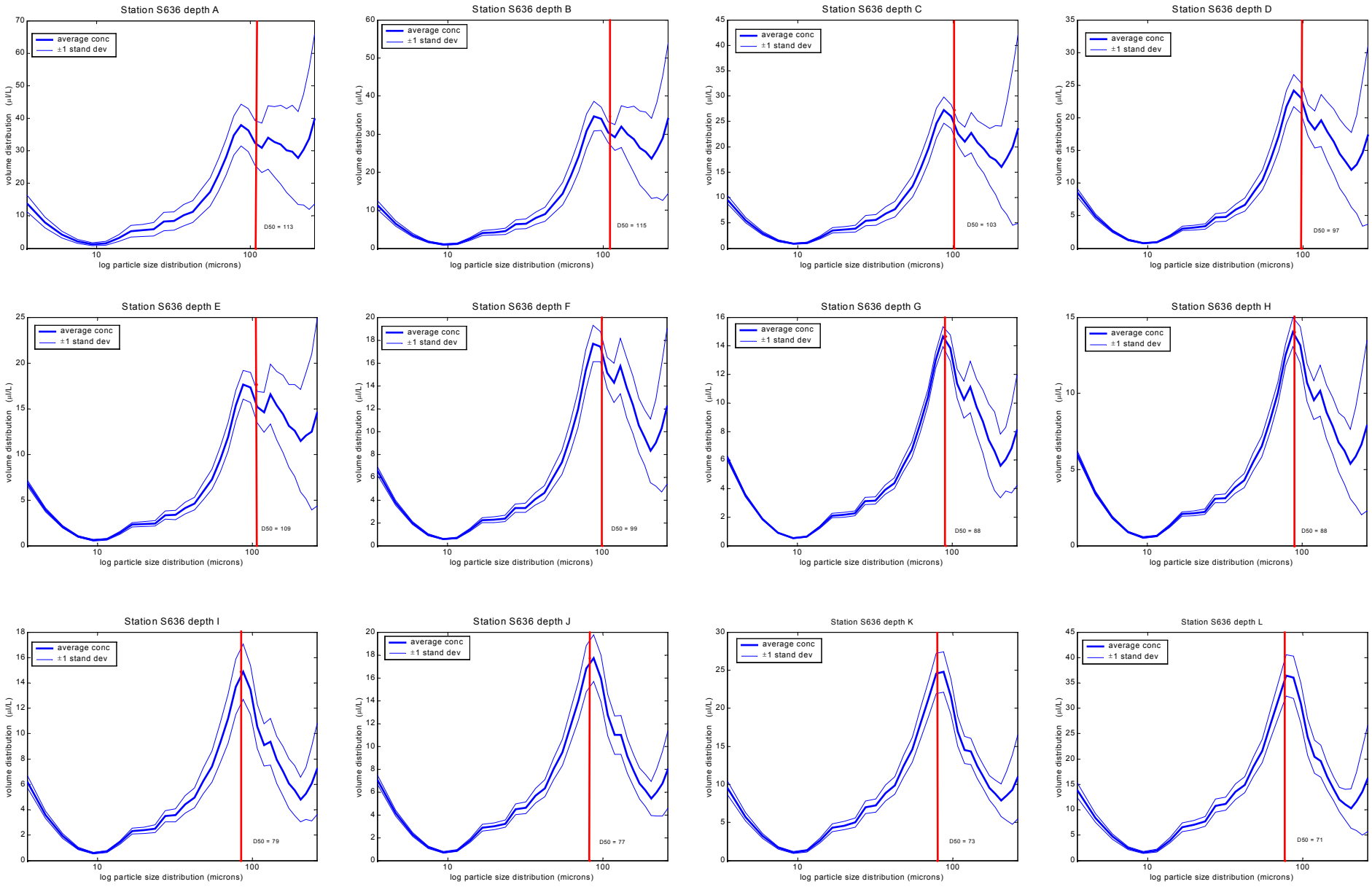


Figure 11.1 LISST 100 mean and standard deviation distributions for station S636

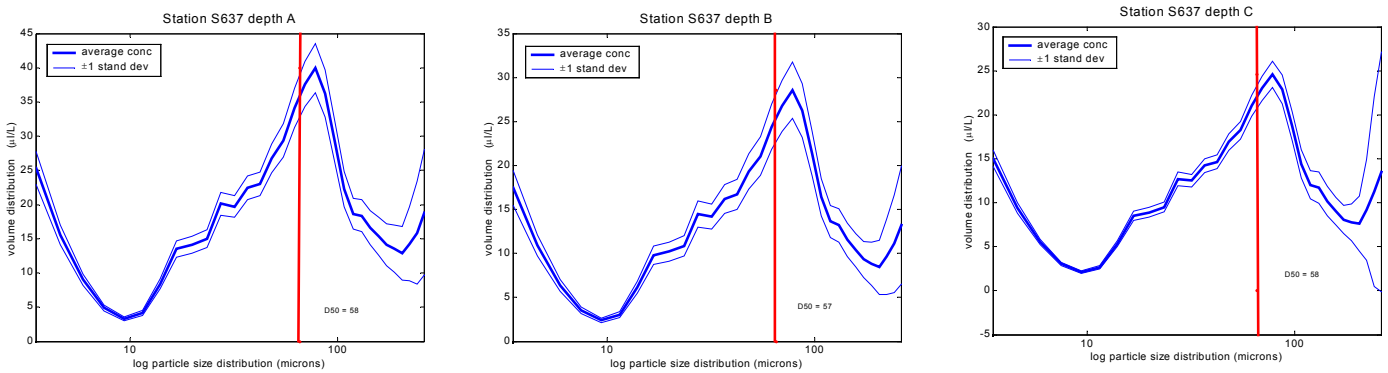


Figure 11.2 LISST 100 mean and standard deviation distributions for station S637

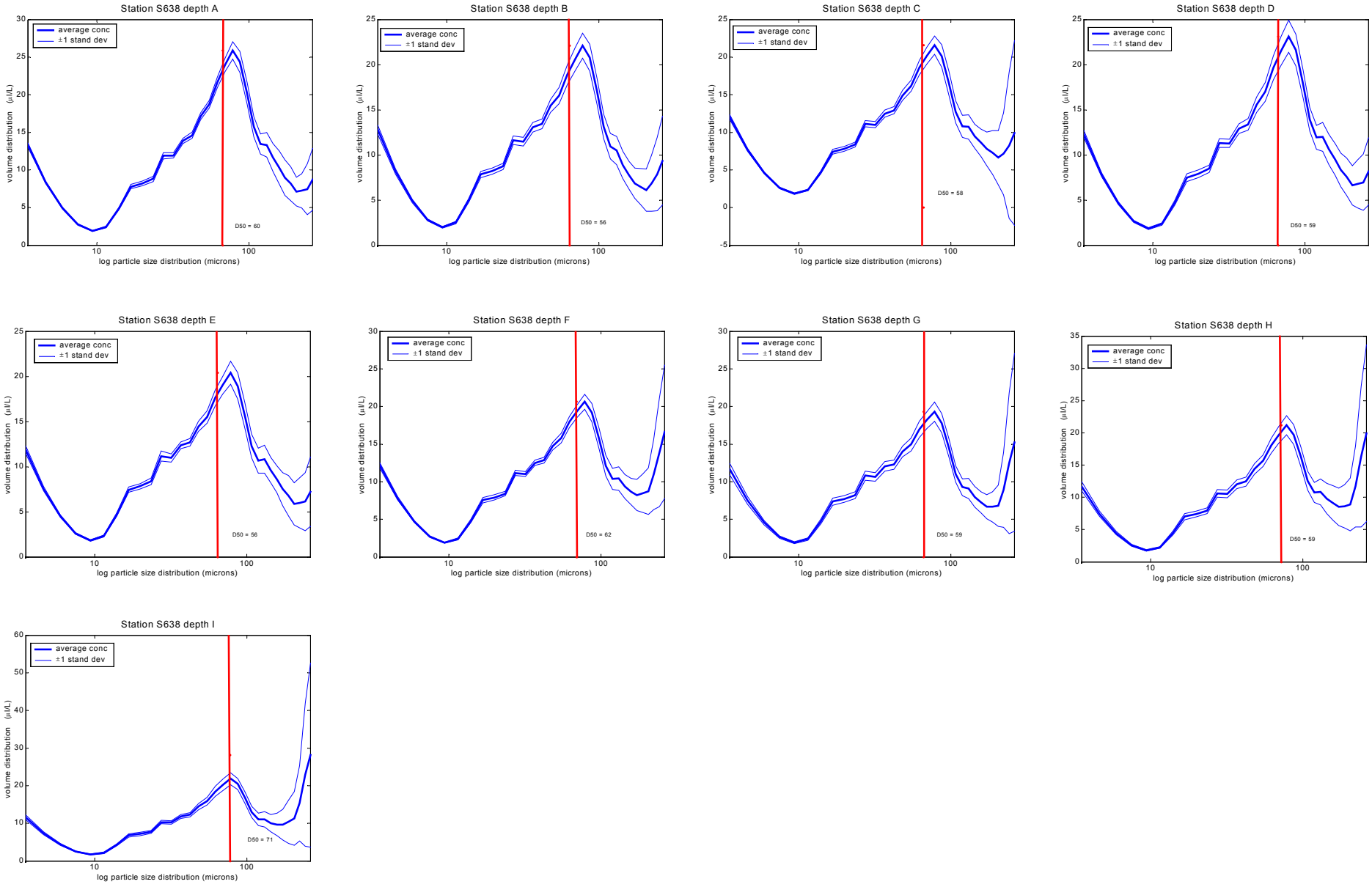


Figure 11.3 LISST 100 mean and standard deviation distributions for station S638

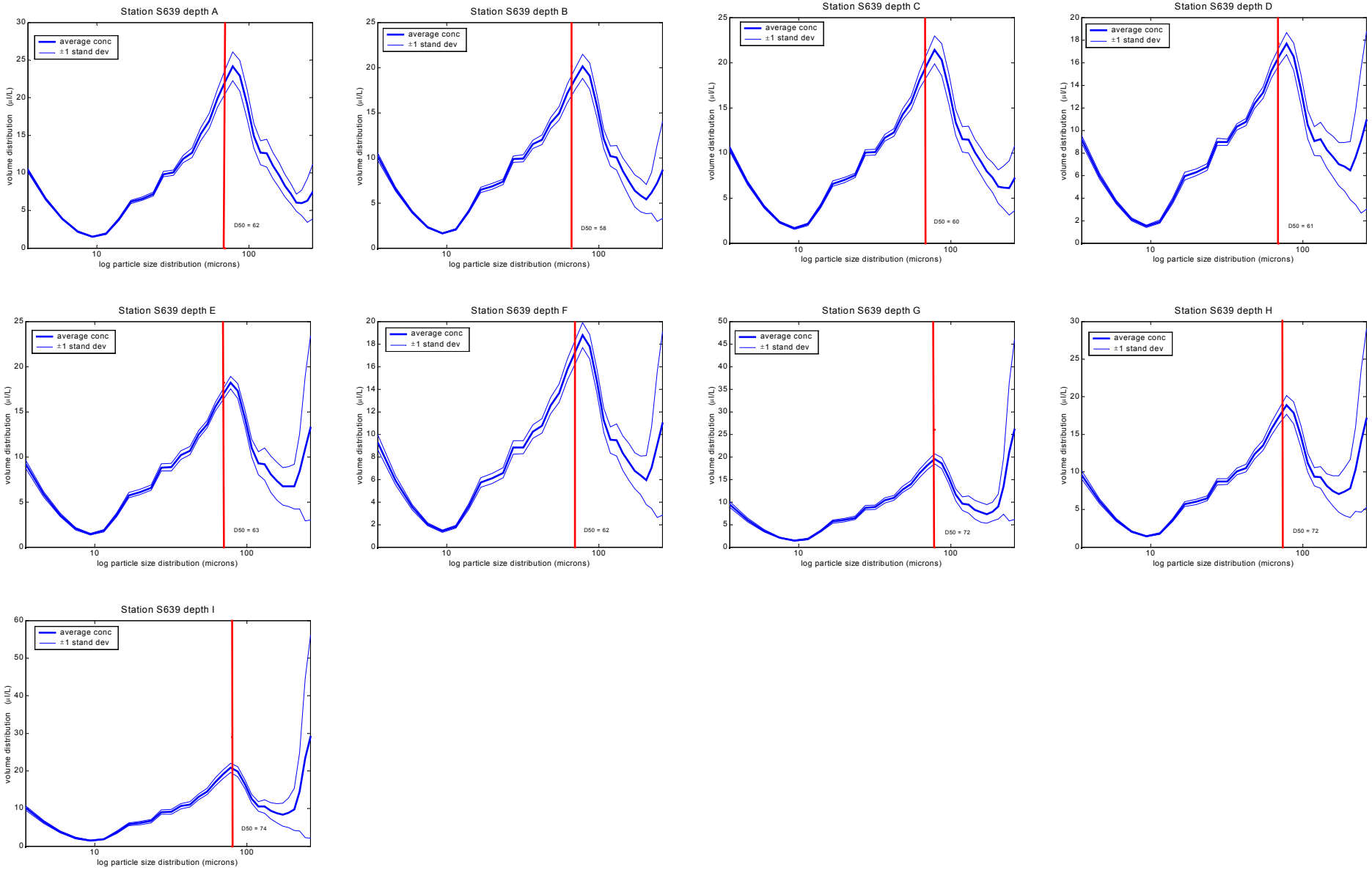


Figure 11.4 LISST 100 mean and standard deviation distributions for station S639

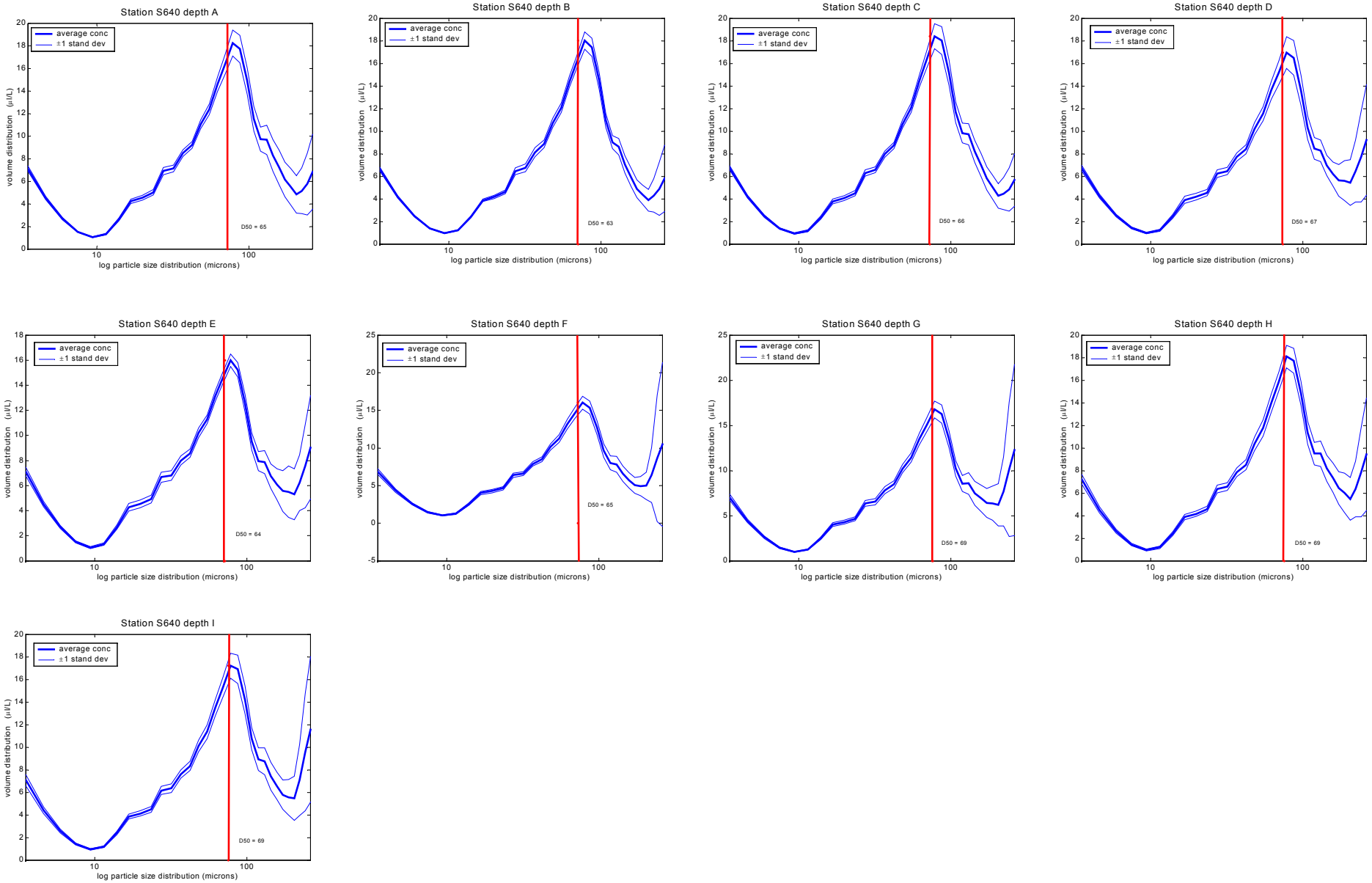


Figure 11.5 LISST 100 mean and standard deviation distributions for station S640

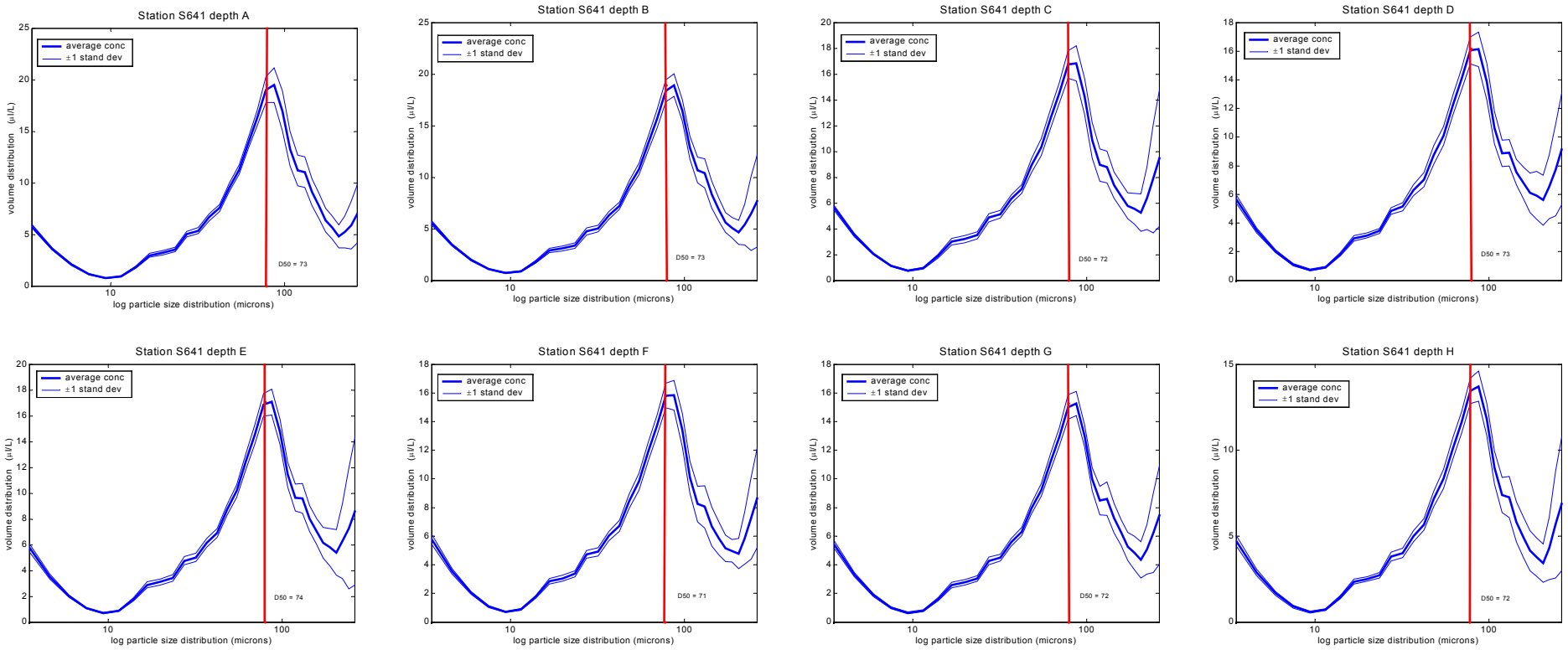


Figure 11.6 LISST 100 mean and standard deviation distributions for station S641

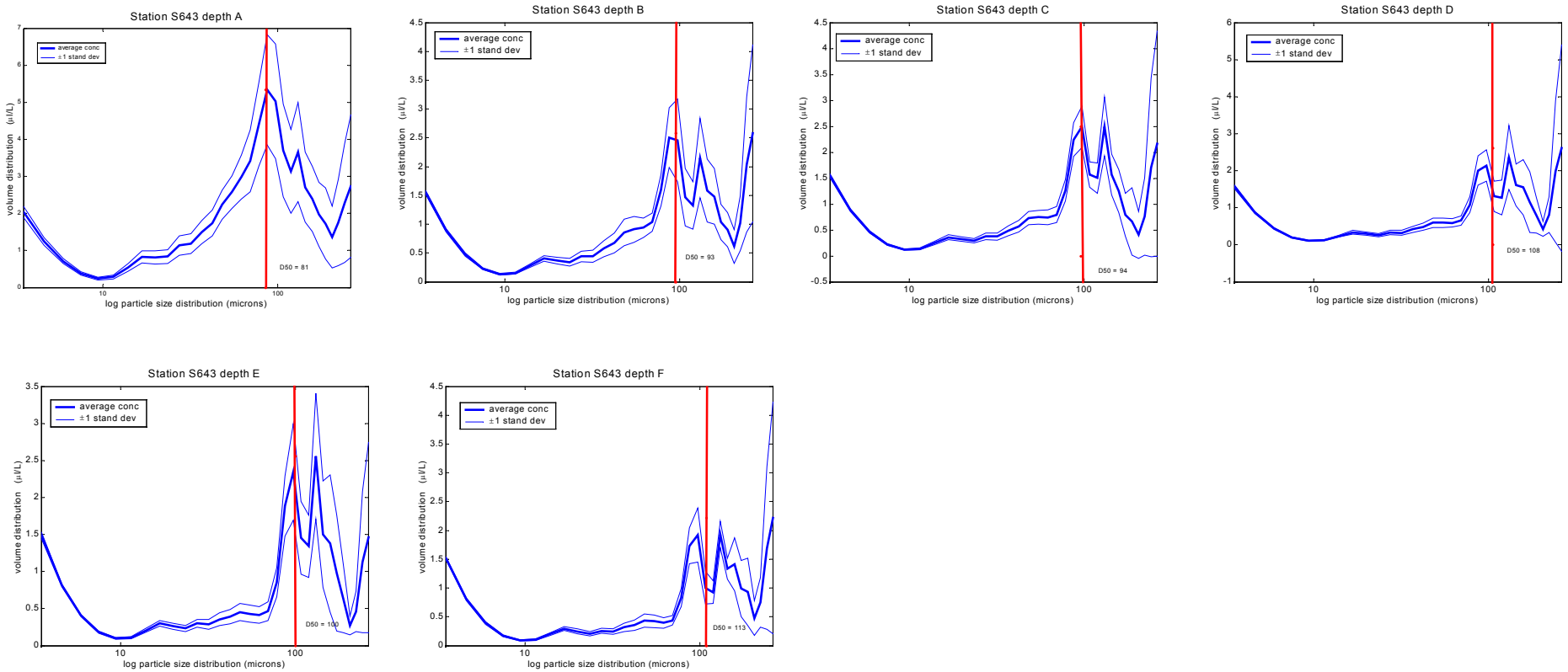


Figure 11.7 LISST 100 mean and standard deviation distributions for station S643

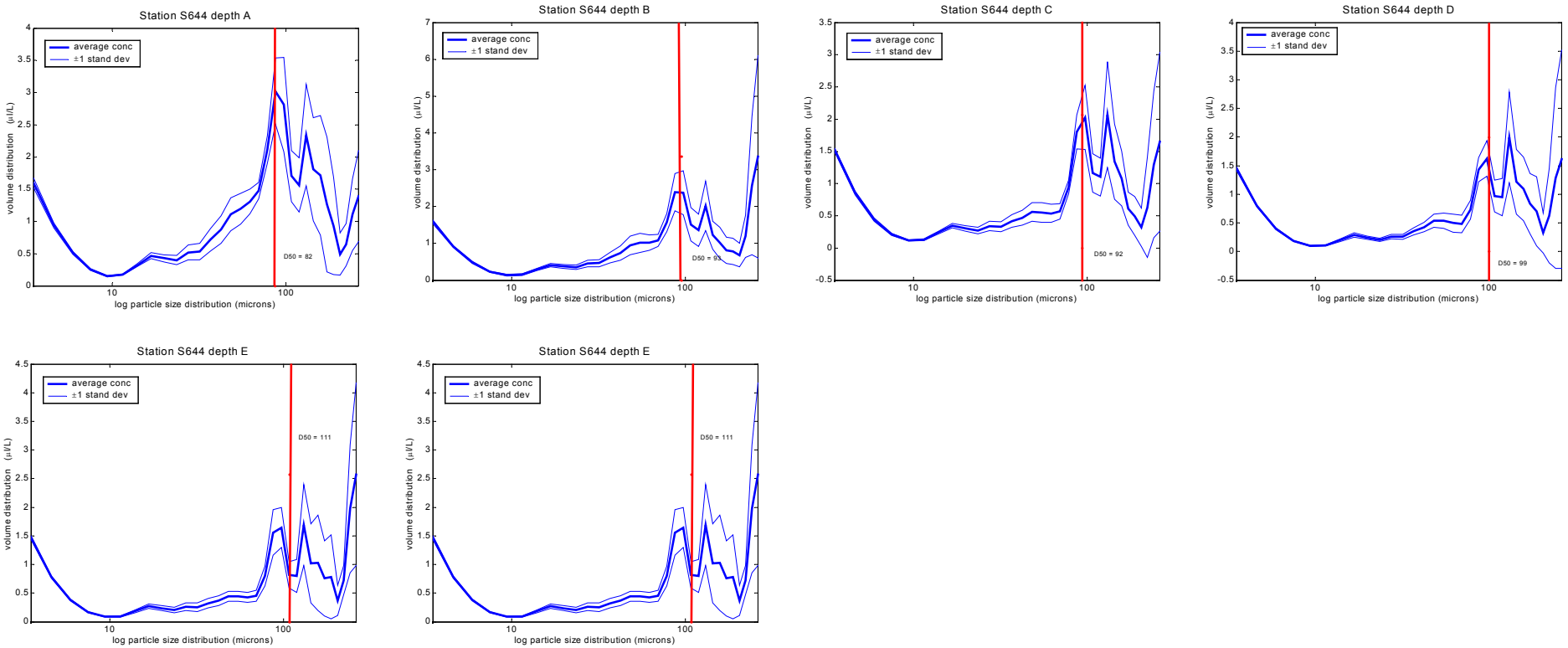


Figure 11.8 LISST 100 mean and standard deviation distributions for station S644

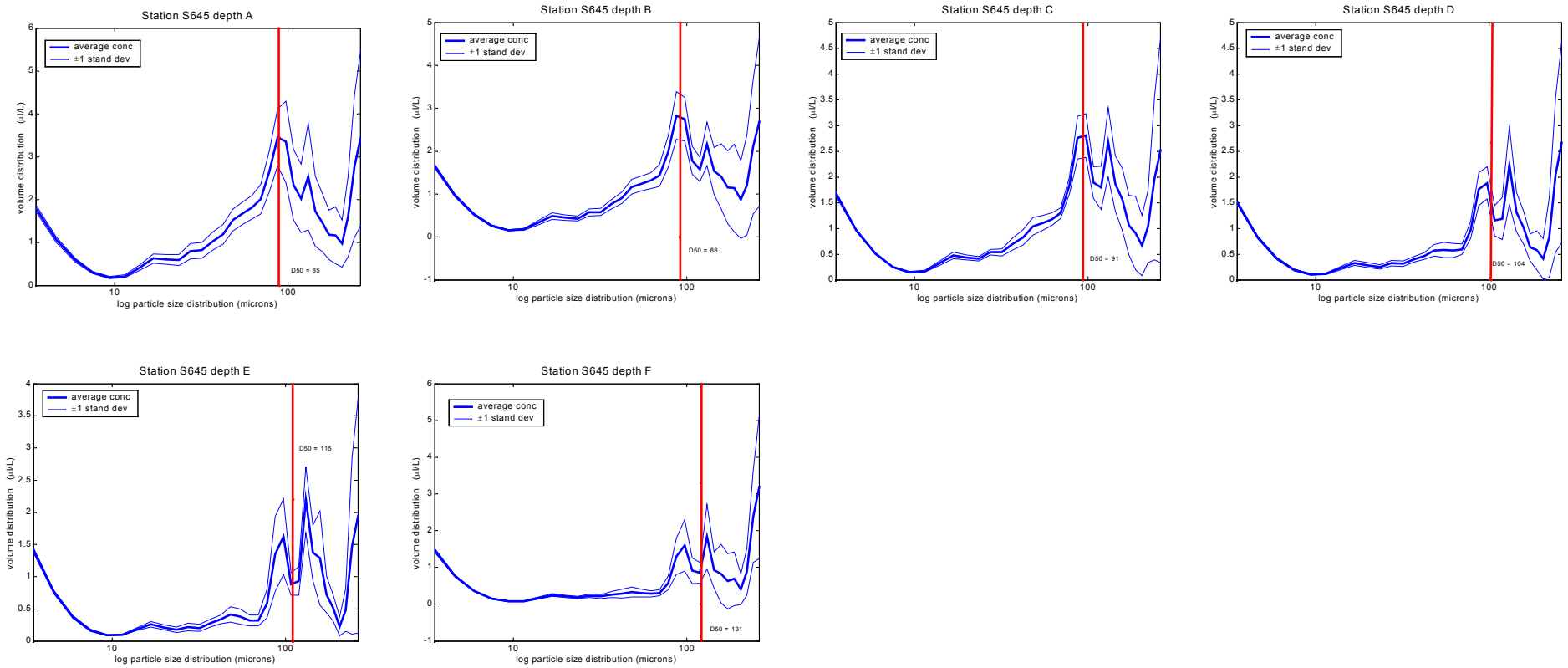


Figure 11.9 LISST 100 mean and standard deviation distributions for station S645

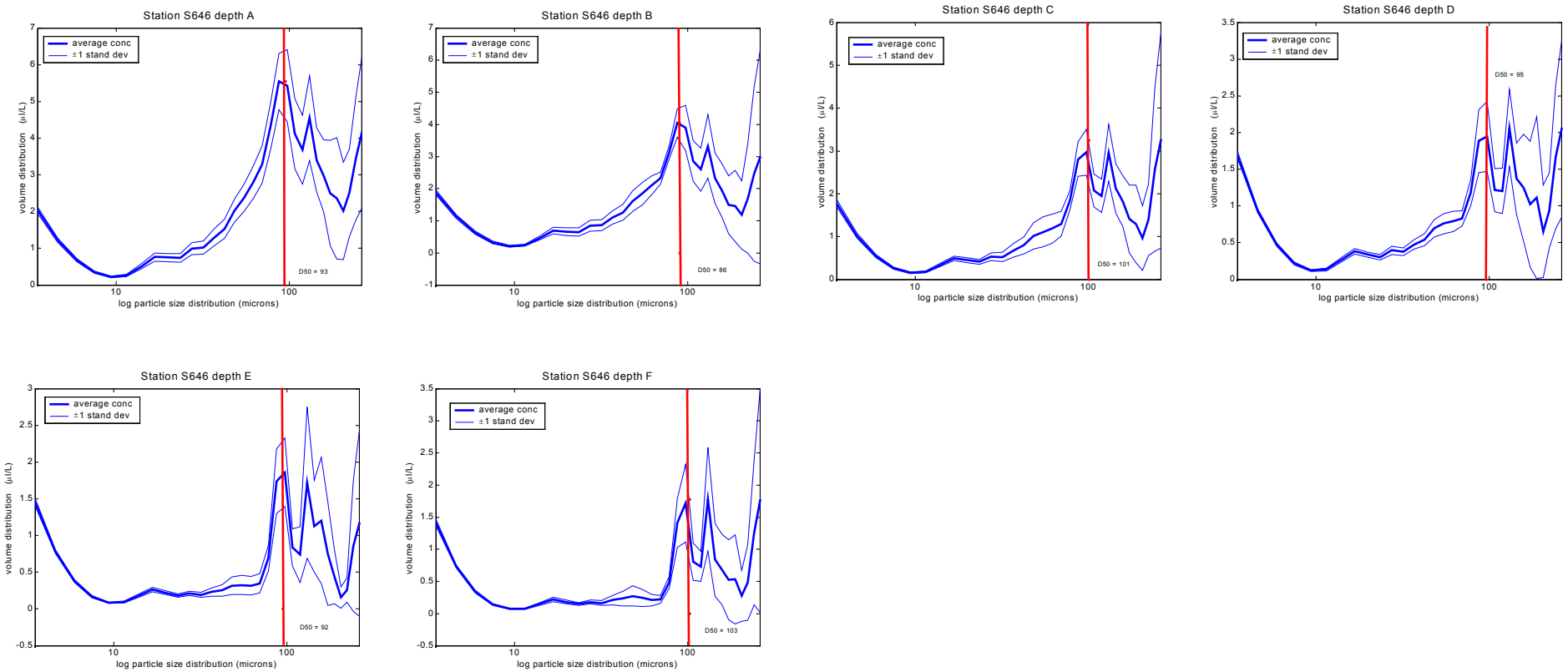


Figure 11.10 LISST 100 mean and standard deviation distributions for station S646

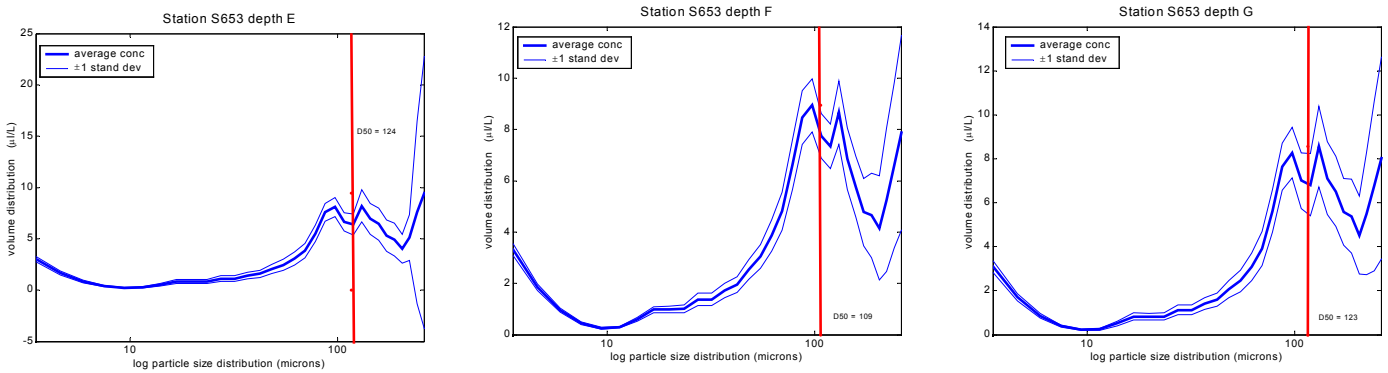


Figure 11.11 LISST 100 mean and standard deviation distributions for station S653

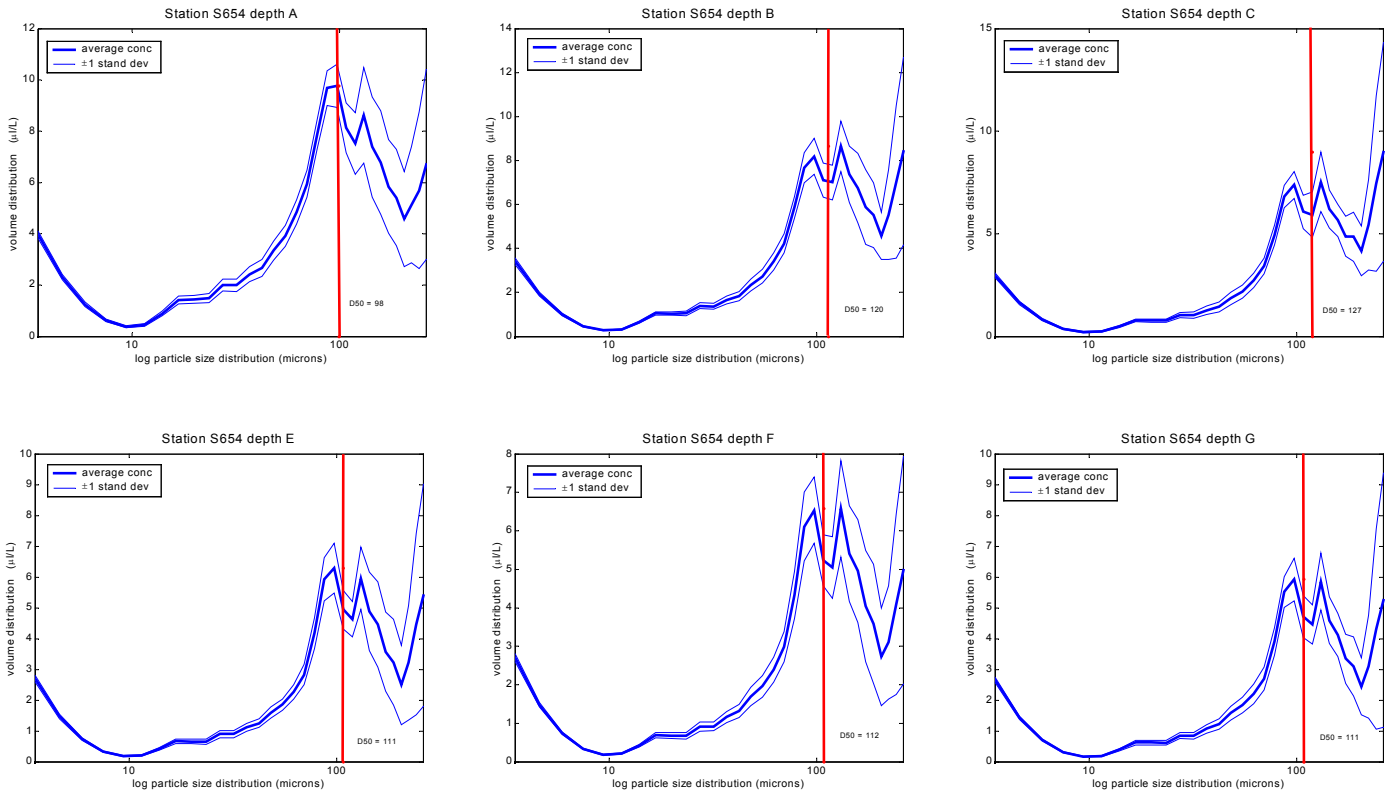


Figure 11.12 LISST 100 mean and standard deviation distributions for station S654

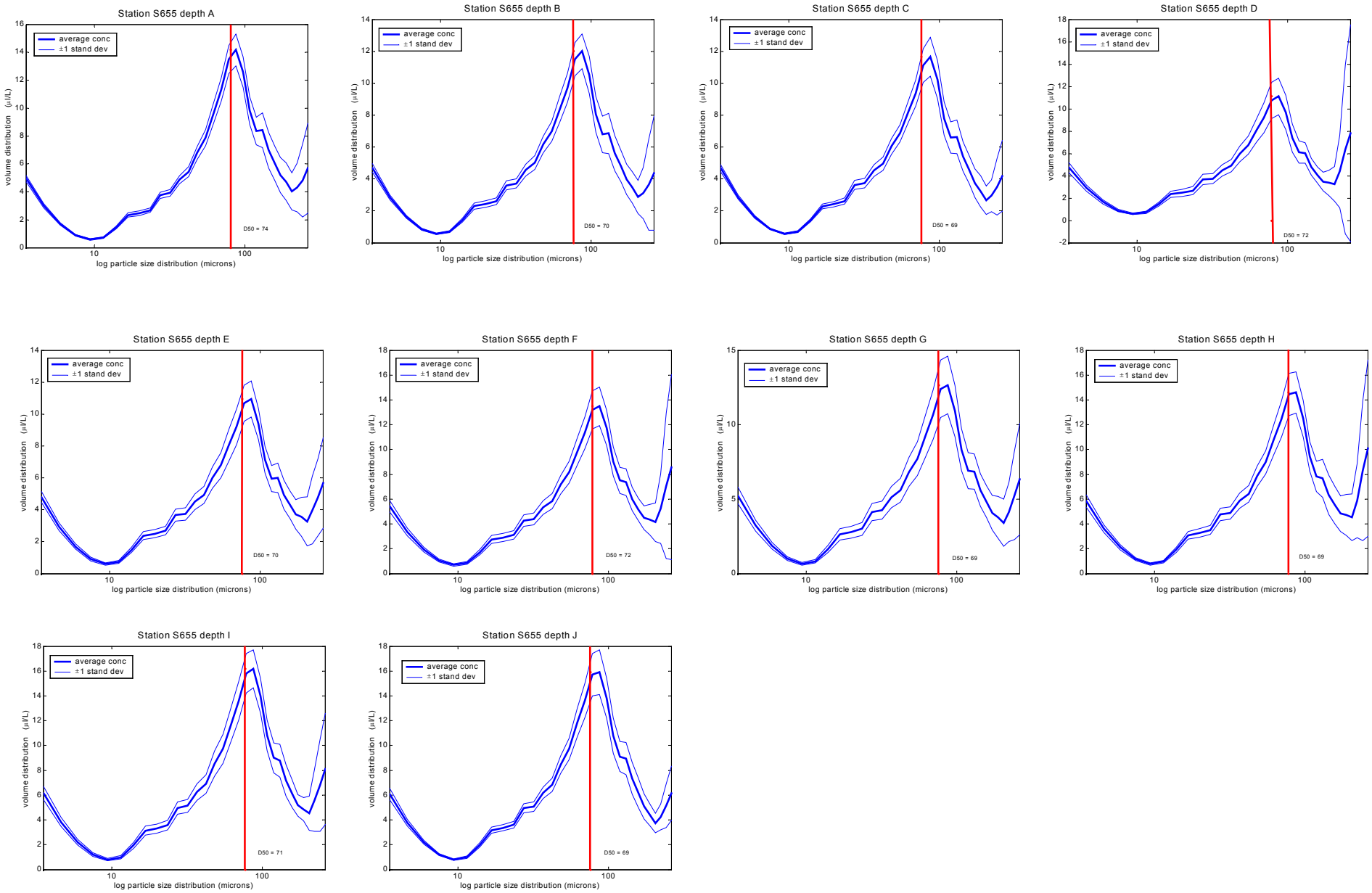


Figure 11.13 LISST 100 mean and standard deviation distributions for station S655

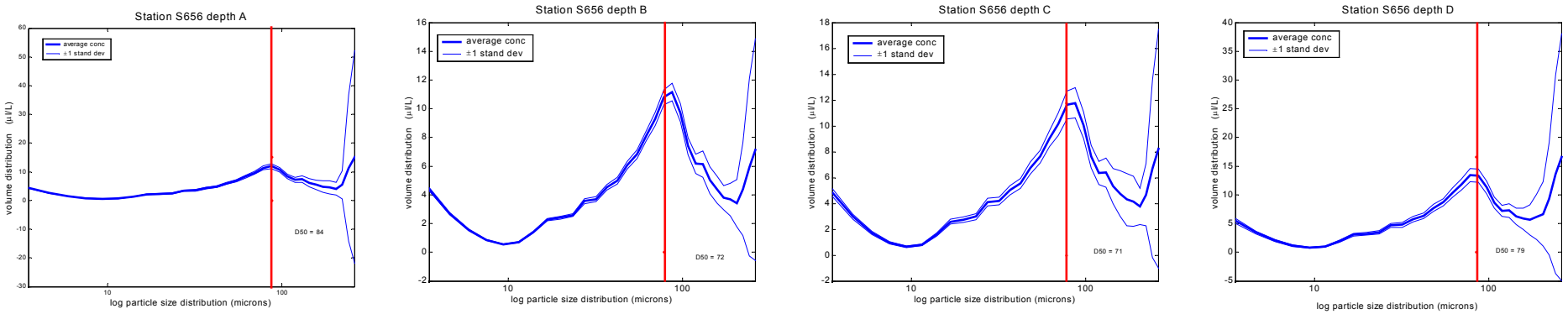


Figure 11.14 LISST 100 mean and standard deviation distributions for station S656