

BITMAXII Cruise BM0801 Report

Project title: Dynamic stability and particle transformations: tracing pathways of production in Estuarine Turbidity Maxima (NSF-OCE-0453905)

23-26 January 2008

Research Vessel

R/V Hugh R. Sharp

Scientists

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Sampling Area

Upper Chesapeake Bay from the southern extent of the Susquehanna River flats (Lat. 39.43893) to the Chesapeake Bay Bridge (Lat 38.99750).

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I. Activities

Objectives of this cruise were to sample the estuarine turbidity maximum (ETM) region of the Chesapeake Bay with CTD casts, Niskin bottles, MOCNESS zooplankton nets, and video-equipped bottom withdrawal tubes. The ETM in this system is most prominent in deeper waters of the shipping channel near the freshwater/saltwater interface. Our sampling strategy included 1) axial surveys of the region with CTD casts and niskin bottles conducted at 11 stations, 2) axial surveys to sample zooplankton with net tows, and 3) time course sampling at three anchor stations.

The ship was loaded at the Sailwinds dock in Cambridge, MD, on 22-Jan, and departed that evening. Operations began at 1210¹ on 23-Jan with an axial survey of the study area (campaign axial-1) consisting of CTD casts at 11 stations (Table 1) to measure conductivity, temperature, dissolved oxygen, fluorescence, optical backscatter, particle scattering and transmission with a

¹ Times/dates are in UTC (Coordinated Universal Time, from the French: Temps Universel Coordonné)

Laser In-Situ Scattering and Transmissometry device (LISST 100C), and zooplankton density with a Tracor Acoustic Profiling System (TAPS). At each station, water samples were collected at three depths with a small well pump to directly measure total suspended solids for calibration of optical devices. At five stations (as03, as06, as09, as11, as13c), water samples were collected with 20L Niskin bottles from surface, middle and bottom depths, poured from one end of the Niskins into 6 gallon buckets, stirred with stir bars to homogenize suspended particles, and sampled for multiple biological and chemical analyses (Table 2). During this first CTD survey we found the ETM centered at station as11 (station 9 in continuous station log).

A site for the first anchor station series was selected based on these axial survey results. It was located between Stations as10 and as11, which was the safest anchor location near the middle of the ETM region. CTD casts were conducted every hour for 24 hours starting at 2131 on 23-Jan with all equipment described above except for the well pump. To observe particle size and settling speed a Digital Imaging Particle Settling Tube with In-situ Capture (DIPSTIC) was cast 32 times at this station using the A-frame. Water samples for biological and chemical analyses were collected from the middle water column at 2328, the surface at 2351, and the bottom at 0010. The two bottom water samples were sequentially fractionated with a series of screens (63, 20 & 10 micron Nitex mesh, and a 3 micron polycarbonate filter), and sub-sampled for biological and chemical analyses. Water samples were also collected from the DIPSTIC after two deployments for biological and chemical analyses. A zooplankton sample was collected on this anchor station using a 50 cm diameter ring net fitted with 200 micron mesh. The sample was comprised almost entirely of *Eurytemora affinis* copepods, with all stages present and females bearing large egg sacs. Subsamples were used in an experiment to determine the egg production rate, egg hatching success, egg development time, and copepodite development times using a cohort-ratio approach. Briefly, the entire copepod sample was divided among 9- 250 ml polycarbonate bottles and incubated in a running seawater bath (at ambient surface temperature) for 48 hours. Triplicate jars were preserved (4% buffered formaldehyde) at 12 hour intervals for analysis in the lab after the cruise. Additional subsamples were sorted for females and both individual *E. affinis* females and whole community samples were frozen at -80 °C in 1 ml cryovials and acid cleaned polycarbonate bottles, respectively, for lipid analyses. In addition some subsamples of bulk zooplankton were collected on precombusted filters for CHN and stable isotope analyses.

During this anchor station, the TAPS ceased communicating with the computer during a charging and data download session, so it was removed from the CTD frame. It has since been determined that the RS-232 chip was damaged, so the data from the first axial survey and from some of the early casts during the anchor station was retrieved intact. However, no other TAPS data was collected on this cruise.

The ship was then moved to station as13c to begin axial surveys of zooplankton using a multiple opening closing net sampler (MOCNESS) equipped with one 333 and four 200 micron mesh nets and temperature, salinity, pressure, turbidity, Chlorophyll *a* fluorescence, and PAR sensors. The sampling plan for the MOCNESS was to fish the net at six stations along the transect (as- 13c, 11, 9, 7, 5, 3) to within 3 m of the bottom during both nighttime and daytime surveys. Due to weather (sustained winds >25 knots, gusts to 35 knots), three stations during the nighttime MOCNESS axial survey (as- 07, 05, and 03) were postponed for 24 hours; these were sampled

during a transit between anchor stations (see below). All daytime stations were completed during the allotted time. The 333 micron mesh net was fished first, between the surface and near-bottom, and the three to four 200 micron mesh nets were fished in 3-5 m depth intervals between the surface to the bottom, depending on the depth and structure of the water column. All samples were preserved in 4% buffered (sodium borate) formaldehyde within thirty minutes of collection.

Small zooplankton (e.g. nauplii and eggs) were sampled with water collected from Niskin bottles which were closed at surface, middle, and bottom depths during a CTD cast done prior to MOCNESS deployment at each station. The water in the Niskin bottles was drained through the stopcock onto 35 μ m mesh sieves. These samples were then preserved in a 4% buffered (sodium borate) formaldehyde solution within 30 minutes of collection. Water samples for chemical analyses were collected from CTD casts on three of the MOCNESS stations during the daytime survey.

A second anchor station survey (anchor-2) was conducted at a site up-estuary of the ETM region near station as13c. CTD casts were conducted hourly from 2058 on 25-Jan, to 0100 on 26-Jan. The DIPSTIC was cast twice as described above. One bottom water sample was collected for particle fractionation and biological and chemical analyses. Water samples were also collected from one DIPSTIC for biological and chemical analyses.

A third anchor station survey (anchor-3) was conducted at a site down-estuary of the ETM region near station as04. CTD casts were conducted hourly from 0700 to 1000 on 26-Jan. The DIPSTIC was cast four times as described above. One middle-depth water sample was collected for particle fractionation and biological and chemical analyses. Water samples were also collected from one DIPSTIC for biological and chemical analyses.

A second axial survey (axial-2), beginning at 1131 on 26-Jan, was identical to the first axial survey and completed in record time (< 5 hours).

Cruise objectives were met thanks to the hard work of the science and ship's crews. High winds during the nighttime MOCNESS sampling forced postponement of some samples, so nighttime MOCNESS samples were not all collected on the same night.

III. Contact Information

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Table 1. Sampling locations

StationID	Campaign	Latitude	Longitude	Water Depth
as03	Axial	38.99750	-76.35967	21
as04	Axial	39.05700	-76.33017	12.4
as05	Axial	39.10842	-76.30323	5.3
as06	Axial	39.16310	-76.30335	9
as07	Axial	39.20717	-76.25295	7.5
as08	Axial	39.26148	-76.23610	9.1
as09	Axial	39.30942	-76.21962	9.8
as10	Axial	39.34710	-76.17215	7.5
as11	Axial	39.37490	-76.11537	10
as12	Axial	39.39778	-76.05027	9.1
as13c	Axial	39.4397	-76.0237	3.4
anchor1 (btw as10 & as11)	Anchor	39.3702	-76.1213	8
anchor2 (as13c)	Anchor	39.4393	-76.0242	10
anchor3 (as03)	Anchor	39.0693	-76.3213	4.3

Table 2. Biological and Chemical analyses

Measurements	Axial samples	Particle fractions	DIPSTIC fractions	Abbreviation description
NH4	X			Ammonia
SRP	X			Inorganic Dissolved P
NO3+NO2, DSi	X			Nitrate+Nitrite, dissolved silica
DOC	X			Dissolved Organic Carbon
TDN, TDP	X			Dissolved Nitrogen, Dissolved Phosphorous
TSS	X			Total Suspended Sediment
ChlA	X	X	X	Chlorophyll a
POC, PON	X	X	X	Carbon, Hydrogen, Nitrogen
TPP	X	X	X	Total Particulate Phosphorous
IPP	X	X	X	Inorganic Particulate Phosphorous
TEP	X	X	X	Transparent Extra cellular Polysaccharide
HPLC pigments	X			
BSi	X			Particulate silica, biogenic silica
Tcarb	X	X	X	Total carbohydrates
DCarb	X	X	X	Dissolved carbohydrates
Tprot	X	X	X	Total protein
Dprot	X	X	X	Dissolved protein
Tlipid	X	X	X	Total lipids
Dlipid	X	X	X	Dissolved lipids
BP	X	X	X	Bacterial production
PP	X			Primary production
Respiration	X	X		Oxygen Respiration rate
OM bioavailability				Organic Matter bioavailability
Preserved bacteria	X	X	X	
Preserved phytoplankton	X			
Preserved protists				
DNA	X	X		

Table 3. Consecutive station log.

Station	Date	Time (UTC)	Time (LMT)	Latitude (degree)	Latitude (minutes)	Longitude (degree)	Longitude (minutes)	Depth (m)	CTD #	Water Sample #s	DIPSTIC/MOC #	Other Activities	Notes
001	01/23/08	12:10	07:10	38	59.83	076	21.54	24.1	001	289,291,291			as03
002	01/23/08	13:01	08:01	39	00.93	076	21.18	14.5	002			time on sail system incorrect	as04
003	01/23/08	13:39	08:39	39	06.49	076	18.22	12.0	003				as05
004	01/23/08	14:15	09:15	39	09.80	076	18.27	11.9	004	292-294			as06
005	01/23/08	14:51	09:51	39	12.35	076	15.44	12.0	005				as07
006	01/23/08	15:25	10:25	39	15.61	076	14.21	13.9	006				as08
007	01/23/08	15:55	10:55	39	18.33	076	13.30	13.6	007	295-297			as09
008	01/23/08	16:30	11:30	39	20.79	076	10.38	13.0	008				as10
009	01/23/08	17:09	12:09	39	22.48	076	06.92	16.2	009	298-300			as11
010	01/23/08	17:48	12:48	39	23.80	076	03.16	12.1	010				as12
011	01/23/08	18:27	13:27	39	26.38	076	01.42	6.6	011	301-303			as13
012	01/23/08	21:31	16:31	39	22.21	076	07.28	11.6	012				ETM anchor
013	01/23/08	22:27	17:27	39	22.21	076	07.27	11.7	013		DS01		
014	01/23/08	23:28	18:28	39	22.24	076	07.28	12.0	014	305		-for middle water\	
015	01/23/08	23:51	18:51	39	22.24	076	07.28	12.0	015	size 17	DS02	-for surf water--	size fraction
016	01/24/08	00:10	19:10	39	22.24	076	07.28	12.1	016	size 18		-for bottom water/	
017	01/24/08	00:30	19:30	39	22.24	076	07.27	12.3	017		DS03		
018	01/24/08	01:28	20:28	39	22.23	076	07.27	12.4	018		DS04		
019	01/24/08	02:31	21:31	39	22.23	076	07.27	12.4	019		DS05		

	8												
020	01/24/08	03:29	22:29	39	22.23	076	07.28	12.3	020		DS06		
021	01/24/08	04:30	23:30	39	22.21	076	07.32	12.2	021		DS07		
022	01/24/08	05:30	00:30	39	22.22	076	07.33	12.2	022		DS08		
023	01/24/08	06:30	01:30	39	22.21	076	07.33	11.8	023		DS09, DS10		
024	01/24/08	07:39	02:39	39	22.21	076	07.34	11.9	024		DS11,DS12	CTD computer restart	
025	01/24/08	08:31	03:31	39	22.21	076	07.33	11.7	025		DS13		
026	01/24/08	09:29	04:29	39	22.21	076	07.33	11.7	026		DS14,DS15		
027	01/24/08	10:28	05:28	39	22.21	076	07.31	11.8	027		DS16		
028	01/24/08	11:27	06:27	39	22.23	076	07.29	12.1	028		DS17		
029	01/24/08	12:25	07:25	39	22.22	076	07.27	12.2	029	307 & 308			
030	01/24/08	12:43	07:43	39	22.22	076	07.28	12.1	030	size 19	DS18		
031	01/24/08	13:26	08:26	39	22.22	076	07.27	12.2	031		DS19,DS20		
032	01/24/08	14:26	9:26	39	22.23	076	07.28	12.2	032				

Table 3. Consecutive station log (continued).

Station	Date	Time (UTC)	Time (LMT)	Latitude (degree)	Latitude (minutes)	Longitude (degree)	Longitude (minutes)	Depth (m)	CTD #	Water Sample #s	DIPSTIC/MOC #	Other Activities	Notes
033	01/24/08	15:26	10:26	39	22.24	076	07.32	12.7	033		DS21,DS22		
034	01/24/08	16:23	11:23	39	22.20	076	07.32	12.1	034		DS23		
035	01/24/08	17:27	12:27	39	22.21	076	07.33	12.2	035		DS24,DS25		
036	01/24/08	18:27	13:27	39	22.22	076	07.34	12.0	036		DS26,DS27		
037	01/24/08	19:27	14:27	39	22.21	076	07.33	11.7	037		DS28		
038	01/24/08	20:26	15:26	39	22.21	076	07.33	11.7	038		DS29		
039	01/24/08	21:26	16:26	39	22.20	076	07.32	11.6	039		DS30,DS31		
040	01/24/08	22:28	17:28	39	22.20	076	07.30	11.6	040		DS32		
041	01/25/08	23:33	18:33	39	22.19	076	07.30	11.7	041				
042	01/25/08	00:42	19:42	39	26.32	076	01.36	6.2	042		1		
043	01/25/08	02:03	21:03	39	22.47	076	06.97	16.2	043		2		
044	01/25/08	03:23	22:23	39	18.40	076	13.24	13.8	044		3		
045	01/25/08	04:47	23:46	39	12.47	076	15.23	12.2	045		X	No MOC b/c weather	
046	01/25/08	05:43	00:43	39	06.25	076	18.19	9.4	046				
047	01/25/08	06:36	01:48	38	59.89	076	21.62	22.8	047				
048	01/25/08	13:14	08:14	38	59.83	076	21.58	23.8	048	310-312	4		as03
049	01/25/08	14:58	09:58	39	06.53	076	18.22	11.8	049		5		as05
050	01/25/08	16:09	11:09	39	12.33	076	15.47	12.8	050		6		as07

051	01/25/08	17:16	12:16	39	18.54	076	13.21	13.8	051		7		as09
052	01/25/08	18:27	13:27	39	22.52	076	06.91	16.6	052	313-315	8		as11
053	01/25/08	19:35	14:35	39	26.37	076	01.40	6.7	053	316-318	10	MOC#9 not kept	as13
054	01/25/08	20:58	15:58	39	26.36	076	01.45	6.6	054	size 20			
055	01/25/08	21:15	16:15	39	26.39	076	01.44	6.6	055		DS34		
056	01/25/08	22:00	17:00	39	26.37	076	01.44	6.6	056		DS35		
057	01/25/08	22:59	17:59	39	26.37	076	01.44	6.7	057				
058	01/26/08	00:02	19:02	39	26.38	076	01.44	6.7	058				
059	01/26/08	01:00	20:00	39	26.38	076	01.45	6.8	059				
060	01/26/08	03:35	22:35	39	12.56	076	15.23	13.2	-		11		as07
061	01/26/08	04:56	23:56	39	06.25	076	18.06	11.9	-		12		as05
062	01/26/08	05:54	00:54	38	59.86	076	21.43	22.3	-		13		as03
063	01/26/08	07:00	02:00	39	04.16	076	19.28	12.6	060	size 21	DS37	Anchor 3 - Down ES	
064	01/26/08	07:59	02:59	39	04.17	076	19.29	13.0	061		DS38,DS39		

Table 3. Consecutive station log (continued).

Station	Date	Time (UTC)	Time (LMT)	Latitude (degree)	Latitude (minutes)	Longitude (degree)	Longitude (minutes)	Depth (m)	CTD #	Water Sample #s	DIPSTIC/MOC #	Other Activities	Notes
065	01/26/08	08:57	03:57	39	04.17	076	19.28	12.6	062		DS40		
066	01/26/08	10:00	05:00	39	04.16	076	19.27	12.7	063				
067	01/26/08	11:31	06:31	38	59.81	076	21.65	23.8	064	321-323			as03
068	01/26/08	12:28	07:28	39	03.32	076	19.90	13.7	065				as04
069	01/26/08	12:55	07:55	39	06.47	076	18.18	12.2	066				as05
070	01/26/08	13:23	08:23	39	09.74	076	18.33	13.1	067	324-326		and CTD 068-needed	as06
071	01/26/08	13:53	08:53	39	12.36	076	15.42	12.5	069			another surface bottle	as07
072	01/26/08	14:20	09:20	39	15.62	076	14.18	13.9	070				as08
073	01/26/08	14:42	09:42	39	18.42	076	13.22	13.8	071	327-329			as09
074	01/26/08	15:09	10:09	39	20.85	076	10.23	13.0	072				as10
075	01/26/08	15:32	10:32	39	22.60	076	06.75	16.1	073	330-332			as11
076	01/26/08	15:57	10:57	39	23.78	076	03.28	14.4	074				as12
077	01/26/08	16:23	11:23	39	26.29	076	01.46	7.1	075	333-335			as13

Figure 1. CTD results from first axial survey.

