APPENDIX A

Littoral Processes

Sediment Transport Flux Rate Sensitivity to Wave Direction and Wave Height

The sediment transport flux rate is sensitive to changes in wave climate (Fig A-1). Two potential sources of error in estimating sediment transport potential are examined: change in wave direction and change in wave height.

Wave direction was adjusted by 2° to determine sensitivity of wave direction on net and gross transport rates. At Nags Head, a +2° change in direction means that waves originate from a 2° more southerly position, while a –2° change in direction means the waves originate from a 2° more northerly position. Wave heights were modified uniformly by 10 percent to determine how sensitive net and gross sand transport rates are to change in wave heights.

Results indicate that net transport is strongly affected by moderate change in direction, while gross transport rates are relatively unaffected (Table A-1, top). Net transport rates at Nags Head may increase by 57 percent for a +2° change in direction and decrease by 57 percent for a –2° change in wave direction. Gross transport changed by ~1 percent. The findings suggest that uniform changes in wave direction affect transport rates by modifying the relative directional rates. A +2° change in wave direction causes a 5 percent increase in the gross northerly transport rate relative to gross southerly transport rate. A –2° change in direction causes a 5 percent decrease in gross northerly transport rate relative to gross southerly transport.

Uniform change in wave heights produce similar results to change in wave direction. A 10 percent decrease in overall wave heights cause a 19 percent decrease in the net transport rate, while a 10 percent increase in wave heights cause the net transport rate to increase by 21 percent (Table A-1, bottom).

Gross transport rates are similarly affected by roughly the same rates. Uniform change in wave amplitude cause no practical change in relative directional transport rates. They only amplify or reduce the magnitude of net and gross transport rates.

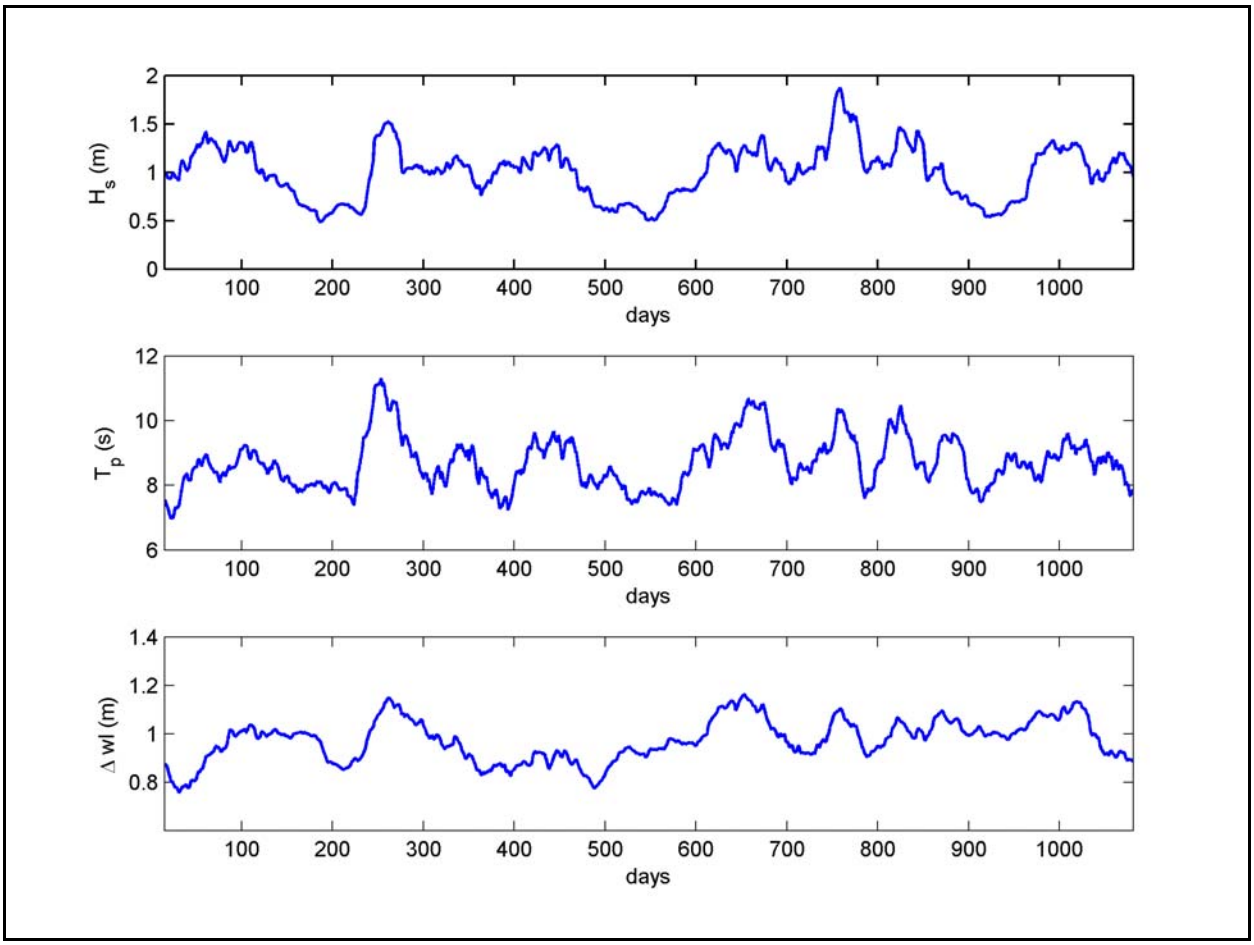

FIGURE A-1. Monthly-averaged 24-hour wave climate measured at Duck (NC) from 01-01-2003 to 12-31-2005. Significant wave height (top), peak wave period (middle), and water level fluctuation (bottom).

APPENDIX TABLE A-1. Sediment transport flux rate estimates for 2º change in wave direction (top) and 10 percent change in wave height (bottom).

Hs (m)	Tp (s)	P(event)	Wave direction (°N)	a (°)	Ql (m3/yr)	a -2o (°)	Ql (m3/yr)	a+2o (°)	Ql (m3/yr)
1.28	5.2	1.82	10-20	53	98,900	51	96,680	55	100,640
1.30	5.5	2.61	20-30	43	163,900	41	164,300	45	162,700
1.31	6.0	3.44	30-40	33	227,080	31	233,580	35	219,480
1.38	6.6	4.92	40-50	23	323,820	21	344,850	25	301,220
1.60	8.1	6.06	50-60	13	418,040	11	476,820	15	357,240
1.56	9.5	7.36	60-70	3	132,990	1	220,940	5	44,400
1.26	10.5	9.80	70-80	-7	-286,800	-9	-205,860	-5	-366,340
0.94	10.2	10.60	80-90	-17	-388,250	-19	-350,130	-15	-431,120
0.67	9.6	14.04	90-100	-27	-367,370	-29	-345,790	-25	-382,810
0.59	9.2	11.96	100-110	-37	-278,760	-39	-270,670	-35	-281,750
0.69	8.5	13.27	110-120	-47	-404,290	-49	-407,640	-45	-403,670
0.67	7.5	7.78	120-130	-57	-180,180	-59	-185,340	-55	-174,150
					-540,920		-228,260		-854,160

Hs (m)	Tp (s)	P(event)	Wave direction (°N)	a (°)	Ql (m3/yr)	10% dec Hs (m)	Ql (m3/yr)	10% inc Hs (m)	Ql (m3/yr)
1.28	5.2	1.82	10-20	53	98,900	1.27	80,110	1.41	119,670
1.30	5.5	2.61	20-30	43	163,900	1.29	132,760	1.43	198,320
1.31	6.0	3.44	30-40	33	227,080	1.30	183,940	1.44	274,770
1.38	6.6	4.92	40-50	23	323,820	1.37	262,300	1.52	391,830
1.60	8.1	6.06	50-60	13	418,040	1.58	338,620	1.76	505,830
1.56	9.5	7.36	60-70	3	132,990	1.54	107,730	1.72	160,920
1.26	10.5	9.80	70-80	-7	-286,800	1.25	-232,310	1.39	-347,020
0.94	10.2	10.60	80-90	-17	-388,250	0.93	-317,180	1.03	-473,810
0.67	9.6	14.04	90-100	-27	-367,370	0.67	-295,800	0.74	-441,880
0.59	9.2	11.96	100-110	-37	-278,760	0.59	-224,280	0.65	-335,030
0.69	8.5	13.27	110-120	-47	-404,290	0.68	-329,380	0.76	-492,040
0.67	7.5	7.78	120-130	-57	-180,180	0.66	-145,950	0.74	-218,020
					-540,920		-439,440		-656,460