

**Table S1:** Seasonal surface area (*S*), fresh water discharge (*Q*), residence time (*Rt*), *FCO<sub>2</sub>* and *NEM* of all simulated estuaries. W, Sp, Su, F correspond to winter, spring, summer and fall, respectively.

System name	long degrees	lat degree	Season	$Q$ $m^3 s^{-1}$	$T$ $^{\circ}C$	$\overline{FCO_2}$ $mol\ C\ m^{-2}\ yr^{-1}$	$\overline{NEM}$ $mol\ C\ m^{-2}\ yr^{-1}$	$FCO_2$ $10^6\ mol\ C\ yr^{-1}$	$NEM$ $10^6\ mol\ C\ yr^{-1}$
<b>NAR</b>									
-	-67.25	44.75	W	29.4	3.52	5.2	-19.7	9	-34
	-67.25	44.75	Sp	97.4	5.6	2.6	-31.5	5	-55
	-67.25	44.75	Su	26.2	11	2.7	-56.0	5	-98
	-67.25	44.75	F	46.6	9	4.3	-42.3	8	-74
-	-67.25	45.25	W	56.2	3.52	6.8	-31.9	19	-88
	-67.25	45.25	Sp	186.2	5.6	4.1	-51.9	11	-144
	-67.25	45.25	Su	50.1	11	5.9	-77.7	16	-215
	-67.25	45.25	F	89.1	9	7.3	-65.2	20	-181
-	-67.25	45.25	W	56.2	3.52	14.4	-31.9	40	-88
	-67.25	45.25	Sp	186.2	5.6	11.2	-51.8	31	-144
	-67.25	45.25	Su	50.1	11	11.3	-77.7	31	-215
	-67.25	45.25	F	89.1	9	18.1	-65.1	50	-181
-	-67.75	44.75	W	55.8	3.52	7.9	-33.7	7	-29
	-67.75	44.75	Sp	184.9	5.6	10.0	-41.8	9	-36
	-67.75	44.75	Su	49.8	11	2.7	-103.4	2	-89
	-67.75	44.75	F	88.5	9	6.0	-75.1	5	-65
<b>Penobscot</b>									
	-68.25	44.75	W	53	3.52	5.3	-30.0	18	-100
	-68.25	44.75	Sp	175.8	5.6	2.6	-43.1	9	-144
	-68.25	44.75	Su	47.3	11	3.9	-87.9	13	-294
	-68.25	44.75	F	84.1	9	4.7	-63.9	16	-214
<b>Kennebec</b>									
	-68.75	44.75	W	236.2	3.52	20.3	-31.5	418	-648
	-68.75	44.75	Sp	783.5	5.6	16.4	-51.4	337	-1057
	-68.75	44.75	Su	210.9	11	39.5	-83.3	813	-1712
	-68.75	44.75	F	374.8	9	33.3	-66.5	685	-1367
-	-69.75	44.25	W	473.5	3.52	28.2	-44.0	323	-505
	-69.75	44.25	Sp	1570.	5.6	17.6	-61.1	202	-701
	-69.75	44.25	Su	422.8	11	40.0	-107.3	459	-1230
	-69.75	44.25	F	751.1	9	43.3	-85.3	497	-978
-	-70.25	43.75	W	19.7	0	3.4	-19.4	3	-16
	-70.25	43.75	Sp	65.3	0	1.8	-22.5	1	-18
	-70.25	43.75	Su	17.6	0	1.0	-21.2	1	-17
	-70.25	43.75	F	31.3	0	2.5	-21.1	2	-17
-	-70.75	41.75	W	34.1	5	4.7	-2.8	315	-184
	-70.75	41.75	Sp	70.5	8	4.4	-3.8	295	-253
	-70.75	41.75	Su	16.2	16	5.0	-5.2	336	-350
	-70.75	41.75	F	35.2	10	5.7	-4.1	379	-276
<b>Merrimack</b>									
	-70.75	42.25	W	162.8	5	12.5	-20.1	190	-305
	-70.75	42.25	Sp	226.8	9	9.9	-29.0	150	-439
	-70.75	42.25	Su	51.3	18	25.5	-48.6	387	-737
	-70.75	42.25	F	116.5	10	16.9	-34.0	256	-515
<b>MAR</b>									
-	-70.75	43.25	W	165.9	4	16.5	-20.8	119	-151
	-70.75	43.25	Sp	231.2	7	15.6	-29.3	112	-212
	-70.75	43.25	Su	52.3	14	32.5	-61.6	235	-445
	-70.75	43.25	F	118.7	9	21.9	-37.8	158	-273
-	-71.25	41.75	W	32	5	3.2	-1.6	193	-93
	-71.25	41.75	Sp	66.3	8	3.9	-2.5	237	-151
	-71.25	41.75	Su	15.3	16	4.0	-3.4	241	-202
	-71.25	41.75	F	33.1	10	4.4	-2.7	263	-162
-	-71.75	41.25	W	127	5	53.8	-17.2	261	-84
	-71.75	41.25	Sp	262.9	8	17.8	-26.1	86	-126
	-71.75	41.25	Su	60.5	16	35.8	-54.9	174	-266
	-71.75	41.25	F	131.2	10	33.5	-32.2	162	-156
-	-72.75	40.75	W	28.9	5	31.5	-15.9	150	-76

	-72.75	40.75	Sp	59.9	10	11.5	-28.6	55	-136
	-72.75	40.75	Su	13.8	21	9.9	-19.6	47	-93
	-72.75	40.75	F	29.9	13	69.8	-20.4	333	-97
-	-72.75	41.25	W	157.7	5	167.3	-20.0	407	-49
	-72.75	41.25	Sp	326.5	8	12.0	-32.3	29	-79
	-72.75	41.25	Su	75.2	16	28.8	-58.9	70	-143
	-72.75	41.25	F	163	10	395.1	-36.4	962	-89
Connecticut	-72.75	41.75	W	509.4	5	52.3	-25.2	679	-327
	-72.75	41.75	Sp	1054.	8	48.8	-43.7	633	-566
	-72.75	41.75	Su	242.9	16	68.1	-68.6	884	-890
	-72.75	41.75	F	526.5	10	54.3	-45.2	704	-586
Hudson	-74.25	40.75	W	835.2	5	14.2	-10.1	3927	-2800
	-74.25	40.75	Sp	1128.	10	17.7	-12.7	4905	-3511
	-74.25	40.75	Su	329.3	21	14.1	-12.4	3907	-3426
	-74.25	40.75	F	680.8	13	15.8	-12.0	4384	-3313
-	-75.25	37.75	W	141.3	9	18.0	-5.4	1715	-516
	-75.25	37.75	Sp	157.7	14	17.0	-5.9	1615	-557
	-75.25	37.75	Su	40	24	7.1	-4.3	672	-405
	-75.25	37.75	F	88.4	16	13.6	-4.7	1294	-442
-	-75.25	38.75	W	55.9	5	8.9	-2.7	729	-224
	-75.25	38.75	Sp	62.4	13	8.4	-2.9	685	-240
	-75.25	38.75	Su	15.8	23	5.1	-3.5	422	-286
	-75.25	38.75	F	35	14	7.6	-3.0	628	-247
Delaware	-75.25	39.75	W	664.7	5	9.3	-6.7	3730	-2667
	-75.25	39.75	Sp	726.6	12	9.4	-7.0	3783	-2812
	-75.25	39.75	Su	307.6	22	10.5	-9.4	4205	-3778
	-75.25	39.75	F	529.6	13	10.5	-8.2	4225	-3294
-	-75.75	39.25	W	32.1	5	7.9	-2.4	409	-125
	-75.75	39.25	Sp	35.8	12	7.9	-2.6	410	-134
	-75.75	39.25	Su	9.1	22	5.3	-3.6	275	-185
	-75.75	39.25	F	20.1	13	9.0	-2.9	467	-150
Susquehann	-76.25	39.25	W	1259.	5	10.6	-6.1	8381	-4836
	-76.25	39.25	Sp	1404.	12	10.4	-6.7	8234	-5290
	-76.25	39.25	Su	356.2	22	4.3	-3.1	3396	-2447
	-76.25	39.25	F	788	13	7.0	-4.4	5508	-3444
Potomac	-76.75	38.75	W	538.1	5	28.7	-16.9	3831	-2258
	-76.75	38.75	Sp	443.1	13	19.9	-13.7	2655	-1827
	-76.75	38.75	Su	154.4	23	7.8	-5.7	1037	-766
	-76.75	38.75	F	205.5	14	10.4	-6.8	1382	-906
-	-76.75	37.75	W	75.3	9	16.2	-8.2	589	-296
	-76.75	37.75	Sp	62	14	12.0	-6.9	437	-249
	-76.75	37.75	Su	21.6	24	7.7	-6.4	280	-233
	-76.75	37.75	F	28.8	16	7.0	-5.1	255	-187
-	-76.75	39.25	W	147.7	5	48.0	-28.8	650	-390
	-76.75	39.25	Sp	121.7	12	51.5	-33.7	698	-457
	-76.75	39.25	Su	42.4	22	50.2	-43.3	681	-587
	-76.75	39.25	F	56.4	13	44.8	-32.7	608	-444
-	-77.25	38.25	W	62.6	5	10.8	-4.7	525	-226
	-77.25	38.25	Sp	51.6	13	6.5	-3.8	315	-185
	-77.25	38.25	Su	18	23	3.5	-2.4	170	-115
	-77.25	38.25	F	23.9	14	3.7	-2.3	181	-111
James River	-77.75	37.25	W	481.3	9	21.6	-13.8	2969	-1905
	-77.75	37.25	Sp	334.7	14	14.9	-9.7	2046	-1334
	-77.75	37.25	Su	208	24	13.2	-10.0	1813	-1374
	-77.75	37.25	F	206.4	16	10.6	-8.1	1459	-1110
SAB									
-	-78.25	34.25	W	229.3	21	129.4	-70.2	1444	-783
	-78.25	34.25	Sp	226.7	24	141.5	-69.0	1578	-770
	-78.25	34.25	Su	120.5	28	94.1	-50.6	1050	-565
	-78.25	34.25	F	144.8	25	125.1	-59.9	1396	-669
-	-79.25	33.25	W	104.7	17	51.2	-36.7	560	-402

	-79.25	33.25	Sp	59.6	22	32.6	-24.3	357	-266
	-79.25	33.25	Su	43.7	27	49.5	-49.5	541	-541
	-79.25	33.25	F	45.7	22	40.5	-35.5	443	-389
Pee Dee	-79.25	33.75	W	400.1	17	81.7	-84.7	853	-885
	-79.25	33.75	Sp	395.5	22	97.7	-87.6	1020	-915
	-79.25	33.75	Su	210.2	27	77.3	-72.2	807	-754
	-79.25	33.75	F	252.7	22	83.9	-70.2	876	-732
-	-79.75	33.25	W	62.8	17	39.1	-35.7	233	-212
	-79.75	33.25	Sp	35.8	22	31.4	-20.5	187	-122
	-79.75	33.25	Su	26.2	27	39.5	-39.3	235	-234
	-79.75	33.25	F	27.4	22	41.6	-35.8	248	-213
-	-80.25	32.75	W	57.7	17	61.6	-39.8	357	-231
	-80.25	32.75	Sp	32.8	22	35.4	-27.5	205	-159
	-80.25	32.75	Su	24.1	27	51.7	-61.1	300	-354
	-80.25	32.75	F	25.2	21	46.5	-41.7	269	-242
Santee	-80.25	33.25	W	140.5	17	86.6	-89.3	1845	-1901
	-80.25	33.25	Sp	79.9	22	57.6	-52.8	1227	-1125
	-80.25	33.25	Su	58.6	27	54.3	-53.7	1157	-1144
	-80.25	33.25	F	61.3	22	52.3	-48.9	1115	-1042
Roanoke	-80.75	32.25	W	39.3	17	13.2	-5.7	223	-95
	-80.75	32.25	Sp	22.4	22	11.1	-4.1	188	-69
	-80.75	32.25	Su	16.4	27	15.8	-11.1	267	-187
	-80.75	32.25	F	17.2	21	11.4	-7.3	191	-123
-	-80.75	32.75	W	117.5	17	24.8	-12.6	945	-479
	-80.75	32.75	Sp	66.9	22	17.7	-7.4	672	-281
	-80.75	32.75	Su	49	27	23.0	-15.1	873	-575
	-80.75	32.75	F	51.2	21	17.0	-10.9	646	-414
-	-81.25	31.75	W	98.5	14	26.8	-20.6	572	-441
	-81.25	31.75	Sp	97.3	22	25.3	-19.0	540	-406
	-81.25	31.75	Su	51.7	28	25.3	-23.5	541	-502
	-81.25	31.75	F	62.2	20	25.2	-20.6	539	-440
Savannah	-81.25	32.25	W	521.3	17	52.0	-41.3	1575	-1252
	-81.25	32.25	Sp	515.3	22	61.9	-41.9	1874	-1267
	-81.25	32.25	Su	273.8	27	46.2	-38.4	1397	-1162
	-81.25	32.25	F	329.2	21	46.8	-35.0	1416	-1061
-	-81.75	30.75	W	25.7	21	15.4	-11.6	123	-93
	-81.75	30.75	Sp	25.4	25	13.1	-9.1	105	-73
	-81.75	30.75	Su	13.5	28	23.4	-22.2	188	-178
	-81.75	30.75	F	16.2	25	18.1	-15.7	146	-126
-	-81.75	31.25	W	24.4	14	4.4	-3.0	132	-90
	-81.75	31.25	Sp	24.1	22	4.6	-3.1	140	-92
	-81.75	31.25	Su	12.8	28	7.4	-6.0	225	-180
	-81.75	31.25	F	15.4	20	5.5	-4.1	165	-123
Althamaha	-81.75	31.75	W	479.2	14	48.8	-41.7	636	-543
	-81.75	31.75	Sp	473.7	22	81.9	-84.7	1066	-1104
	-81.75	31.75	Su	251.7	28	98.8	-80.4	1287	-1047
	-81.75	31.75	F	302.7	20	61.5	-62.8	801	-818