

Table S1 Effects of intensification of tropical cyclones, and increased sea level rise and storm surges on wave height on the reef flat at the study site.

Case	SWH _o (m)	SWP _o (s)	SLR (m)	Tide relative to present MSL (m)	Storm surge (m)	SWH _r at degraded reef (m)	Effect of increasing of intensity of tropical cyclone to SWH _r at degraded reef (%)*	SWH _r at healthy reef (m)	Effect of increasing of intensity of tropical cyclone to SWH _r at healthy reef (%)*
Effect of increasing of intensity of tropical cyclone									
3	8.70	13.0	0.24	0.80	0.00	1.11		0.88	
7	10.0	14.0				1.45	30.6%	1.21	37.5%
11	11.0	15.0				1.31	18.0%	1.49	69.3%
4	8.70	13.0	0.24	0.80	1.00	1.37		1.22	
8	10.0	14.0				1.57	14.6%	1.52	24.6%
12	11.0	15.0				1.93	40.9%	1.66	36.1%
5	8.70	13.0	0.30	0.80	0.00	0.97		1.09	
9	10.0	14.0				1.51	55.7%	1.46	33.9%
13	11.0	15.0				1.53	57.7%	1.50	37.6%
6	8.70	13.0	0.30	0.80	1.00	1.33		1.35	
10	10.0	14.0				1.67	25.6%	1.26	-6.7%
14	11.0	15.0				2.14	60.9%	1.70	25.9%
15	8.70	13.0	0.44	0.80	0.00	1.07		1.06	
21	10.0	14.0				1.54	43.9%	1.33	25.5%
25	11.0	15.0				1.63	52.3%	1.40	32.1%
16	8.70	13.0	0.44	0.80	1.00	1.32		1.21	
22	10.0	14.0				1.87	41.7%	1.45	19.8%
26	11.0	15.0				1.97	49.2%	1.77	46.3%
17	8.70	13.0	0.74	0.80	0.00	1.34		1.11	
23	10.0	14.0				1.48	10.4%	1.18	6.3%
27	11.0	15.0				1.68	25.4%	1.77	59.5%
18	8.70	13.0	0.74	0.80	1.00	1.24		1.40	
24	10.0	14.0				1.59	28.2%	1.64	17.1%
28	11.0	15.0				1.92	54.8%	1.66	18.6%
20	8.70	13.0	0.98	0.80	1.00	1.47		1.30	
29	11.0	15.0				2.00	36.1%	1.80	38%
						Mean	38.0%	Mean	30.7%
						SD	16.0%	SD	18.2%
Effect of sea level rise									
1	8.70	13.0	0.00	0.80	0.00	-		1.05	
3			0.24			1.11		0.88	-16.2%
5			0.30			0.97	-12.6%	1.09	3.8%
15			0.44			1.07	-3.6%	1.06	1.0%
17			0.74			1.34	20.7%	1.11	5.7%
19			0.98			1.28	15.3%	1.12	6.7%
2	8.70	13.0	0.00	0.80	1.00	-		1.24	
4			0.24			1.37		1.22	-1.6%
6			0.30			1.33	-2.9%	1.35	8.9%
16			0.44			1.32	-3.6%	1.21	-2.4%
18			0.74			1.24	-9.5%	1.40	12.9%
20			0.98			1.47	7.3%	1.30	4.8%
7	10.0	14.0	0.24	0.80	0.00	1.45		1.21	
9			0.30			1.51	4.1%	1.46	20.7%
21			0.44			1.54	6.2%	1.33	9.9%
23			0.74			1.48	2.1%	1.18	-2.5%
8	10.0	14.0	0.24	0.80	1.00	1.57		1.52	
10			0.30			1.67	6.4%	1.26	-17.1%
22			0.44			1.87	19.1%	1.45	-4.6%
24			0.74			1.59	1.3%	1.64	7.9%

11	11.0	15.0	0.24	0.80	0.00	1.31		1.49	
13			0.30			1.53	16.8%	1.50	0.7%
25			0.44			1.63	24.4%	1.40	-6.0%
27			0.74			1.68	28.2%	1.77	18.8%
12	11.0	15.0	0.24	0.80	1.00	1.93		1.66	
14			0.30			2.14	10.9%	1.70	2.4%
26			0.44			1.97	2.1%	1.77	6.6%
28			0.74			1.92	-0.5%	1.66	0.0%
29			0.98			2.00	3.6%	1.80	8.4%
						Mean	6.5%	Mean	3.0%
						SD	11.0%	SD	9.2%

Case	SWH _o (m)	SWP _o (s)	SLR (m)	Tide relative to present MSL (m)	Storm surge (m)	SWH _r at degraded reef (m)	Effect of storm surge to SWH _r at degraded reef (%)*	SWH _r at healthy reef (m)	Effect of storm surge to SWH _r at healthy reef (%)*
Effect of storm surge									
1	8.70	13.0	0.00	0.80	0.00	-		1.05	
2					1.00	-		1.24	18.1%
3	8.70	13.0	0.24	0.80	0.00	1.11		0.88	
4					1.00	1.37	23.4%	1.22	38.6%
5	8.70	13.0	0.30	0.80	0.00	0.97		1.09	
6					1.00	1.33	37.1%	1.35	23.9%
7	10.0	14.0	0.24	0.80	0.00	1.45		1.21	
8					1.00	1.57	8.3%	1.52	25.6%
9	10.0	14.0	0.30	0.80	0.00	1.51		1.46	
10					1.00	1.67	10.6%	1.26	-13.7%
11	11.0	15.0	0.24	0.80	0.00	1.31		1.49	
12					1.00	1.93	47.3%	1.66	11.4%
13	11.0	15.0	0.30	0.80	0.00	1.53		1.50	
14					1.00	2.14	39.9%	1.70	13.3%
15	8.70	13.0	0.44	0.80	0.00	1.07		1.06	
16					1.00	1.32	23.4%	1.21	14.2%
17	8.70	13.0	0.74	0.80	0.00	1.34		1.11	
18					1.00	1.24	-7.5%	1.40	26.1%
19	8.70	13.0	0.98	0.80	0.00	1.28		1.12	
20					1.00	1.47	14.8%	1.30	16.1%
21	10.0	14.0	0.44	0.80	0.00	1.54		1.33	
22					1.00	1.87	21.4%	1.45	9.0%
23	10.0	14.0	0.74	0.80	0.00	1.48		1.18	
24					1.00	1.59	7.4%	1.64	39.0%
25	11.0	15.0	0.44	0.80	0.00	1.63		1.40	
26					1.00	1.97	20.9%	1.77	26.4%
27	11.0	15.0	0.74	0.80	0.00	1.68		1.77	
28					1.00	1.92	14.3%	1.66	-6.2%
						Mean	20.1%	Mean	17.3%
						SD	14.9%	SD	14.8%

SWH_o: significant wave height at outer ocean

SWP_o: significant wave period at outer ocean

SLR: sea level rise, based on RCP scenarios 2.6 and 8.5 (Church et al., 2013).

MSL: mean sea level

SWH_r: significant wave height at reef flat

* The value is relative to a base value which is shown in bold

Table S2 Effects of intensification of tropical cyclones, and increased sea level rise and storm surges on water level at the shore at the study site.

Case	SWH _o (m)	SWP _o (s)	SLR (m)	Tide relative to present MSL (m)	Storm surge (m)	WL _s at degraded reef (m)	Effect of increasing of intensity of tropical cyclone to WL _s at degraded reef (%)*	WLs at healthy reef (m)	Effect of increasing of intensity of tropical cyclone to WL _s at healthy reef (%)*
Effect of increasing of intensity of tropical cyclone									
32	8.70	13.0	0.24	0.80	0.00	1.19		1.24	
36	10.0	14.0				1.58	32.8%	1.55	25.0%
40	11.0	15.0				1.87	57.1%	1.90	53.2%
33	8.70	13.0	0.24	0.80	1.00	2.30		2.29	
37	10.0	14.0				2.44	6.1%	2.53	10.5%
41	11.0	15.0				2.87	24.8%	2.86	24.9%
34	8.70	13.0	0.30	0.80	0.00	1.30		1.41	
38	10.0	14.0				1.54	18.5%	1.64	16.3%
42	11.0	15.0				1.97	51.5%	1.99	41.1%
35	8.70	13.0	0.30	0.80	1.00	2.42		2.35	
39	10.0	14.0				2.55	5.4%	2.54	8.1%
43	11.0	15.0				2.89	19.4%	2.89	23.0%
44	8.70	13.0	0.44	0.80	0.00	1.50		1.52	
50	10.0	14.0				1.82	21.3%	1.81	19.1%
54	11.0	15.0				2.07	38.0%	2.12	39.5%
45	8.70	13.0	0.44	0.80	1.00	2.49		2.50	
51	10.0	14.0				2.70	8.4%	2.69	7.6%
55	11.0	15.0				3.00	20.5%	2.98	19.2%
46	8.70	13.0	0.74	0.80	0.00	1.82		1.90	
52	10.0	14.0				2.09	14.8%	2.07	8.9%
56	11.0	15.0				2.41	32.4%	2.45	28.9%
47	8.70	13.0	0.74	0.80	1.00	2.81		2.83	
53	10.0	14.0				2.97	5.7%	2.96	4.6%
57	11.0	15.0				3.23	14.9%	3.32	17.3%
49	8.70	13.0	0.98	0.80	1.00	3.00		3.01	
58	11.0	15.0				3.45	15.0%	3.51	16.6%
						Mean	22.7%	Mean	21.4%
						SD	15.3%	SD	13.3%
Effect of sea level rise									
30	8.70	13.0	0.00	0.80	0.00	-		0.86	
32			0.24			1.19		1.24	44.2%
34			0.30			1.30	9.2%	1.41	64.0%
44			0.44			1.50	26.1%	1.52	76.7%
46			0.74			1.82	52.9%	1.90	120.9%
48			0.98			2.06	73.1%	2.12	146.5%
31	8.70	13.0	0.00	0.80	1.00	-		2.10	
33			0.24			2.30		2.29	9.0%
35			0.30			2.42	5.2%	2.35	11.9%
45			0.44			2.49	8.3%	2.50	19.0%
47			0.74			2.81	22.2%	2.83	34.8%
49			0.98			3.00	30.4%	3.01	43.3%
36	10.0	14.0	0.24	0.80	0.00	1.58		1.55	
38			0.30			1.54	-2.5%	1.64	5.8%
50			0.44			1.82	15.2%	1.81	16.8%

52			0.74			2.09	32.3%	2.07	33.5%
37	10.0	14.0	0.24	0.80	1.00	2.44		2.53	
39			0.30			2.55	4.5%	2.54	0.4%
51			0.44			2.70	10.7%	2.69	6.3%
53			0.74			2.97	21.7%	2.96	17.0%
40	11.0	15.0	0.24	0.80	0.00	1.87		1.90	
42			0.30			1.97	5.3%	1.99	4.7%
54			0.44			2.07	10.7%	2.12	11.6%
56			0.74			2.41	28.9%	2.45	28.9%
41	11.0	15.0	0.24	0.80	1.00	2.87		2.86	
43			0.30			2.89	0.7%	2.89	1.0%
55			0.44			3.00	4.5%	2.98	4.2%
57			0.74			3.23	12.5%	3.32	16.1%
58			0.98			3.45	20.2%	3.51	22.7%
						Mean	18.7%	Mean	32.2%
						SD	18.1%	SD	37.8%

Case	SWH _o (m)	SWP _o (s)	SLR (m)	Tide relative to present MSL (m)	Storm surge (m)	WL _s at degraded reef (m)	Effect of storm surge to WL _s at degraded reef (%)*	WLs at healthy reef (m)	Effect of storm surge to WL _s at healthy reef (%)*
Effect of storm surge									
30	8.70	13.0	0.00	0.80	0.00	-		0.86	
31					1.00	-		2.10	144.2%
32	8.70	13.0	0.24	0.80	0.00	1.19		1.24	
33					1.00	2.30	93.3%	2.29	84.7%
34	8.70	13.0	0.30	0.80	0.00	1.30		1.41	
35					1.00	2.42	86.2%	2.35	66.7%
36	10.0	14.0	0.24	0.80	0.00	1.58		1.55	
37					1.00	2.44	54.4%	2.53	63.2%
38	10.0	14.0	0.30	0.80	0.00	1.54		1.64	
39					1.00	2.55	65.6%	2.54	54.9%
40	11.0	15.0	0.24	0.80	0.00	1.87		1.90	
41					1.00	2.87	53.5%	2.86	50.5%
42	11.0	15.0	0.30	0.80	0.00	1.97		1.99	
43					1.00	2.89	46.7%	2.89	45.2%
44	8.70	13.0	0.44	0.80	0.00	1.50		1.52	
45					1.00	2.49	66.0%	2.50	64.5%
46	8.70	13.0	0.74	0.80	0.00	1.82		1.90	
47					1.00	2.81	54.4%	2.83	48.9%
48	8.70	13.0	0.98	0.80	0.00	2.06		2.12	
49					1.00	3.00	45.6%	3.01	42.0%
50	10.0	14.0	0.44	0.80	0.00	1.82		1.81	
51					1.00	2.70	48.4%	2.69	48.6%
52	10.0	14.0	0.74	0.80	0.00	2.09		2.07	
53					1.00	2.97	42.1%	2.96	43.0%
54	11.0	15.0	0.44	0.80	0.00	2.07		2.12	
55					1.00	3.00	44.9%	2.98	40.6%
56	11.0	15.0	0.74	0.80	0.00	2.41		2.45	
57					1.00	3.23	34.0%	3.32	35.5%
						Mean	56.5%	Mean	59.5%
						SD	17.2%	SD	27.7%

SWH_o: significant wave height at outer ocean

SWP_o: significant wave period at outer ocean

SLR: sea level rise, based on RCP scenarios 2.6 and 8.5 (Church et al., 2013).

MSL: mean sea level

SWH_r: significant wave height at reef flat

* The value is relative to a base value which is shown in bold