Table 1. Relation of littoral sand grain size to shoreline aspect (wind and wave exposure) in Hawaii.

[modified from Moberly and Chamberlain, 1964; phi, phi units; mm, millimeters; -, no data]

Sample characteristics	Shoreline aspect				
	Windward	Southeastern	Leeward	Northeastern	All
Kauai					
Number of samples	58	54	70	92	274
Median size (phi)	1.17	1.82	1.50	1.26	1.41
Median size (mm)	0.47	0.27	0.35	0.42	0.38
Oahu					
Number of samples	224	77	107	133	521
Median size (phi)	1.52	0.73	0.89	0.66	1.09
Median size (mm)	0.35	0.60	0.54	0.63	0.47
Maui					
Number of samples	35	0	258	81	374
Median size (phi)	2.42	-	1.79	1.21	1.72
Median size (mm)	0.18	-	0.29	0.43	0.30
All					
Number of samples	317	131	435	306	1169
Median size (phi)	1.52	1.28	1.50	1.21	1.41
Median size (mm)	0.35	0.44	0.35	0.43	0.38

Table 2. Observed maximum annually recurring significant wave heights (H_s) and the largest 10-percent ($H_{1/10}$) and 1-percent ($H_{1/100}$) wave heights for various directions around Hawaii.

[Modified from Vitousek and Fletcher, 2008; Window, degrees from true north; m, meters]

Window (degrees)		Annually recurring wave heights (meters)		
		H_s	$H_{1/10}$	$H_{1/100}$
0	30	5.9	7.4	9.8
30	60	6.0	7.6	10.0
60	90	5.1	6.5	8.5
90	120	4.3	5.5	7.2
120	150	2.8	3.5	4.6
150	180	3.0	3.8	5.0
180	210	2.4	3.0	3.9
210	240	1.6	2.0	2.7
240	270	1.5	1.9	2.5
270	300	3.7	4.7	6.2
300	330	5.9	7.5	9.9
330	360	5.8	7.4	9.7

Table 3. Range of errors in position of historical shorelines for Kauai, Oahu, and Maui.

Source of error	Magnitude range (meters)		
	Maui	Oahu	Kauai
Seasonal error (E_s)	± 1.2 - 7.1	± 3.6 - 6.2	± 2.5 - 19.9
Tidal error (E_{td})	± 1.4	± 2.5 - 3.4	± 2 - 6
T-sheet conversion error (E_c)	± 1.9 - 7.5	± 3.4 - 5.7	± 1.0 - 13.8
Digitizing error (E_d)	± 0.8 - 5.1	± 0.5 - 5.7	± 0.8 - 9.7
Pixel error (E_p)	± 0.5	± 0.5	± 0.5 - 3.41
Rectification error (E_r)	± 0.1 - 6.1	± 0.6 - 3.0	± 0.0 - 7.3
T-sheet plotting error (E_{ts})	± 5.1	± 5.1	± 5.1

Table 4. Number and range in years of historical shorelines for long- and short-term shoreline change analysis on Kauai.

	Long-term		Short-term	
Region	Number of shorelines[1]	Range in years[1]	Number of shorelines[1]	Range in years[1]
North	4 - 11	1927 - 2008	3 - 10	1950 - 2008
East	3 - 9	1927 - 2008	3 - 8	1950 - 2008
South	3 - 8	1927 - 2008	3 - 7	1950 - 2008
West	3 - 9	1927 - 2006	3 - 8	1950 - 2006

[1]Number of shorelines and range in years vary in each region

Table 5. Shoreline change trends for Kauai, Oahu, and Maui.

[km, kilometers; m/yr, meters per year]

Region	Number of transects	Beach loss (km)	Beach loss (percent)	Average rate (m/yr)		Percent eroding		Percent accreting	
				Long-term (LT)	Short-term (ST)	LT	ST	LT	ST
Kauai									
North	1104	1.7	8	-0.11 ± 0.02	-0.06 ± 0.02	76	60	23	38
East	867	1.0	6	-0.15 ± 0.02	-0.06 ± 0.02	78	63	19	33
South	790	1.9	14	-0.01 ± 0.02	0.05 ± 0.04	63	57	34	39
West	962	1.5	7	-0.13 ± 0.04	0.16 ± 0.08	64	48	33	49
Total	3723	6.0	8	-0.11 ± 0.01	0.02 ± 0.02	71	57	27	40
Oahu									
North	1287	0.2	1	-0.11 ± 0.01	-0.07 ± 0.01	73	68	25	30
East	2108	5.5	13	0.01 ± 0.01	-0.01 ± 0.01	50	54	47	44
South	1319	3.0	11	-0.04 ± 0.01	-0.03 ± 0.02	50	47	48	50
West	628	0.0	0	-0.25 ± 0.01	-0.13 ± 0.02	83	71	16	27
Total	5342	8.7	8	-0.06 ± 0.01	-0.05 ± 0.01	60	58	38	40
Maui									
North	903	0.9	6	-0.26 ± 0.02	-0.22 ± 0.03	87	74	12	16
Kihei	1011	2.1	11	-0.13 ± 0.01	-0.12 ± 0.02	83	77	16	20
West	1519	3.8	14	-0.15 ± 0.01	-0.13 ± 0.01	85	77	14	18
Total	3433	6.8	11	-0.17 ± 0.01	-0.15 ± 0.01	85	76	14	18
Hawaii (all beaches studied)									
Total	12498	21.5	9	-0.11 ± 0.01	-0.06 ± 0.01	70	63	28	34

Table 6. Maximum shoreline change rates on Kauai.

[m/yr, meters per year; max., maximum]

Region	Long-term rate (m/yr)	Location[1]	Short-term rate (m/yr)	Location[1]
North				
Max. erosion	-0.7 ± 0.6	Haena Point	-1.0 ± 2.6	Kauapea, seasonal variability
Max. accretion	0.7 ± 0.7	Hanalei Bay, near middle	0.8 ± 1.5	Kahili Beach, near Kilauea Stream
East				
Max. erosion	-0.7 ± 0.4	Aliomanu Beach, west end	-1.6 ± 0.3	Anahola, Kuaehu Point
Max. accretion	0.7 ± 0.4	Anahola Stream mouth	1.1 ± 0.6	Anahola Stream mouth
South				
Max. erosion	-1.5 ± 0.4	pocket beach near Koki Point[2]	-1.7 ± 9.9	Lawai Bay; east end, beach lost[2]
Max. accretion	1.4 ± 0.7	Waimea, east side Kikiaola Harbor	1.7 ± 0.3	Waimea, east side Kikiaola Harbor
West				
Max. erosion	-1.4 ± 0.2	Oomano, west side Kikiaola Harbor	-1.5 ± 0.3	Oomano, west side Kikiaola Harbor
Max. accretion	1.6 ± 1.8	Major's Bay, seasonal variability[2]	2.8 ± 6.2	Polihale, seasonal variability[3]

[1]Locations show n in figures 16, 17, 19, and 21.

[2]Maximum erosion or accretion for Kauai.

[3]Maximum erosion or accretion for all three islands (Kauai, Oahu, and Maui).

Table 7. Average shoreline change rates for Kauai subregions.

[m/yr, meters per year]

Region	Subregion	Number of transects	Average rate (m/yr)	
			Long-term	Short-term
North	Kilauea	546	-0.13 ± 0.03	-0.09 ± 0.04
	Hanalei	212	0.11 ± 0.03	0.10 ± 0.03
	Haena	346	-0.23 ± 0.03	-0.12 ± 0.03
East	Lihue	267	-0.15 ± 0.02	-0.02 ± 0.03
	Kapaa	315	-0.17 ± 0.02	-0.08 ± 0.02
	Anahola	285	-0.13 ± 0.04	-0.07 ± 0.05
South	Waimea	128	0.74 ± 0.05	0.95 ± 0.04
	Hanapepe	360	-0.16 ± 0.03	-0.15 ± 0.04
	Poipu	123	-0.15 ± 0.04	-0.12 ± 0.05
	Mahaulepu	179	-0.15 ± 0.03	-0.08 ± 0.13
West	Polihale	272	-0.14 ± 0.07	0.37 ± 0.11
	Barking Sands	585	-0.04 ± 0.06	0.18 ± 0.11
	Oomano	105	-0.64 ± 0.03	-0.44 ± 0.02

Table 8. Number and range in years of historical shorelines for long- and short-term shoreline change analysis on Oahu.

	Long-term		Short-term	
Region	Number of shorelines[1]	Range in years[1]	Number of shorelines[1]	Range in years[1]
North	5 - 11	1910 - 2007	5 - 8	1949 - 2007
East	4 - 12	1911 - 2006	3 - 10	1949 - 2006
South	3 - 10	1927 - 2005	3 - 9	1949 - 2005
West	6 - 12	1910 - 2007	5 - 9	1949 - 2007

[1]Number of shorelines and range in years vary in each region

Table 9. Maximum shoreline change rates on Oahu.

[m/yr, meters per year; max., maximum]

Region	Long-term rate (m/yr)	Location[1]	Short-term rate (m/yr)	Location[1]
North				
Max. erosion	-1.3 ± 0.8	Haleiwa Beach Park, beach lost	-1.3 ± 0.8	Haleiwa Beach Park, beach lost
Max. accretion	0.8 ± 0.8	Rocky Point, high seasonal change	1.1 ± 0.9	Rocky Point, high seasonal change
East				
Max. erosion	-1.8 ± 0.3	Kualoa Point[2]	-1.9 ± 0.9	Kualoa Point[3]
Max. accretion	1.5 ± 0.4	Kaneohe Bay, west of Kualoa Point	1.3 ± 1.8	Kaneohe Bay, west of Kualoa Point
South				
Max. erosion	-1.6 ± 2.7	west side Natatorium, beach lost	-1.6 ± 2.7	west side Natatorium, beach lost
Max. accretion	0.8 ± 0.2	Kaimana, south side Natatorium	0.9 ± 0.3	Kaimana, east side Natatorium
West				
Max. erosion	-1.2 ± 0.5	Maili, sand mining	-1.0 ± 0.3	Yokohama, sand mining
Max. accretion	1.7 ± 0.6	Pokai Bay, north of harbor breakwall[2]	1.7 ± 0.6	Pokai Bay, north of harbor breakwall[3]

[1]Locations shown in figures 24, 26, 29, and 30.

[2]Maximum erosion or accretion for all three islands (Kauai, Oahu, and Maui).

[3]Maximum erosion or accretion for Oahu.

Table 10. Average shoreline change rates for Oahu subregions.

[m/yr, meters per year]

Region	Subregion	Number of transects	Average rate (m/yr)	
			Long-term	Short-term
North	Sunset	673	-0.10 ± 0.02	-0.04 ± 0.02
	Mokuleia	614	-0.12 ± 0.01	-0.11 ± 0.01
East	Northeast	1245	-0.07 ± 0.01	-0.09 ± 0.02
	Southeast	863	0.12 ± 0.01	0.09 ± 0.02
South	Ewa	499	-0.06 ± 0.01	-0.03 ± 0.01
	Honolulu	376	-0.05 ± 0.02	-0.05 ± 0.02
	Maunalua	394	-0.02 ± 0.02	-0.01 ± 0.05
	Kaiwi	50	-0.02 ± 0.03	-0.06 ± 0.04
West	Makua	174	-0.28 ± 0.03	-0.08 ± 0.06
	Waianae	264	-0.25 ± 0.02	-0.09 ± 0.02
	Nanakuli	190	-0.21 ± 0.02	-0.24 ± 0.02

Table 11. Number and range in years of historical shorelines for long- and short-term shoreline change analysis on Maui.

	Long-term		Short-term	
Region	Number of shorelines[1]	Range in years[1]	Number of shorelines[1]	Range in years[1]
North	4 - 8	1899 - 2002	3 - 5	1960 - 2002
Kihei	3 - 9	1900 - 2007	3 - 8	1949 - 2007
West	5 -10	1912 - 1997	3 - 8	1949 - 1997

[1]Number of shorelines and range in years vary in each region

Table 12. Average shoreline change rates for Maui subregions.

[m/yr, meters per year]

Region	Subregion	Number of transects	Average rate (m/yr)	
			Long-term	Short-term
North	Waihee - Waiehu	277	-0.12 ± 0.02	-0.17 ± 0.02
	Kahului Harbor	63	-0.05 ± 0.03	-0.06 ± 0.08
	Kanaha - Paia	563	-0.35 ± 0.02	-0.26 ± 0.04
Kihei	Makena - Wailea	335	-0.13 ± 0.02	-0.13 ± 0.02
	Central Kihei	283	-0.07 ± 0.03	-0.12 ± 0.03
	Maalaea Bay	393	-0.17 ± 0.02	-0.10 ± 0.04
West	Lahaina	986	-0.15 ± 0.01	-0.11 ± 0.01
	Kaanapali	228	-0.08 ± 0.02	-0.13 ± 0.03
	Napili - Kapalua	305	-0.22 ± 0.02	-0.19 ± 0.03

Table 13. Maximum shoreline change rates on Maui.

[m/yr, meters per year; max., maximum]

Region	Long-term rate (m/yr)	Location[1]	Short-term rate (m/yr)	Location[1]
North				
Max. erosion	-1.5 ± 1.1	Baldwin Park, sand mining[2]	-2.2 ± 1.1	Baldwin Park, sand mining[3]
Max. accretion	1.5 ± 1.3	Kanaha Beach Park, groins	2.1 ± 0.2	Kanaha Beach Park, groins[2]
Kihei				
Max. erosion	-1.1 ± 0.6	Kawililipoa, within fishpond remains	-1.8 ± 7.5	Kalepolepo Beach Park, beach lost
Max. accretion	1.6 ± 0.4	Kawililipoa, accretional cusp[2]	1.8 ± 0.5	Kawililipoa, accretional cusp
West				
Max. erosion	-0.9 ± 0.6	Ukumehame, coastal road revetment	-0.7 ± 1.7	Kapalua, Mokuleia Beach; variable
Max. accretion	0.6 ± 0.2	Lahaina, Puunoa Point	0.7 ± 0.2	Lahaina, Puunoa Point

[1]Locations shown in figures 33, 35, and 38.

[2]Maximum erosion or accretion for Maui.

[3]Maximum erosion or accretion for all three islands (Kauai, Oahu, and Maui).