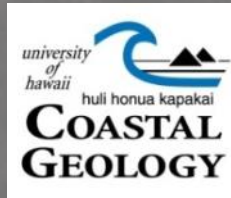
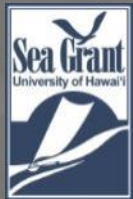


COASTAL DATA EXCHANGE

HISTORICAL SHORELINE CHANGE DATA FOR HAWAII



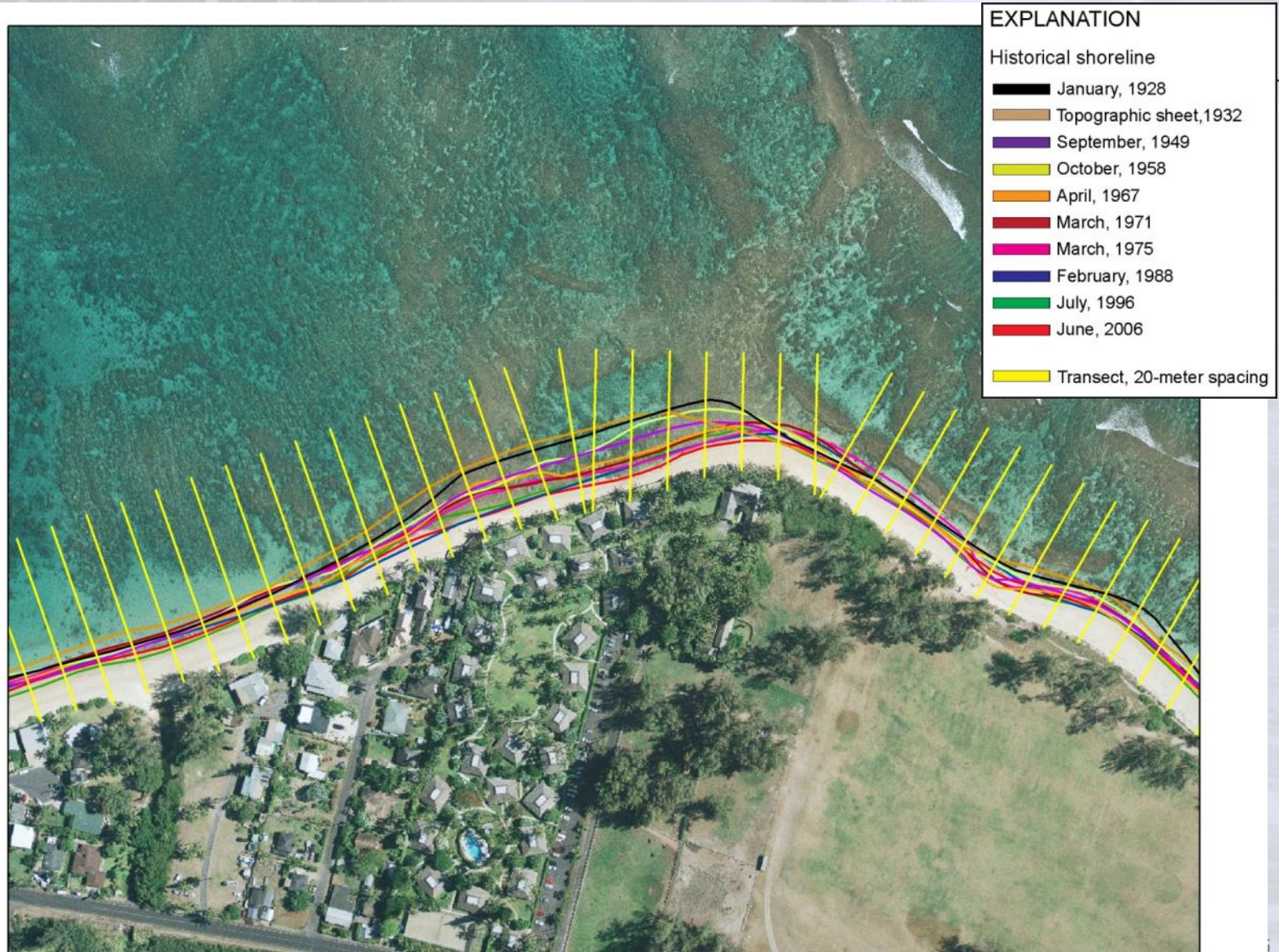
Brad Romine

Coastal Geologist, Extension Faculty

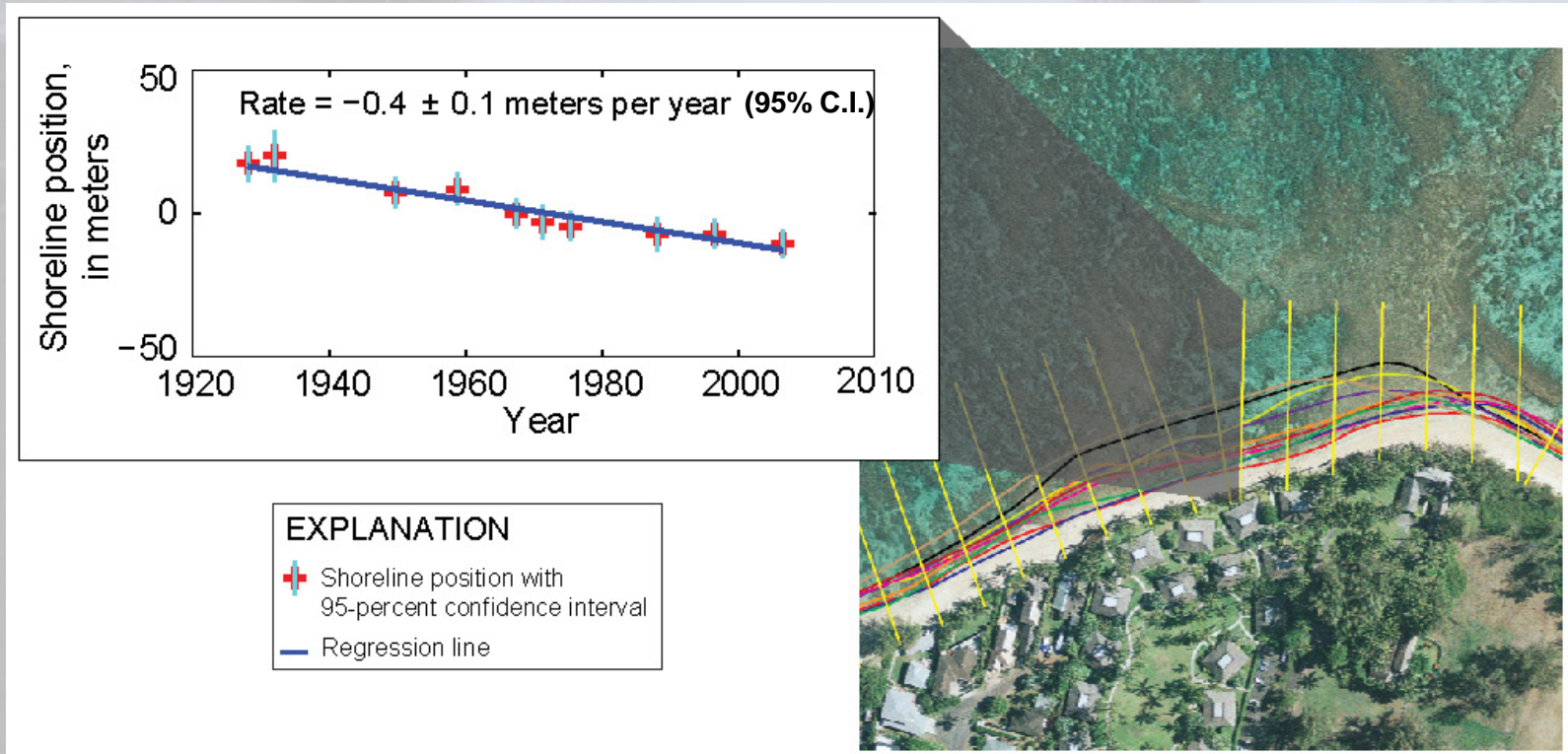
University of Hawaii Sea Grant College Program

DLNR, Office of Conservation and Coastal Lands

Methods: Mapping Historical Shorelines



Methods: Calculating Shoreline Change Rates



HAWAII COASTAL EROSION WEBSITE: soest.hawaii.edu/coasts/erosion/

The screenshot shows a web browser window with the URL www.soest.hawaii.edu/coasts/erosion/. The page title is "Hawaii Coastal Erosion Website" by the Coastal Geology Group. Navigation tabs include Home, Oahu, Maui, Kauai, and Contact. A sidebar on the left lists links to USGS reports, the Department of Land and Natural Resources, and various shoreline prediction methods. The main content area features a heading "Hawaii Coastal Erosion Website" and a paragraph explaining the study's purpose: to provide shoreline change data to public and government partners for decision-making in the coastal zone. It lists hazards like tsunamis, storm surges, and coastal erosion, and discusses the impact of building on eroding coasts. A second paragraph highlights the benefit of defining zones of avoidance for environmental conservation, noting that armoring with seawalls can exacerbate erosion and beach loss. A third paragraph states that the website provides historical maps, air photos, and modern maps of shoreline change rates for Oahu, Maui, and Kauai. Three maps of the islands are shown, each with red lines indicating erosion points and labels for specific locations.

SOEST Hawaii Coastal Erosion Website

www.soest.hawaii.edu/coasts/erosion/

Apps WORK SURF DATA NEWS REFERENCES CLIMATE UH Google@UH Other bookmarks

Hawaii Coastal Erosion Website

- Coastal Geology Group

Home Oahu Maui Kauai Contact

> Home Page : Hawaii Coastal Erosion Website




Links

- ▶ NEW - USGS OFR 2011-1051: National Assessment of Shoreline Change, Hawaiian Islands
- ▶ Hawaii Department of Land and Natural Resources
- ▶ Toward Parsimony in Shoreline Change Prediction (I): Basis Function Methods
- ▶ Toward Parsimony in Shoreline Change Prediction (II): Applying Basis Function Methods to Real and Synthetic Data

Hawaii Coastal Erosion Website

The Hawaii Shoreline Study provides shoreline change data to the public and government partners to assist in decision-making in the coastal zone. Shorelines are highly variable environments characterized by a number of natural hazards. These include: tsunami, storm surge, high winds, coastal erosion, sea-level rise, and high wave overtopping. Building on eroding coasts increases vulnerability to all these hazards. A direct step to mitigating the impact of coastal hazards is to exercise avoidance (Hwang, 2005) by mapping high hazard zones designed, in part, on data such as found in this study.

Shoreline Study of Oahu, Maui and Kauai



A significant additional benefit to shoreline change data is to define zones of avoidance for the purpose of environmental conservation. When erosion threatens the built environment a common reaction is to armor the shoreline with a seawall or revetment. Armoring may impound sand thereby impacting the sediment budget of a beach and exacerbating the erosion. Shoreline armoring also increases wave turbulence and reflection. It is common to find that the construction of one seawall on a beach leads to proliferation of additional seawalls. Armoring a chronically eroding coast leads to beach loss (Fletcher, et al., 1997). In an era of accelerating sea-level rise (Church and White, 2006) the threat of chronic erosion and beach loss is growing and the use of shoreline data becomes a potentially significant coastal management tool in the effort to conserve beaches for future generations.

This site provides sets of historical maps and air photos, modern vertical and oblique air photos, and maps depicting rates of shoreline change spaced every 20 m on the sandy beaches of Maui, Oahu, and Kauai. Please click on an island to access the database.



Erosion Maps

AREA DESCRIPTION

The shoreline fronting the community of Sunset Beach (transects 119 – 269) on the north shore of Oahu is the site of world famous big wave surf breaks including Sunset and Vetzlyland. The area is exposed to swells from the north Pacific in winter months and easterly tradewind waves year-round. Sunset Beach is the central portion of a continuous (4 mi long) beach composed of carbonate sand, and characterized by occasional outcrops of limestone that may be intermittently buried or exposed by shifting sand.

Shoreline change rates at Sunset Beach (1928 – 2006) are mostly low (< 1 ft/yr). Large winter swell causes dramatic changes in shoreline position that largely recover the following season. Because of this, shoreline change rates at Sunset Beach have high uncertainty due to short-term variations in shoreline position. Despite wide variations in beach width, the vegetation line has remained approximately stable since 1928. The high rate uncertainty and stable vegetation line suggest that the shoreline has remained approximately stable over the long-term or that seasonal variations are masking the true long-term change. These characteristics may also reflect shoreline stabilization by armoring that holds the vegetation line in place.

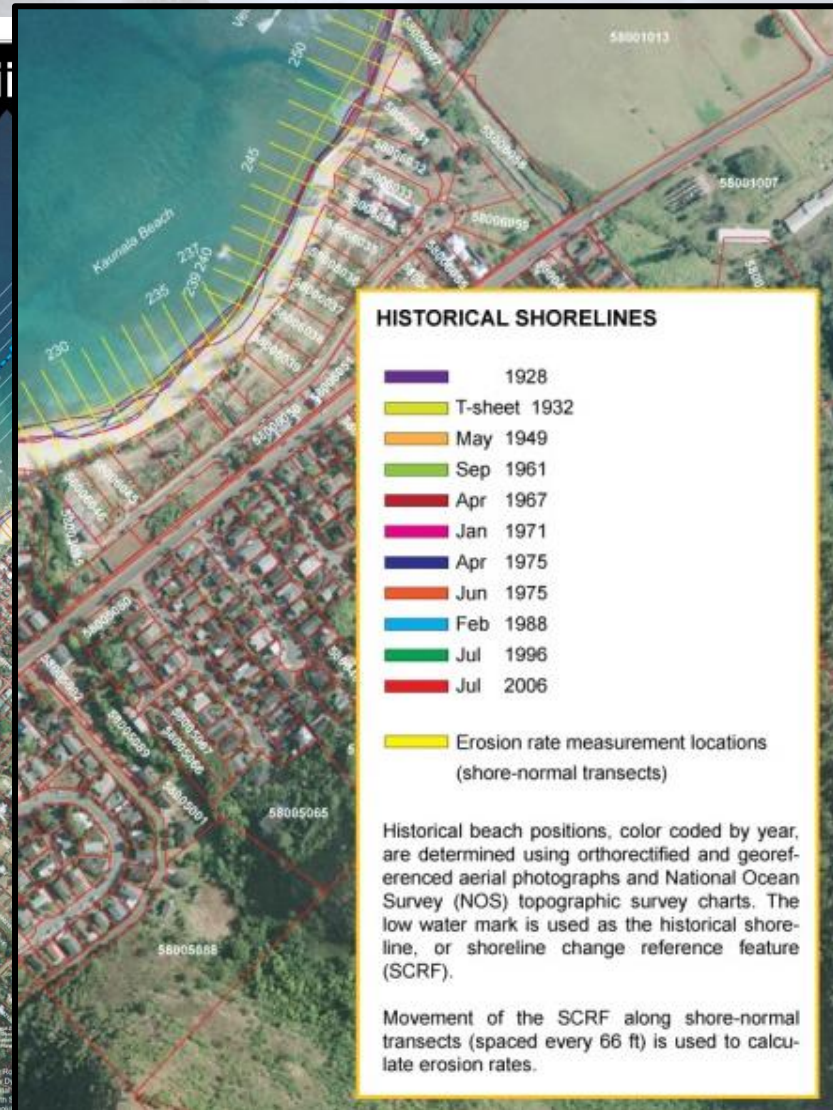
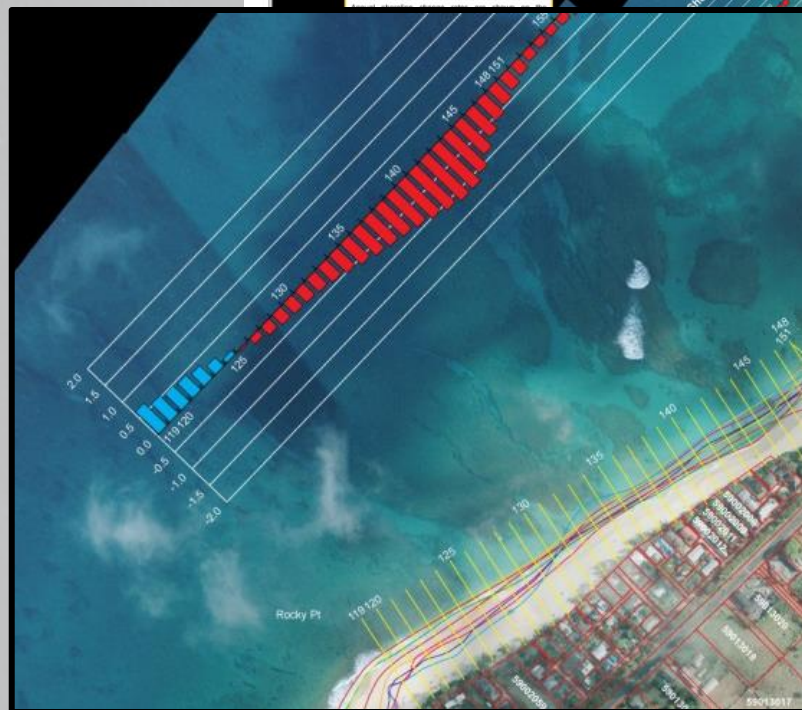
Short-term erosion is a significant hazard to beach-front homes, especially in winter with run-up from large waves. A number of beach-front homes were destroyed during a massive winter 1969 swell.

Previous studies by Hwang (1981) and Sea Engineering (1988) found little net change or small seaward growth of the vegetation line at Sunset Beach 1949 – 1988, except at Sunset Beach Park and at the west end of Kaunala Beach where the vegetation line eroded. The vegetation line has since recovered at Kaunala Beach (1988 – 2006).

For more information see: <http://www.soest.hawaii.edu/asp/coasts/oahu/>

Hwang, D. (1981), "Beach changes on Oahu as revealed by aerial photographs," State of Hawaii, Department of Planning and Economic Development.

Sea Engineering (1988), "Oahu shoreline study," City and County of Honolulu, Dept of Land Utilization.



Erosion Rate Tables and Plots

Bellows - Smoothed Rates

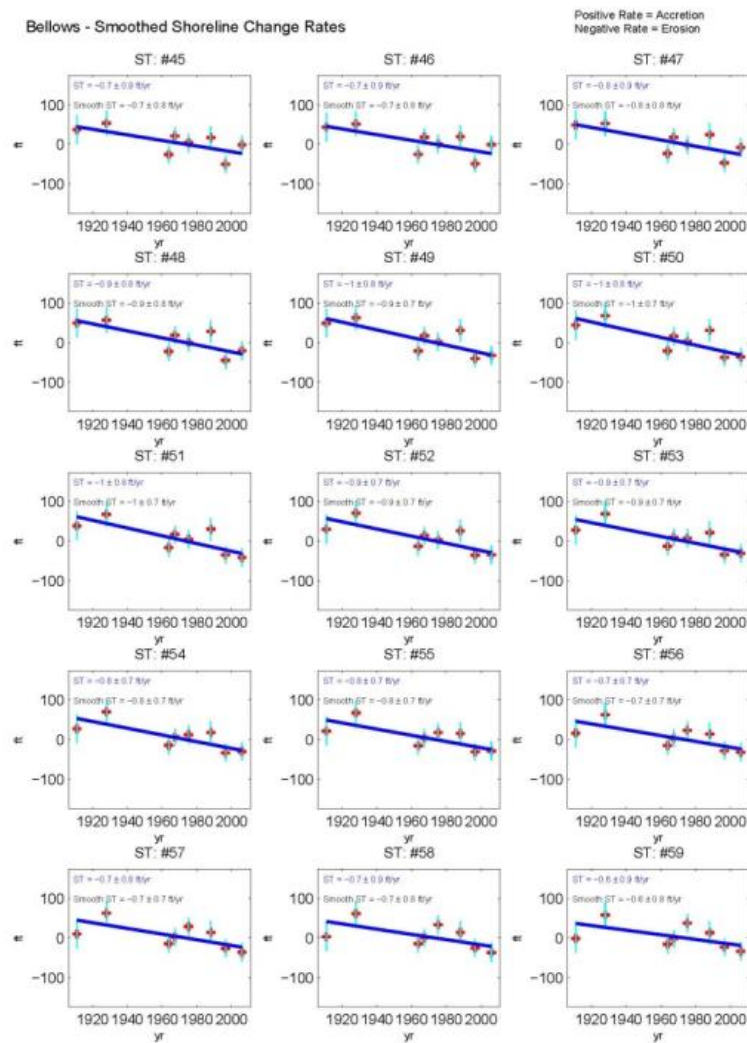
Transect	Smoothed Rate (ft/yr)	± Smoothed Uncert. (ft/yr)
0*	-1.0	0.9
1*	-1.2	0.9
2*	-1.3	0.8
3*	-1.4	0.8
4*	-1.4	0.9
5*	-1.5	0.9
6*	-1.5	0.9
7*	-1.6	0.9
8*	-1.7	0.9
9*	-1.7	0.9
10*	-1.7	0.9
11*	-1.7	1.0
12*	-1.7	1.1
13*	-1.7	1.1
14*	-1.7	1.2
15*	-1.6	1.2
16*	-1.6	1.2
17*	-1.5	1.2
18*	-1.3	1.2
19*	-1.3	1.2
20*	-1.3	1.2
21*	-1.3	1.2
22*	-1.4	1.1
23*	-1.6	1.0
24*	-1.7	1.0
25*	-1.8	0.9
26*	-1.8	0.9
27*	-1.8	0.9
28*	-1.7	0.9
29*	-1.7	0.9
30*	-1.6	1.0
31*	-1.5	1.0
32*	-1.4	1.0
33*	-1.4	1.0
34*	-1.3	0.9
35	-1.2	0.7
36	-1.1	0.7
37	-1.0	0.7
38	-0.9	0.7
39	-0.8	0.7
40	-0.8	0.8
41	-0.7	0.8
42	-0.7	0.8
43	-0.7	0.8
44	-0.7	0.8
45	-0.7	0.8

Positive Rate = Accretion
Negative Rate = Erosion

Transect	Smoothed Rate (ft/yr)	± Smoothed Uncert. (ft/yr)
46	-0.7	0.8
47	-0.8	0.8
48	-0.9	0.8
49	-0.9	0.7
50	-1.0	0.7
51	-1.0	0.7
52	-0.9	0.7
53	-0.9	0.7
54	-0.8	0.7
55	-0.8	0.7
56	-0.7	0.7
57	-0.7	0.7
58	-0.7	0.8
59	-0.6	0.8
60	-0.6	0.8
61	-0.6	0.8
62	-0.7	0.8
63	-0.6	0.9
64	-0.6	0.9
65	-0.5	0.9
66	-0.4	0.9
67	-0.4	0.9
68	-0.4	0.8
69	-0.4	0.7
70	-0.4	0.6
71	-0.5	0.6
72	-0.5	0.5
73	-0.5	0.5
74	-0.5	0.5
75	-0.5	0.6
76	-0.4	0.7
77	-0.3	0.7
78	-0.2	0.8
79	-0.1	0.8
80	0.0	0.9
81	0.0	1.0
82	0.0	1.0
83	0.1	0.9
84	0.1	0.9
85	0.3	1.2
86	0.3	1.1
87	0.3	1.1
88	0.3	1.0
89	0.2	0.9
90	0.1	0.9
91	0.1	0.8

*Aerial photographs show beach loss during the period of analysis. Rates calculated using historical shorelines up to and including the first shoreline with no beach and show the speed at which the beach disappeared.

Bellows - Smoothed Shoreline Change Rates

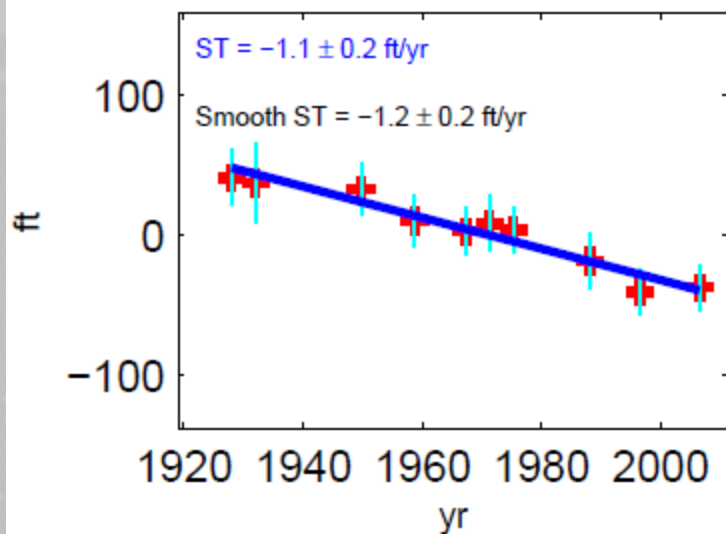


*Hardened shorelines with no beach are shown with a blue square. The analysis stops at the first hardened shoreline.

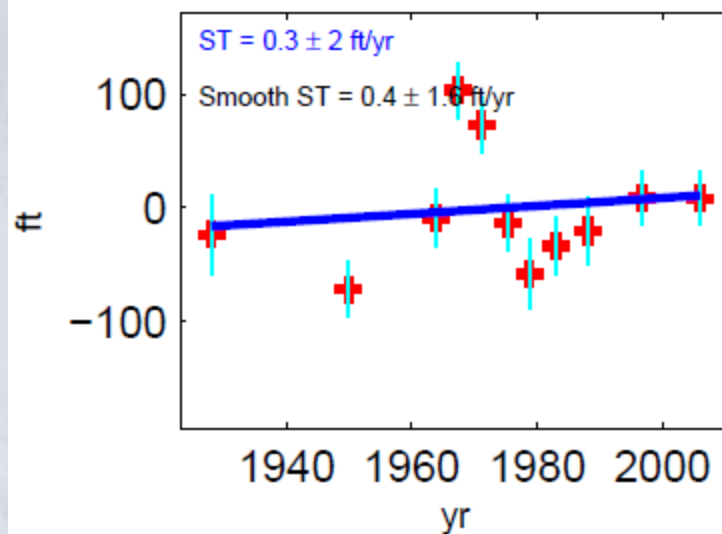


Erosion Rate Plots

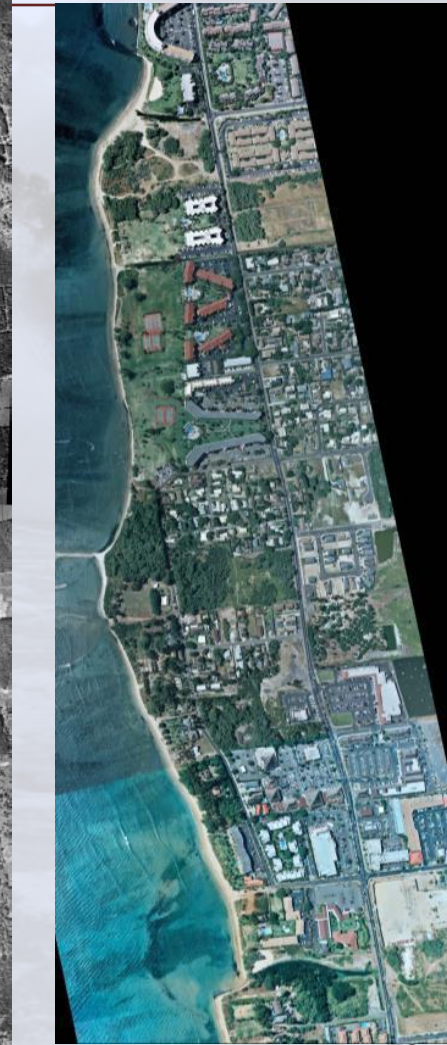
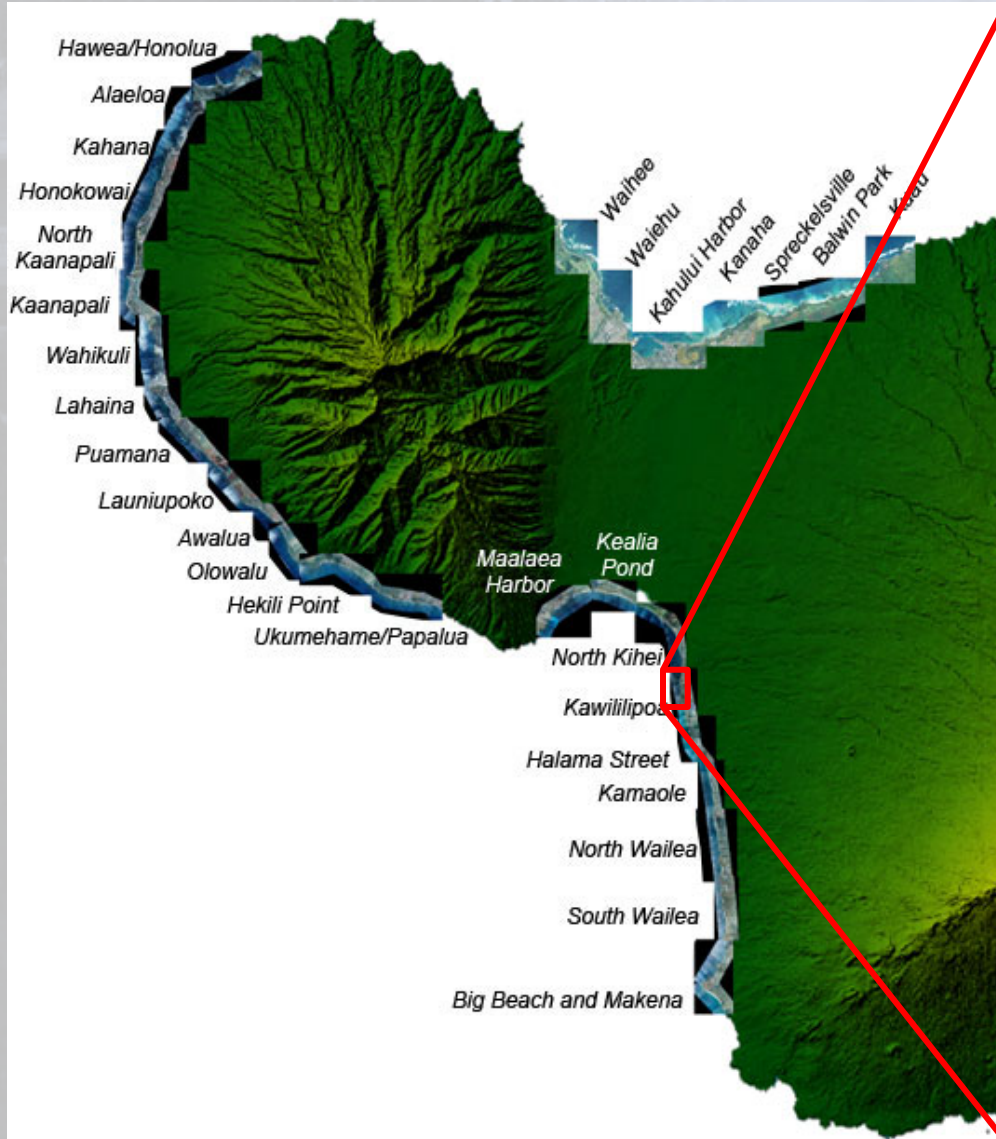
Mokuleia, Oahu; Transect 293



Kailua BP, Oahu; Transect 217



Historical Air Photo Mosaics



NATIONAL ASSESSMENT OF SHORELINE CHANGE, HAWAII

coastal.er.usgs.gov/shoreline-change/



National Assessment of Shoreline Change: Historical Shoreline Changes in the Hawaiian Islands



Open-File Report 2011-1051

U.S. Department of the Interior
U.S. Geological Survey

34 National Assessment of Shoreline Change: Historical Shoreline Change in the Hawaiian Islands

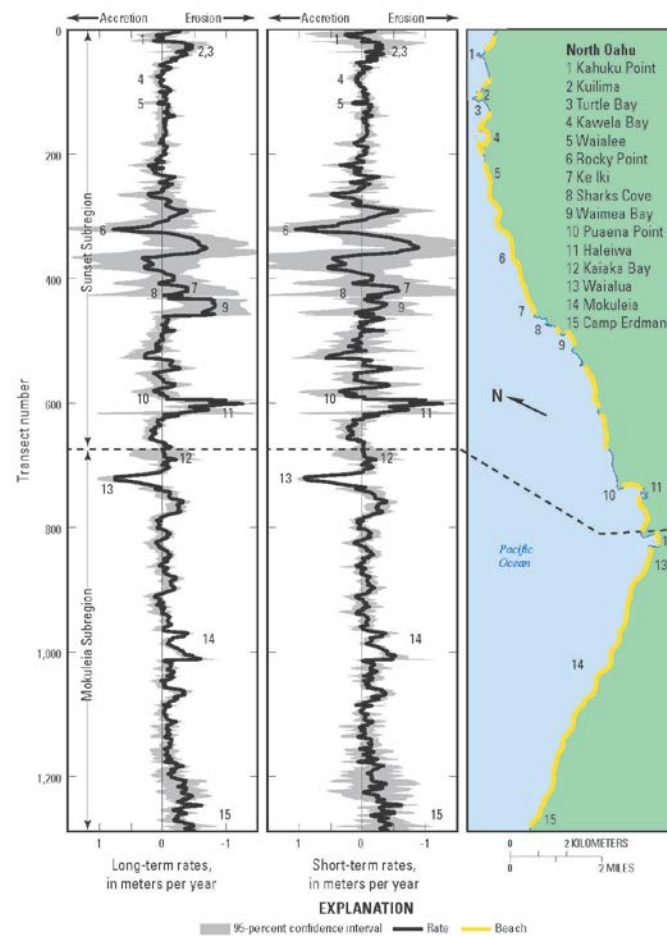



Figure 24. Long-term (all available years) and short-term (1940s to present) shoreline change rates, North Oahu. (Location shown in figure 22)

Historical Shoreline GIS Layers at the NATIONAL ASSESSMENT OF SHORELINE CHANGE, HAWAII

coastal.er.usgs.gov/shoreline-change/



U.S. Geological Survey Open-File Report 2011-1009

National Assessment of Shoreline Change: A GIS Compilation of Vector Shorelines and Associated Shoreline Change Data for the Sandy Shorelines of Kauai, Oahu, and Maui, Hawaii

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Geospatial Data

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- Geospatial Data
- Acknowledgments
- References Cited

Data in this report are available as downloadable files based on the 11 geomorphic regions within the Kauai (fig. 1), Oahu (fig. 2), and Maui (fig. 3) study areas. These index maps show the extent of each region. All vector data are delivered as ESRI shapefiles in the geographic coordinate system (WGS84) and distributed with Federal Geographic Data Committee- (FGDC) compliant metadata in Extensible Markup Language (*.xml) format. Tabular data are delivered as dBase IV (*.dbf) structured files, which can be read with ESRI ArcGIS software as well as many other available spreadsheet programs. Metadata are also provided for all spatial and tabular data in text (*.txt) and FGDC Classic (*.html) format. ESRI ArcCatalog 9.x can also be used to examine the metadata in a variety of additional formats.

This report includes all of the files necessary to perform shoreline-change analyses using the [Digital Shoreline Analysis System](#) (DSAS) software. Please refer to Thieler and others (2009) for information about the DSAS software application that was used to perform the rate calculation, which are discussed at length in the detailed report, National Assessment of Shoreline Change: Historical Shoreline Change in the Hawaiian Islands (Fletcher and others, 2011).

The following files are available for download for each geomorphic region (see index maps in figures 1-3):

1. compiled shorelines from T-sheets and aerial photographs, which are attributed within each dataset and included in the metadata;
2. offshore baseline used for generating shore-normal transects in DSAS;
3. long-term transect file with rates; and
4. short-term transect file with rates.

Data layers can be downloaded individually using the table below. Individual layers are provided as WinZip® files. If WinZip® is not currently installed on the local system, go to WinZip® (<http://www.winzip.com>) to download the most recent version.

Kauai			
Kauai North			
File	Description	Metadata	Download
KauaiN_shorelines.shp	Compiled shorelines and associated positional uncertainties for North Kauai region	.html .txt	.zip (260 KB)
KauaiN_baseline.shp	Offshore baseline for generating shore-normal transects in DSAS	.html .txt	.zip (76 KB)
KauaiN_LT.shp	Shore-normal transects and associated long-term rate calculations	.html .txt	.zip (106 KB)
	Shore-normal transects and		

Click on figures for larger images.

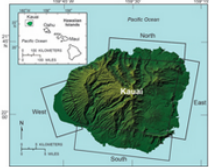


Figure 1. Map of Kauai showing shoreline study regions: north, east, south, west.

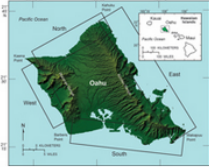


Figure 2. Map of Oahu showing shoreline study regions: north, east, south, west.




Figure 3. Map of Maui showing shoreline study regions: north, Kihel, west.



Historical Erosion Studies Are Used For:

- Coastal building setbacks
- Coastal hazard assessment
- Erosion management
- Beach management plans and restoration projects
- Environmental Assessment / Impact Statements



Coastal Building Setbacks

- Maui:
erosion rate (ft/yr) x 50 yrs + 25 ft
- Kauai, DLNR:
erosion rate (ft/yr) x 70 yrs + 40 ft



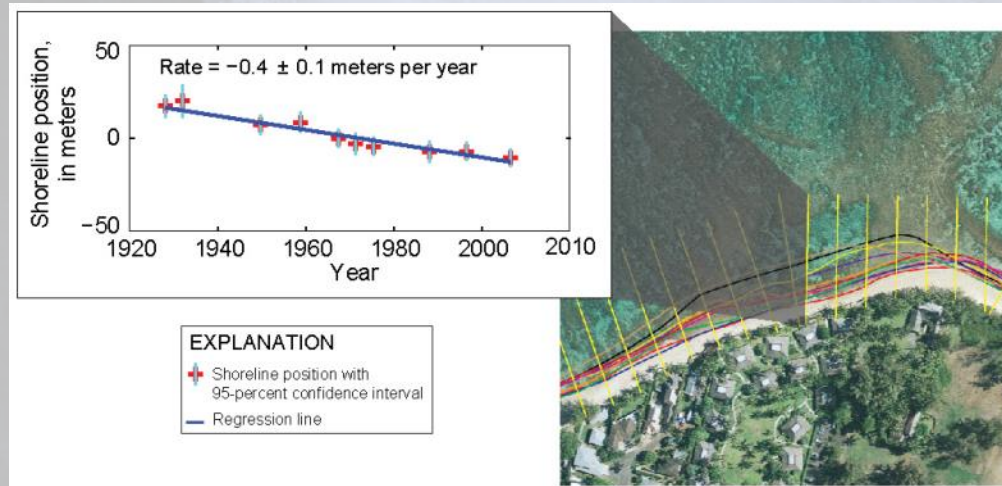
This Data May Also Be Used For:

- Long-term planning, General Plans
- Vulnerability and risk assessment
- Understanding shorter-term variability (shoreline positions, plots)
- Documentation of other historical changes along the coast (e.g., aerial photos)



Strengths

- Best available data on long-term historical shoreline trends
- Observation-based data
- Uses widely accepted GIS and statistical methods



Limitations

- Not available for Niihau, Molokai, Lanai, Kahoolawe, Big Island
- Uncertainties / errors due to:
 - Limited historical shorelines (~8-10)
 - Mapping process
 - Short-term variability
- Long-term forecasts using this data would not account for increasing erosion with accelerating sea-level rise



Needs, Next Steps

- Erosion maps for other islands
- Update existing maps with new air photos
- Research into how increasing sea-level rise will affect erosion rates
- Improved understanding of short-term, episodic erosion hazards



Mahalo

Brad Romine

UH Sea Grant, DLNR-OCCL

Ph: 587-0049 romine@hawaii.edu

Hawaii Coastal Erosion website: soest.hawaii.edu/coasts/erosion/

USGS Nat. Assessment : coastal.er.usgs.gov/shoreline-change/