COASTAL PROCESSES (29)

I Main Topics

A Recognition, characterization, risk evaluation, risk assessment

B Case histories

1 England

2 Whidbey Island, Washington

3 Southern California

4 Hawaii

II Recognition, characterization, risk evaluation, risk assessment

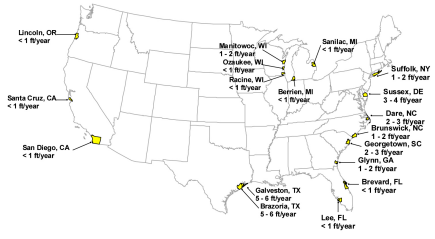
A ~ 25% of homes and other structures within 500 feet of the U.S. coastline and the shorelines of the Great Lakes will fall victim to the effects of erosion within the next 60 years

B Average costs to U.S. homeowners from coastal erosion: $500,000,000+/yr

C The Atlantic and Gulf coasts account for 45 percent of the U.S. coastline and 63 percent of the structures within 500 feet of the shoreline. The nation's highest average erosion rates - 6 feet+/yr - occur along the Gulf coast.

D The average erosion rate on the Atlantic coast is ~2-3′/yr. However, actual erosion rates can vary widely from one location to another and from one year to another. A hurricane or other major storm can cause the coast to erode 100 feet or more in a single day.

E Development in several high-risk coastal areas studied has increased by more than 60% over the last 20 years.



"Evaluation of Erosion Hazards"
http://www.fema.gov/pdf/library/erosion.pdf

II Recognition, characterization, risk evaluation, risk assessment

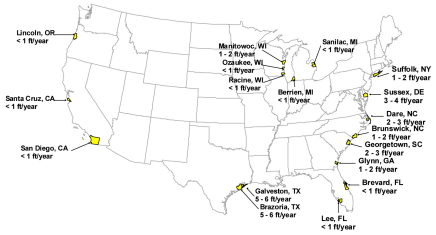
F Property owners within the first few hundred feet of the nation's coasts face as large a risk of damage from erosion as they do from flooding.

G Only about half of homeowners in high erosion areas on the Atlantic and Gulf coasts currently hold flood insurance policies.

H To fully reflect erosion risk, insurance rates in the highest hazard coastal areas would have to be double today's rates, on the average.

I ~ 10,000 structures exist on land expected to erode within 10 years.

J ~ 87,000 structures within the estimated 60-year erosion zone.



"Evaluation of Erosion Hazards"
http://www.fema.gov/pdf/library/erosion.pdf

II Recognition, characterization, risk evaluation, risk assessment

K Most research on coastal erosion has focused on sediments

L Rock cliffs form ~75% of the world's coastline (Rosser et al., 2005)

Sea cliff on the island of Hawaii

http://hvo.wr.usgs.gov/earthquakes/destruct/2006oct15/FAQ.html

II Case Histories

A England

Cornwall

http://en.wikipedia.org/wiki/Cornwall

Dover

http://en.wikipedia.org/wiki/Kent

Norfolk

http://en.wikipedia.org/wiki/Norfolk

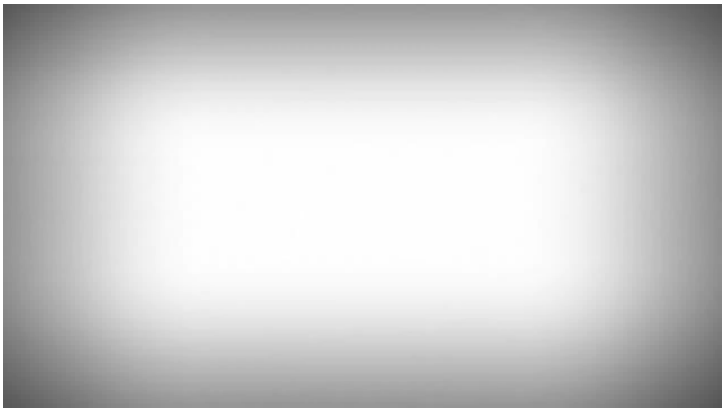
1 North Cliffs
Cornwall, England

http://en.wikipedia.org/wiki/Cornwall

https://www.youtube.com/watch?v=ZVjr4mii3cE

2 White Cliffs
Dover, England

http://en.wikipedia.org/wiki/Kent



https://www.youtube.com/watch?v=IjBvJYCEyGk

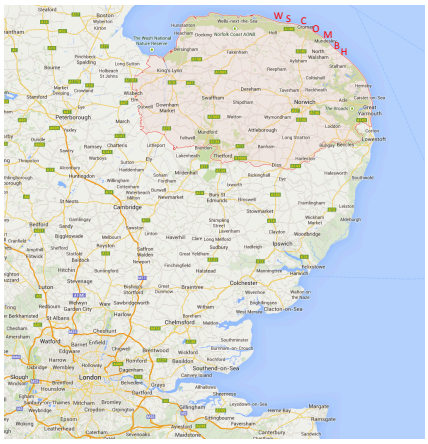
3 Cromer
Norfolk, England

http://en.wikipedia.org/wiki/Norfolk

- "As you stand on the cliff top at Cromer or indeed to the North towards the Runtons and south towards the 'Strands, on the high point of the coast you have to imagine those cliffs as part of a slope that extends seaward, and as you roll back time so the land remains you eventually come to a different coastline one where there probably wasn't really much of a cliff and there sits a series of villages in what is now the North Sea. Foulness, Clare and the most famous Shipden, all of them just off the coast; Foulness was on a promontory hence the 'ness' in the placename, that stuck out into sea just to the North of Overstrand. It had its own lighthouse on a high point some 500 metres further out than the current one at Cromer which was still evident as late as the early 1700s. The beacon fell as the soft material became more and more exposed to the sea, eventually on three sides. Whether it was in itself a settlement is open to question but the name certainly appears on maps in the seventeenth century. To the North of Cromer pier, if you look straight out to sea there is Shipden, about 500 metres out past the end of the pier, there are apparently remains in situ beneath the shifting sands. Shipden was recorded in the a Domesday book as having 117 people, four and a half plough teams, three acres of meadow and enough woodland for 36 swine…"
- "Shipden also had two churches; one serving Shipden-juxta-Felbrigg and Crowmere, just inland, and one serving the town itself. The latter vanished in the early to mid fourteenth century, first the graveyard, then despite the efforts of the local population building a jetty, the church itself and finally the town…"

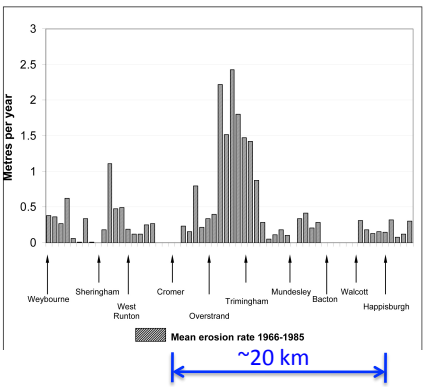
http://www.invisibleworks.co.uk/lost-villages-shipden/

4 Norfolk coast, England



google.com

Erosion rates along Norfolk coast



http://www.north-norfolk.gov.uk/files/coastal_environment_001.pdf

5 Happisburgh, England

- More than 250 m of land lost between 1600 and 1850
- Quote in video clip: 12m/yr

https://www.youtube.com/watch?v=1YQPW41LWTU

6 Erosion rates over different time frames

a Cromer: ~500m/~600yr = 1m/yr

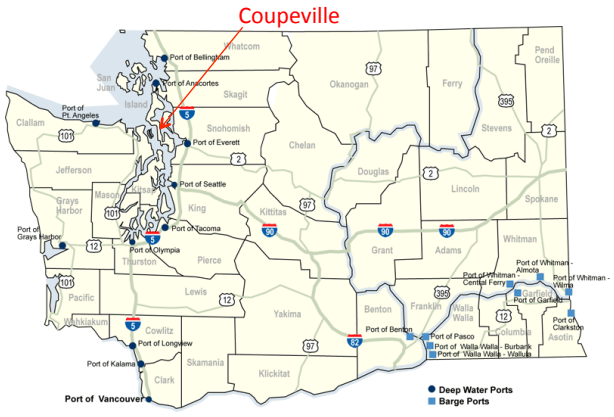
b Happisburgh ~250m/250yr = ~1m/yr

c Cromer: “Long-term”: 6m/yr (Bascom, 1980)

d Happisburgh: 0.2m/yr over 20 years

c Suffolk (1953): 27m, one night (Bascom, 1980)

B Whidbey Island, Washington



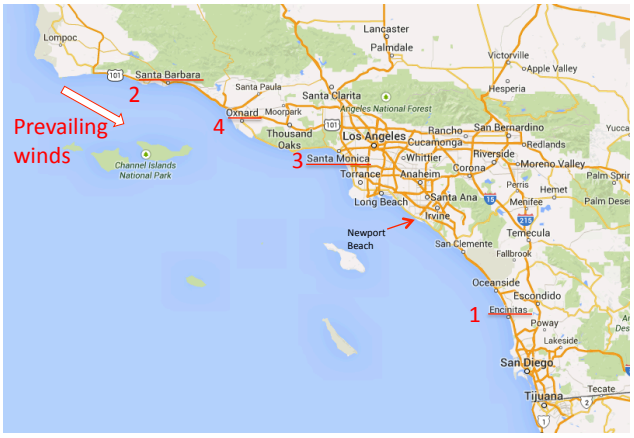
http://www.wsdot.wa.gov

Whidbey Island, Washington

March 27, 2013

https://www.youtube.com/watch?v=YyyOI5Oc-rc

C Southern California

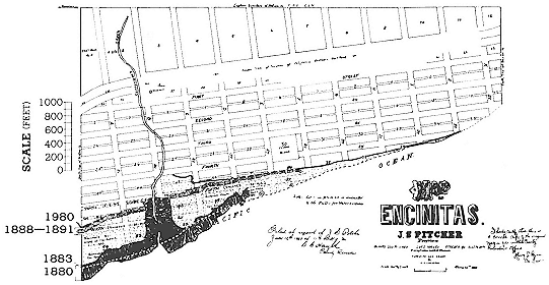


Map from Google Maps

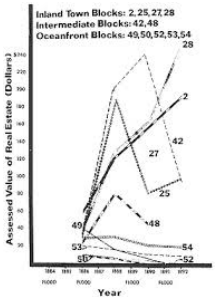
1 Encinitas

a 1883-1976: six city blocks lost, maximum retreat of 800'
b Retreat concentrated in four storms: 1884, 1886, 1889, and 1891
c Choice of action: acceptance of hazard & change in assessed property value

Map of shoreline at Encinitas



Assessed value of property



http://publishing.cdlib.org/ucpressebooks/view?docId=ft0h4nb01z&chunk.id=d0e918&toc.depth=1&toc.id=d0e918&brand=ucpress

2 Santa Barbara breakwater (1928)

a Breakwater built in 1928. Immediate accretion of sand.
b Federal dredging authorized in 1935 at $30,000 per year

1928 shoreline (view to west)

1934 shoreline (view to east)

http://www.geog.ucsb.edu/~jeff/sb_historical/

2 Santa Barbara breakwater (1928)

b Federal dredging authorized in 1935 at $30,000 per year
c Federal dredging costs in 1992: ~$800,000 per year

1949 shoreline (view to northwest)

1965 shoreline (view to north)

http://www.geog.ucsb.edu/~jeff/sb_historical/

3 Santa Monica breakwater (1934)

Santa Monica Pier opens in 1909

Construction of Looff Hippodrome begins 1916

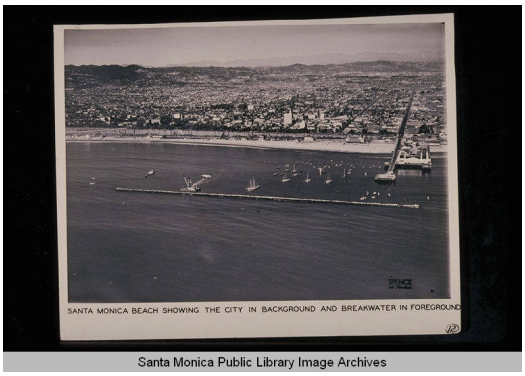
http://www.westlandtraveler.com/ca/santa_monica/santa_monica_pier/history/

3 Santa Monica breakwater (1934)

1933 Bond issue passed to build a breakwater and create a yacht harbor

1934 Breakwater built from scrapped cars

Design intended to allow sand to pass by breakwater



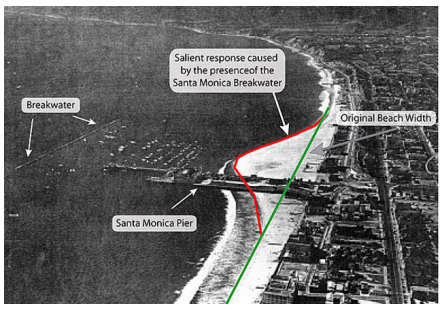
Santa Monica Public Library Image Archives

http://digital.smpl.org/cdm/search/collection/smarchive/searchterm/Breakwaters/field/all/mode/any/conn/and/cosuppress/

3 Santa Monica breakwater (1934)

1934 Results: deposition behind breakwater, erosion "downstream"

Santa Monica Public Library Image Archives



http://digital.smpl.org/cdm/ref/collection/smarchive/id/1483

http://www.surfline.com/templates/article_html.cfm?n=3&id=20360&p=1

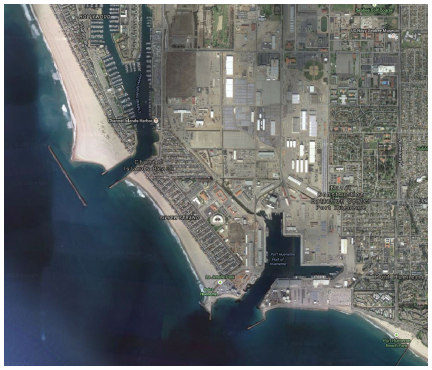
4 Channel Islands harbor and breakwater, Oxnard (1963)

a Dredging from mid-1950's to 1963

b Designed to lessen the effect of downshore beach erosion, provide dredged material for beach replenishment for downcoast beaches, and prevent sand loss to the submarine canyon off of Port Hueneme.

c Currently, authorized by Congress for dredging on a biennial basis; ~1.8 million cubic yards of material will be dredged biennially.

Aerial image of Channel Islands harbor



From Google Maps

D Hawaii

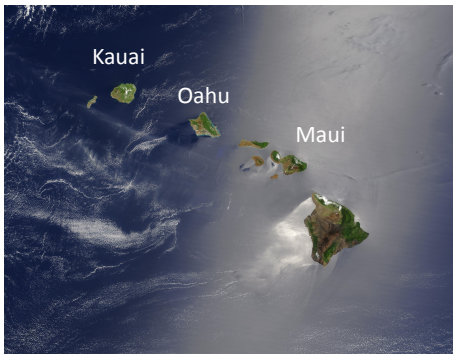
1 Beaches of Kauai, Oahu, and Maui

A Average long-term rate (post-early 1900s) for all shoreline measurement locations of -0.11 ± 0.01 m/yr, with erosion at 70% of transects

B Average short-term rate (post WWII) of -0.06 ± 0.01 m/yr, with erosion at 63% of transects

C Twenty two kilometers of beach, or 9% of the total length of beach studied, completely lost to erosion over the past century.

NASA image of Hawaii



http://eoimages.gsfc.nasa.gov/images/imagerecords/66000/66578/Hawaii.A2003147.2110.250m.jpg

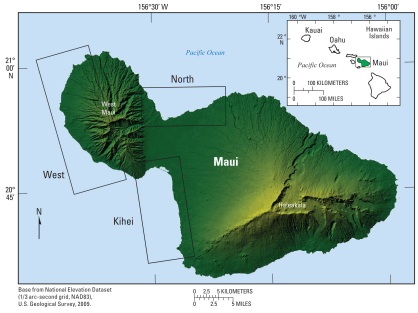
http://pubs.usgs.gov/of/2011/1051/pdf/ofr2011-1051_report_508.pdf

D Hawaii
2 Beaches of Maui

A Annual long-term average shoreline change rate of -0.17 ± 0.01 m/yr, with erosion at 85% of transects

B Annual short-term average shoreline change rate average rate of -0.15 ± 0.01 m/yr, with erosion at 76% of transects

C Beach completely lost to erosion over the past century: nearly 7 km (11%)



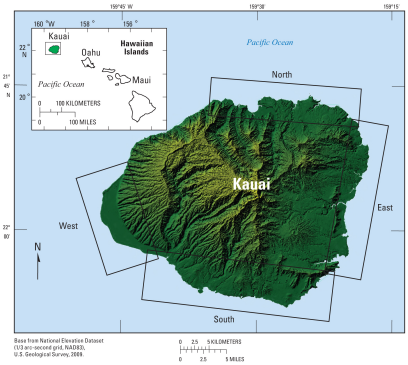
http://pubs.usgs.gov/of/2011/1051/pdf/ofr2011-1051_report_508.pdf

D Hawaii
3 Beaches of Kauai

A Annual long-term average shoreline change rate of -0.11 ± 0.01 m/yr, with erosion at 71% of transects.

B Annual short-term average shoreline change rate of 0.02 ± 0.02 m/yr, with erosion at 57% of transects

C Beach completely lost to erosion over the past century: 6 km (8%)



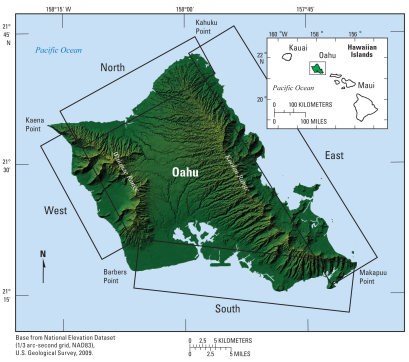
http://pubs.usgs.gov/of/2011/1051/pdf/ofr2011-1051_report_508.pdf

D Hawaii
4 Beaches of Oahu

A Annual long-term average shoreline change rate of -0.06 ± 0.01 m/yr, with erosion at 60% of transects

B Annual short-term average shoreline change rate of of -0.05 ± 0.01 m/ yr, with erosion at 58% of transects

C Beach completely lost to erosion over the past century: 8.7 km (8%)



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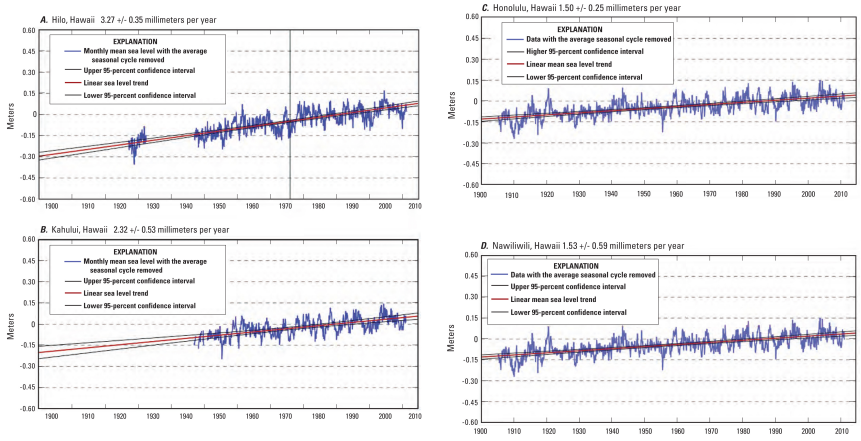
D Hawaii
5 Mathematical models of coastal retreat



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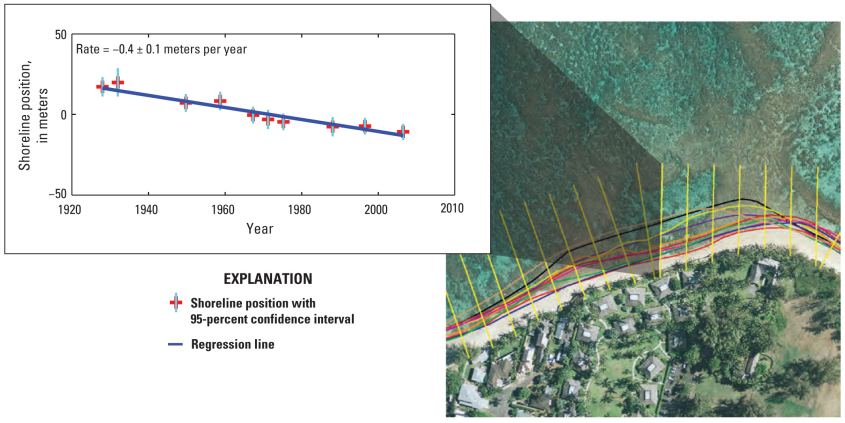
D Hawaii
6 Mathematical model for one transect



http://pubs.usgs.gov/of/2011/1051/pdf/ofr2011-1051_report_508.pdf

D Hawaii
7 Maximum shoreline change rates on Oahu

Table 9. Maximum shoreline change rates on Oahu.

[m/yr, meters per year; max., maximum; ±, plus or minus]

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.

http://pubs.usgs.gov/of/2011/1051/pdf/ofr2011-1051_report_508.pdf

References

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- http://www.fema.gov/pdf/library/erosion.pdf