Frequency and Duration of Coinciding High Surf and Tides along the North Shore of Oahu, Hawaii 1981-2007

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Photo: Debbie and Kimbal Milikan

10<sup>th</sup> International Conference on Wave Hindcasting and Forecasting And Coastal Hazards, November 11-16, 2007

**Motivation Historical Context For Understanding Wave Run-up** 

Photo: Dolan Eversole, DLNR

# Application

- Beach dynamics
- Shoreline setback
  - for building permits
- Coastal engineering
- Influence on aquifers

# Methodology



#### Data

Waves: 51001, Waimea Tides: Haleiwa and Kaneohe

#### **Procedure**

Summary of Conclusions **Method for correcting 51001** Hs to Waimeahourly surf time series Marginal event (surf ~ 9m, tide > 1  $\sigma$ ) -10/year, duration within 1-8 hrs or 3.1 hrs on ave. Significant (surf ~ 12 m, tide > 1.5  $\sigma$ ) rear, duration within 1-5 hrs or 2.5 hrs on ave.

**Extreme**: surf ~15 m, tide >1.5  $\sigma$  or surf > 18m, tide > 1 $\sigma$ ) - 1 per 7 years, duration within 1-4 hrs, or 1.9 hrs on ave





#### Make hourly tidal predictions based on 2001-2002 Haleiwa tide gauge data

- no datum

100

0

Jan

Feb

-100

- 1998-2004 difference of daily means with Mokuoloe (Kaneohe) steady
- 2001-2002 inter-annual variability of Mokuoloe steady near long-term mean
  - \* hourly predictions for Haleiwa assumed relative to long-term mean
- inter-annual variability not taken into account for this study (+/- 10 cm)

#### **STEP 2**

## **Correct 51001 Hs to Waimea**



# **Results**



# **STEP 3** From deep-water, near-shore hourly Hs, Pd time series, calculate surf

- -Caldwell-Aucan empirical method 8th Wave Workshop; JCR 2007
- $H_{1/10}$  basis for study
- -Surf height refers to troughto-crest distance in zones of high refraction for moment and location along wave front of maximum cresting
- -Under extra-large or higher conditions, zones of high refraction are on outer reefs



# Results

- -Decrease in occurrence as surf height and tide increase
- -Hawaii scale used as basis for surf height categories
  - \*essential for validation
    \*based on bench marks
    \*temporally consistent (Caldwell, JCR, 2005)



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# 0



don chapman

MON. IN A MESS: Welcome to the Messiest Desk in Town Contest. Or as the sign on the side of the desk (you probably wouldn't be able to see it if it was somewhere on top of the desk) reads; "A clean desk is the sign of a sick mind." The subject came up when Michael W. Perry was taping bits for last night's "Hawaiian Moving Co." at The Advertiser. He made a comment about Wayne Harada and yers truly sharing honors for the messiest desk here a claim I vigorously dispute because Wayne's desk is much neater. And now come the sports from our fun & games dept., nominating Ferd Borsch for not just the in-house title, but also for the overall Messiest Desk in Town honor: "He's got notes there from Islanders games he covered at the old stadium in 1962" . . . Says Patti Cook, who greets visitors to her Century Square office over stacks of crucial flotsam and jetsam: "Maybe we should have a citywide competition." Yes, we should. Nominations (with explanations) are being accepted here

DIS AND DOT: Yes. Joe Moore confirms, that was him and "Wheel of Fortune" hostess Vanna White



having a "cozy" dinner last week. They were introduced by Joe's old Army buddy, Pat Sajak, who is also the show's host, during a party at the Walkiki Yacht Club, Joe and Vanna hit it off so well that there were several more dinners and they're talking about spending their

White

next vacations together . . . Is Andy Anderson a candidate for governor? Would he have agreed to be a judge for the Carole Kai Bed Race if he wasn't? . . From the silly fashion trend

dept.: Add managers at Johnny Appleseed restaurant to those who are wearing coats and ties at work Winner of a contest to design Hawaii Loa College's Pacific Center for the Media Arts is Adele Santos, chanwoman of the architecture depi, at the U. of Pennsylvania, Her "East-West influenced design" won over 171 other entries, including 12 from Honolulu

NONE EAR: Boo flu dept.: The high-falutin' get the flu, too. Geraldine Ferraro, former vice

presidential candidate.



Mid. And Antohit

The big surf which damaged several homes late Saturday was still pounding the North Shore yesterday, providing competitive turf for the Quiksliver/ Eddle Alkau Big Wave Invitational meet and a spectacle for a beachful of fans at nearby Walmea Bay.

#### Huge waves crush N. Shore homes

#### from page A-1

said Alice Tracy, owner of the Ke Iki Hale vacation cottages where Jenkins was staying

Tracy said she rushed out and found Richard and his mattress washed up against a hedge. Jenkins was later discovered pinned in his bed under a collapsed wall. Neither was reported hurt

Tracy estimated \$100,000 damage to her complex, with one cottage destroyed and a duplex, next door heavily damaged. She said she grateful no one was killed.



Advertiser photo by Ron Jett Waves pinned Bruce Jenkins in this bed at Ke Iki Hale vacation cottages Saturday night, white his companion floated out of an adjoining bedroom on a mattress.

"We can rebuild," she said. "We can work harder. Nothing happened that is irreversible." The wave caught neighbor Susan Hendry on

foot when it climbed a sea wall and carried her bouncing down a rocky lane that had suddenly become a raging river.

"It was like a toboggan, except there wasn't any toboggan under me," she said.

As she was carried away. Hendry saw a house on the o side of the lane "explore eemed use up about a foot, the walls go out, the roof settled down. It was just like in a dream, just as I went flying by.

The entire house was torn from its concrete foundation, crushed, and slammed eight feet mauka before it jammed to a halt against palm and ironwood trees. Owner William Olson was said to be off island.

Next door, salesman William "Billy" Graham and his wife, Donna, a computer operator, cowered behind a partition as seven feet of water and foam smashed at the front of their house, shattering one window and carrying a motorcycle and a washing machine and dryer 80 yards in-

m tape-recorded the sound of the ers. Donna d wastard replayed the recording, in which Graham is heard yelling, "Oh, God, look! This one's coming over the wall!" . The next sound is breaking glass, and then a roar like a 747 going through the house. "I thought we were going to be a meatball sandwich crushed behind that wall." Graham said

About one-quarter of a mile away, at the Waimea Bay end of Ke fkt Road, a wave hurled boulders at disabled veteran Richard Williams, then tossed him 20 feet into a Jence from where he stood at the corner of his house.

Williams picked himself up and rushed into the kitchen, only to see a plate window explode in a burst of water and flying glass. He went outside again and tried to board up the window but had to grab the roof and hold on when another 30footer swept in.

He and his wife, Barbara, snatched up sons

Christopher, 4, and David, 2, from their beds and

The Honolulu Advertiser \*\* Monday, February 24, 1988 A.S

Most victims and several other residents fled to stay with friends on higher ground. At a make-shift Red Cross shelter at Sunset Elementary School, a handful spent the night huddled on the floor and others slept in their cars in the parking lot.

Dozens of other residents suffered property damage when churning salt water rolled through homes, ripped out utility connections and paving, looded parked cars and carried away personal essions

Mo of the renters and some of the owners had no nsurance,

ay, Civil Defense volunteers warned Yester sightseen off the beaches, and police motorcycle officers tried to clear a monster traffic jam made nearby surf meet. worse by

Stunner surfers who cruise that coast awoke to find four-new house-sized rocks pushed up on an offs ore reef.

Williams, Oahu Civil Defense logistics offisaid eight homes, including one fourplex and ine triplex, were seriously damaged by waves carrying 6,000 pounds of energy per square foot. in less than an hour beginning at about 11:30 p.m. Saturday\_

A high surf advisory had been in effect for several hours Saturday, and Civil Defense alerted the media to chances of sets reaching 30 feet.

Williams of Civil Defense said the sets increased in size from 12 feet to 35 feet in only about 45 minutes late Saturday.

A high surf advisory remained in effect last night for the north and west shores of Kauai and Oahu

Along the coast, people dug out and made plans.

Lee Murray, who has seen two people drowp outside her window in the past year, said she never wants to live on that shore again. Donna Graham said, "People say it's a rare thing, so we were thinking maybe it won't happen again." Richard Williams said: "I'm going to stay and fight.



#### **STEP 4** Count events, calculate annual recurrence

Annual recurrence: number of years (27) divided by number of events



### **STEP 5** Determine duration

-Find average duration of each category



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# Future Work

-Exceedence probability (S. Vitousek, Univ. Hawaii)

> -In situ measurement (geodetic) of run-up

-Vertical reach potential of each category linked to datum (include monthly sea level anomalies)

- Return periods

**Photo: Patrick Holzman**