# Wave research at Department of Oceanography, University of Hawai'i

- Hawaii wave climate.
- Directional waverider buoys around Hawaii.
- Past and present wave-related research projects.
- Effect of tides on wave field around Oahu.

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# Hawaii Wave climate :

General features :

-West to North swells from the North Pacific, during boreal winters.

-South swells from the South Pacific during meridional winters.

-East seas/swell, year round, from the Trade winds.

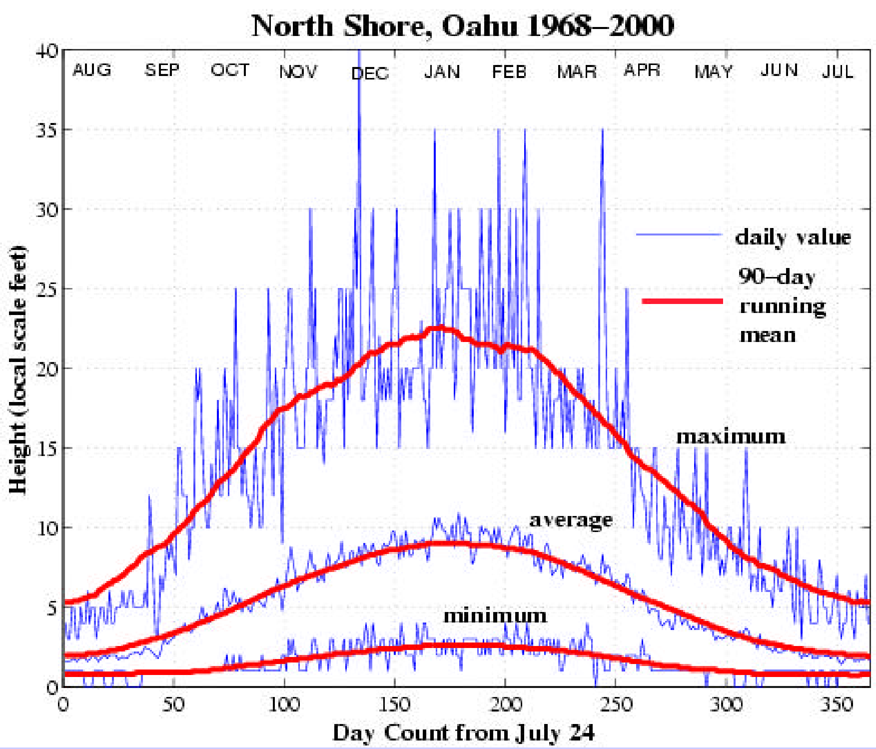
Exceptional events :

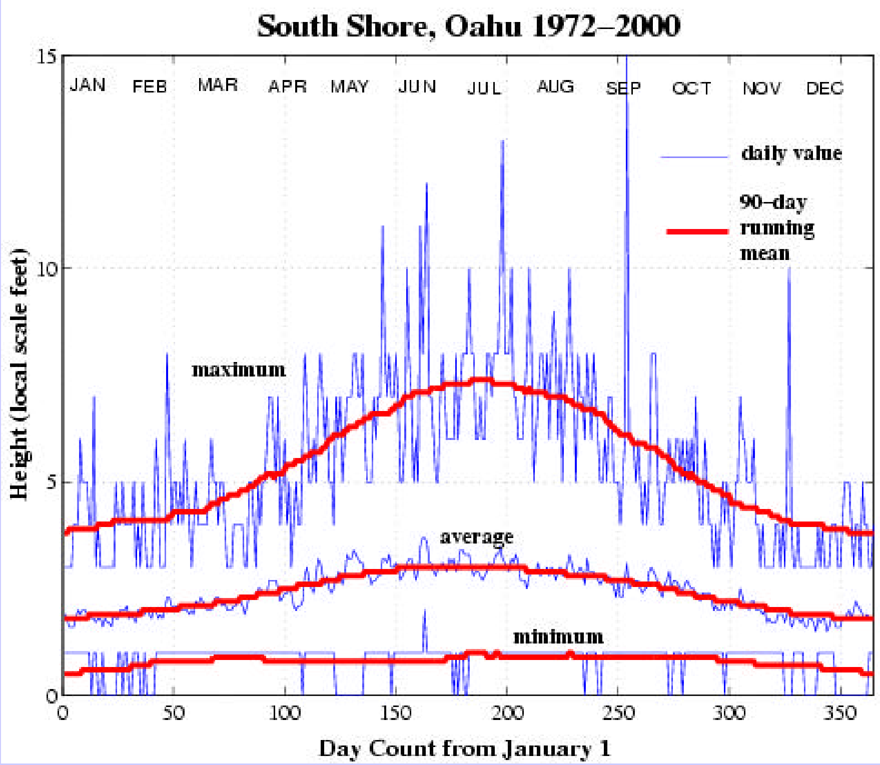
Large North-East swells, Hurricanes (all directions), Kona storm (combined swell and sea from the West).

Seasonality of wave climate based on the Goddard-Caldwell dataset (Caldwell JCR 2005), based on visual surf height estimations.

North shore: peak near December-January.

South shore : Peak near May-September.



# University of Hawaii wave buoys

(Datawell directional waverider)

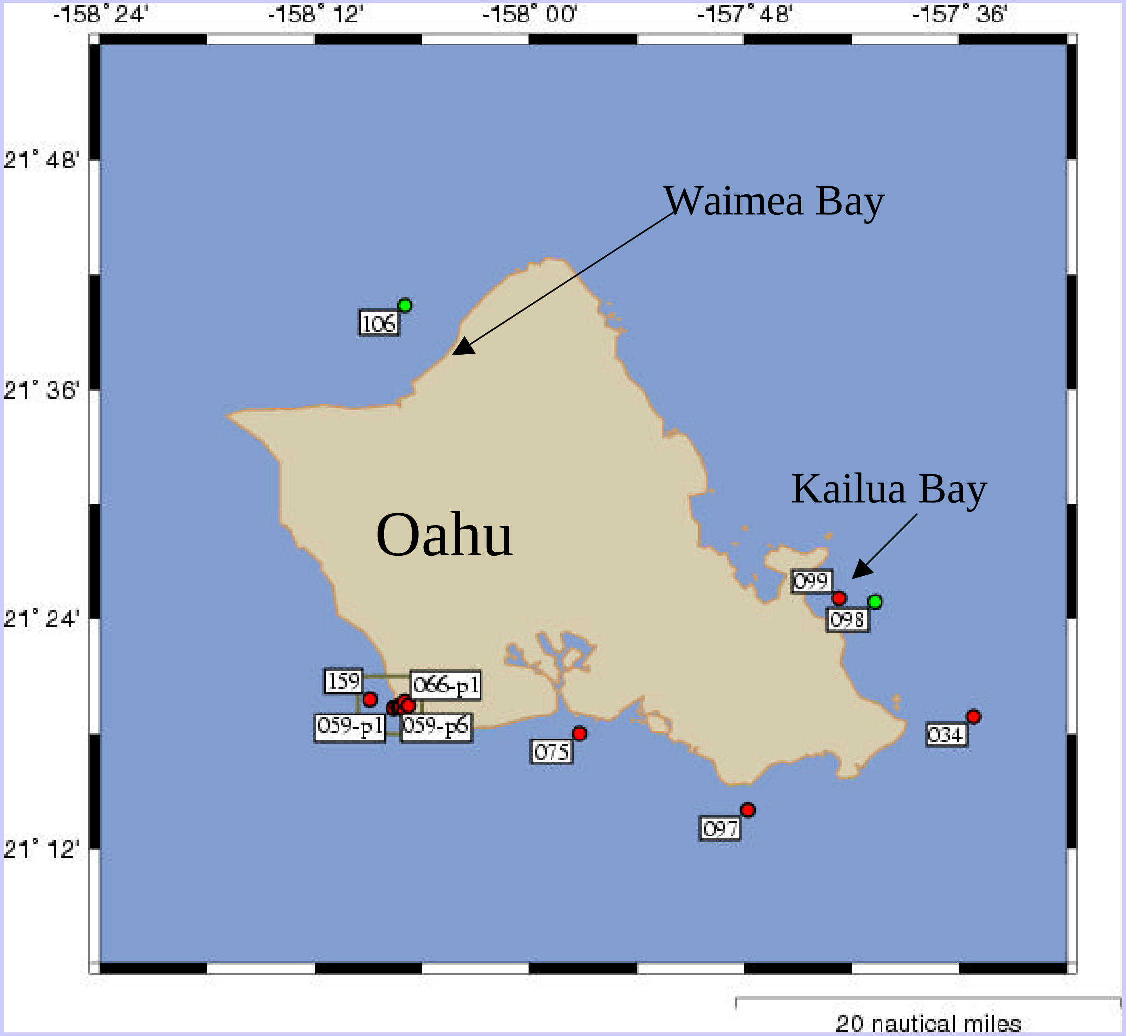
-Obtained by Pr. Mark Merrifield, University of Hawaii, through an ONR instrumentation grant

-Data collection supervised by CDIP.

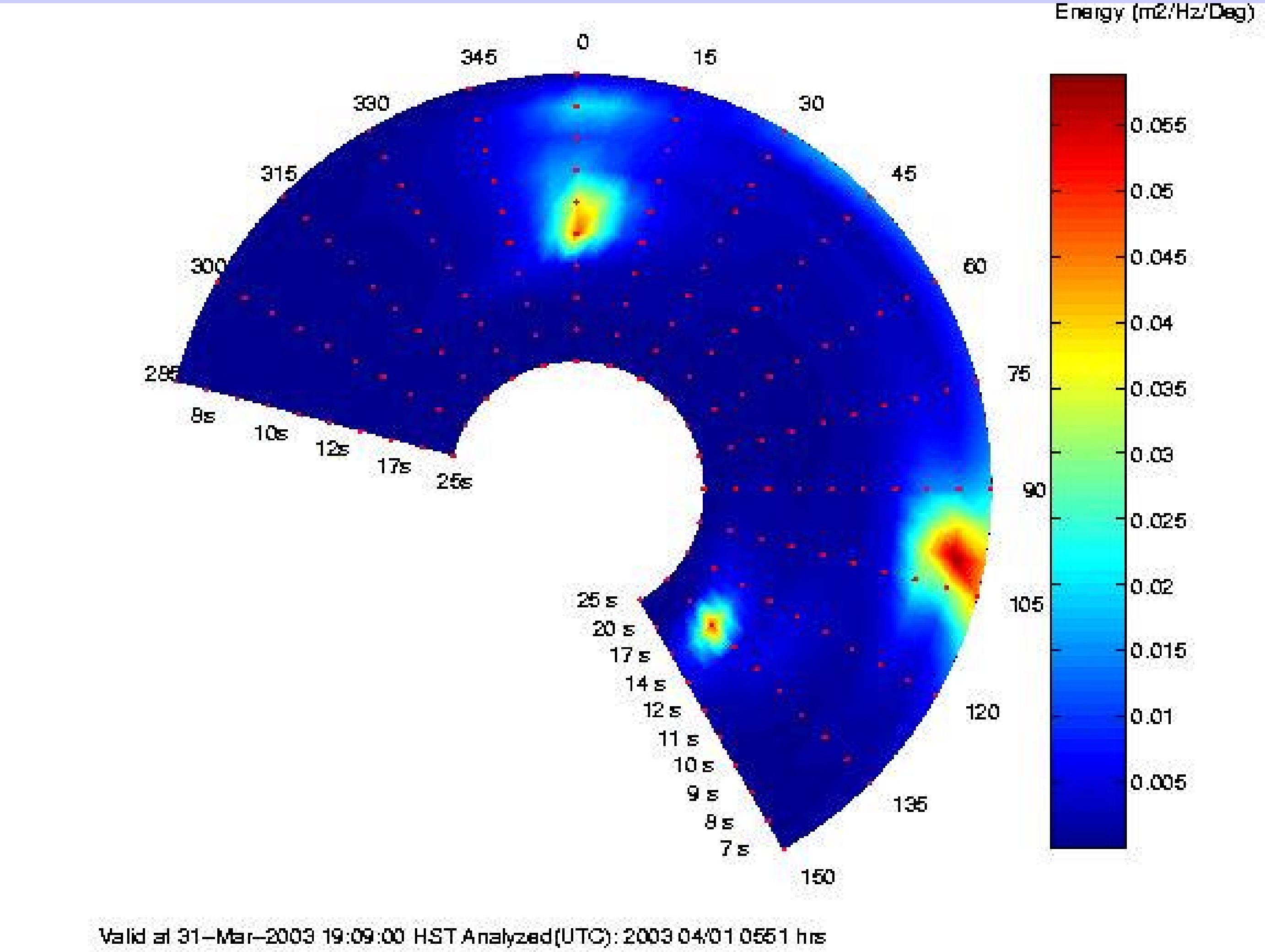
-2 active buoys :

-Kailua Bay (CDIP 098) since Aug. 2000.

-Waimea Bay (CDIP 106) since Dec. 2001.



Hawai'i wave climatology, summarized on one day (March 03), measured by the Kailua Bay buoy.



# Wave related projects

•Bedload transport in a high energy pocket beach.

•Infragravity waves under large swell conditions.

•Infrasounds generated by waves.

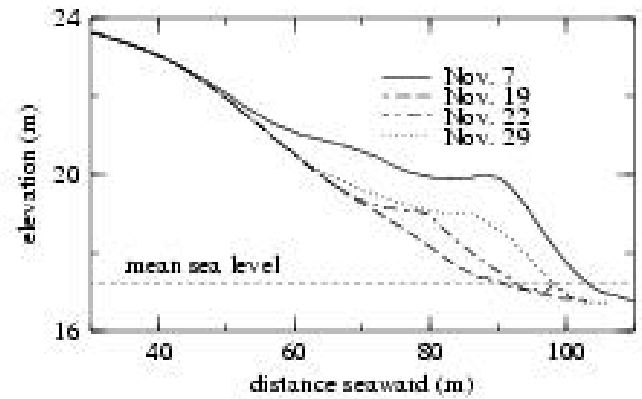
•Wave transformation over rough reef bottom (PILOT exp. And Kailua Bay)

# Wave-driven sediment transport in Waimea bay.

Waimea Bay is a pocket beach, ~ 500 m wide, open to the NW.

It experiences rapid beach changes during large swells, followed by slow recovery during smaller wave events.

(Dail et al., Marine Geology 1999)



# Wave-driven sediment transport in Waimea bay.

Ongoing Research, beach change, and sediments transport and sand ripples (Pr. Janet becker, Pr. Mark Merrifield and Yvonne Firing, funded by UH Sea Grant) :

# Wave-driven sediment transport in Waimea bay.

Bottom mounted instruments package to be deployed in the Bay during the coming weeks.

# Wave attenuation and infragravity study in Waimea Bay

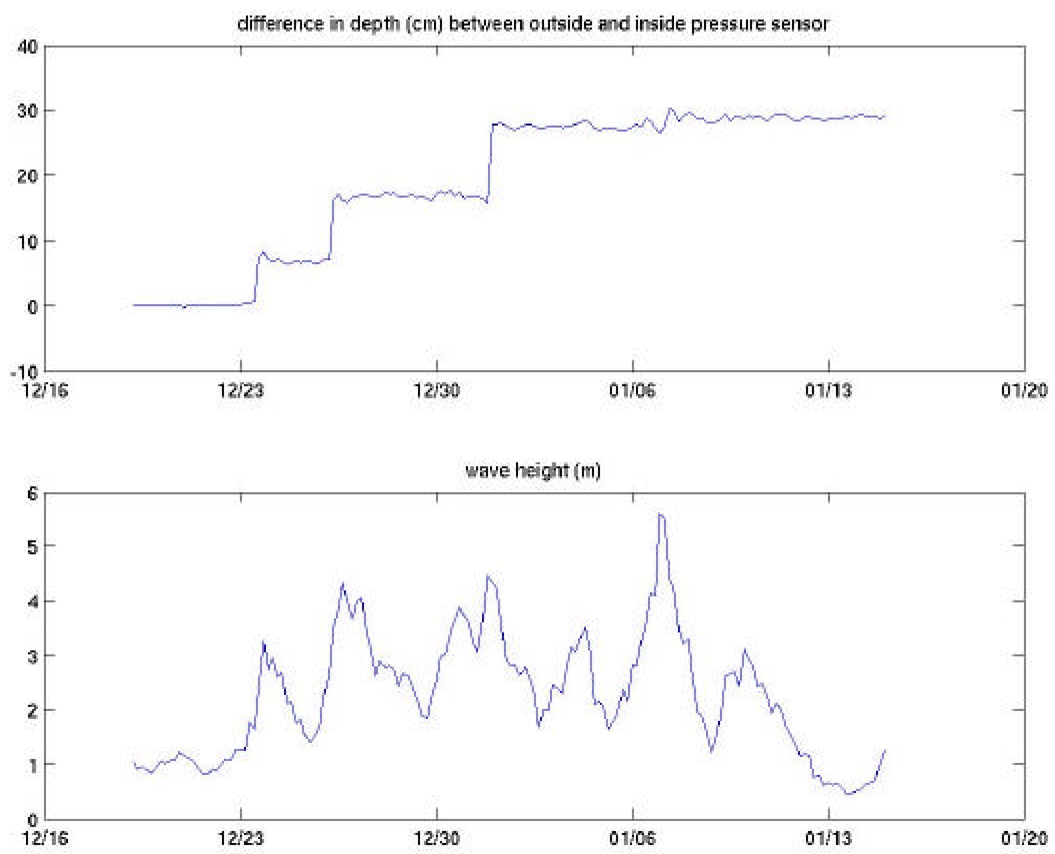
## Logistics issues when measuring large waves in the nearshore:

We reproduced results from other studies, but with larger waves (Herbers et al. JGR 1995 and others) :

•Infragravity signal increases shoreward.

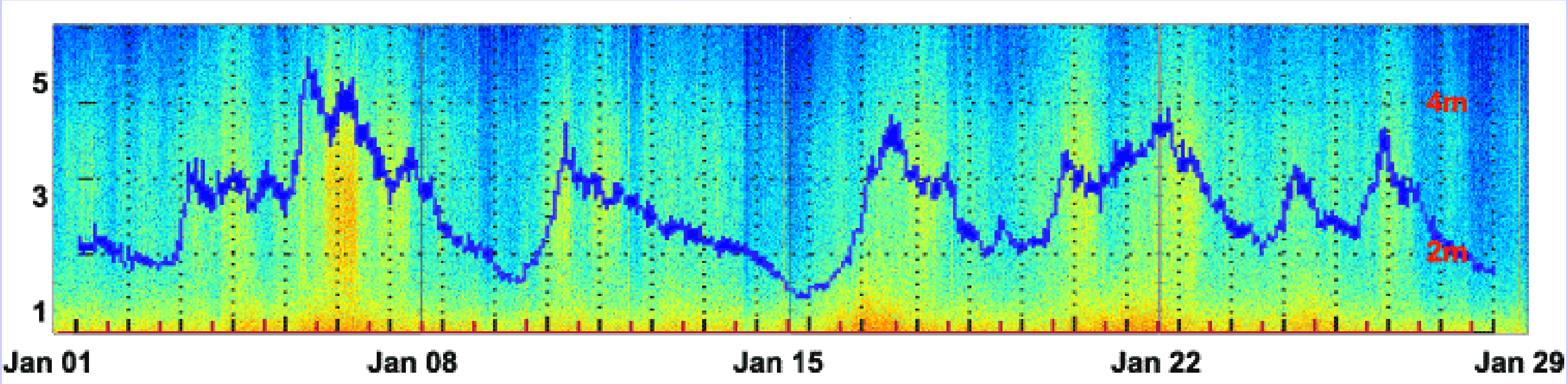
•Infragravity is strongly correlated to incoming swell energy.

•Ratio of free over bound infragravity increases towards shore.



# Infrasound generated by ocean waves

Collaboration with the Infrasound Lab (UH/HIGP)




Overlay of ocean wave height from the Waimea buoy (blue) over the spectrogram for one channel of I59US during the month of January 2003. The red tick marks denote GMT time for the acoustic data, the scale for the wave height is in red on the right, and the vertical axis on the left hand side is infrasonic frequency, in Hz. (Garces et al. GRL 2003)

A more thorough study is planned for this winter on Big Island, with portable infrasound array, and local wave sensors.

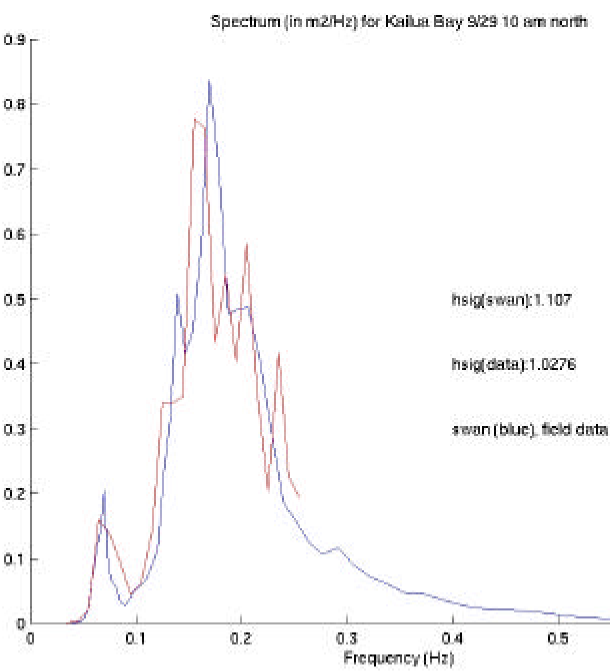
# PILOT: Pacific Island Land Ocean Typhoon Experiment

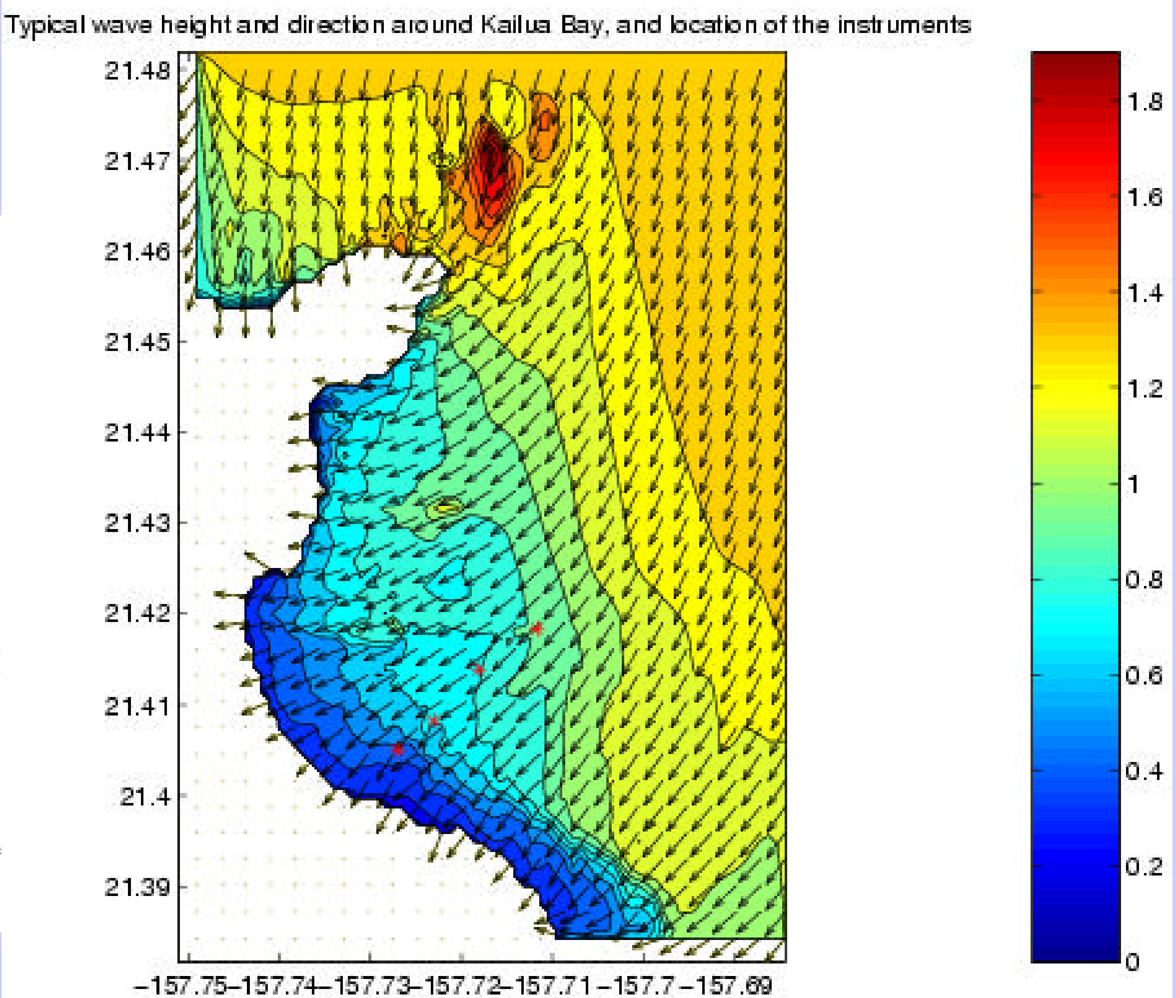
(Collaboration USACE, NDBC, CDIP, UH)

- Pacific islands are prone to hazardous wave inundation in low-lying coastal areas during typhoons.
- The study goal is improved prediction of inundation events through a better understanding of the underlying physical processes.
- The study will consist of measuring and modeling wave, water level, and meteorological conditions during large wave events on the islands of Oahu and Guam.

# Wave dissipation over large fossil reef platform in Kailua Bay, using the SWAN wave model

Friction 30 times greater than for sand was needed to account for observations.



# Interaction between tidal currents/elevation and wave field

- Tidal range in Hawaii is rather small : max. 70 cm

- Initial motivation : surfer observations of surf quality affected by tidal phase

- If surf quality depends on the phase of the tide ( not only the tidal elevation), it has to be both elevation and current.

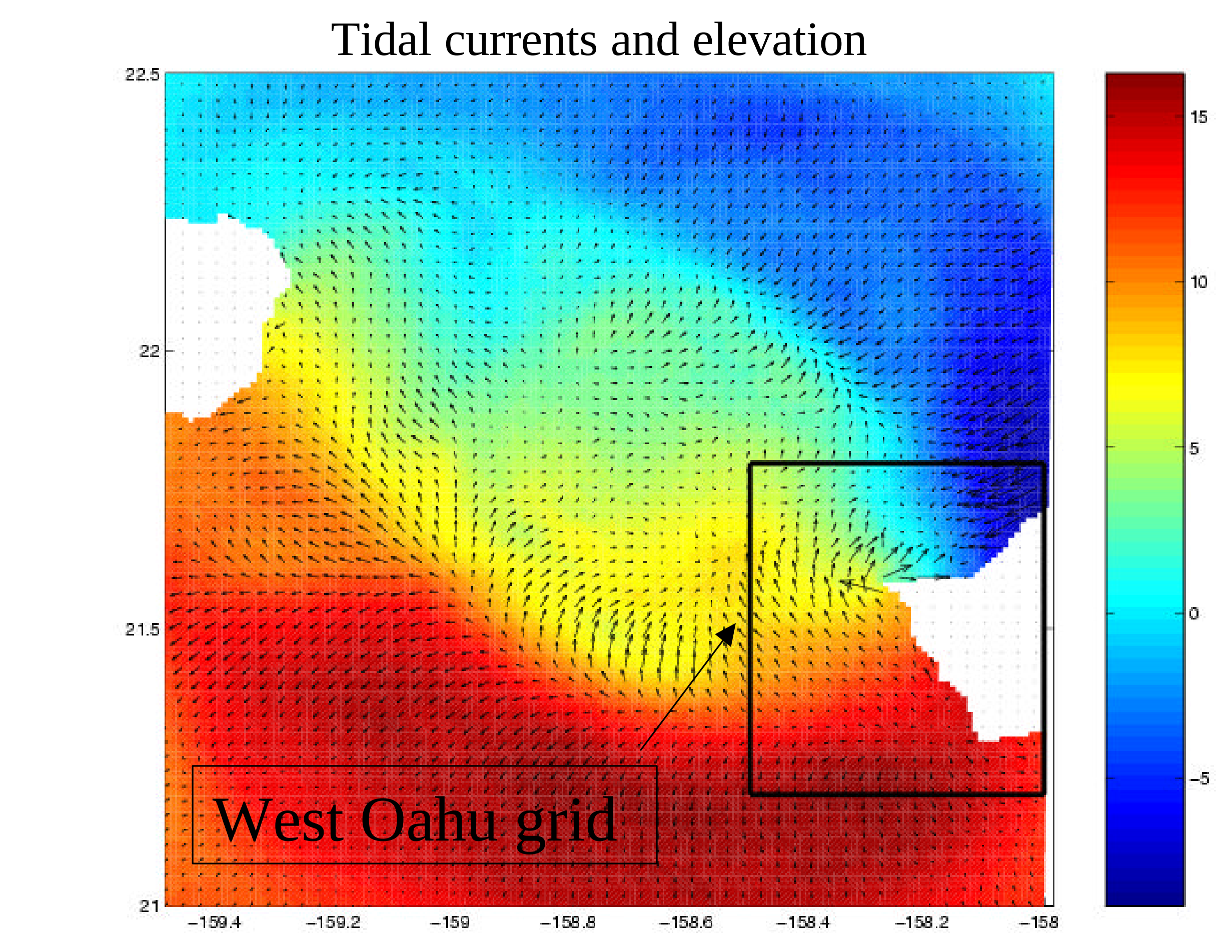
- Can it be answered with a coupled current/wave model ?

# Interaction between tidal currents/elevation and wave field

GCM used for the tidal current forcing.

Princeton Ocean Model, 1km grid, aimed at simulating internal wave generation in the Kauai channel.

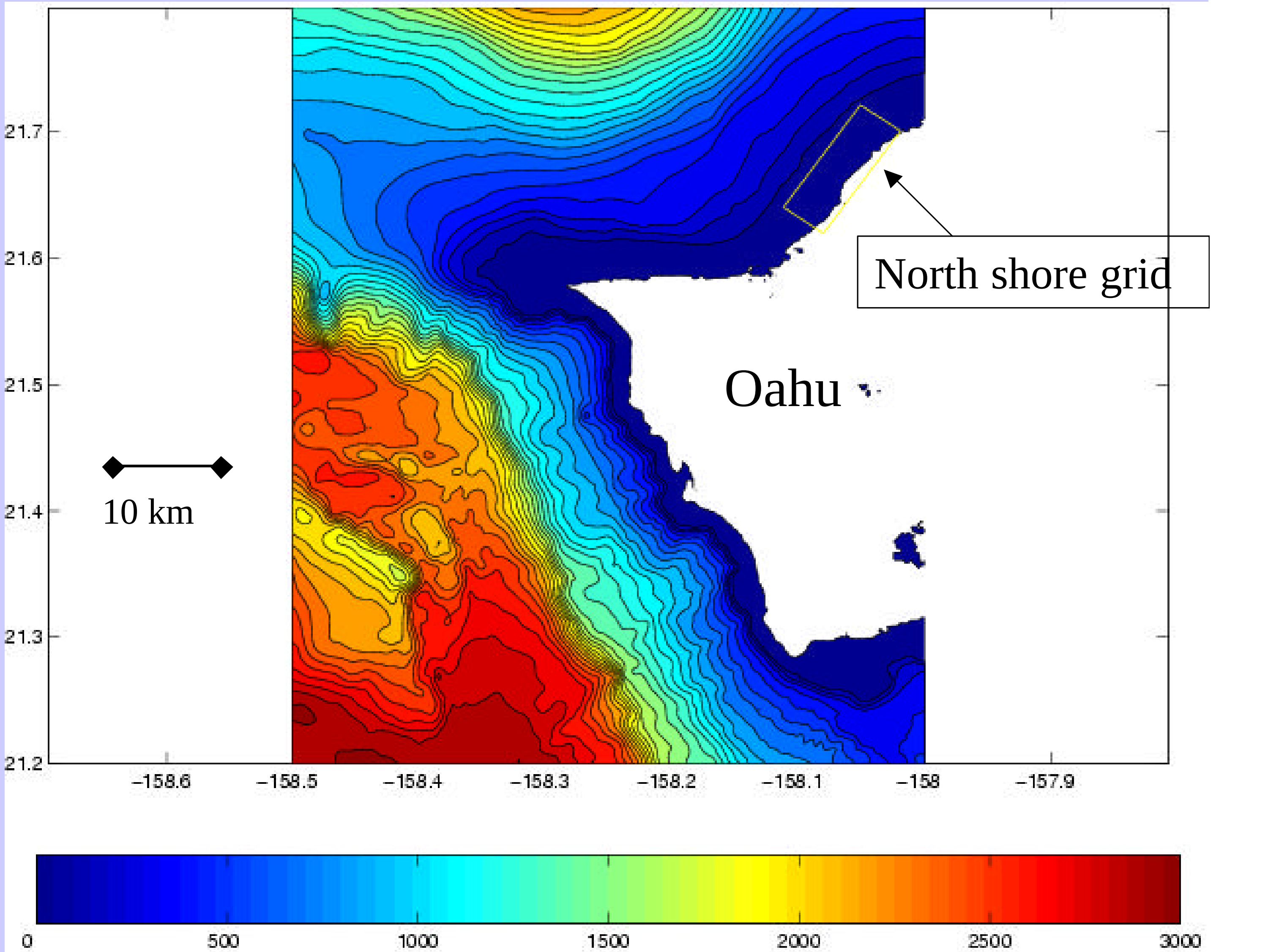
Surface tidal currents are a combination of barotropic and baroclinic tidal currents, primarily oriented alongshore.



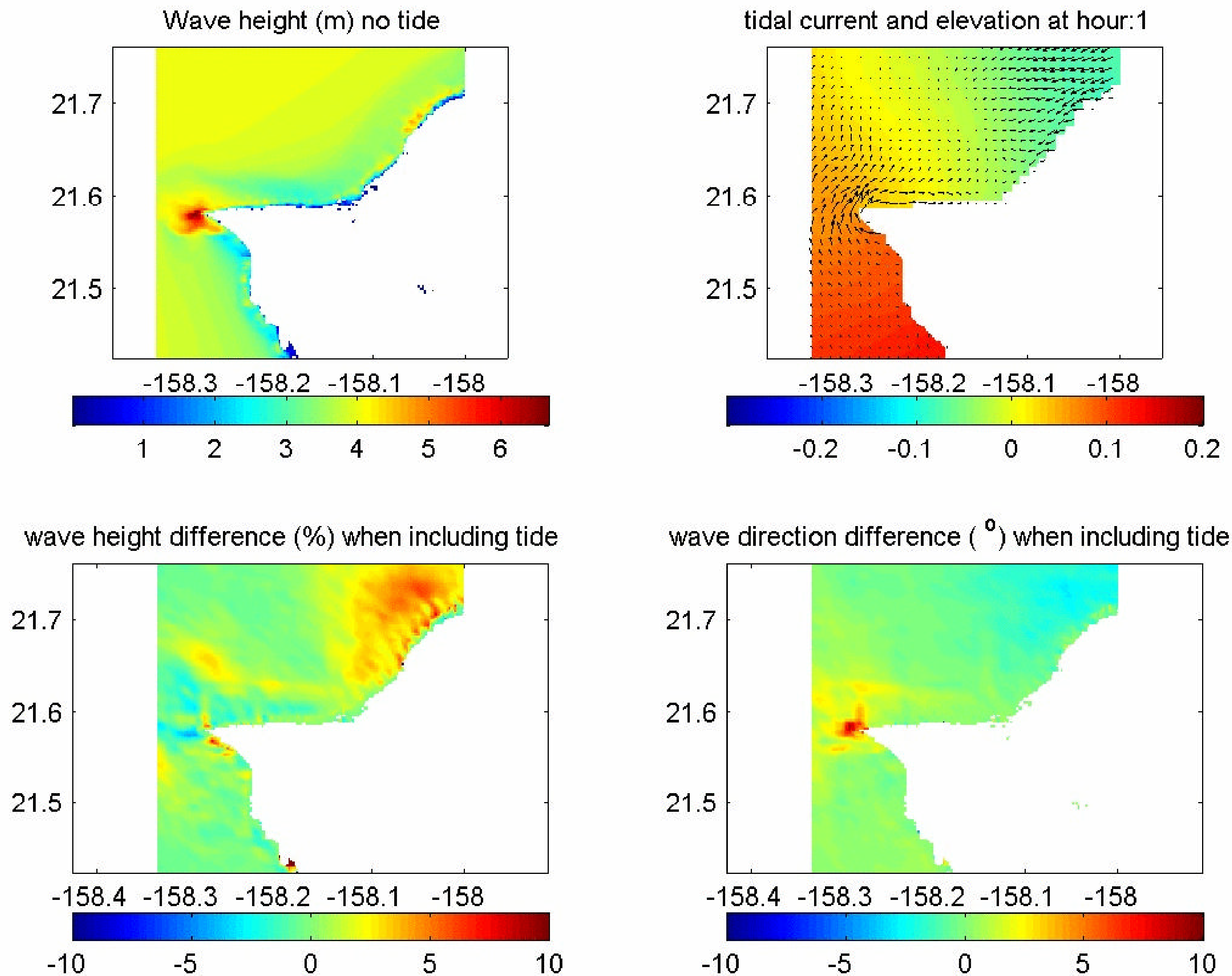
# Interaction between tidal currents/elevation and wave field

Bathymetry (m) used for the west oahu grid for the wave/tidal current study.

(250 m res.)



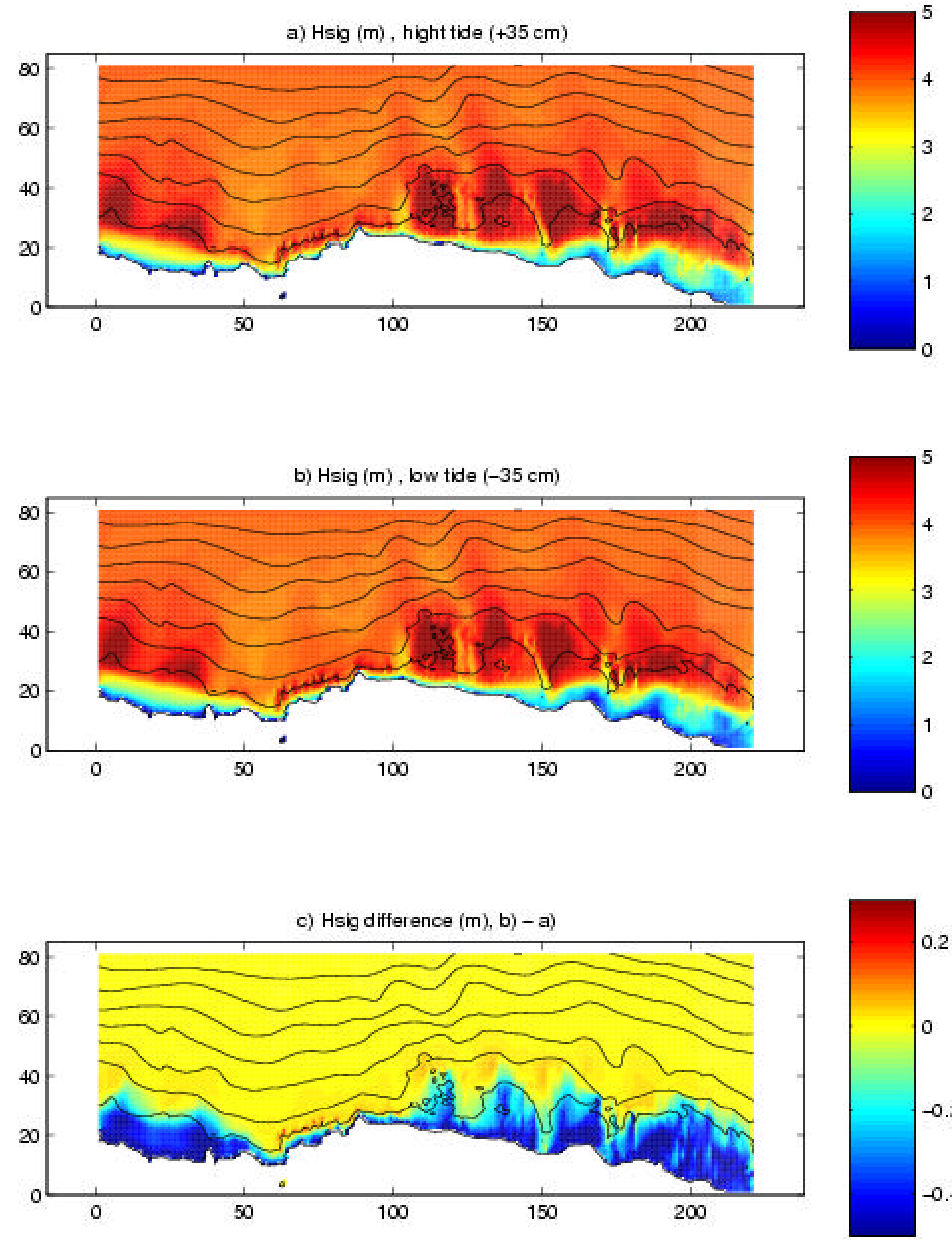
# Incoming swell : 4 m, 18 sec, 305 degrees



Close-up, higher resolution model (50 m grid size) of the north shore.

Forcing : 4 m, 18 sec, 305 degrees.

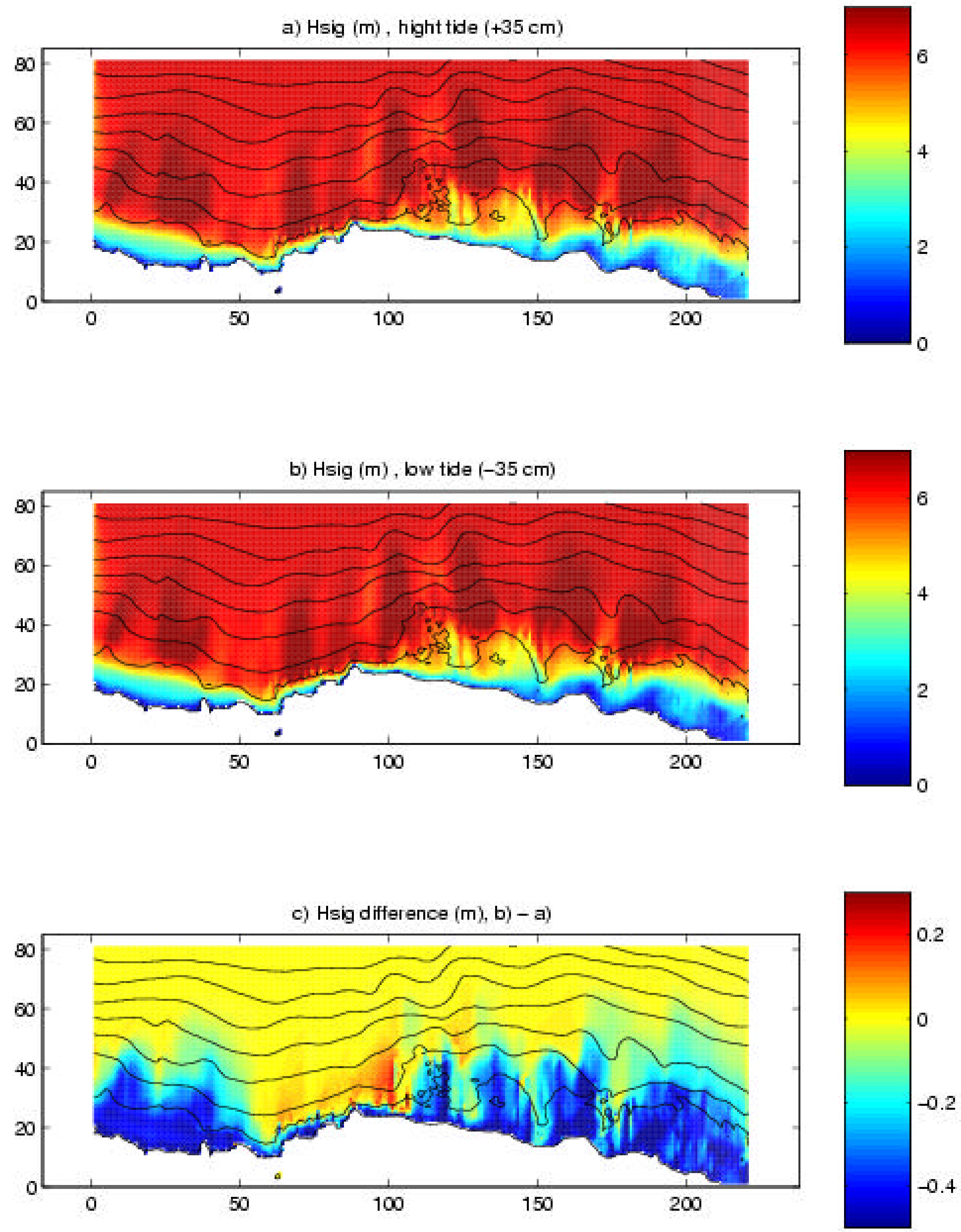
Differences between tidal elevation extremes are small and concentrated in depths below 10 m.



Close-up, higher resolution model (50 m grid size) of the north shore.

Forcing : Eddie swell data (01/07/02), 6.5 m, 18 sec, 320 degrees.

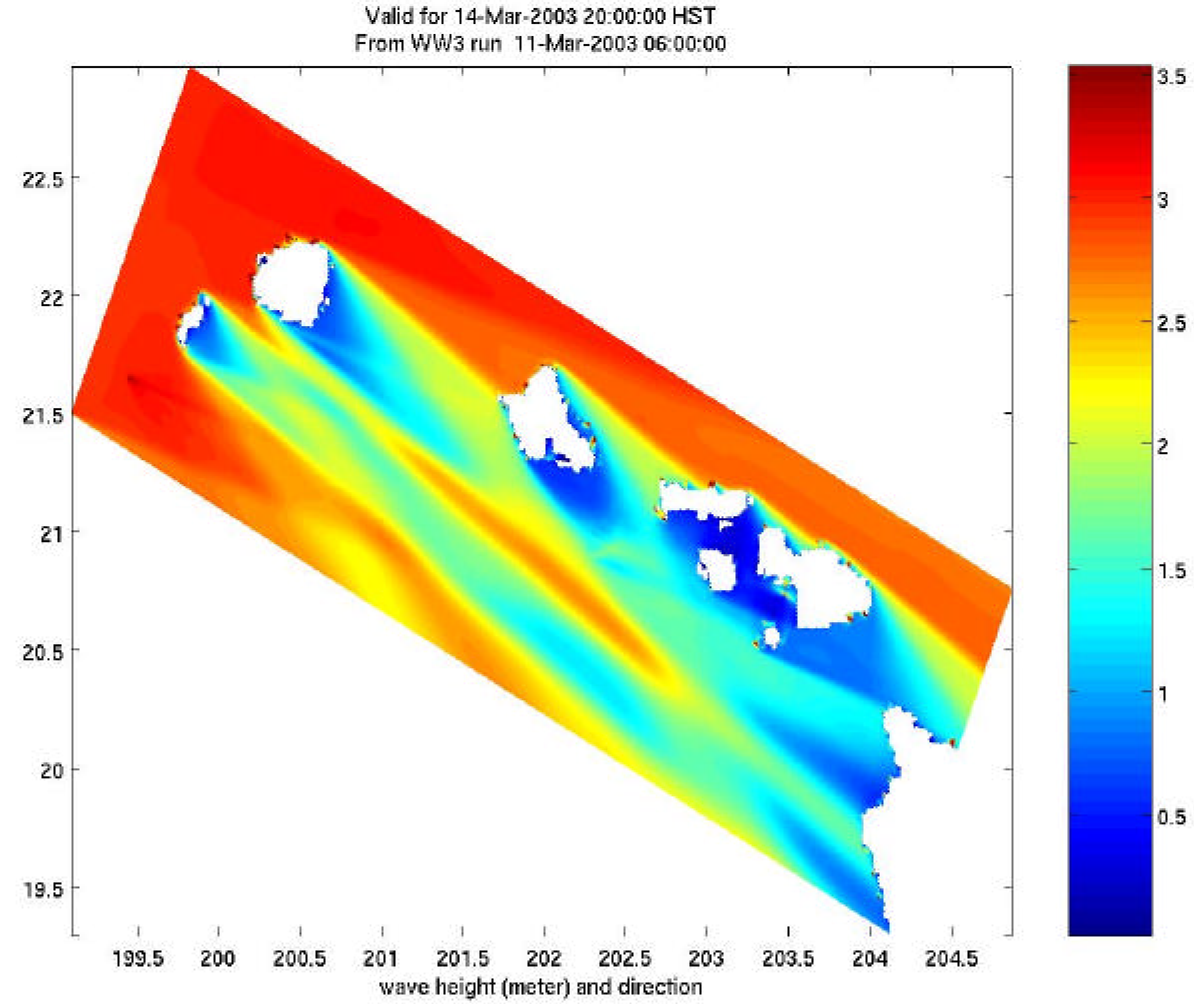
Differences between tidal elevation extremes are small but extend to depths up 30 m.



Importance of regional models for public safety :

Shadowing of Big Island’s Kona coast by the other main Hawaiian Islands.

Validation of such model would require HF radar with wave measuring capabilities over long distances or drifting wave buoys:



Aloha and Mahalo …