Predicting Coastal Hazards: A Southern California Demonstration

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CDIP The Coastal Data Information Program
Integrative Oceanography Division
SCRIPPS Institution of Oceanography
CDBW
USACE

UNIVERSITY OF FLORIDA

OSU Oregon State University
COAS
College of Oceanic and Atmospheric Sciences

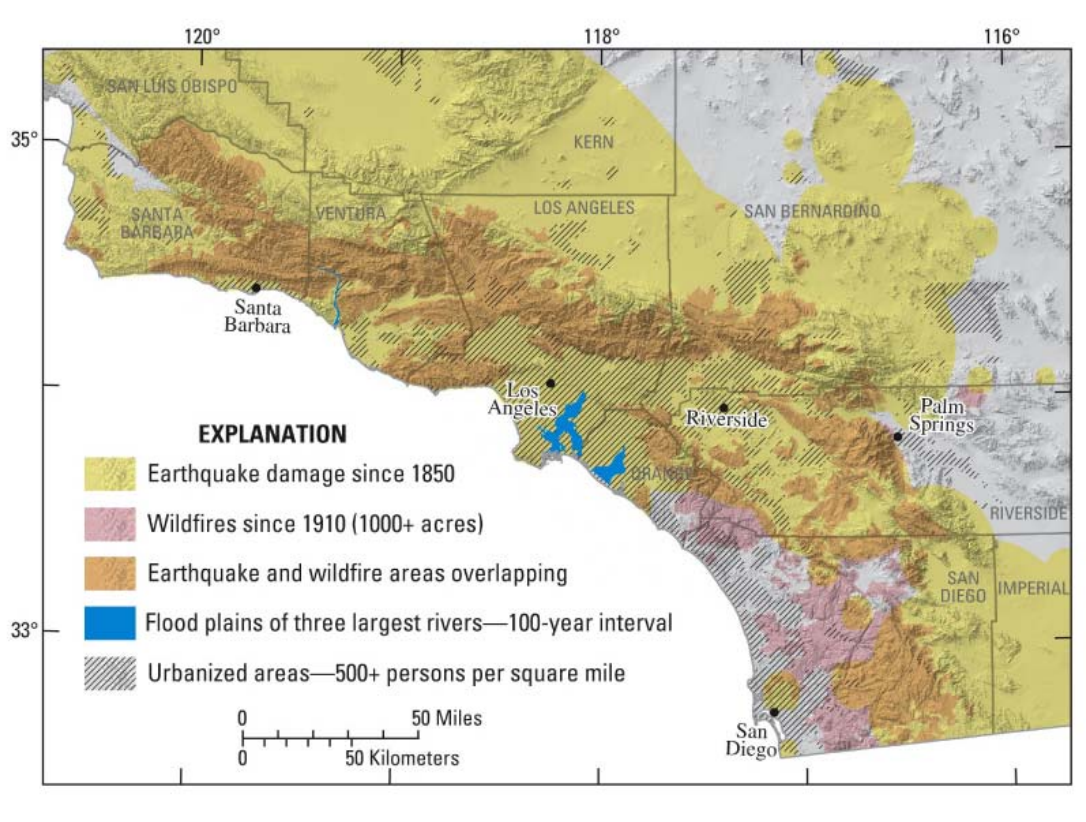
WL | delft hydraulics

SLUG
SANTA CRUZ

Southern California
Multi-hazards Demonstration Project

Objective: Integrate multiple USGS research activities with the needs of external partners such as emergency managers and land-use planners to produce products and information that can be used to create more disaster-resilient communities

- Earthquakes
- Landslides
- Floods
- Tsunamis
- Wildfires
- **Coastal erosion**

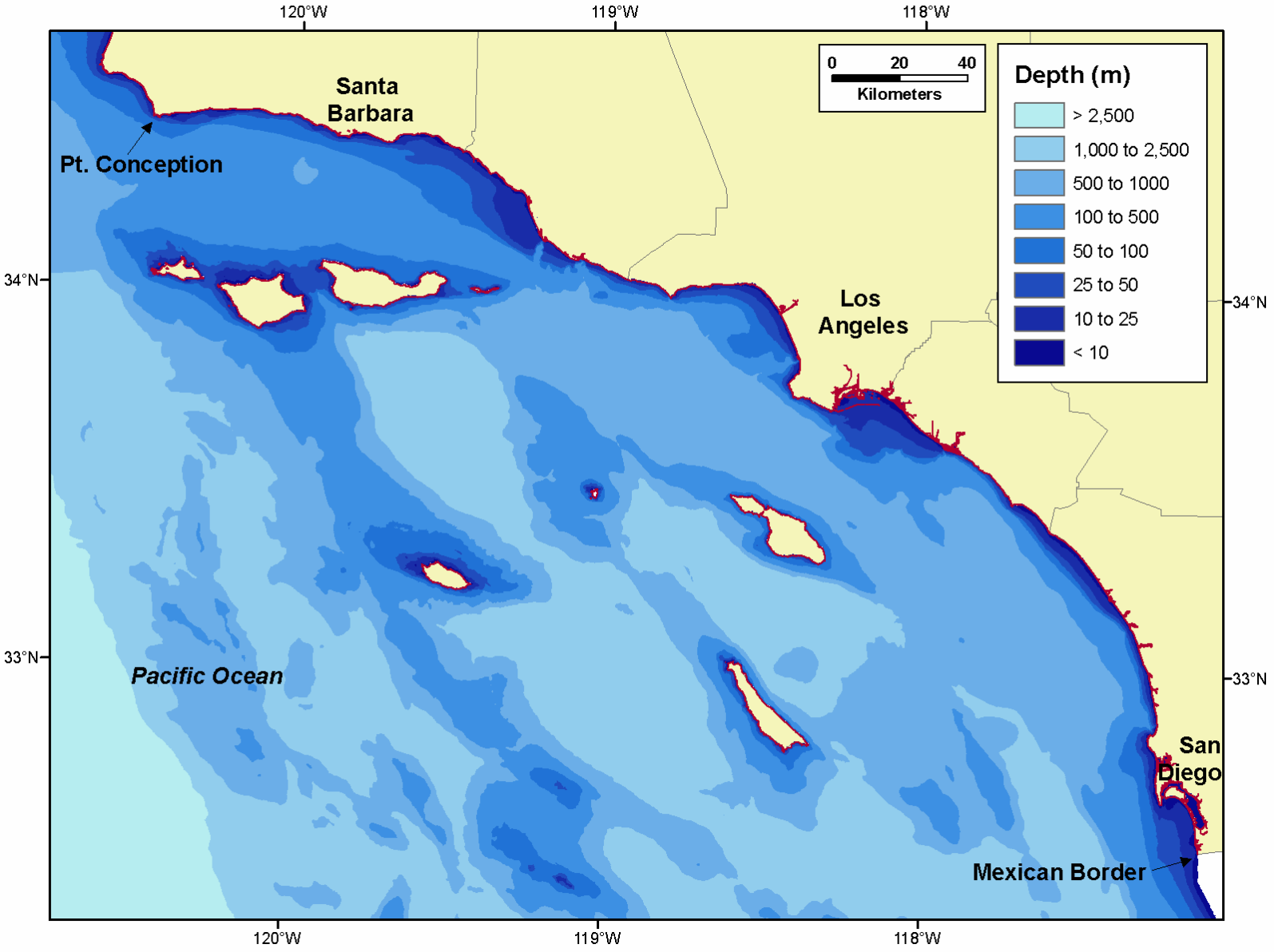


Coastal Erosion Task

Objective: To develop a real-time, state-of-the-art model for predicting coastal hazards along the Southern California coast.

- **Short-term approach: coastal vulnerability assessment using historical storms and extreme value analysis**
- **Long-term approach: real-time predictions**

Study Area


120°W
119°W
118°W
34°N
33°N
Santa Barbara
Pt. Conception
Los Angeles
San Diego
Mexican Border
Pacific Ocean
0 20 40
Kilometers
Depth (m)
> 2,500
1,000 to 2,500
500 to 1000
100 to 500
50 to 100
25 to 50
10 to 25
< 10

Primary Components

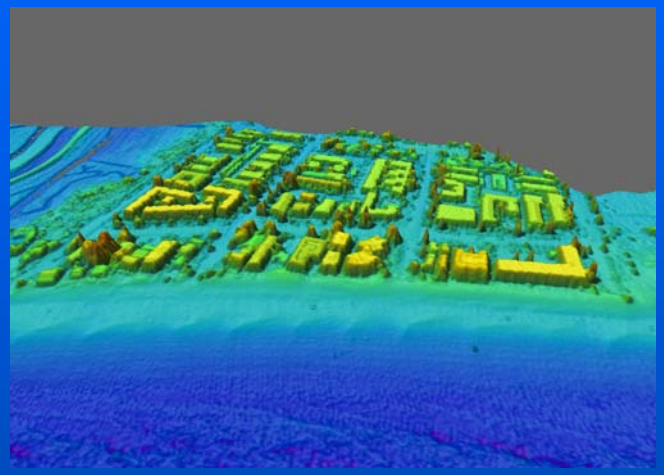
- **High resolution DEM**
- **Spectral Wave Model**
- **Tide Model**
- **Surge Model**
- **Run-up Model**
- **Longshore Transport Model**
- **Profile Change Model**
- **Probabilistic Cliff Failure Model**

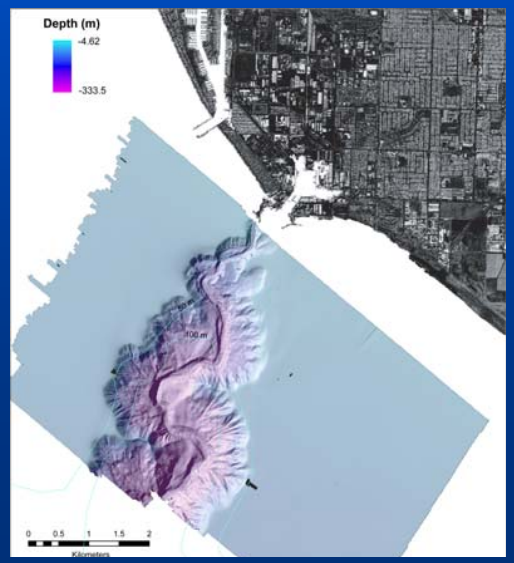
Planned Web Products/ Predictions

- **Breaking wave height**
- Maximum water level
- Extreme run-up height
- **Coastal flooding and inundation**
- **Littoral drift (divergence and convergence)**
- **Profile change**
- Berm overtopping
- Dune incision
- **Cliff failure potential**

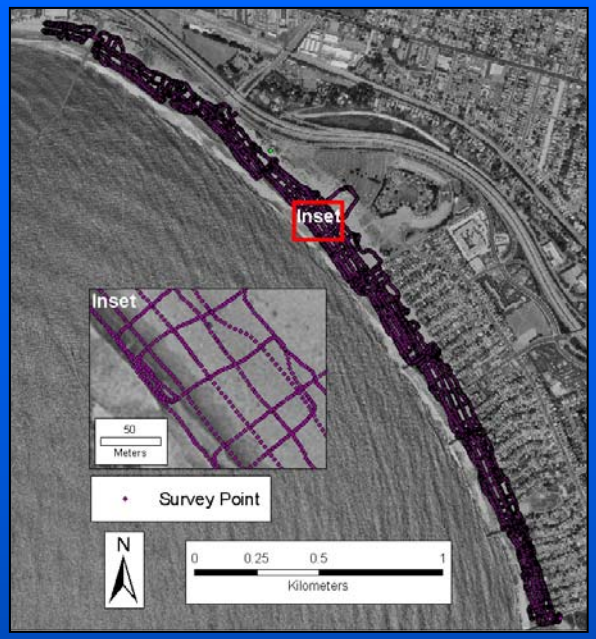
Digital Elevation Model (DEM)

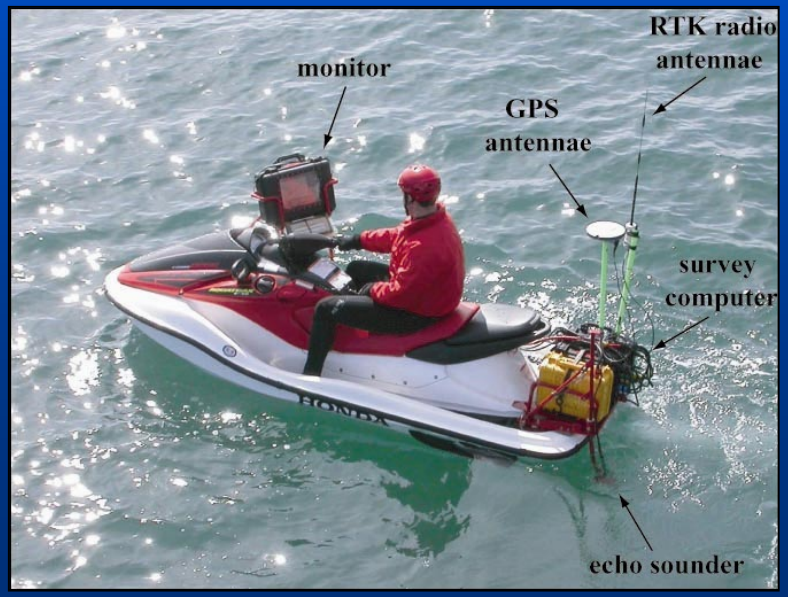
- 2 m resolution
- Continuous offshore-onshore coverage
- Use latest and greatest multibeam bathymetry & lidar
- Update periodically
- Fill-in gaps with focused work
- Extract profiles for analysis every 100 m alongshore from -20 m to at least +20 m
- Over 4,700 profiles/stations



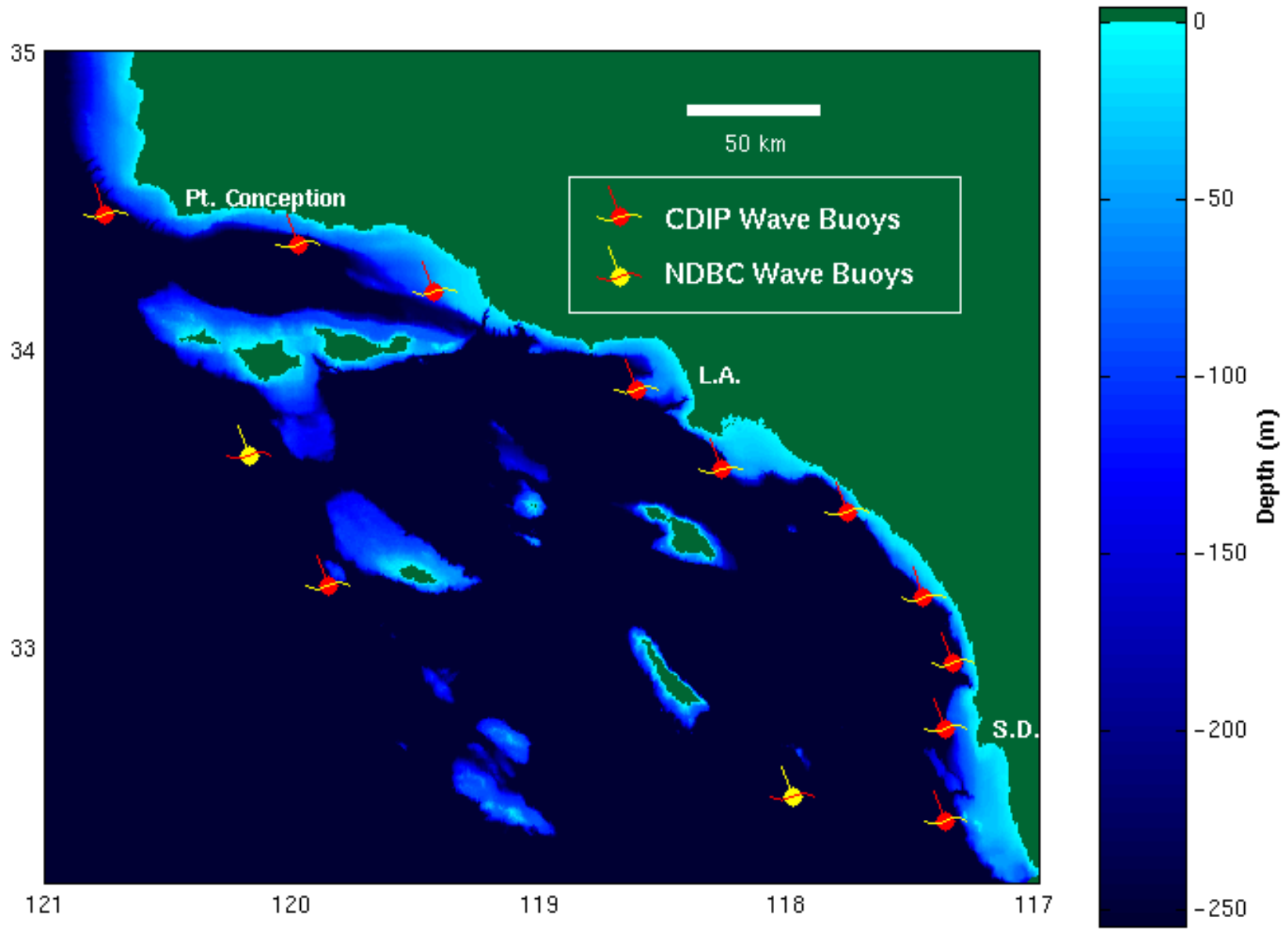


Fill-in Technology





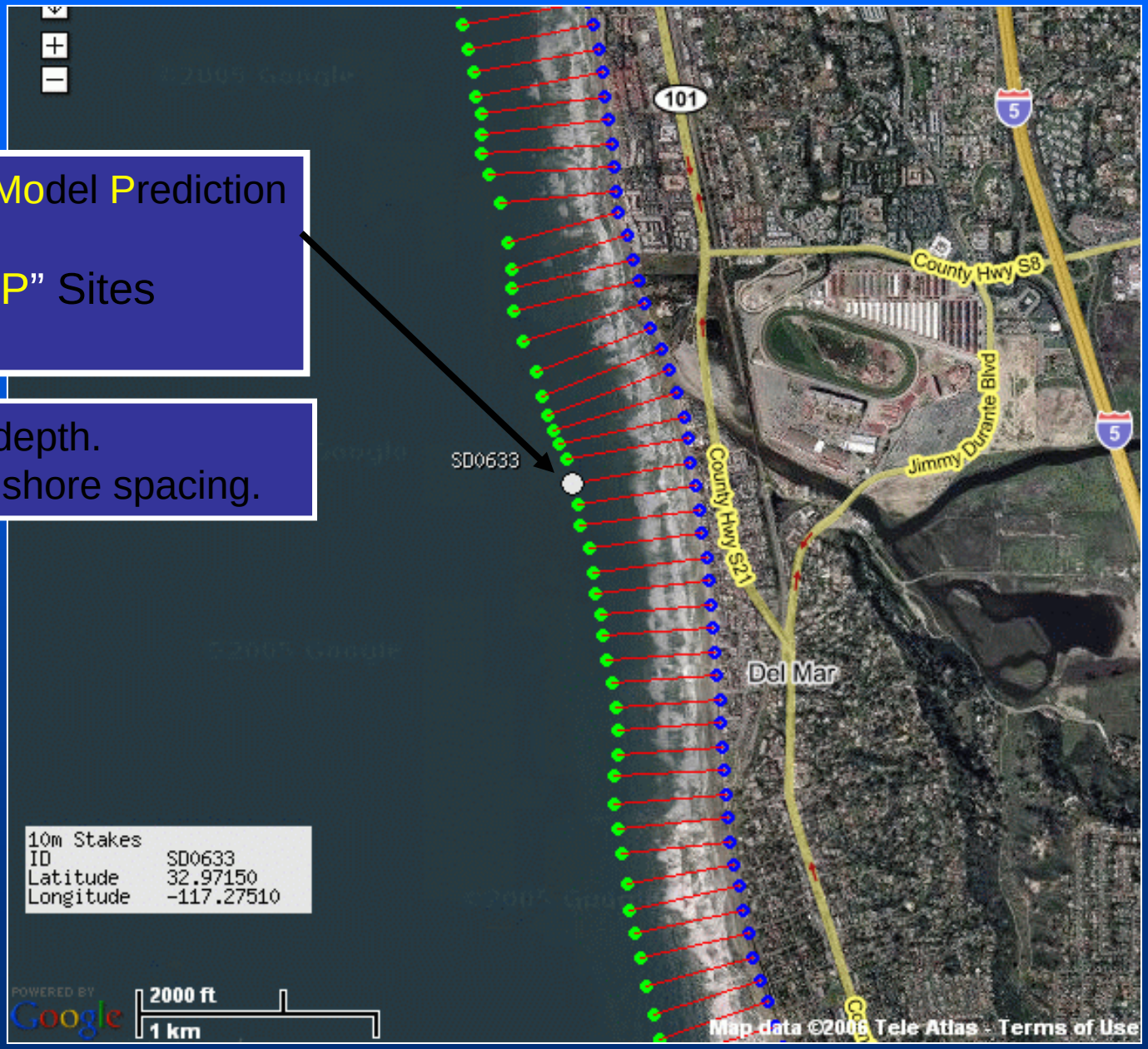
Spectral Wave Model

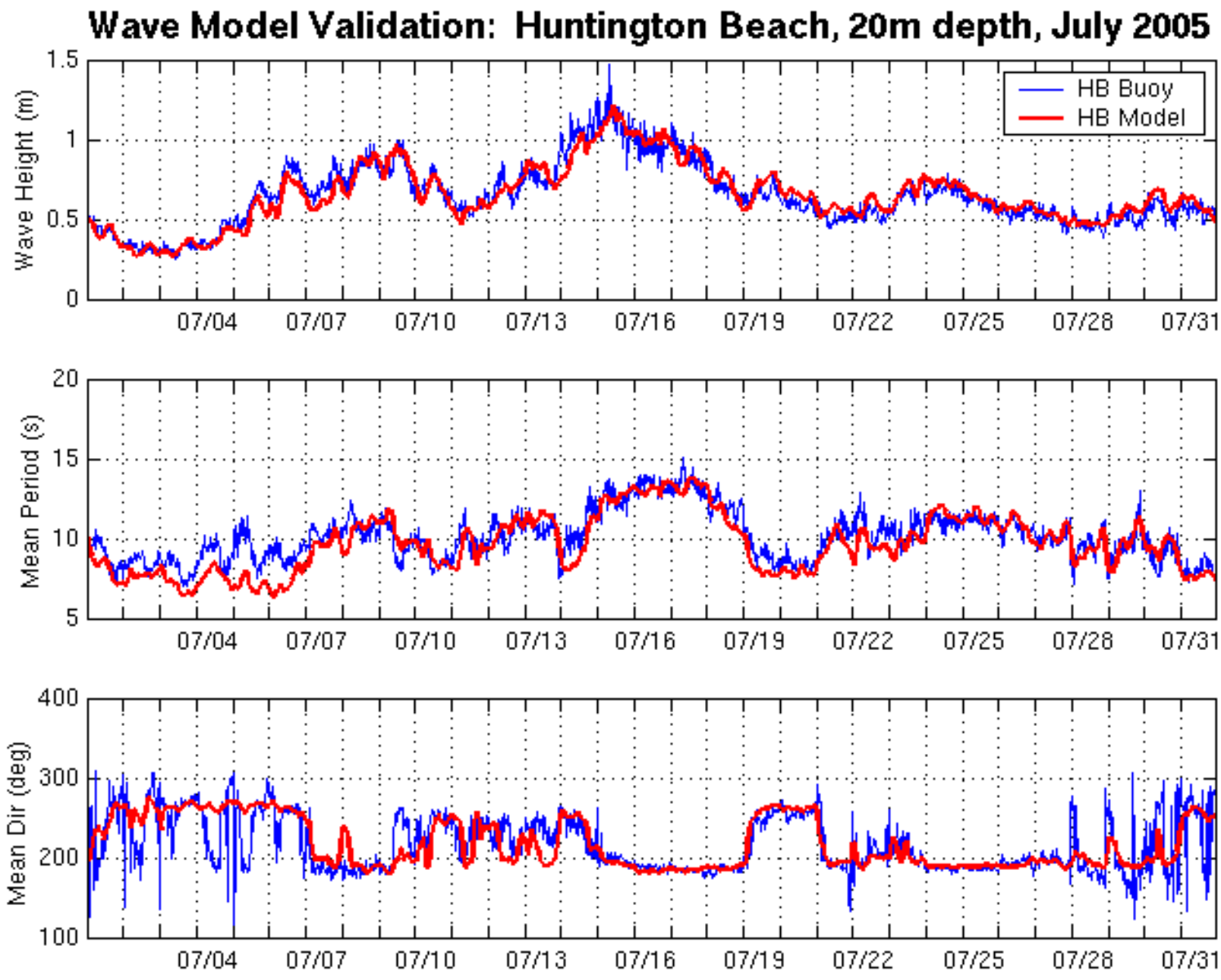


Alongcoast Model Prediction

"MOP" Sites

- 10 m water depth.
- 100 m alongshore spacing.




Wave Model Validation: Huntington Beach, 20m depth, July 2005
Wave Height (m)
1.5
1
0.5
0
HB Buoy
HB Model
07/04
07/07
07/10
07/13
07/16
07/19
07/22
07/25
07/28
07/31
Mean Period (s)
20
15
10
5
Mean Dir (deg)
400
300
200
100

SIO Waves and Beaches

Model Prediction (MOP) System

Wave Monitoring

- **Wave Buoy Network**
- **NOAA WW3 Forecasts**

Coastal Wave Modeling

- **Breaking wave heights**
- **Radiation stresses (Sxx,Sxy)**

Surfzone Monitoring

- **Current Measurements**
- **Dye/Drifter Tracking**
- **Jetski Sand level Surveys**

Surfzone Modeling

- **Current Direction & Speed**
- **Bottom Velocities**

Beach Monitoring

- **LIDAR**
- **ATV Sand level surveys**

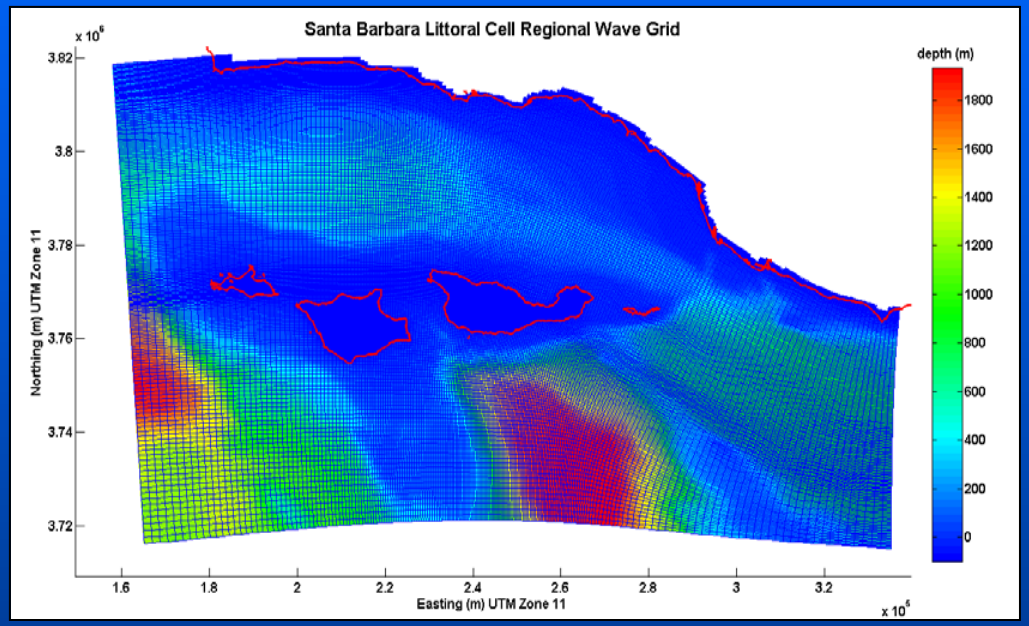
Beach Modeling

- **Beach width change**
- **Inundation levels**

Public Access To Core Coastal Environment Variables Via "MOP Sites"

Tide Model

- Delft3D Hydrodynamic Module
- Boundaries from global tide model
- Series of overlapping curvilinear grids
- Water level output at each MOP station



Other Models

- Surge Model- analytical approaches presented by Jelesnianski (1972) and Hsu (2004), that rely on estimates of the shoaling factor, sea level pressure, and a correction factor for storm approach
- Run-up Model- empirical formulations of Ruggiero et al. (2001) and Stockdon et al. (2006)
- Longshore Transport Model- CERC Formulation
- Profile Change Model- UNIBEST DE (dune erosion)
- Probabilistic Cliff Failure Model- in development by Collins and Hapke

Validation- Winter Experiment 2008-9

- Rapid response (SCRIPPS in San Diego County and USGS in Santa Barbara County)
- Run-up, flooding, profile change, etc.

Timeline

Winter 2007-8- develop conceptual model of model design, identify all PIs

Spring/Summer 2008- set-up preliminary model and testing

Fall 2008- full DEM construction and model testing

Winter 2008-9- winter field test

Spring 2009- coastal storm scenario test with larger hazards group

FY2010+- full model implementation (online?)

FY2011- project completion?

Future Directions

- Real-time integration
- Develop partnerships to improve products and usage
- Sea level rise impacts

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Comments?

- What information is (most) useful to you?
- What is the most efficient format?

Planned Web Products/ Predictions

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Support and Collaboration

- USGS Support:
  - California Urban Oceans Project
  - Southern California Multihazards Demonstration Project
- Academic Partners
  - SCRIPPS
  - University of Florida
  - Oregon State University
  - University of California, Santa Cruz
  - Delft Hydraulics
- Government Agencies:
  - U.S. Army Corps of Engineers
  - California Department of Boating and Waterways
  - NOAA

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