

SANTA BARBARA AND VENTURA COUNTIES COASTAL PROCESSES STUDY

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University of California, Santa Cruz**



A sunset over the ocean with silhouetted trees in the foreground. The sun is low on the horizon, casting a warm orange and yellow glow across the sky and water. The trees are dark and silhouetted against the bright sky.

Products

- **BEACON Final Technical Report (early 2009)**
- **MS Thesis and Dissertation (Summer 2007)**
- **USGS Open File Reports + Scientific Investigations Maps**
- **Journal publications and conference proceedings**
- **Seamless Map Product**

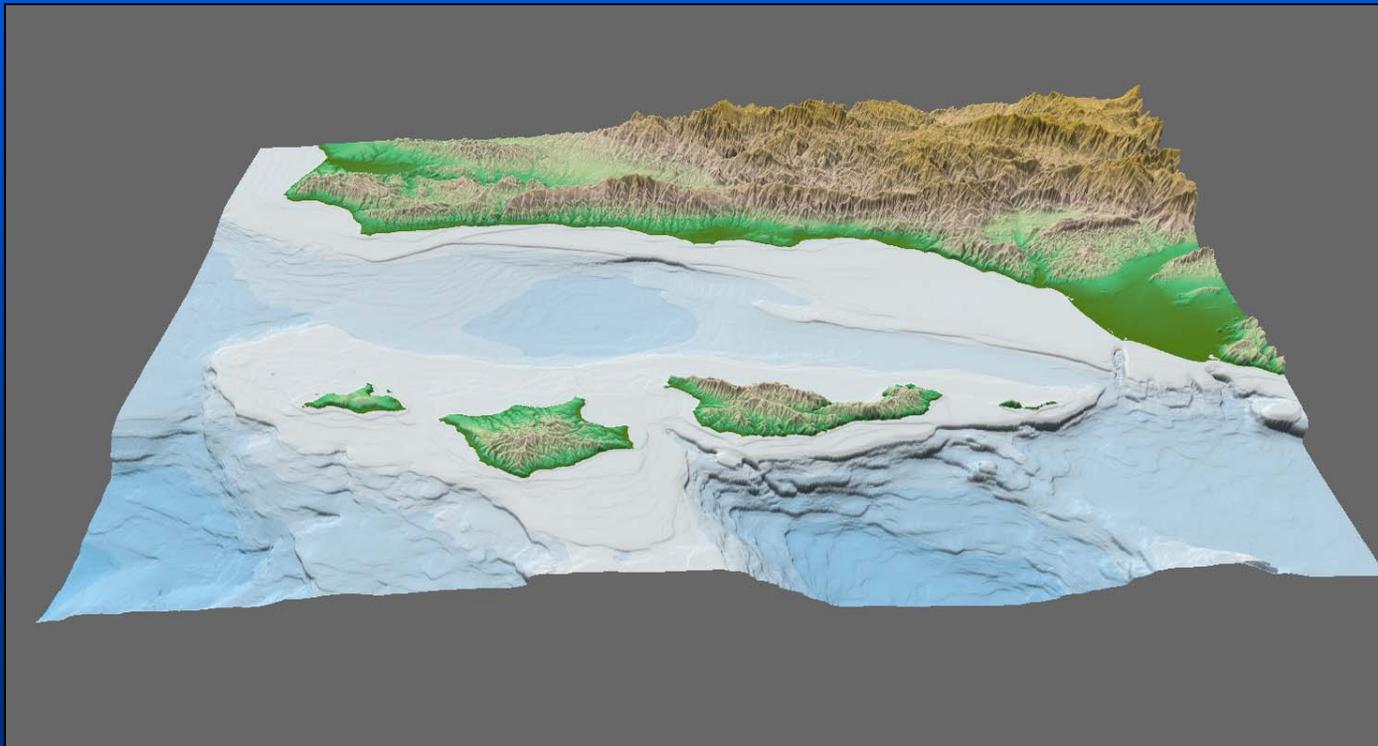
Support and Collaboration

- **USGS Support:**
 - California Urban Oceans Project (PI: Lee)
 - Habitat Mapping Project (PI: Cochrane)
 - Coastal Evolution Modeling Project (PI: Dan Hanes)
 - Delft Hydraulics Cooperative
- **Academic Partners**
 - University of California, Santa Cruz
 - San Francisco State University
 - University of Florida
 - University of California, Santa Barbara
 - California State University, Long Beach
 - SCRIPPS
 - University of Texas
 - California State University, Monterey Bay
- **Government Agencies:**
 - BEACON
 - U.S. Army Corps of Engineers (Los Angeles District)
 - City of Carpinteria
 - California Department of Boating and Waterways
 - California State Parks
 - National Park Service
 - County of Santa Barbara
 - California Coastal Conservancy
- **Private Sector:**
 - Phillip Williams and Associates
 - SedCon Technologies



Project Objectives

- Regional approach with detailed studies in 3 areas- Goleta, Carpinteria, and Ventura
- Quantify historical changes in beach width and shoreline position (Revell)
- Assess alongshore grain size variation onshore and nearshore and identify potential sand bodies (Mustain)
- Analyze nearshore processes and seasonal change
- Determine dominant sediment transport pathways and a sediment budget for the Santa Barbara littoral cell



Field Work

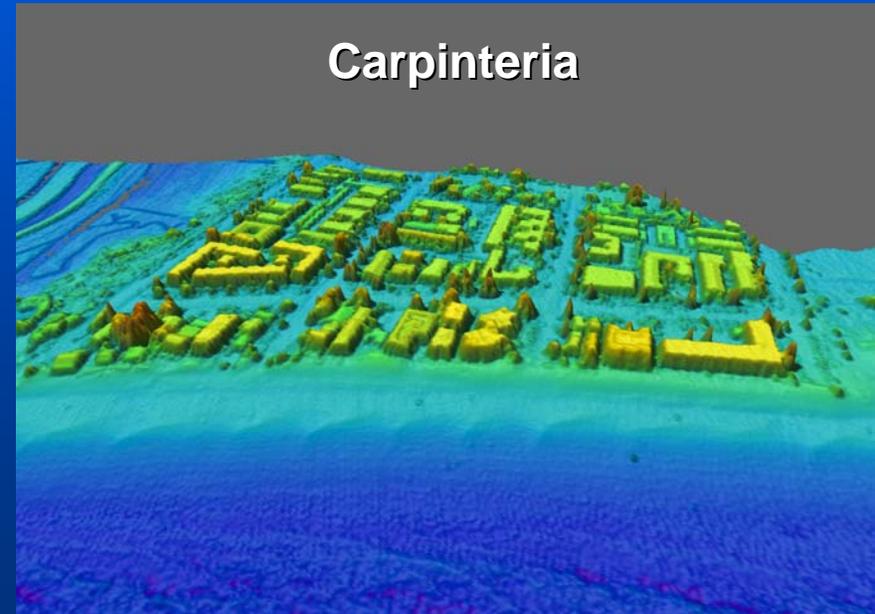
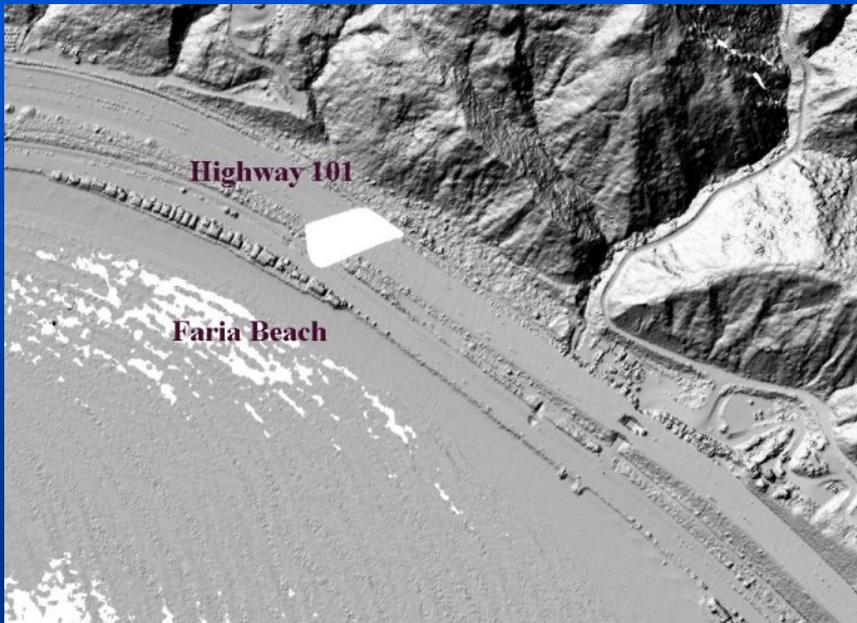
- Lidar (Light Detection and Ranging)
- Topographic beach surveys
- Nearshore bathymetric surveys
- Multibeam/ side scan mapping
- Grain size surveys, nearshore and onshore
- Instrument deployments

Add Ons

- Expanded multibeam/side scan mapping
- Box coring (Summer 2007)
- Sub-bottom profiling (Summer 2007)
- Ground-based Lidar
- Mugu Canyon Study

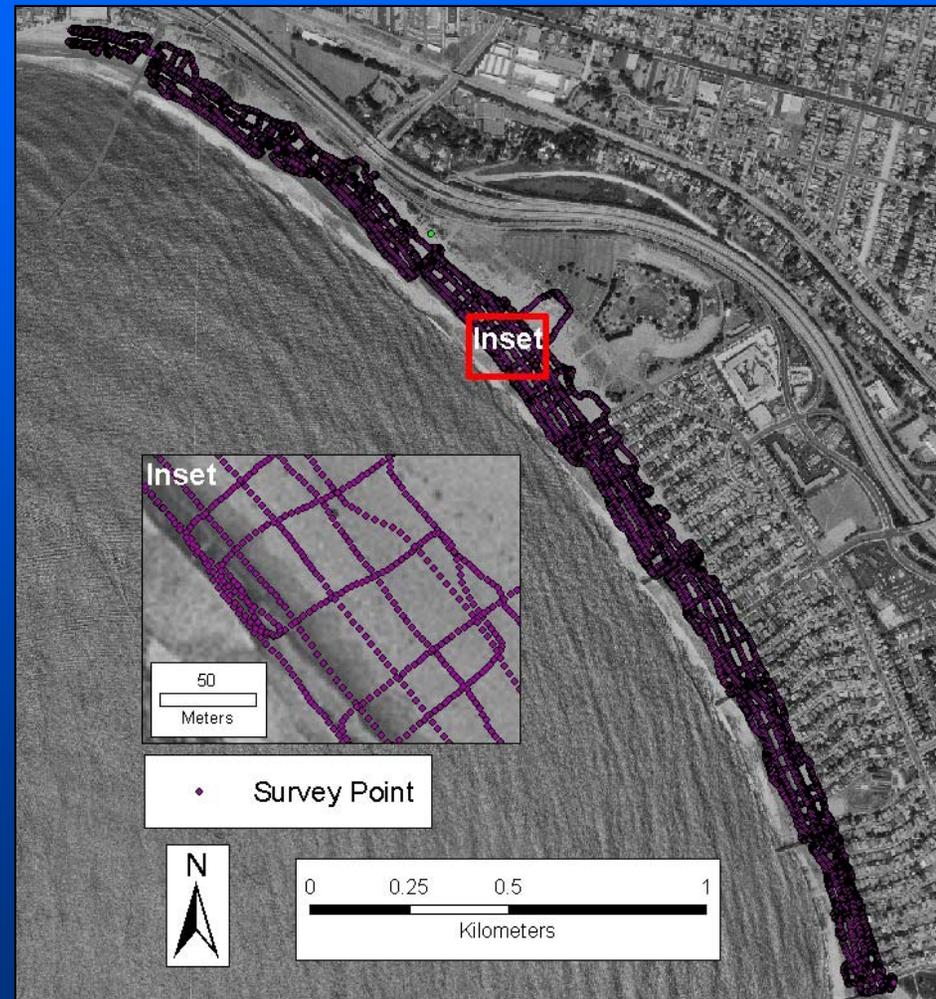
Lidar

- Flown by University of Texas
- Covers entire littoral cell from Pt. Mugu to Conception, ~150 km
- 1 m cell coverage with 8 cm accuracy
- Use to assess shoreline, beach width, and volume change since last Lidar surveys in 1997-8
- Generate sub-aerial BEACON profiles



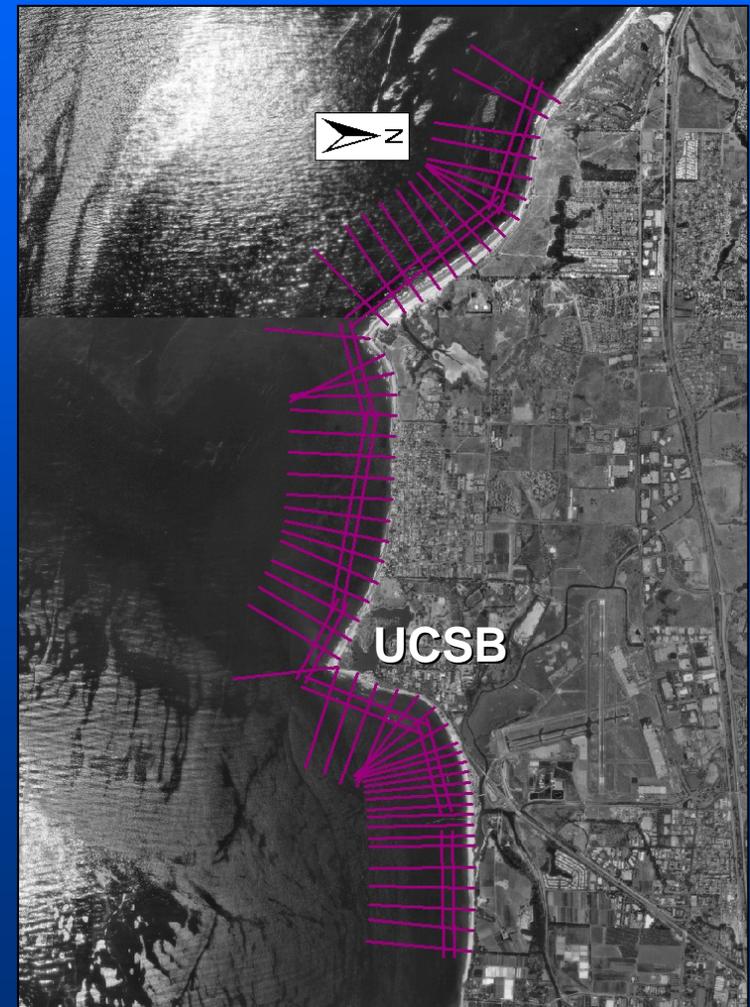
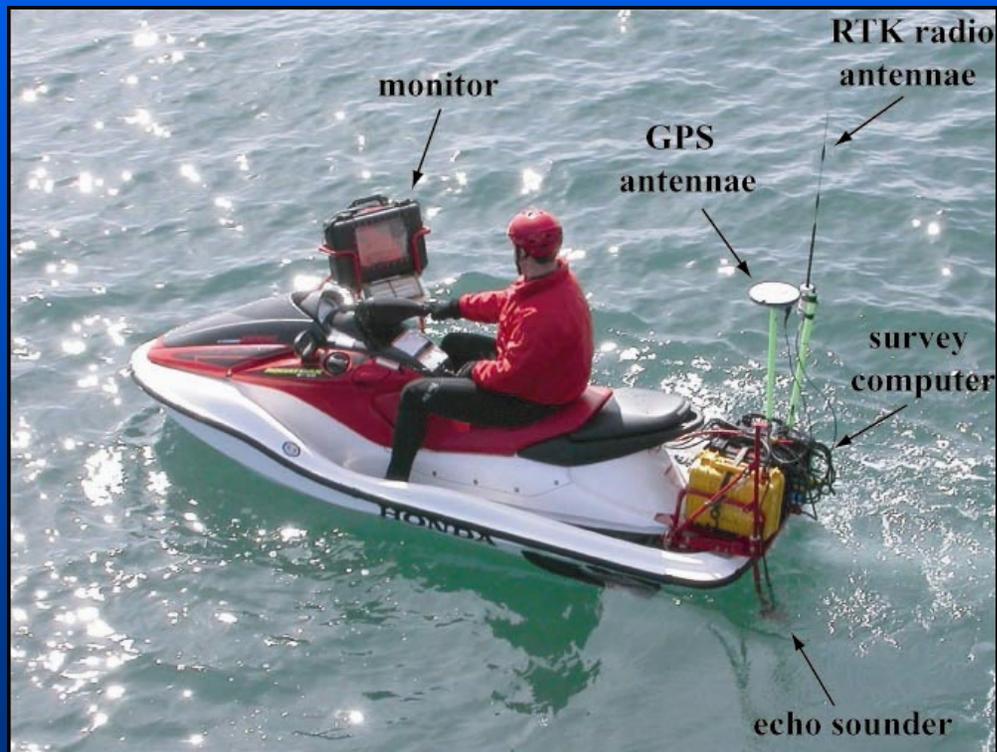
Topographic Beach Mapping

- Semi-annual surveys- early fall and spring
- Quantify seasonal rates of cross-shore transport
- Annual changes in shoreline position, beach width, and volume
- Compare with LIDAR, BEACON profiles, and aerial photos for longer term rates
- 4 cm horizontal accuracy, 1.7 cm vertical accuracy

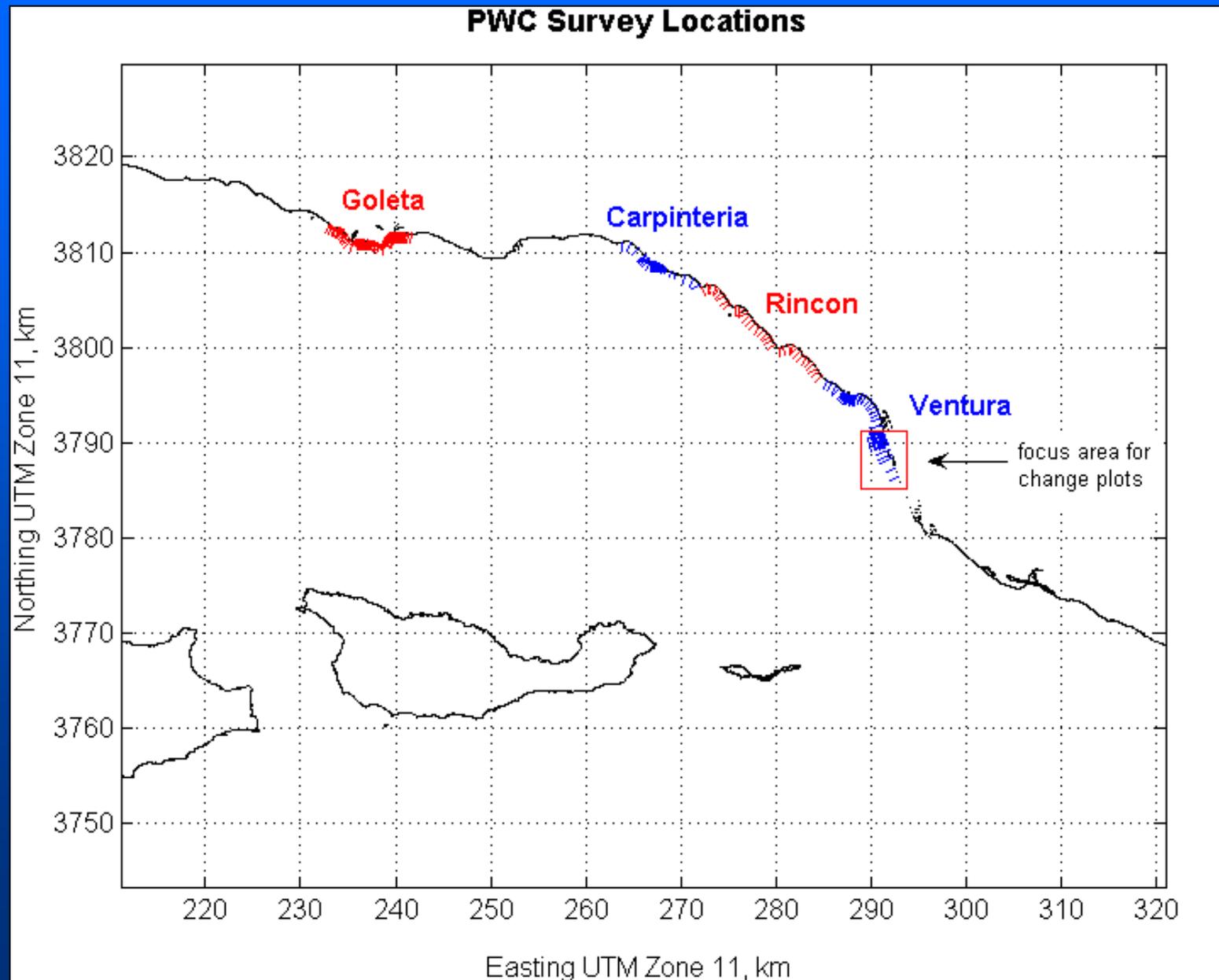


Nearshore Bathymetry

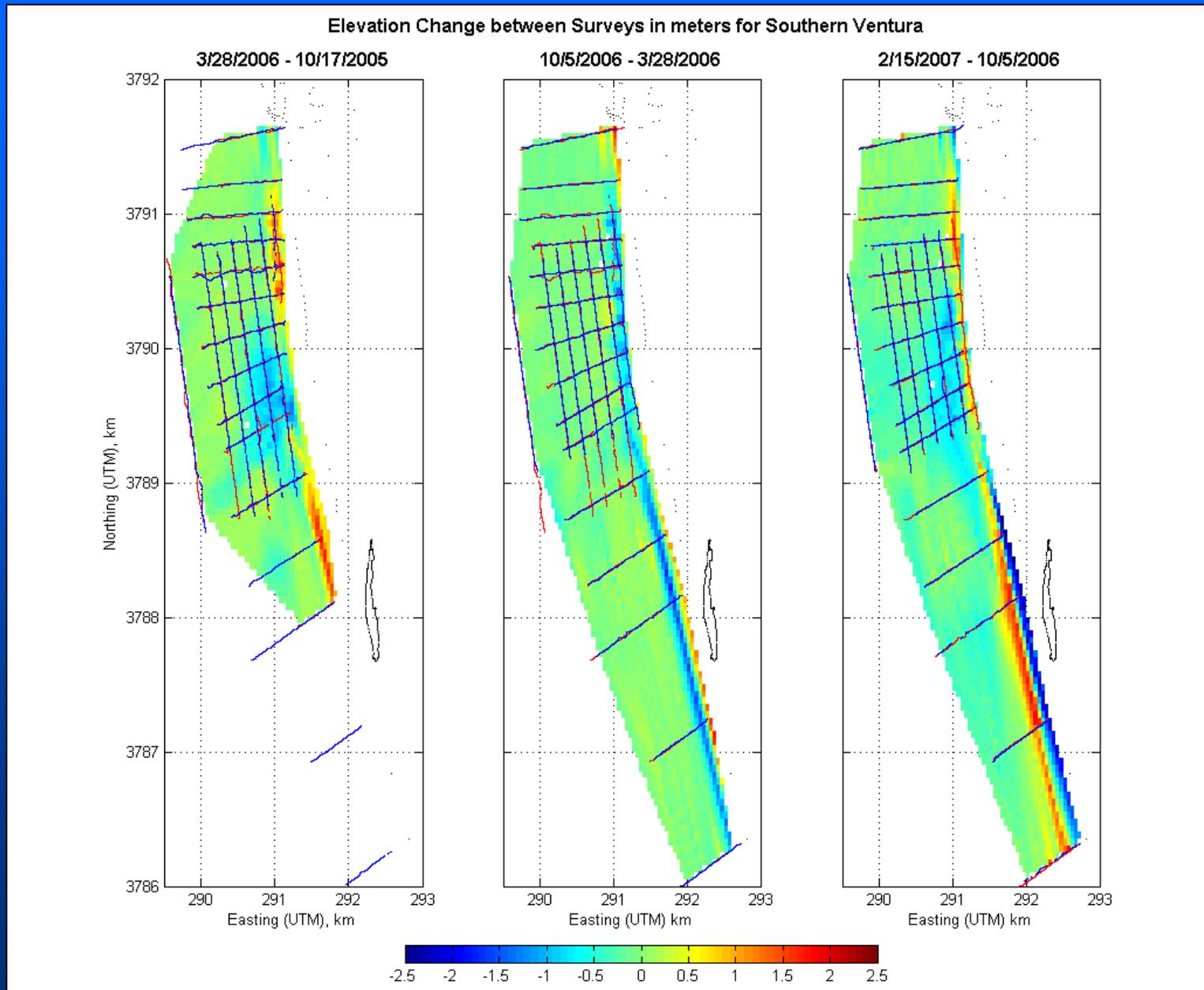
- Focus on three high resolution sites + Rincon Parkway
- Quantify seasonal and annual nearshore change
- Determine cross-shore transport rates
- Updated bathymetry for model input



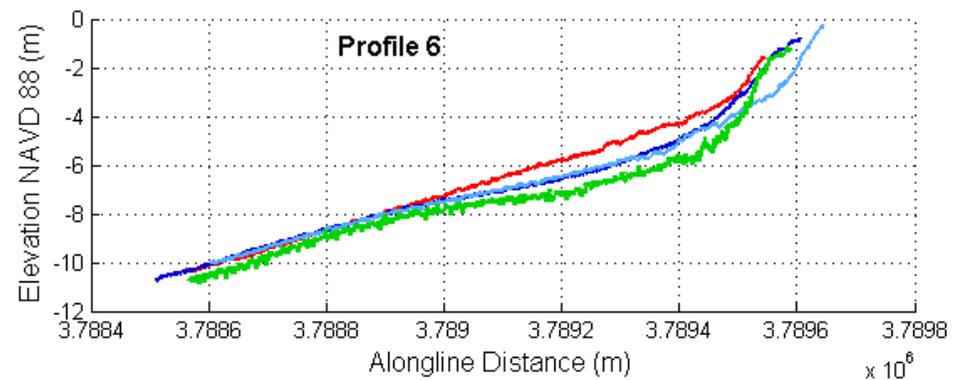
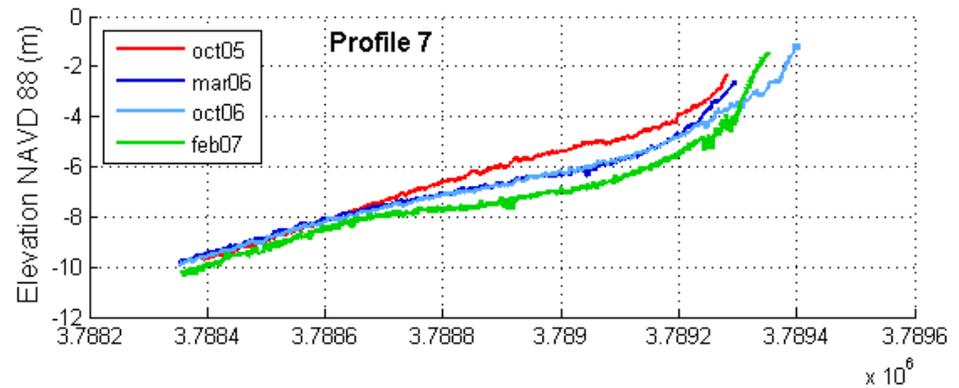
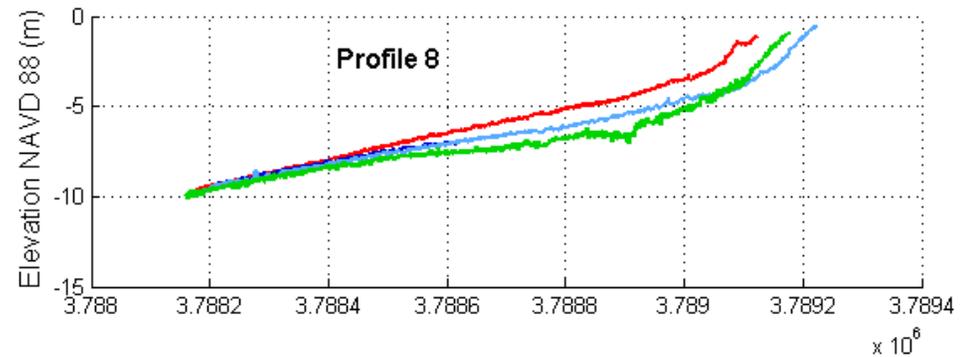
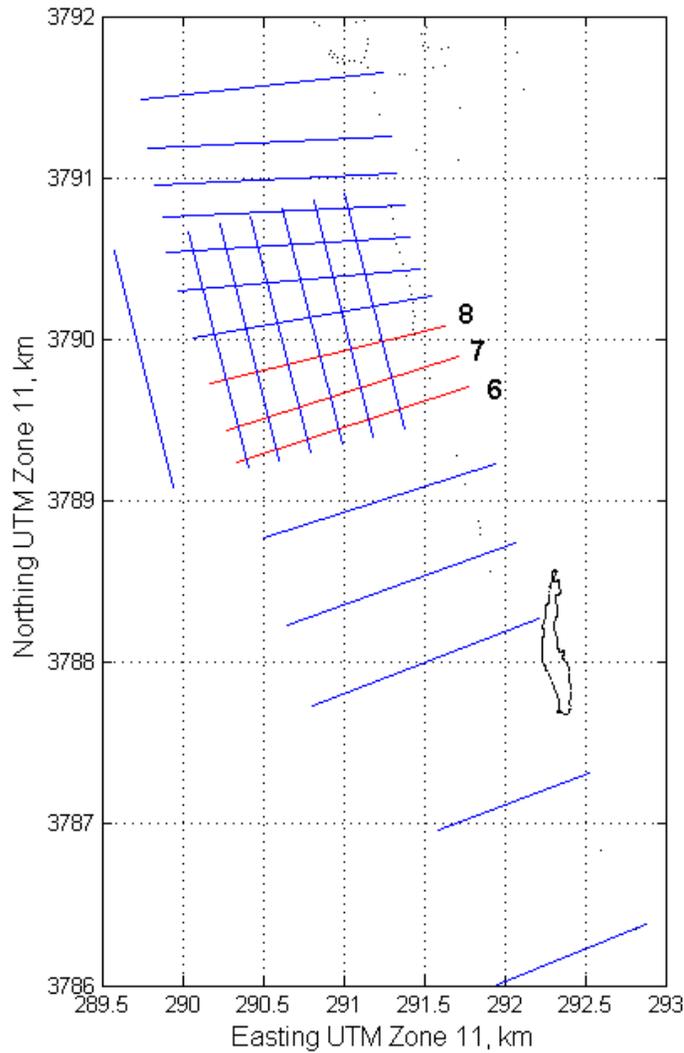
Nearshore Bathymetry



Nearshore Bathymetry

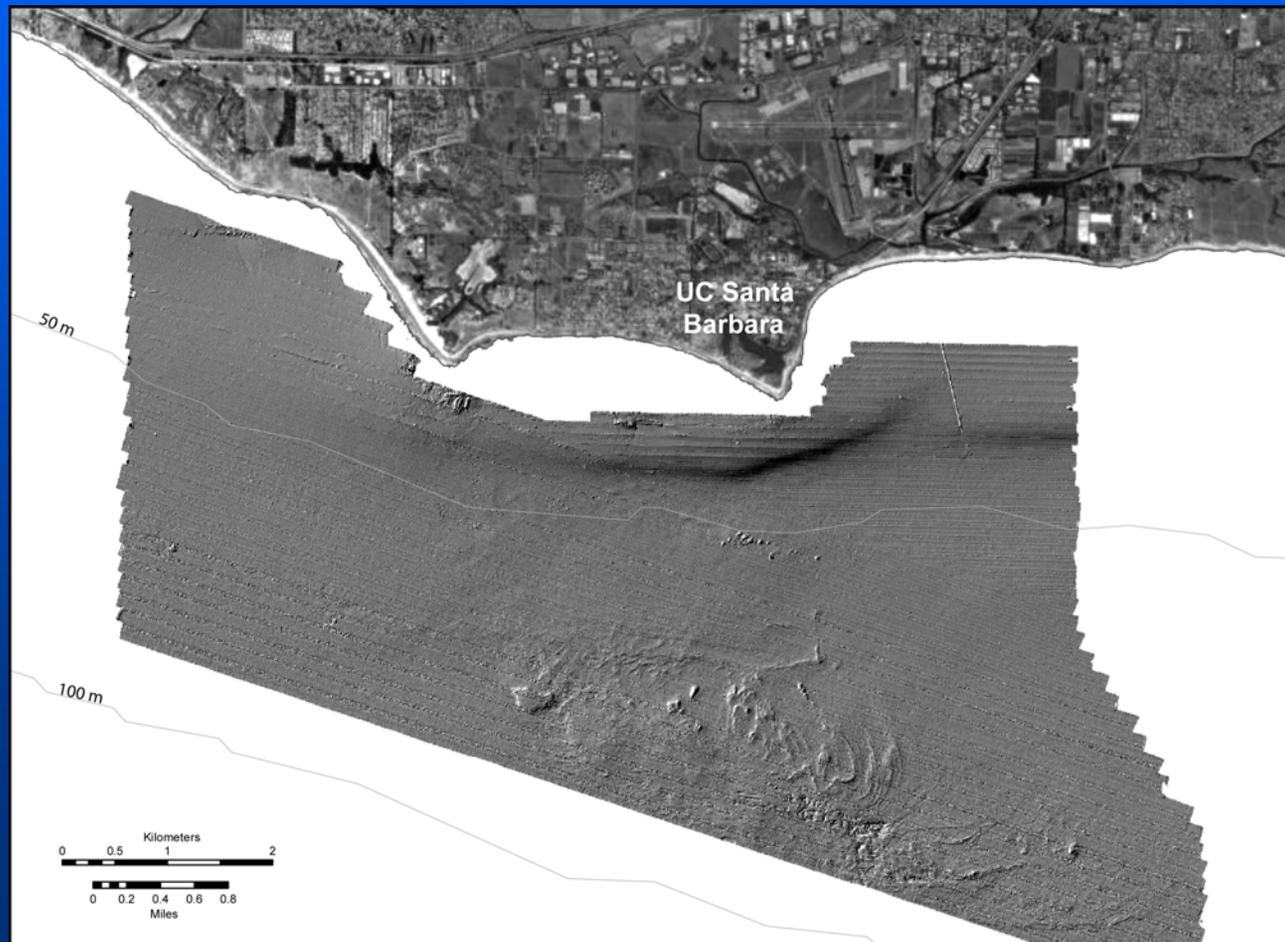


Nearshore Bathymetry



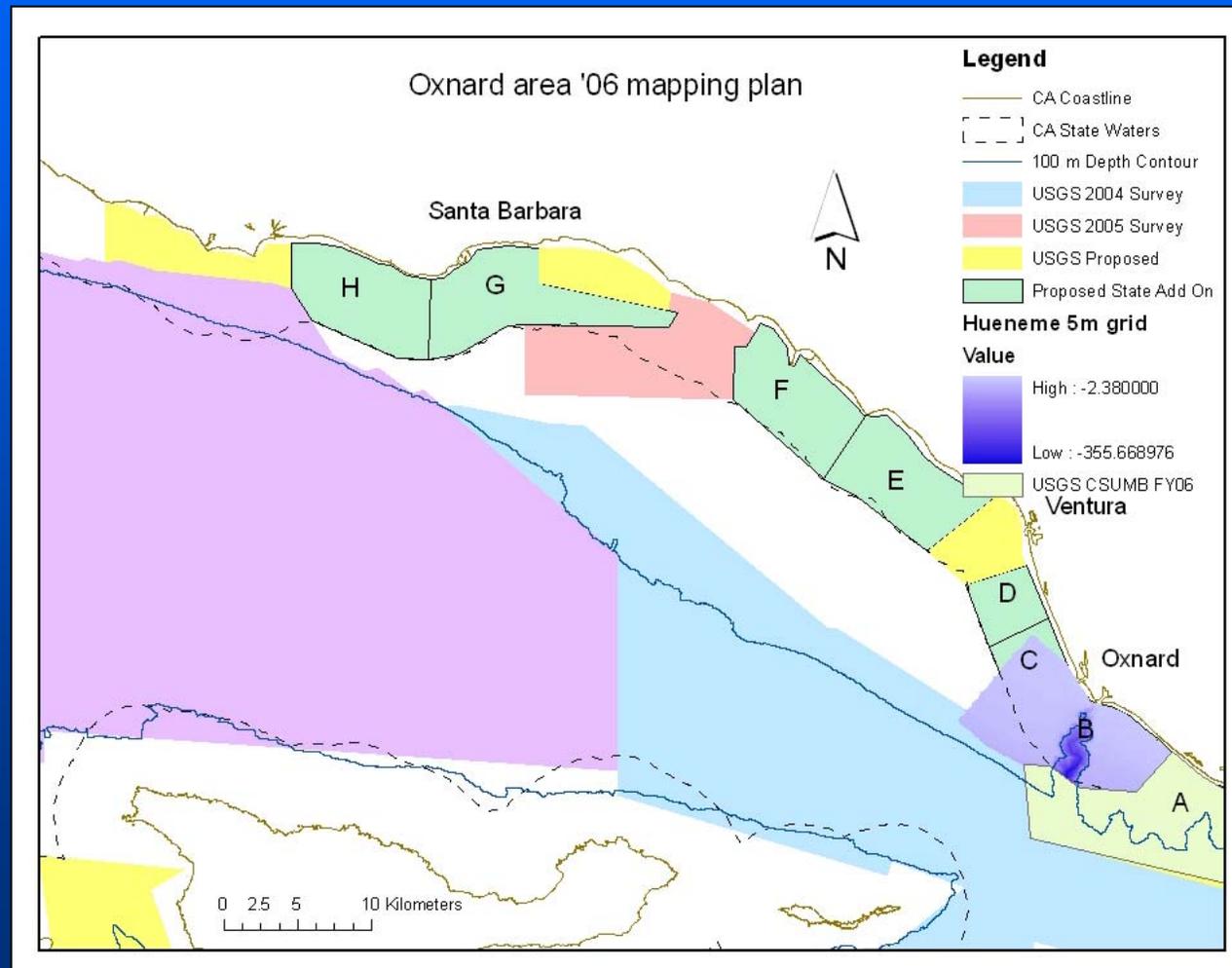
Multibeam Bathymetry

- Focus on three high resolution sites
- Quantify long term nearshore change
- Seabed classification
- Updated bathymetry for model input

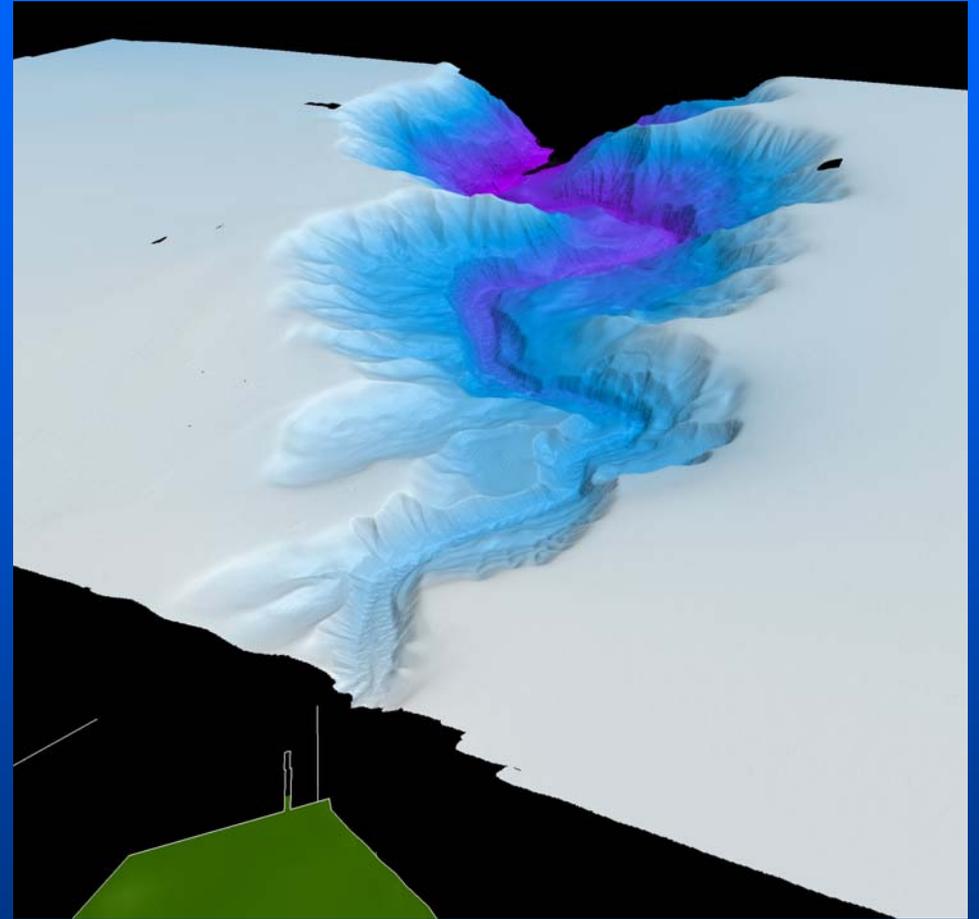
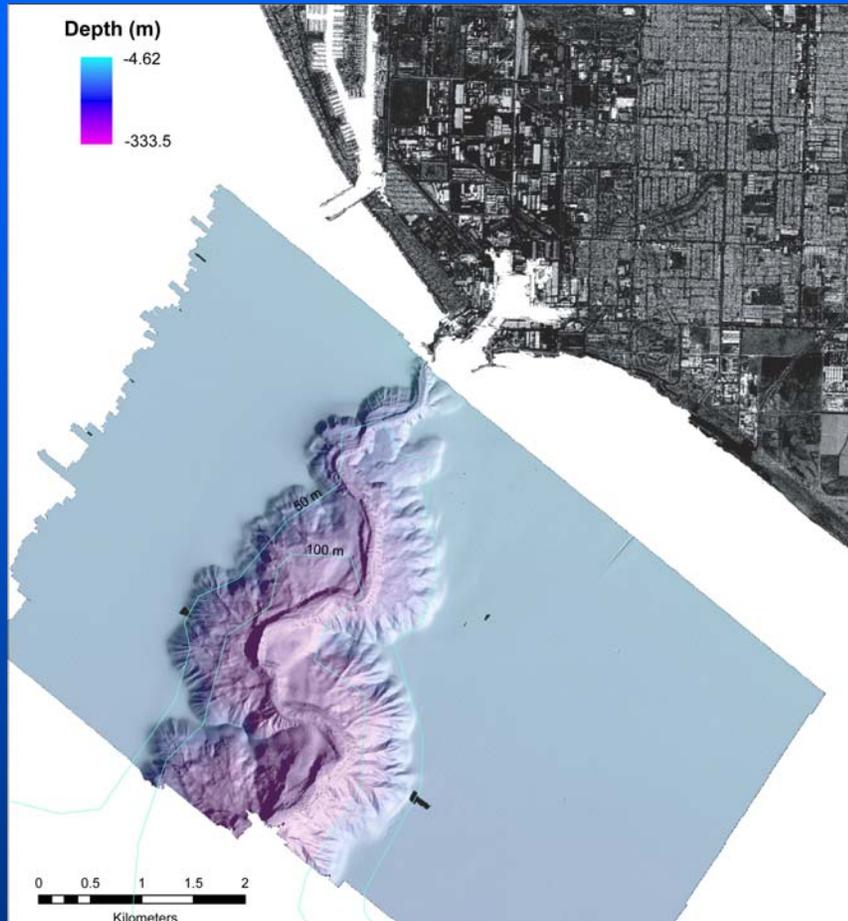


Expanded Multibeam

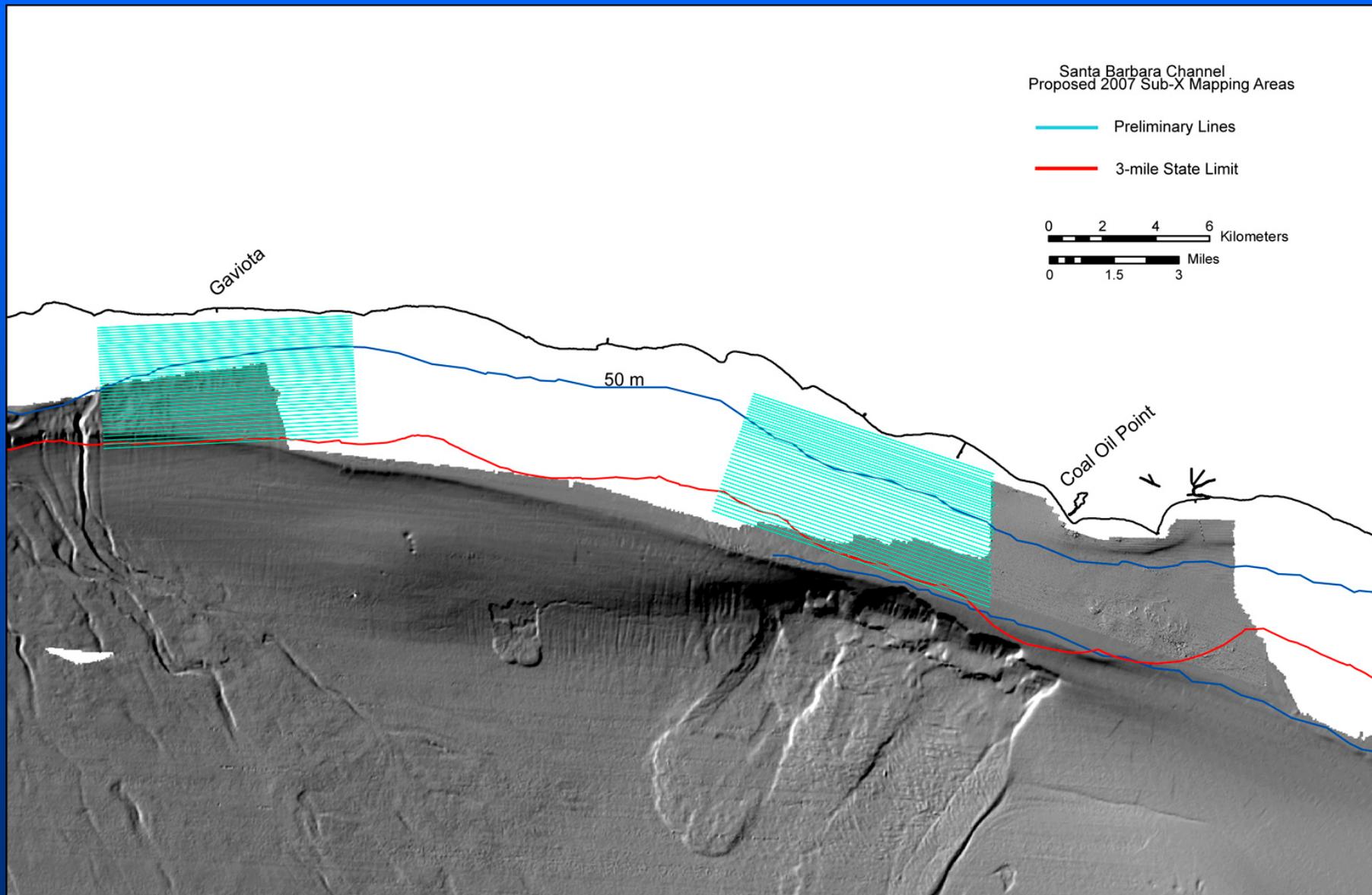
- \$400,000 from California Coastal Conservancy + \$135,000 (field) from USGS
- Map inside 3 mi limit from Mugu to Goleta, Summer 2006 and 2007
- Cochrane and Dartnell offshore work in 2004 and 2005



Hueneme Canyon



USGS Summer 2007



Grain Size Studies

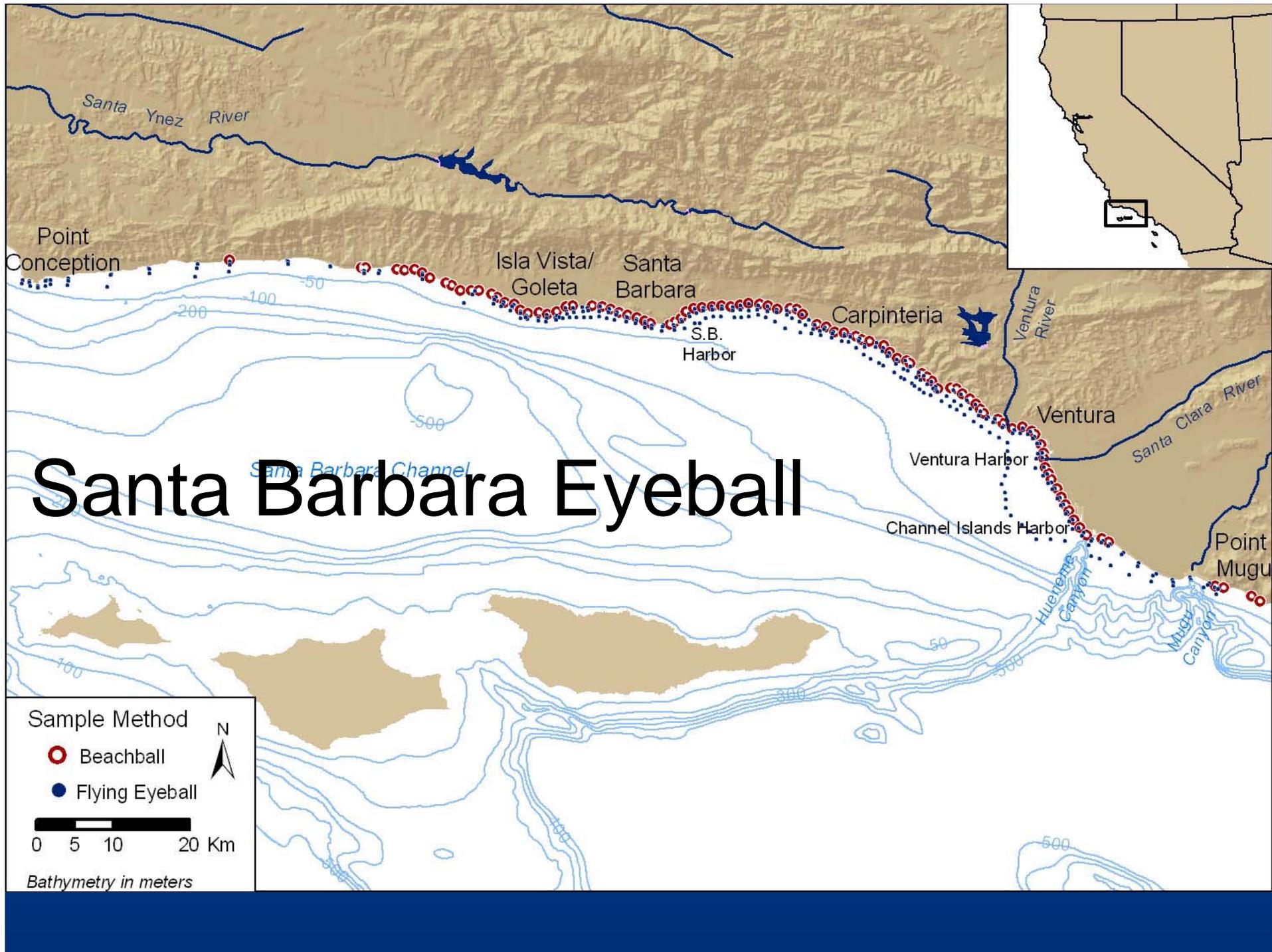
- 192 beach sample locations, 576 images
- 300 nearshore sampling stations, 1500 images
- Products to come

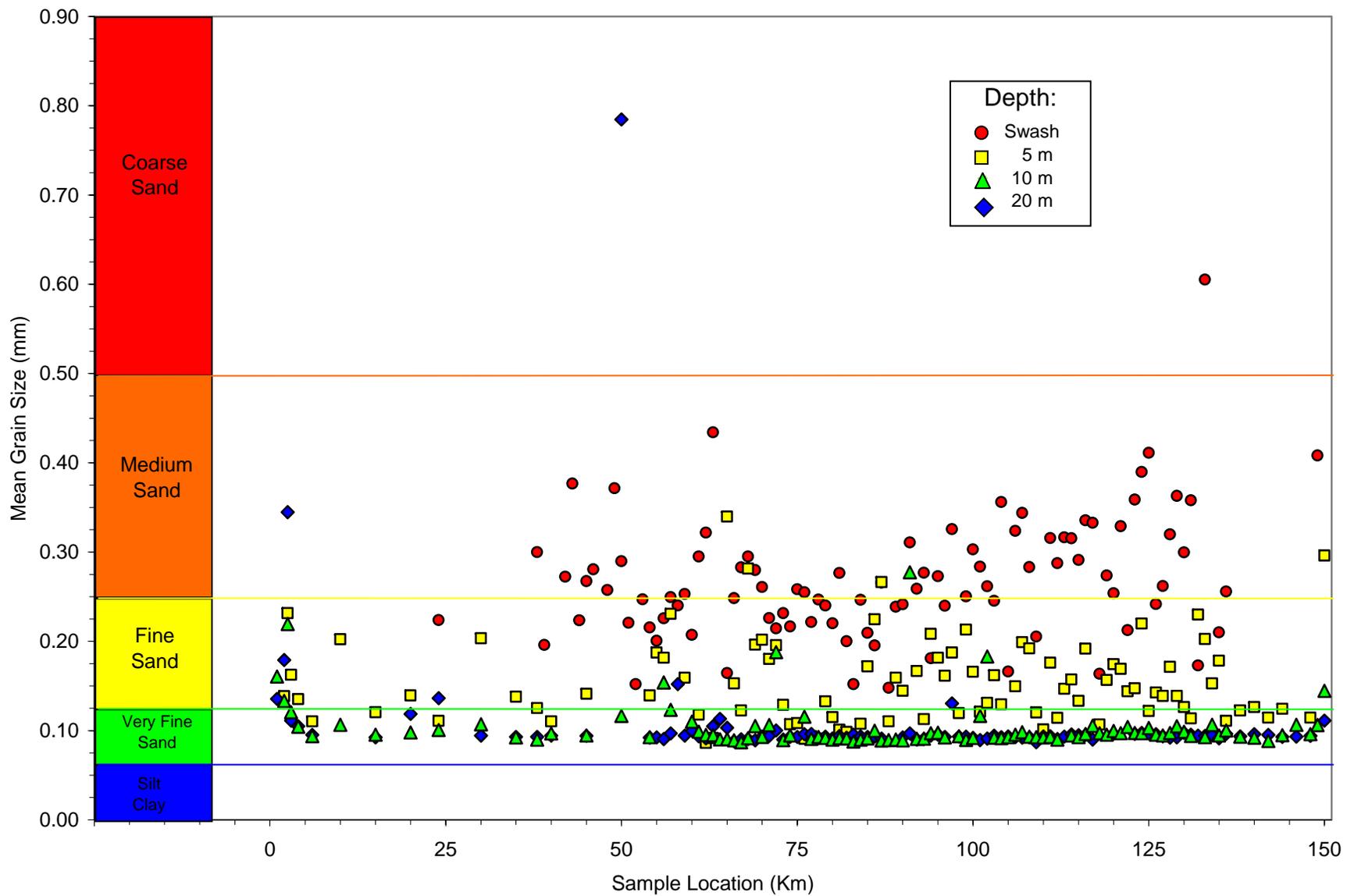
Mustain, N., Griggs, G. and Barnard, P.L. (2007). A Rapid Compatibility Analysis of Potential Offshore Sand Sources for Beaches of the Santa Barbara Littoral Cell. Coastal Sediments 07, New Orleans, LA.

Mustain, N. (2007). Grain Size Distribution in the Santa Barbara Littoral Cell and Implications for Beach Nourishment. M.S. Thesis, U.C. Santa Cruz.

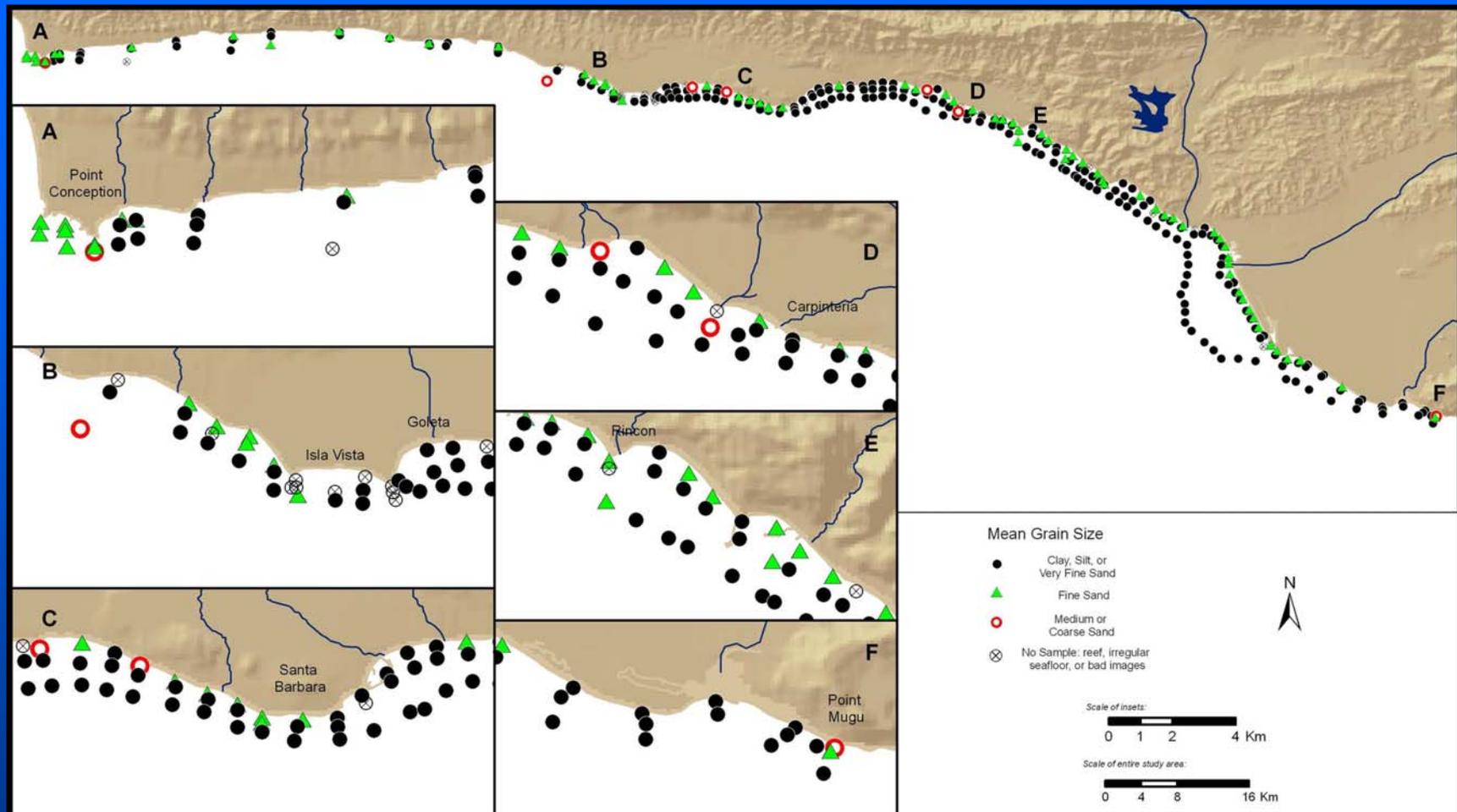
Santa Barbara Littoral Cell Beach and Nearshore Grain Size Map, USGS Scientific Investigations Map





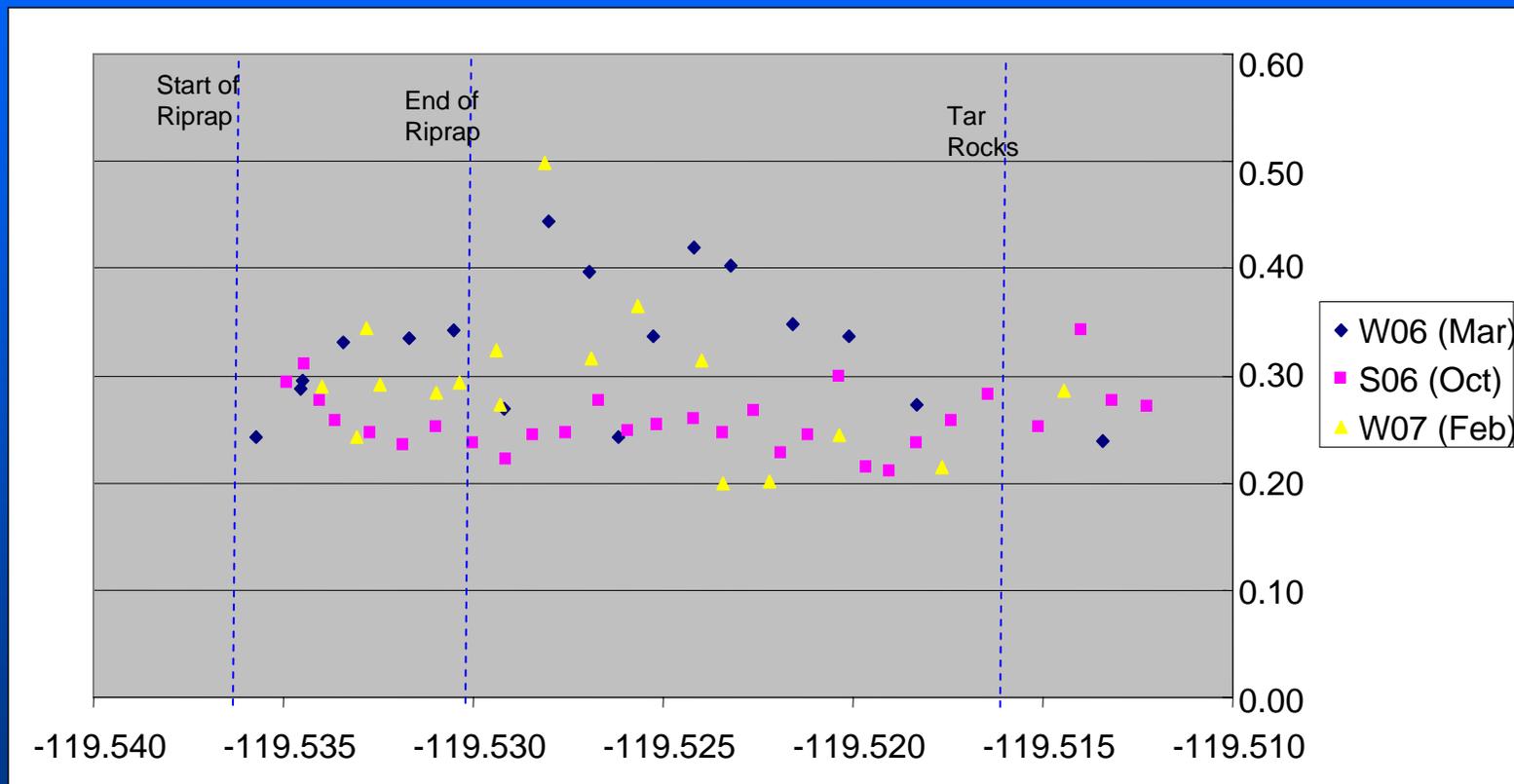


Mean grain size of beach and nearshore samples.
Horizontal axis is distance east of Pt. Conception.



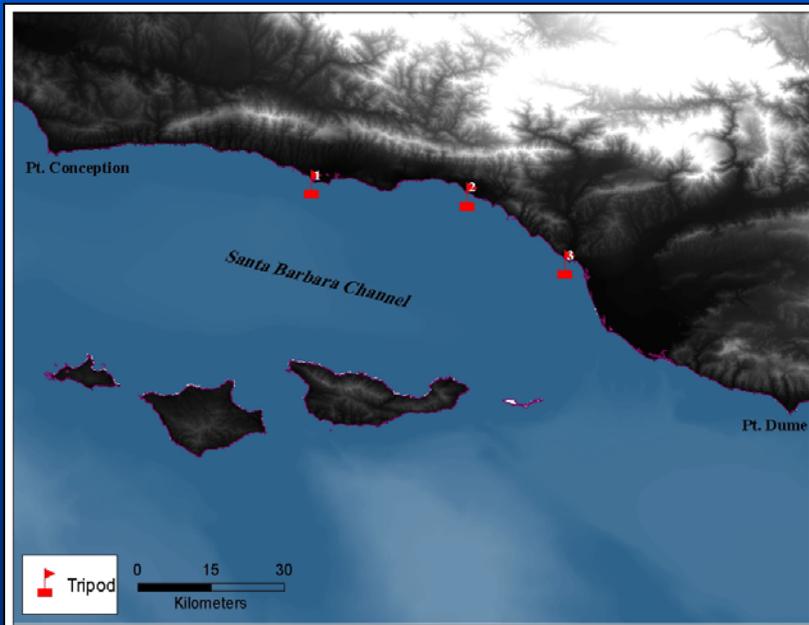
Mean grain size of nearshore (5, 10, 20 m) Flying Eyeball samples in the Santa Barbara Littoral Cell.

Seasonal Sampling in Carpinteria

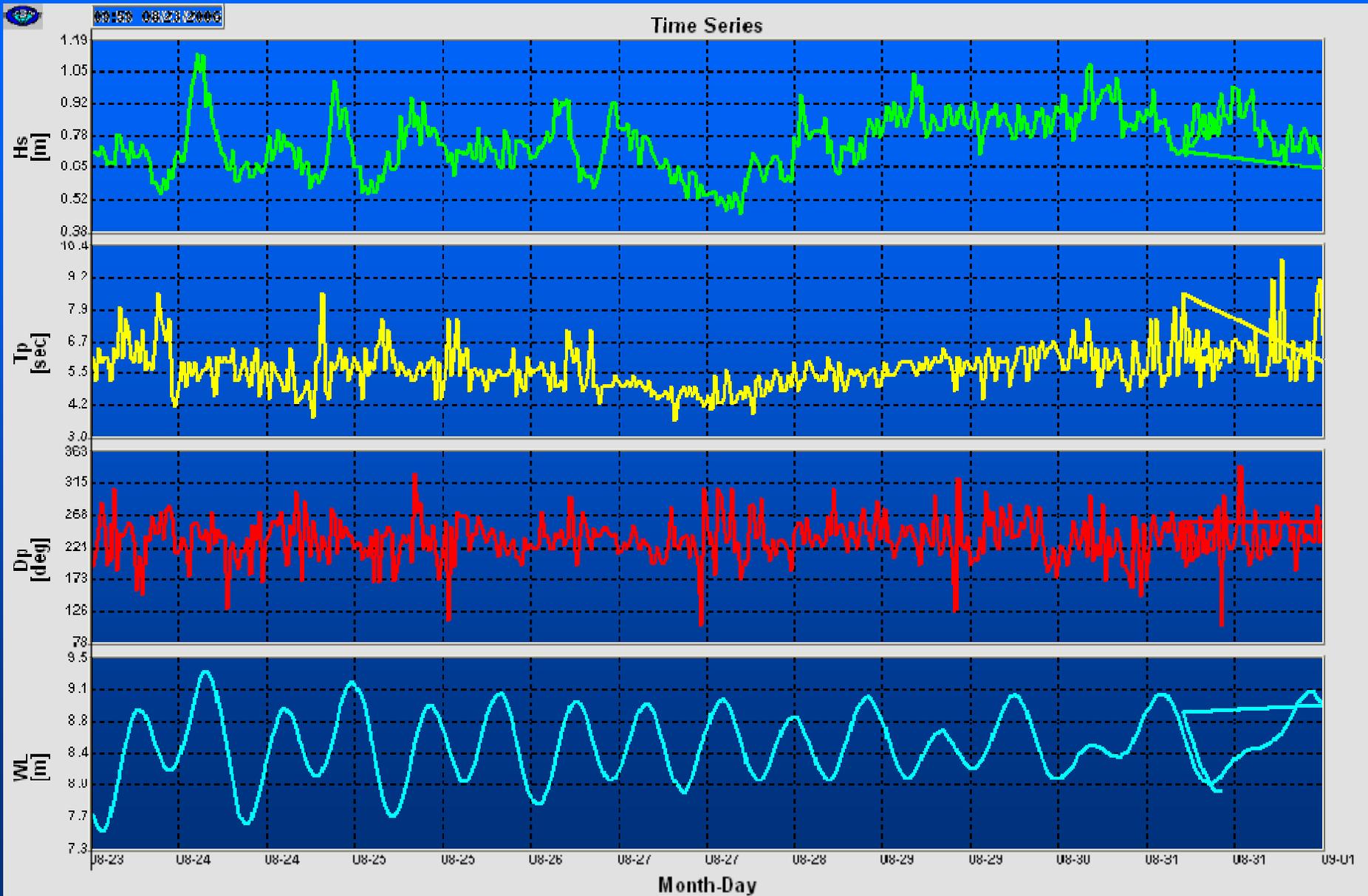


Instrument Deployments

- Summer 2006 and Winter 2007
- Place in 10 m water depth offshore of 3 high res sites
- Use for model calibration/ validation

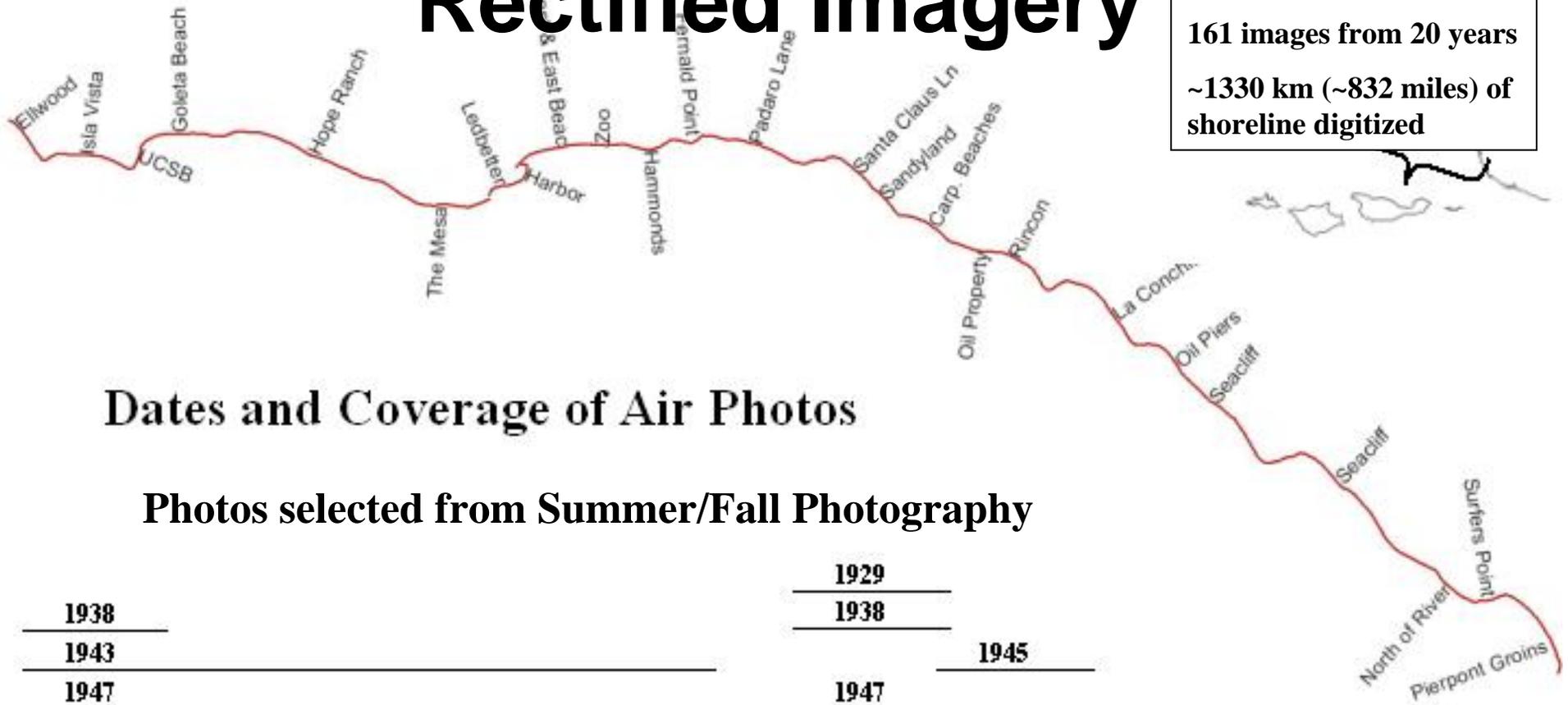


Wave Parameters Through Time : 8/23/06 – 9/1/06



Rectified Imagery

span of ~70 years
 161 images from 20 years
 ~1330 km (~832 miles) of
 shoreline digitized

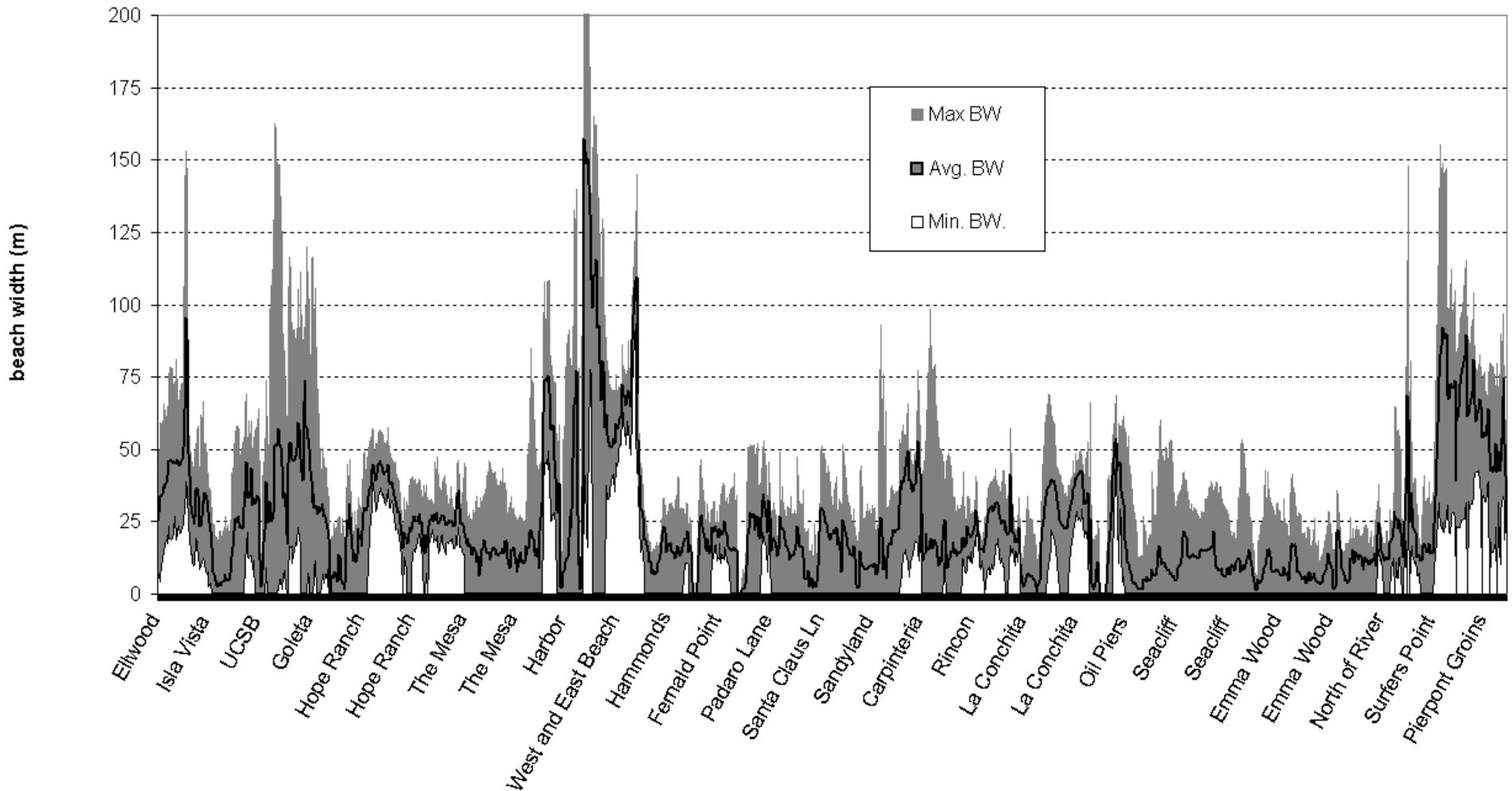


Dates and Coverage of Air Photos

Photos selected from Summer/Fall Photography

1938	1929	
1943	1938	
1947	1945	
1959	1947	
1966	1959	1959
1969, 1971, 1973	1966	1966
1975	1969	1968
1983		1981
1986	1986	
1989	1989	
1994, 2001		1992
2003	2003	

Beach Width Variability ~70 years



Revell and Griggs, 2007 Coastal Sediments'07

Carpinteria

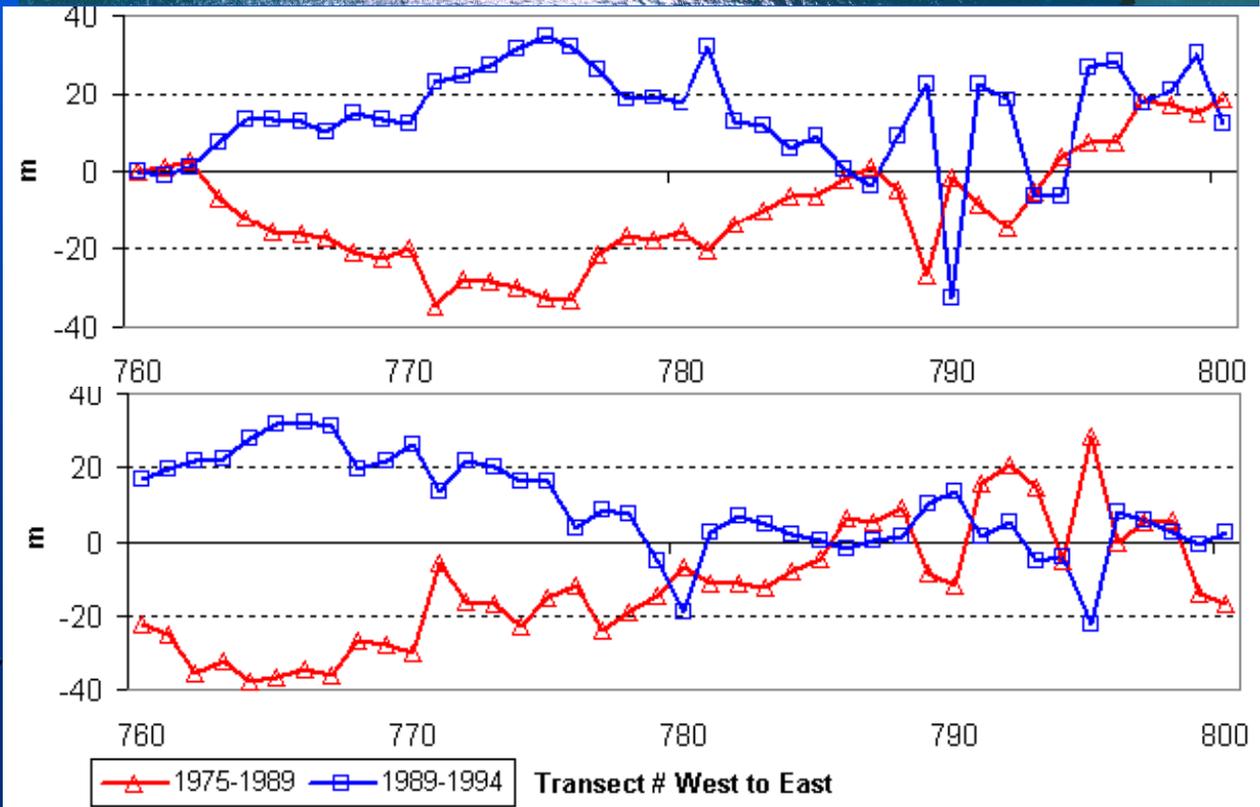


Beach Width Changes

1997-98 El Nino

1982-83 El Nino

Revell and Griggs, 2007
Coastal Sediments '07



David Revell Publications in Santa Barbara Littoral Cell

drevell@es.ucsc.edu

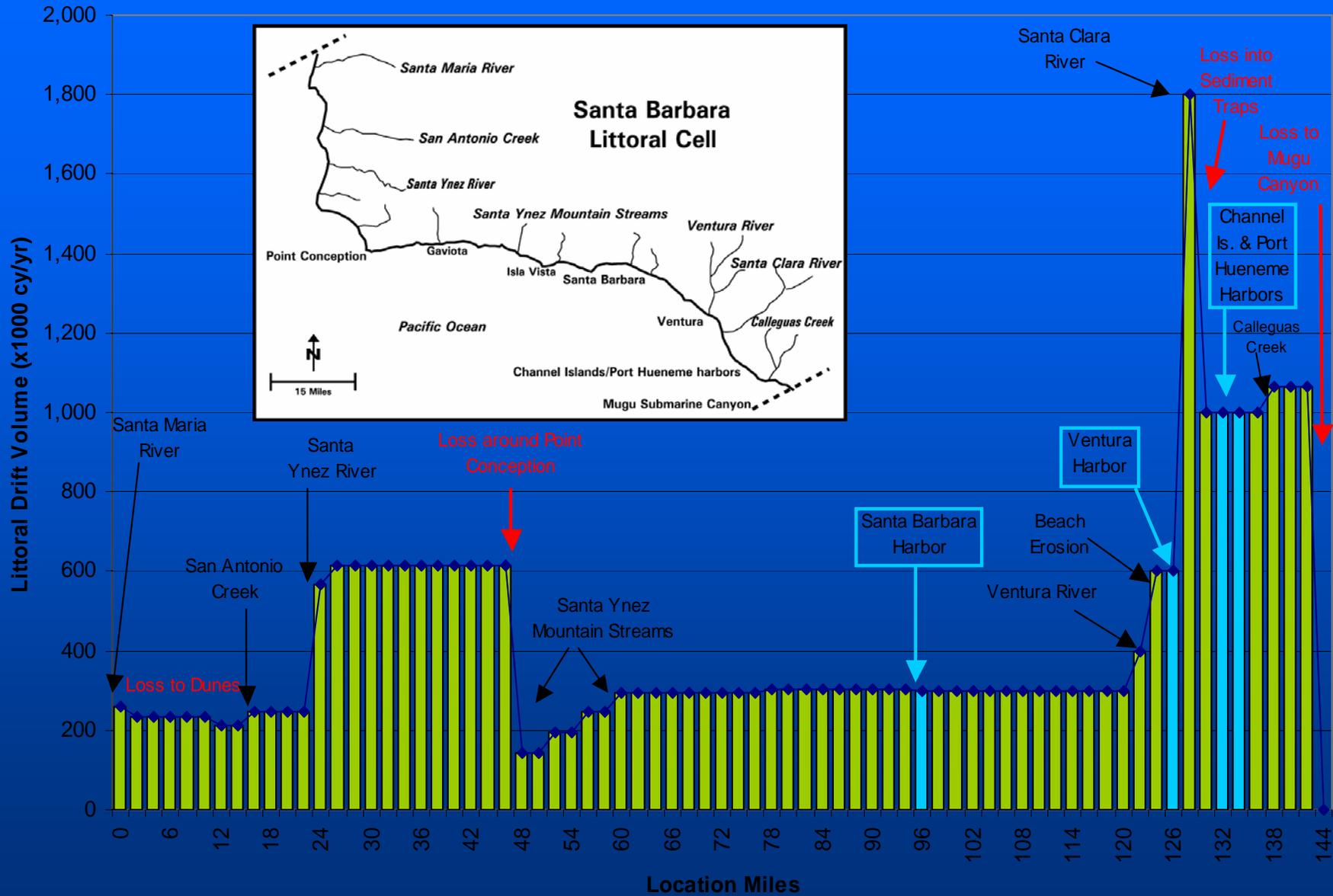
Dissertation Defense March 9, 2007...

Beach Width and Climate Oscillations in Isla Vista, Santa
Barbara, CA. *Shore and Beach* 74(3):8-15

Regional Shoreline and Beach Changes in the Santa Barbara
Sandshed. In Proceedings of *Coastal Sediments '07*

Physical and Ecological Response of Sandy Beaches to the
1997-98 El Nino (submitted to *Journal of Coastal Research*)

Santa Barbara Littoral Cell Longshore Transport Volumes Santa Maria River to Mugu Submarine Canyon



Patch and Griggs Work

Box Coring

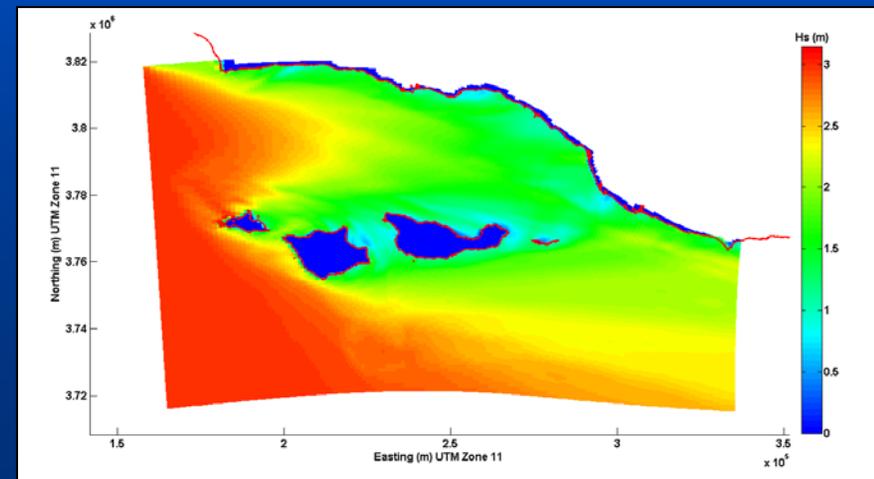
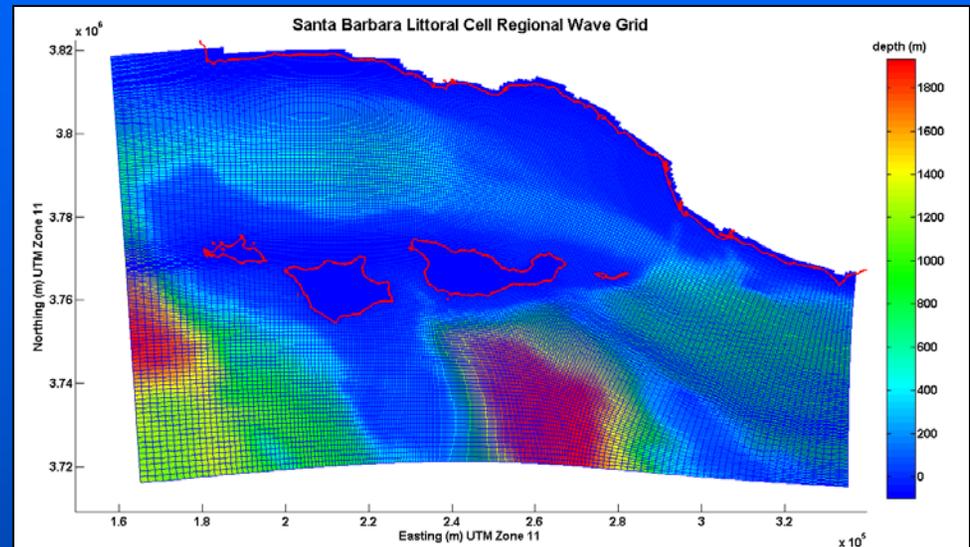
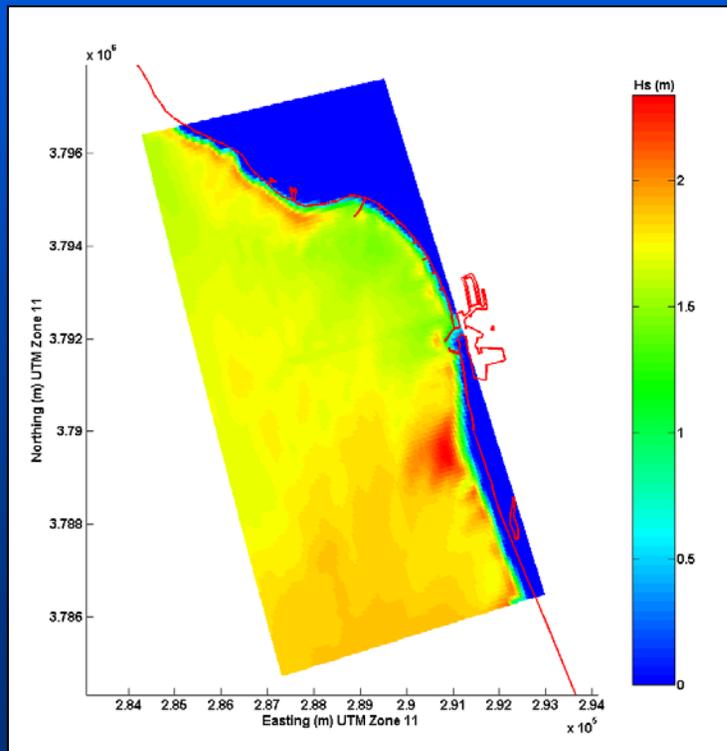
- Summer/Fall 2007
- Approximately 50 cores throughout littoral cell
- Ground truth surface samples
- Identify potential sand bodies

Subbottom Profiling

- \$60,000 from USGS
- Regional profile lines with some focused studies
- Determine Holocene sediment thickness in select areas

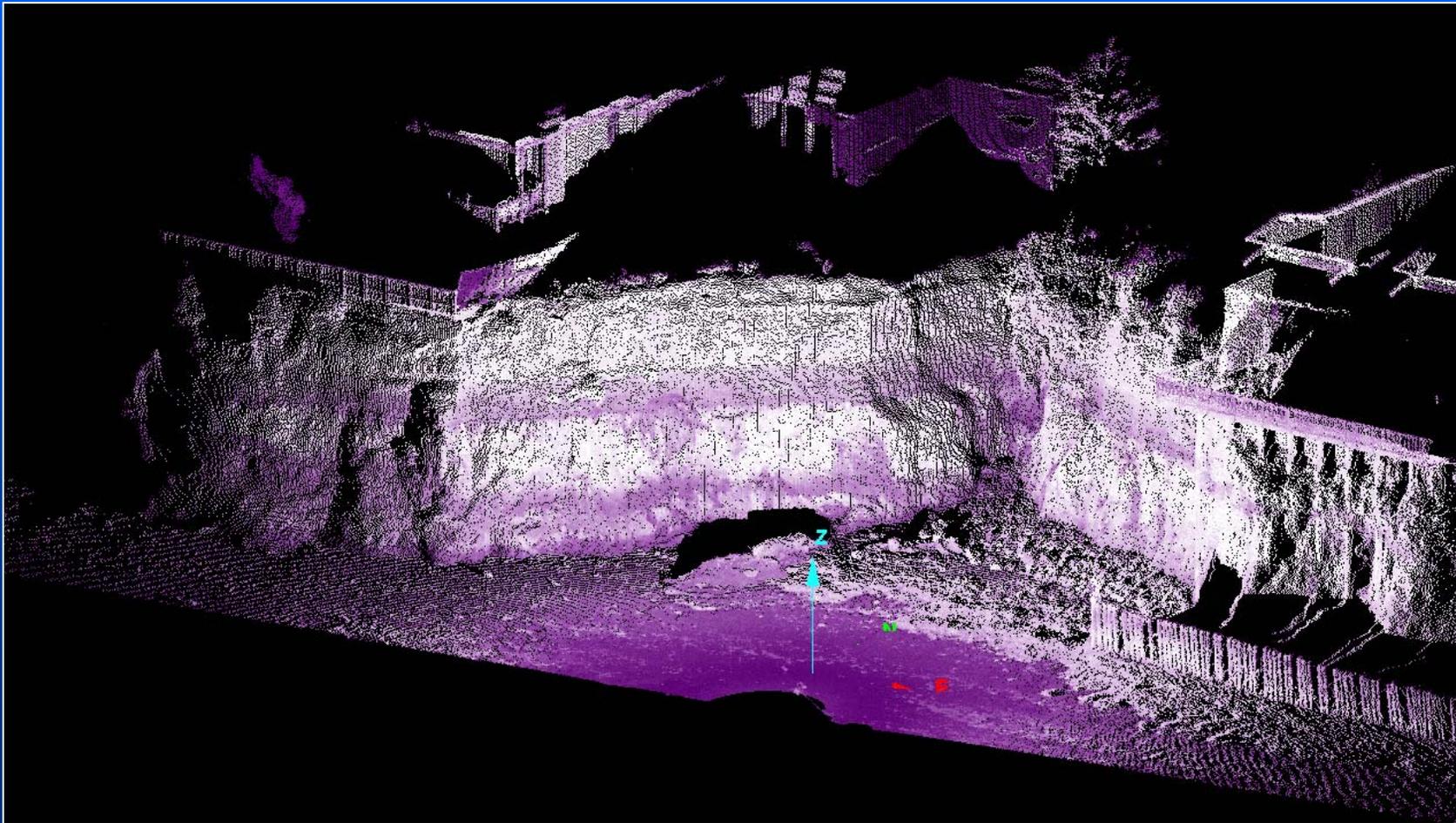
Numerical Modeling

- Delft3D
- Regional and nested high resolution models for waves and currents
- Use to predict littoral drift rates, storm impact, sediment budget



Ground-based Lidar

- USGS, Brian Collins
- Goleta, Isla Vista/Ellwood Region
- Used to assess cliff retreat rates
- 500,000 points/min, 10-50 cm resolution



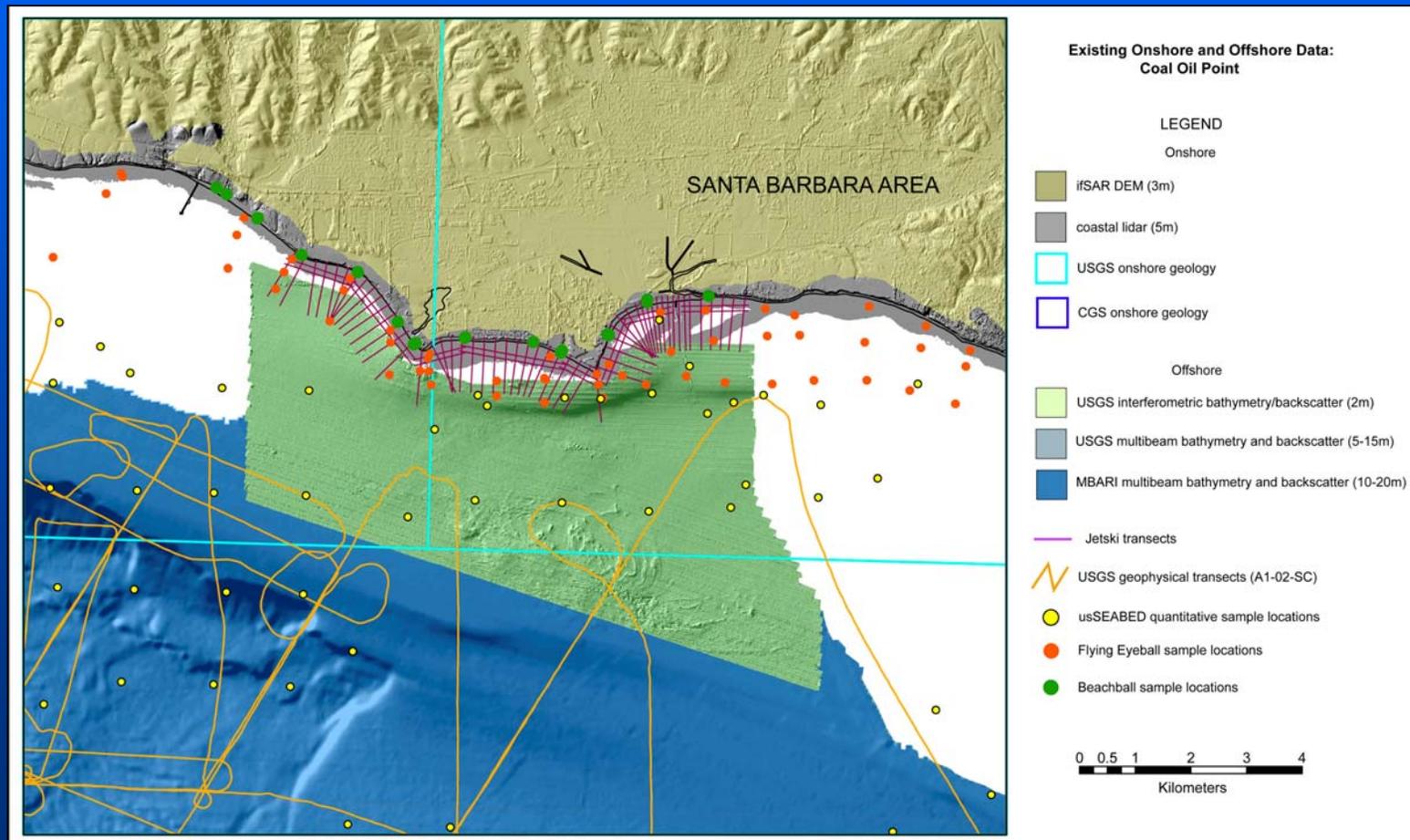
Multihazards Demonstration Project

- Use Santa Barbara Littoral Cell as test case
- Assess coastal vulnerability to winter storms using Lidar data sets, Delft3D, SWAN, and wave run-up models



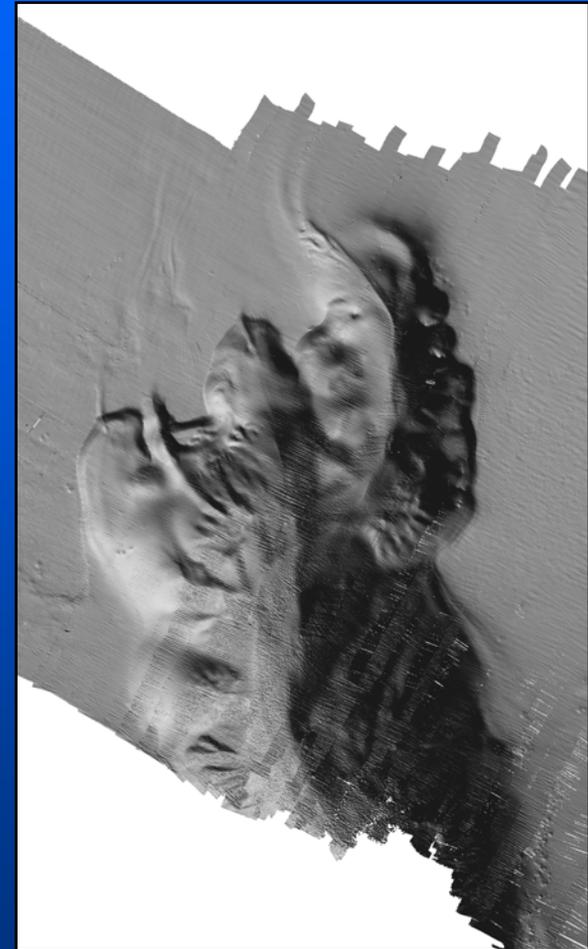
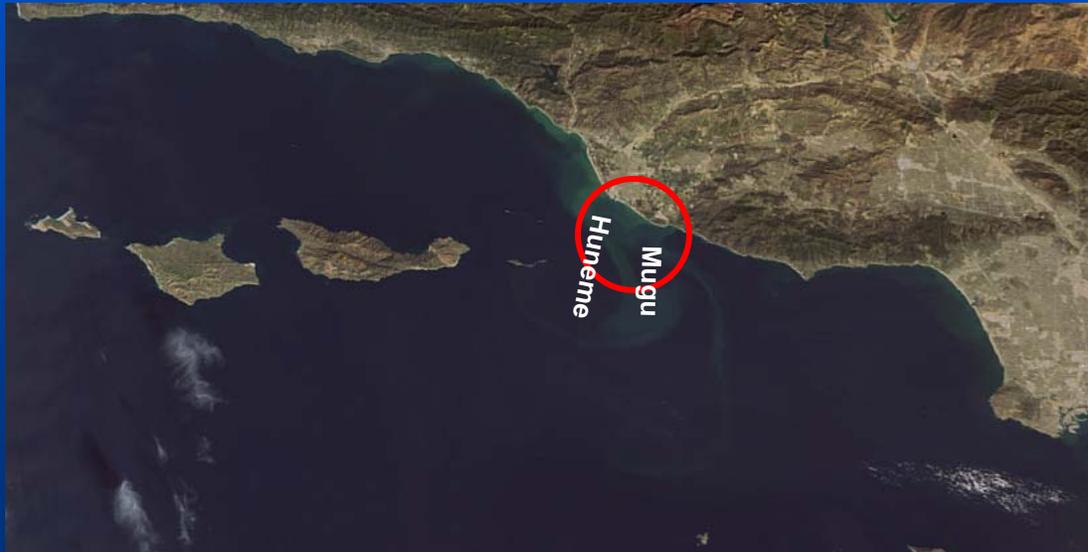
Seamless Map Product

- USGS Venture Capital Fund, \$30,000
- Using Goleta/Isla Vista/Ellwood Region as test case
- Integrates multiple data sets and types, e.g. Lidar, multibeam, jet ski bathy, ATV topo, sub-bottom, and geologic units

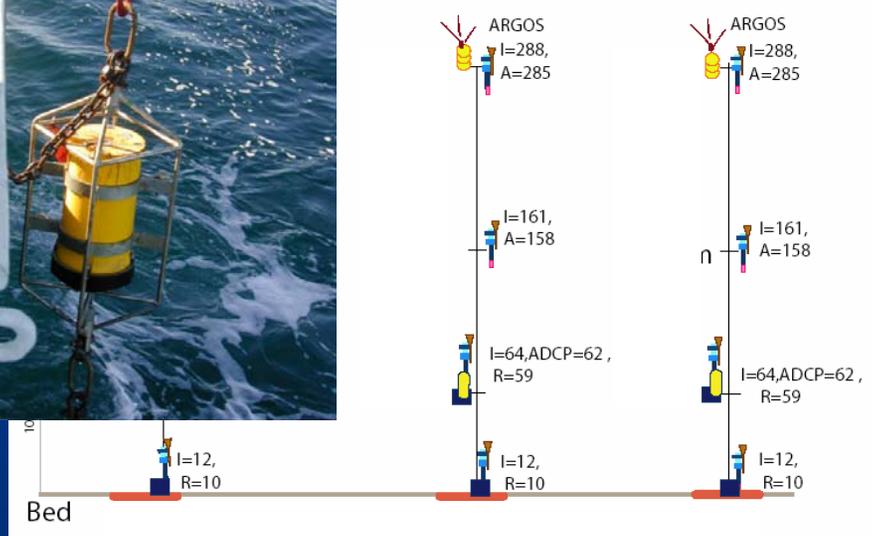
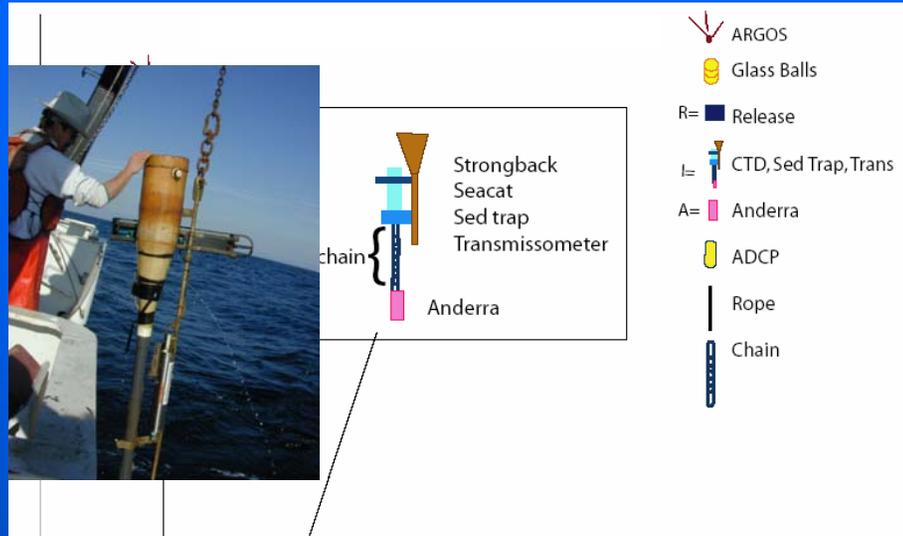


Mugu Submarine Canyon Study

- Jingping Xu, USGS
- Mugu Canyon is currently receiving ~1 million yd^3 of sediments (sand, mud) every year from longshore drift and other sources
- What are the processes within the canyon where such sediments are accumulated, eroded, and transported downcanyon?



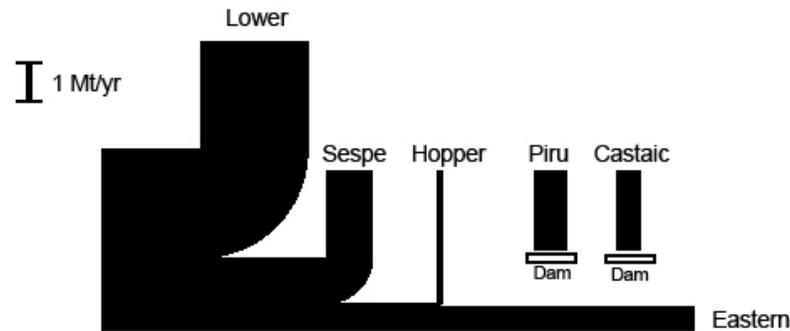
Two moorings will be deployed in Mugu Canyon for 6 - 12 months



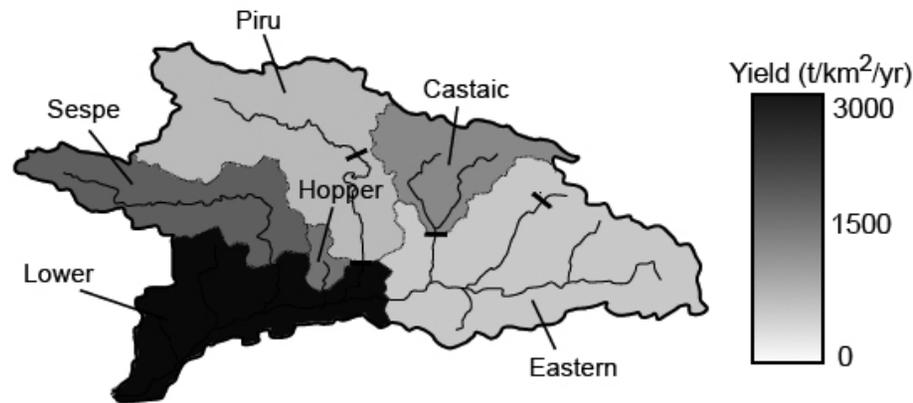
Santa Clara River Sediment Budget

Warrick and Farnsworth (in review)

(a) Mean Annual Suspended-Sediment Budget



(b) Mean Annual Suspended-Sediment Yield



Additional Research

River plume water quality

- physical processes
- nutrients and bacteria
- remote sensing

Warrick et al. (in press)

Nezlin et al. (submitted)

Reifel et al. (in prep)

Warrick et al. (2005)

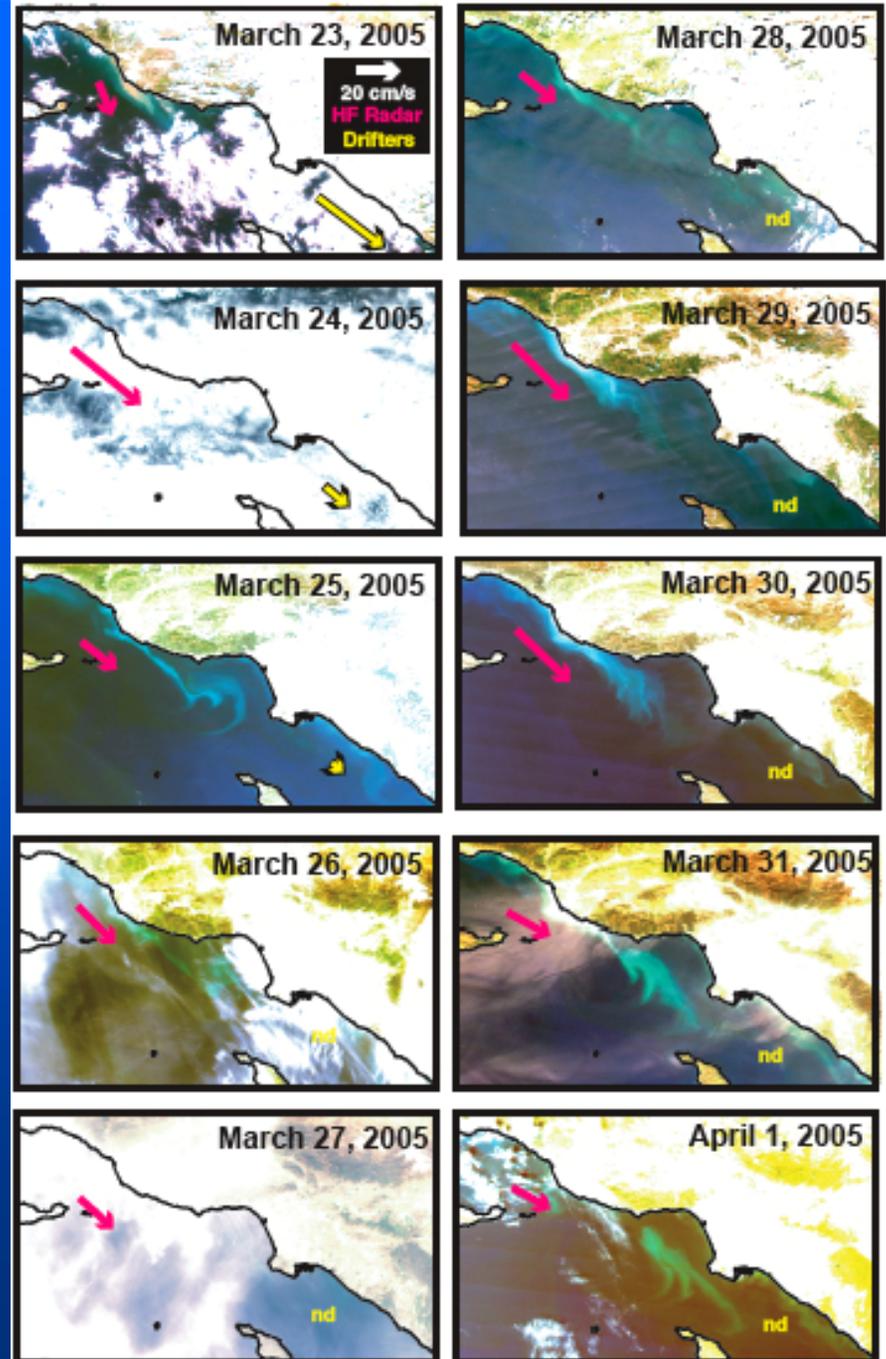
Warrick et al. (2004)

Watershed modifications

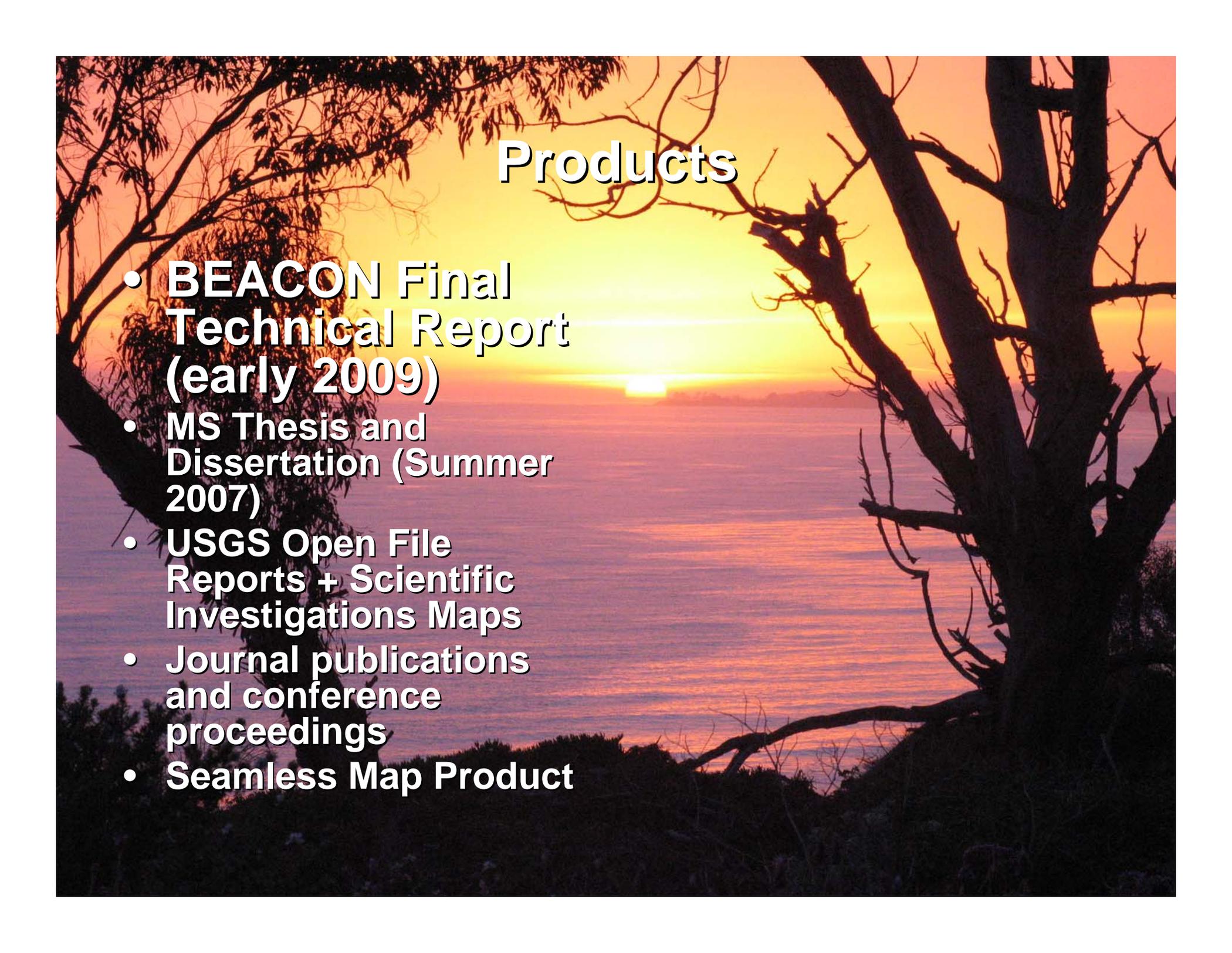
- urbanization
- wildfire

Warrick and Rubin (in press)

Warrick and Orzech (2006)



Warrick et al. (in press)

A sunset over the ocean with silhouettes of trees in the foreground. The sun is low on the horizon, creating a bright orange and yellow glow. The water reflects the light, and the sky transitions from yellow to a darker orange. The trees are dark against the bright background.

Products

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- **MS Thesis and Dissertation (Summer 2007)**
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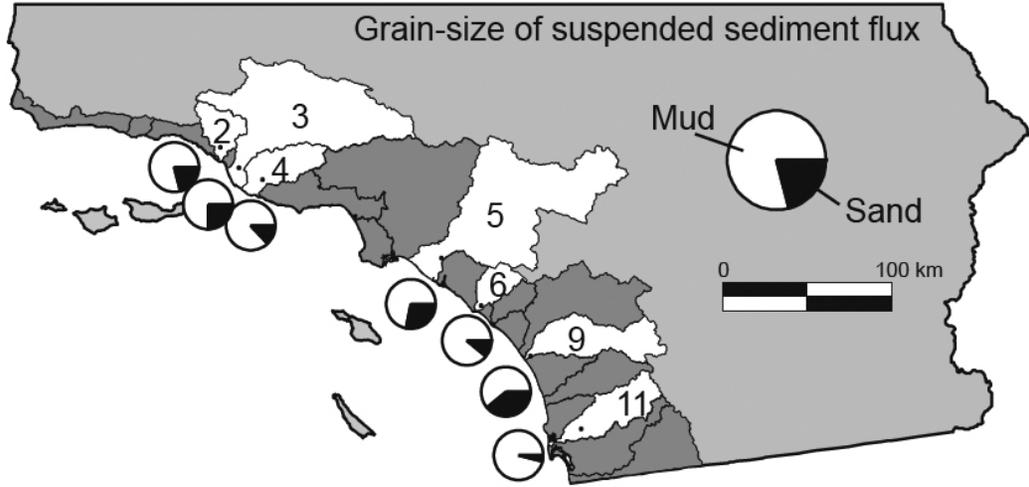
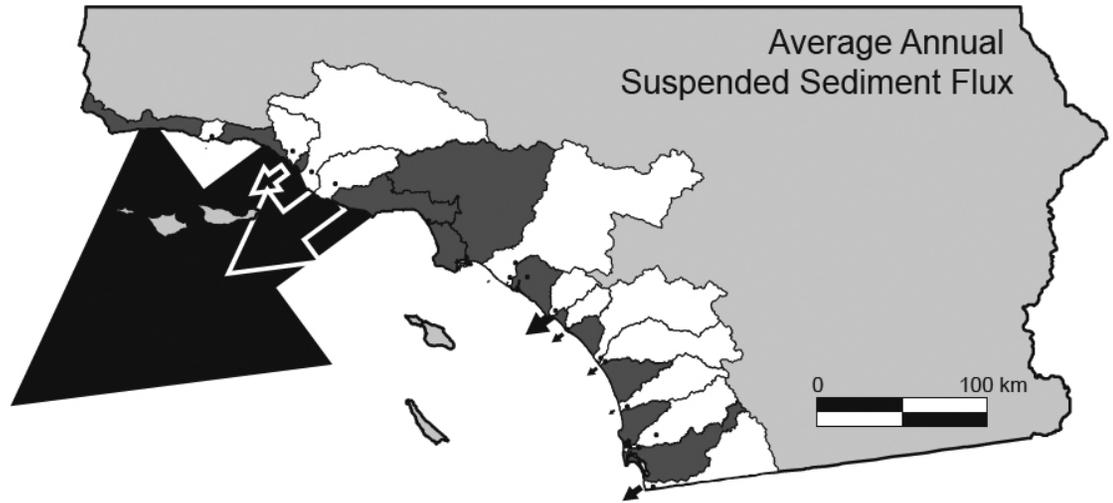
Future Directions

- Complete BEACON tasks (Dec 2008)
- Coastal vulnerability assessment for USGS Multihazards Investigation
- Seamless Map Product



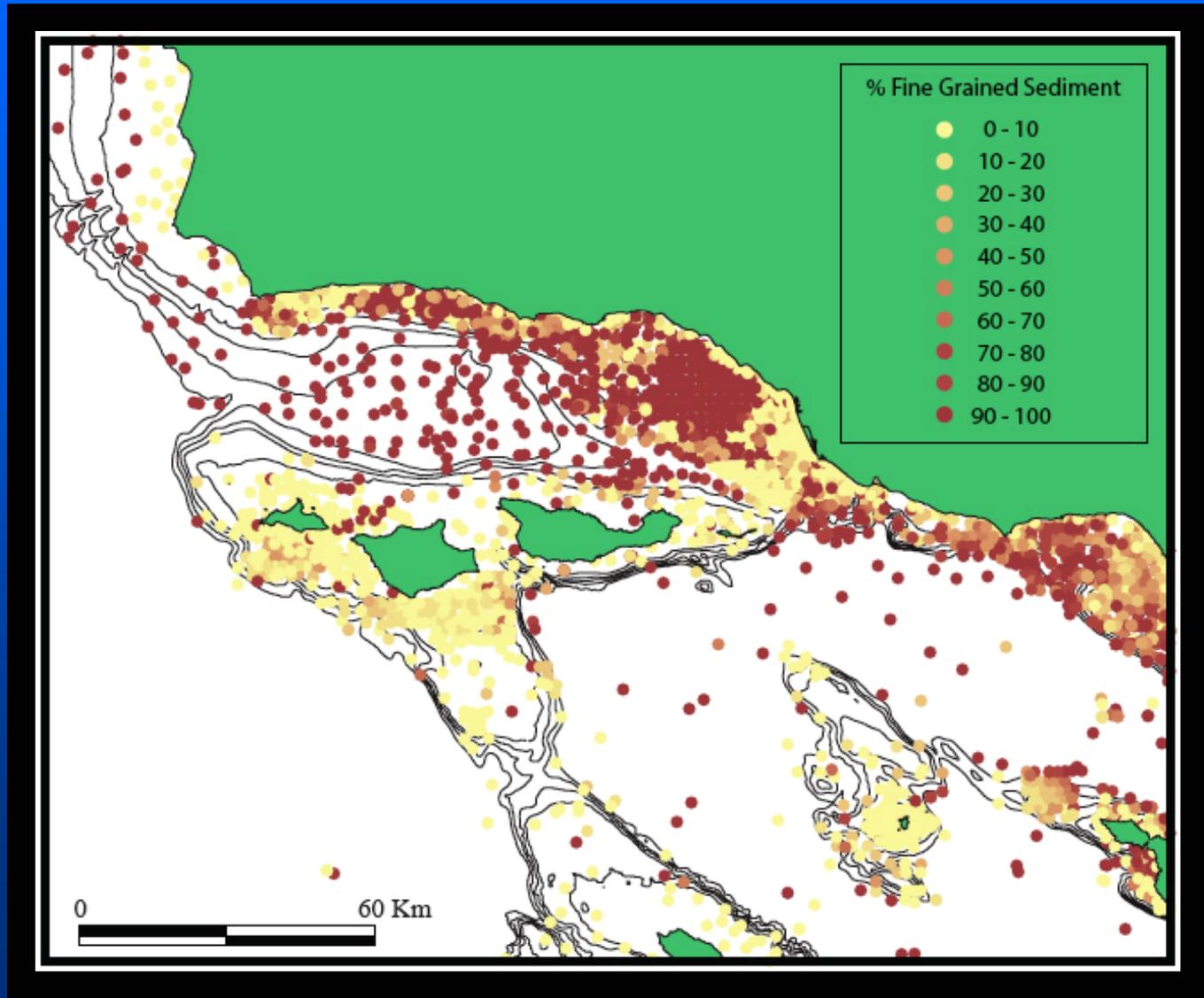
Southern California Sediment Budget

Farnsworth and Warrick (in review)



Fine-Grained Sediment Budget

Farnsworth and Warrick (in review)



Some of David Revell's Conclusions

Regional

No regional pattern of beach width narrowing due to sand supply reductions, instead beach widths oscillate.

Regional narrowing of beaches due to placement loss resulting from construction and encroachment of shore protection structures.

Study area can be divided based on location relative to Santa Barbara Harbor.

- Updrift – Beach minimums controlled by El Ninos with PDO influences
- Downdrift - dredge controlled

Patterns of long-term shoreline change rates match patterns of beach responses to El Ninos

El Ninos

Beach widths generally narrow by >50%

Erosion hotspots fit observed pattern of shoreline rotations with beaches rotating clockwise at west and southwest facing beaches, and counterclockwise at east facing beaches.

Transport Rates

Evidence of alongshore transport about 1 mile per year with pulses of sand detectable primarily along stable beaches