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Title
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Seasonal Changes in Sand Level and Wave Energy on Southern California Beaches

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Abstract Number 821

Funded by: US Army Corps of Engineers

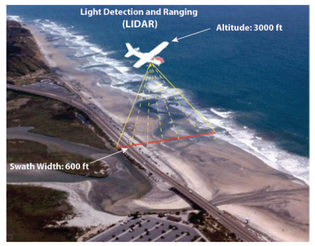
Introduction

- Investigate seasonal variability of sand levels in Southern California
- Sand levels: LIDAR and In-situ surveys at two focus sites
- Waves: regional network and numerical model

S. Cal. Beach Process Study

GPS Sand Level Observations

- Back beach to waterline
- Vertical accuracy ~10 cm



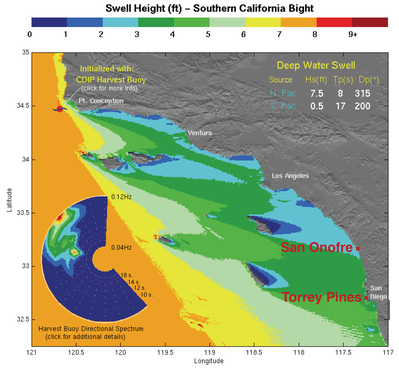
- 8 LIDAR flights since 2002
- Survey 79 km, extended to 170 km
- High spatial resolution (multiple points per square meter)

- Monthly in-situ surveys since 2000
- Focus sites at Torrey Pines (~7 km) and San Onofre (~3 km)
- Increased temporal resolution

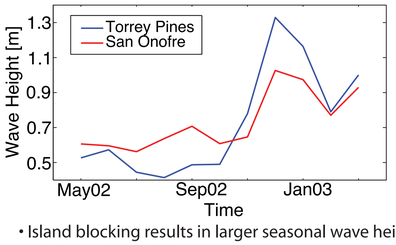
Wave Observations

- Wave observations combined with numerical model
- Hourly estimates every 100 m alongshore
- Alongshore variability in wave field due to offshore islands

Southern California Wave Field: Dec. 21, 2004



Wave Height

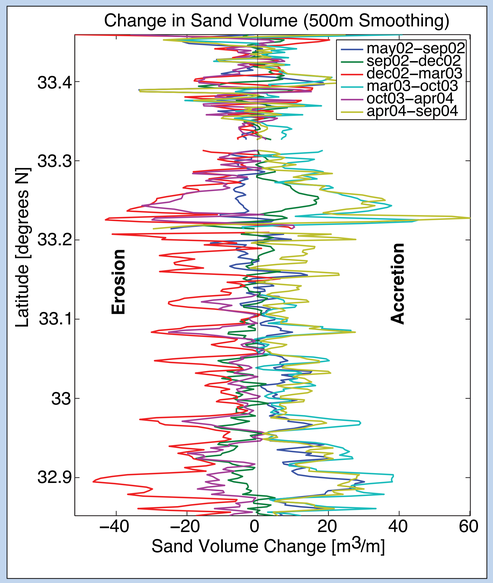


- Island blocking results in larger seasonal wave height variation at Torrey Pines

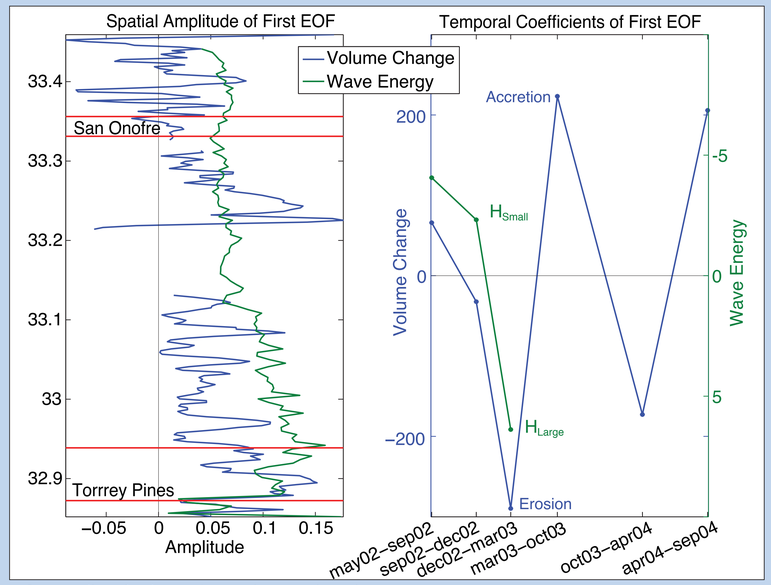
Results

LIDAR

70 km



- Seasonal cycle: winter erosion (═) and summer accretion (═) with significant alongshore variability



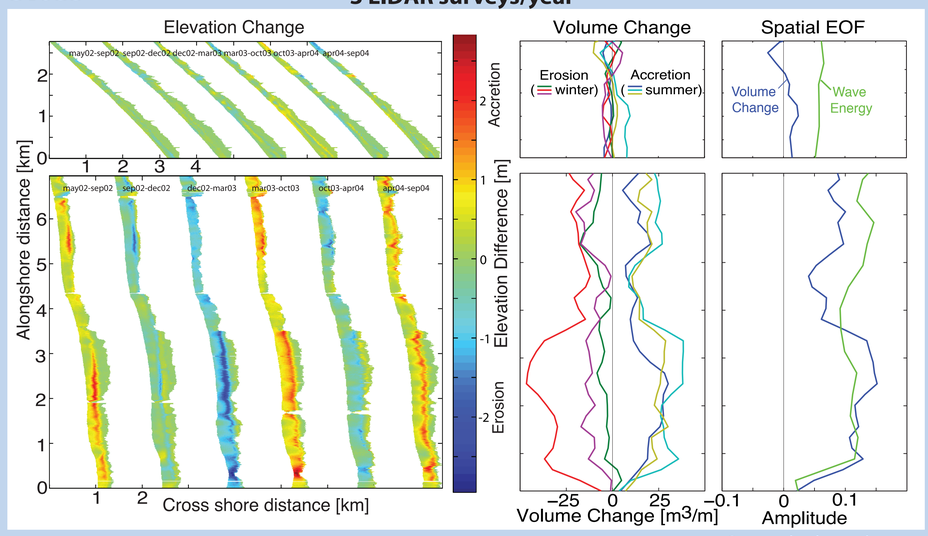
- Seasonality of volume change (85% variance) and wave energy (99% variance)
- Greater variability in volume change fluctuations
- Accretion with decreased wave energy (H_{Small})
- Erosion with increased wave energy (H_{Large})

Focus Sites

3 LIDAR surveys/year

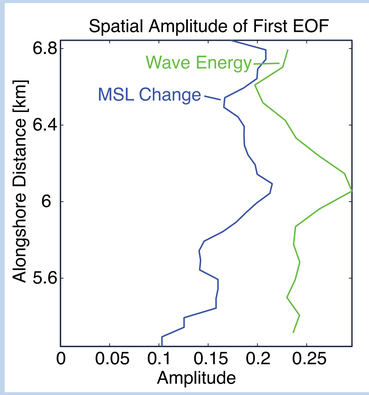
San Onofre Beach 3km

Torrey Pines Beach 7 km



- Sand level fluctuations at Torrey Pines three times larger than at San Onofre
- Primarily winter erosion and summer accretion in the focus sites
- Seasonal volume change (—) and wave energy (—) are correlated

Monthly In-situ Surveys



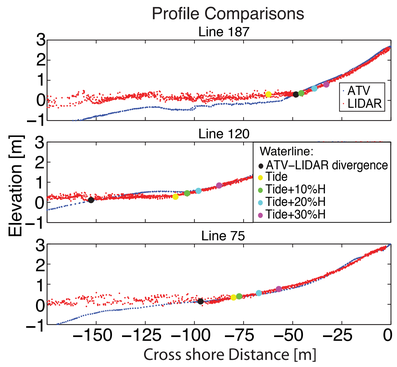
- Similar results with monthly in-situ surveys
- MSL change and wave energy correlated on scales <1 km

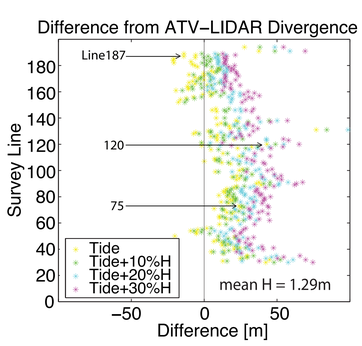
Finding the Waterline: April 2004

Goal:
- Discard LIDAR returns from ocean surface
- Retain LIDAR returns from sand surface

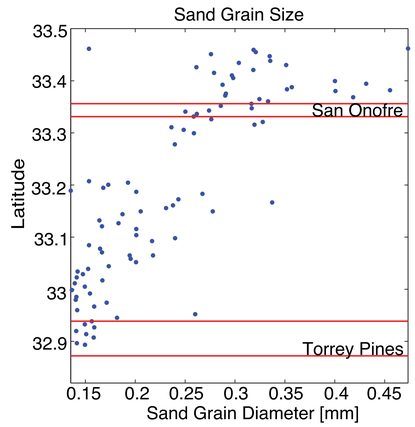
Test:
- Compare LIDAR processing to regions where ATV data is available

- ATV-LIDAR divergence is most offshore acceptable LIDAR data point
- Using LIDAR, tide level, and wave height to define waterline





- Best elevation criterion is Tide + 20% wave height (•)
- Tide only (•) yields water reflections
- Tide + 30% wave height (•) omits too much beach



- Could be a factor in beach response (Grain size data from Jen Haas and Neal Driscoll)

San Onofre Beach

- Heavily cobbled region during high tide (does it matter?)

- Flat, sandy terrace during low tide

Conclusions

- Primarily seasonal cycle in sand level fluctuations: summer accretion when south swell is predominant and winter erosion when north swell is predominant
- Considerable alongshore variability, with three times as much elevation change at Torrey Pines than at San Onofre
- Seasonal volume change and wave energy correlated at the focus sites, but not over the 79 km section
- In general, more variability in seasonal volume changes than seasonal wave field
- Larger sand grain size at San Onofre and elsewhere could contribute to difference
- Future work investigating the influence of grain size (and cobbles), beach width, and wave obliquity

A *BIG* thank you to the engineers and technicians from the hydraulics lab for their labor intensive completion of in-situ surveys.