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Relationship Between Bluff Erosion and Beach Sand Supply for the Oceanside Littoral Cell

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Background

It is a common belief that naturally flowing rivers in Southern California are a major source of beach sand, replenishing grains washed to sea by heavy surf and high tides. As a corollary, dams and other human activities affecting rivers have been seen as robbing beaches of new sand, contributing to beach erosion and intensifying the need for replenishing beaches through engineered beach nourishment projects.

This canon of beach dynamics may be incorrect or overly simplistic.

Recent Sea Grant research has shown that bluff erosion is a major source of beach sand in parts of San Diego County. An implication of this discovery is that coastal structures designed to prevent bluff retreat may reduce the supply of new beach sand to a greater degree than previously thought.

Building a bluff wall.

Project

University of California engineer Scott Ashford and graduate student Adam Young are using a ground-based laser-imaging technology to make detailed images of coastal bluffs before and after bluff failures. From these, they are computing the amount of bluff material lost during erosion events.

Preliminary findings suggest that the amount of material falling from bluffs could account for more than half of the total sand volume on some beaches. This estimate assumes that all material from bluffs is sand and that all eroded material ends up on beaches.

The current Sea Grant project is examining these assumptions more closely. Ashford and Young are continuing to amass LIDAR images of coastal bluffs in the region and to use these to quantify the pace of erosion. (LIDAR is an acronym for light detection and ranging.)

Meanwhile, the co-investigator on the grant, Neal Driscoll, a geoscientist at Scripps Institution of Oceanography, is conducting an experiment to quantify the amount of sand and the fate of sand coming from the Santa Margarita River in northern San Diego County, the only completely un-dammed, free-flowing river in the region.

Driscoll theorizes that much of the sediment flowing through highly episodic rivers like the Santa Margarita does not end up on beaches. Instead, he thinks its destiny may be the deep seafloor.

If this were true, it would be yet more evidence suggesting the relative importance of coastal cliff erosion to maintaining sandy beaches and the relative unimportance of rivers.

Crumbling Solana Beach cliffs. Photos this page Jacobs School of Engineering, UCSD

To investigate this theory, Driscoll and colleagues will produce a detailed map of the ocean floor around the Santa Margarita River mouth using an acoustic technique known as “swath mapping bathymetry,” roughly akin to giving the seafloor a sonogram.

A second technique known as “chirp seismic reflection” will be used to reconstruct an image of how the sediments are layered with depth, similar to how annual growth rings are counted to age trees.

The idea is to re-measure the shape of the seafloor after a major storm, to see if sediments carried by the river are indeed accumulating at depth as theorized. If they are, the chirp seismic reflection data will make it possible to estimate the amount of sand in the newly formed sediment layer.

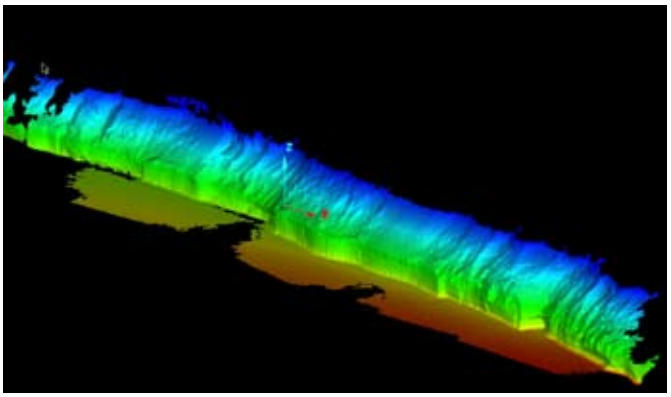
Implications

The California coast is a high wave-energy, actively eroding

environment. A lot of money is spent to build seawalls, jetties and riprap to slow bluff erosion and to add sand to beaches to maintain their recreational value.

The California Coastal Commission requires that owners of ocean-front property pay fees for the construction of private sea walls. These fees are supposed to compensate for lost recreational opportunities for the public at adjacent beaches, due to loss of beach sand. This research thus has implications for coastal permitting and mitigation processes, and hence for coastal land-use decisions and coastal community development.

LIDAR scanning of a section of Solana Beach bluffs. Photos CSG archives



A color-coded contour plot of a 10-mile stretch of sea bluffs from Del Mar to Encinitas, California. Image courtesy I-Site 3D Laser Imaging

Awards

Sea Grant Trainee Adam Young was the recipient of the American Shore and Beach Preservation Association's 2005 Education Award.

Trainees

Adam Young
Elizabeth Johnstone

Publications

Young, A.P., and S.A. Ashford. 2006. Application of Airborne LIDAR for Seacliff Volumetric Change and Beach-Sediment Budget Contributions. *J. Coastal Research* 22[2]:307–318.

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