Sand study shows new data to help manage Southern California's shrinking beaches

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Millions of dollars are being spent to add sand to Southern California beaches—but a new study suggests technology can give a better understanding of how sand moves, offering data decision-makers could

use in planning how to fix the eroding coastline.

A new paper published recently by University of California, Irvine researchers in the *Coastal Engineering Journal* analyzed beaches between Long Beach and La Jolla, offering new data and methods that can be used to figure out the most vulnerable areas of coastline and whether those beaches are suitable for the mega, costly projects often turned toward for trying to replenish and retain sand.

The study comes as coastal cities across the state are grappling with eroding beaches, due in part to human development that has impacted natural sand supply but also rising sea levels and climate change.

Because shrinking sand impacts everything from recreation, public access, infrastructure and the economy, decision-makers are searching for solutions—historically, major sand replenishment projects have moved at a snail's pace, taking years and even decades to get through permitting and secure government funding.

"I'm really excited to have the resources that help, potentially, inform these decisions," said Daniel Kahl, UCI researcher and lead author of the paper. "It can help us inform where nourishments will be most beneficial and where they won't be the best."

The researchers used satellite imagery dating back nearly 20 years and wave data from that same period from the Scripps Institution of Oceanography in San Diego to analyze "longshore transport," which is wave-driven movement of sand along the coast, the pathway that shows which direction sand will be redistributed.

Their paper also analyzed "divergence of drift," which shows whether sand will accumulate or diminish, based on the movements of sand.

"This method characterizes a process that can help us understand which areas of the beach are susceptible for erosion, but also where beaches might grow if given enough sand," Kahl said.

The new information could help decision-makers better understand whether areas are "feeder" beaches that contribute to other coastal communities or whether sand stays put.

"It's more complex than we previously thought," Kahl said. "Maybe there's more ideal locations for nourishments based on these sediment pathways we see. And there's areas where sand won't accumulate, and maybe that's not the best location (for a replenishment) and other sites should be considered."

"The data essentially shows: Where do we get the most bang for our buck when it comes to placing sand on the coast," said Brett Sanders, UCI civil and environmental engineering professor and co-author of the published paper.

The data showed, for example, that the Surfside beach along Orange County's northern coast, is an area that suffers from severe erosion—a well-known fact and why the U.S. Army Corps of Engineers is spearheading a $23 million project now underway to dredge and place 1.1 million cubic yards of sand there. It's a project done periodically since the 1960s.

The project is thought to have regional benefit, with currents expected to spread sand nearly 12 miles to Newport Beach—but the latest data shows that may not be the case, the researchers said.

Sand typically stops in Huntington Beach, part of the reason those beaches have continued to grow over the years at a rate of about 3 feet each year, Sanders said. And sand in West Newport, in turn, travels up

the coast to Huntington Beach.

So maybe Newport Beach officials reconsider if it's worth paying into the pot for that large replenishment project, Sanders said. "This is critical from a management perspective, because it tells us which communities along the coast need to work together on plans to manage the coast."

Their research also validates the importance of sand retention structures in Newport Beach—groin jetties built in the 1960s to trap sand—and the city's regular, ongoing efforts to nourish beaches with sand from the Newport Harbor and the Santa Ana River, Sanders said.

San Clemente is a prime candidate for sand replenishment, with the material wanting to stick around, based on the models.

The problem San Clemente is currently facing, however, is actually getting the sand. A $14 million project more than two decades in the making was put on hold a few weeks ago when the dredger ran into trouble sucking up rocks instead of sand at an Oceanside borrow site, with no definitive answer on when that project may get back on track.

Other areas that need immediate attention are Doheny State Beach and San Onofre, shown in one of the research paper's graphics with bright red coloring, indicating "hot spots" where erosion is occurring at a rapid pace.

Kahl is working on a drone project monitoring a recent small-scale sand project over the summer that involved about 3,000 truckloads of sand dumped on Capistrano Beach and Doheny State Beach, and said those areas hold sand well, according to the data.

The recessed section of coastline in San Clemente, called a bight, from

Cotton's Point in the south up to Dana Point—has good sand retention and is a largely self-contained region from a sand transport perspective, meaning it's a good candidate for replenishment projects, according to the new paper. Sand near Cotton's Point wants to move up the coast, while sand near Dana Point tends to move down the coast, the researchers said.

"This also makes the area well-suited for beach nourishment projects as waves will tend to keep the sand within the bight—to the extent possible, before sand is dispersed offshore with large wave events," Sanders said. "The takeaway here is that fixing beach erosion in the Capistrano bight requires new sand supplies and the waves can do much of the remaining work to spread the sand up and down the coast between the two points."

That kind of information could impact recent discussions in Dana Point and San Clemente about joining a group of coastal cities in San Diego trying to find regional solutions to sand replenishment, or if funds and efforts would be better spent on locally focused projects.

"If you nourish San Clemente or Doheny, the sand isn't going to move south and nourish San Onofre," Kahl said the researchers' data indicates. "It will stay in that area. It will naturally grow if there's enough sand."

"Beaches there have been eroding more rapidly in recent decades, and that area is starved of sand," he said. "If it was given adequate sand supply, our analysis suggests these beaches would be growing."

The study also maps out other areas rapidly eroding, such as near the Wedge in Newport Beach north of the harbor entrance and several beaches in San Diego, including Del Mar and Encinitas.

"We can see which beaches are being hit the hardest, which are doing better," Sanders said. "This satellite data will allow us to step back and

see these hot spots before they turn into disasters. It could give us the ability to act earlier instead of waiting for beaches to completely disappear."

Oceanside is an area that doesn't keep sand well and needs a sand-retention strategy, according to the data.

"Nourishing alone would not be very effective there, that's what our data shows," Sanders said. "Waves want to push that sand back up the coast and even back into the harbor. This suggests the need to consider projects that could help to hold sand on the coast."

The city is working on plans for a "living speed bump" project that would create offshore headlands to retain sand.

"We do need to create an environment where there's space for innovation," Sanders said, adding future sea level rise and changes to the frequency and intensity of storms is expected to put stress on coastlines, especially near urban areas where infrastructure is at risk.

"Communities and governments at every level will be pulled into conversations about ways to manage impacts, including plans for strategic retreat, plans to restore nature-based processes, and plans to nourish beaches," Sanders said.

"Our research reveals an opportunity to make these plans with better data and information, and a better sense for the optimal scale at which to tackle the problem."

More information: Daniel T. Kahl et al, Characterizing longshore transport potential and divergence of drift to inform beach loss trends, *Coastal Engineering* (2024). DOI: 10.1016/j.coastaleng.2024.104473