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Cameron Walker

Eckart Meiburg receives NSF award to study sediment dynamics behind mudslides and erosion

Tiny grains of silt, clay and other materials may be small in size, but when they clump together they can trigger enormous impacts, including landslides and coastal erosion. Mechanical engineer Eckart Meiburg, a UC Santa Barbara distinguished professor, has received a National Science Foundation (NSF) award to study these processes in collaboration with former UCSB mechanical engineering associate professor Alban Sauret, now at the University of Maryland. The three-year, $330,000 award from the NSF supports transformative research aimed at “improving our basic understanding of particulate and multiphase processes,” while revealing how these small-scale phenomena influence broader behavior and dynamics.

“Sediment dynamics are very important to many aspects of the natural and built environment,” said Jeff Moehlis, chair of the Department of Mechanical Engineering. “We are delighted that Eckart Meiburg and this important research are being recognized by NSF.”

Meiburg, a fellow of the American Physical Society and the American Society of Mechanical Engineers, has studied fluid dynamics in the Dead Sea and participated in sending sediment experiments up to the International Space Station. In this new research, he and Sauret are developing novel approaches to studying sediment that will allow them to peer into the hard-to-see interactions of particles.

“We’re trying to understand the attractive forces that make these individual particles stick to each other, but because they are very, very small — typically only a few micrometers — it’s difficult to observe them,” he said, “so we’re looking for a larger-scale analog that allows us to observe the effect of these attractive forces.”

Sand castles are one such analog, Meiburg said. “You cannot make a sand castle with dry sand. But when you make your sand a little bit wet, you form what we call *capillary bridges* between each of your sand grains, and those small amounts of water hold the sand grains together,” he explained. “The attractive force between the individual sand grains allows us to build larger aggregates, like sand castles, which can serve as a model for understanding cohesive sediments, which are much smaller.”

Meiburg will work on computational models and algorithms that describe and predict both those bonds, and how the aggregates created by them – sometimes called *floc* — act in a larger system. In Maryland, Sauret will develop physical models to approach the same questions. The grant will allow for one dedicated Ph.D. student in each lab and may also make it possible to bring in undergraduate students.

The work has the potential to improve understanding of bonding mechanisms not as abstract concepts, but rather as processes having important real-world consequences. Not far from the UCSB campus, the 2017 Thomas Fire scoured hillsides of vegetation from Ventura to Santa Barbara. Then, during an intense rainstorm in January 2018, a mudflow occurred that destroyed more than 100 homes and caused 23 deaths. “With wildfires increasing as a result of climate change and so on, these kinds of things will happen more often,” Meiburg said.

In addition to affecting the land and its inhabitants, sediments also flow at the bottom of waterways, including reservoirs, rivers and seas. “Cohesive sediments are everywhere. They’re on mountains and hillsides, they’re in rivers, they’re on the ocean floor,” Meiburg said. As a result, learning how sediments work will not only help researchers understand the dynamic Earth, but also may ultimately lead to the development of engineering applications intended to prevent natural disasters and protect infrastructure, such as undersea cables, offshore windfarms and dams.

Tags
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Media Contact

Debra Herrick
Associate Editorial Director
(805) 893-2191
debraherrick@ucsb.edu

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