Going By the Flow—

Using Acoustics To Track Stream Sediment

Listening to a flowing creek may be just the thing for relaxing on a peaceful afternoon. But ARS hydraulic engineer Roger Kuhnle listens for a different reason. He's seeking clues about the overall state of the watershed that feeds the creek.

Kuhnle and colleagues use cutting-edge acoustic technology to monitor sediment flow, whose speed and concentration may alert researchers to changes and problems within water systems. The project, undertaken with the University of Mississippi, is being conducted on a model stream channel at the ARS Channel and Watershed Process Research Unit's laboratory in Oxford, Mississippi, as well as in nearby Goodwin Creek.

"Accurate determinations of the rate of sediment movement by streams are necessary because sediment can fill reservoirs and reduce their capacities," says Kuhnle, the project's leader. "It can fill channels and cause flooding, degrade water quality, and destabilize channel banks, destroying land. Monitoring stream sediment also helps us evaluate its potential effect on aquatic organisms."

Physical, chemical, and biological damage associated with sediment flow in North America costs around $16 billion annually, say ARS and U.S. Geological Survey researchers.

The amount of suspended solid material transported in rivers and streams is often the main indicator of watershed stability—as well as water quality—says Kuhnle. Ideally, early warning signals for watersheds will one day trigger effective preventive care and maintenance strategies. But for now, scientists at the unit are concentrating on the initial step: developing a mobile sensing system that would make such improved care possible.

"We need a portable, efficient, automatic system that doesn't require someone to be on site—one that can provide better data than what we get today, not only in quantity, but also in quality," says Kuhnle.

He says years of research indicate that acoustic technology is one of the most promising sediment-tracking methods among those tested.

"It is more cost- and time-effective than current methods and the other methods tested," he says. "The short-duration, high-intensity flows that cause most sediment movement in many streams are best observed by continuous monitoring systems."

The studies have led to development of the Bedform and Sediment Information System, or BASIS. Devised by former University of Mississippi scientist Robert Derrow in close collaboration with ARS scientists, BASIS emits a pulse of acoustic energy and then gauges the strength and travel time of the back echo to determine sediment's location and concentration. Like its predecessor—known as the SedBed Monitor—it locates sediment on a stream's bottom, which can indicate either erosion or accumulation of sediment there.

But the new system's most important enhancement is its ability to detect sediment suspended in water. It converts the acoustic data into a digital image that portrays suspended sediment as a cloud, in a multitude of colors that signify various concentrations. The main BASIS unit is compact, and the entire system can run from a laptop computer.

Kuhnle says BASIS technology is now available for use by private firms and government agencies. More sophisticated technology under development for total suspended-sediment load sampling will become available after about 3 to 5 more years of experimentation and field testing.—By **Luis Pons,** ARS.

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