

Mini subs exploring Sacramento River

by Carl-Gustav Linden

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If you reel in a small sub instead of a rainbow trout from the Sacramento River this summer, don't call Homeland Security.

It belongs to a team of researchers from the University of California at Berkeley trying to learn more about the river currents in the delta.

The researchers are working with propelled 4-foot-long submarines and floating drifters equipped with [GPS](#)-receivers for positioning, GSM-modules for communication, and sensors inside for recording temperature, salinity, and currents.



Researchers prepare to launch a submarine.

(Credit: UC Berkeley)

"We are prototyping an infrastructure and testing it in the delta," said Professor Alexander Bayen, who leads the team at UC Berkeley's Civil Systems Department.

The purpose of all this is to collect data to help the state better understand the river. And researchers have good reason to believe there's urgency to their work. With drought looming for most of California, understanding the state's water supply (much of the state's population drinks run-off from snow melting in the Sierra Nevada range) and how the system works is critical.

The Sacramento River is already monitored by 50 permanent water stations in about 1,000 miles of water channels, but that collection of data is not designed to handle emergency situations, according to the researchers.

"It's totally undersampled if you want a precise, online, real-time measurement of the whole state of the delta," Bayen said.

Heavy rains, levee breaches, or contaminant spills are situations when accurate and up-to-date data is needed. In the river delta in 2004, for example, one of the levees breached and a large agricultural area was flooded. Pumps normally move fresh water from sources in the north down to the south, but silt was confounding in the system. The pumps had to be shut down for a whole month at a cost of around \$1 million a day.

"In retrospect, that was too long. But given the information they had, they were forced to act very conservatively. They could not turn the pumps on," said graduate student and researcher Andrew Tinka.

Floaters equipped with sensors deployed on site could have provided real-time information on how the water was flowing and where the silt was heading.



Development of the floating devices starts from scratch at a UC Berkeley workshop. (Credit: Carl-Gustav Linden/CNET News.com)

In a recent workshop at UC Berkeley, undergraduate students and university staff worked on floater prototypes that will be tested this summer in the river. Inside the floaters are a GSM-module, a GPS-receiver and a \$120 [Gumstix](#) computer running on Linux. (A Gumstix is a computer the size of a stick of gum.)

"They are great little computers that are about as powerful as a 1996-era Pentium. All the power you had at your disposal can be yours in a floating sensor for very little money now, and that's really cool as far as I'm concerned," Tinka said.

The self-guided submarines are developed in Portugal by the University of Porto.

That is the hardware involved. The other part of the project are the algorithms calculated for the complex hydrodynamics models. The software is based on two commercial packages, Telemac and Mike 21, with programs for GPS tracking added.

Bayen said that the combination of the hardware and software is the novelty here. He calls it a "cyber physical system," where the cyber part monitors the flow of information and the physics is the hardware--the floaters.

"In five years, cyber physical system is going to be a tech buzz word," Bayen said.

If the research project is successful, the innovations can be put to use in other parts of the world where there is a need for improved river management. The Berkeley team is already cooperating with Professor Linda Bushnell of the University of Washington on a project in the Mekong--the troubled river that floats through China, Laos, and Cambodia out in its delta in Vietnam.

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