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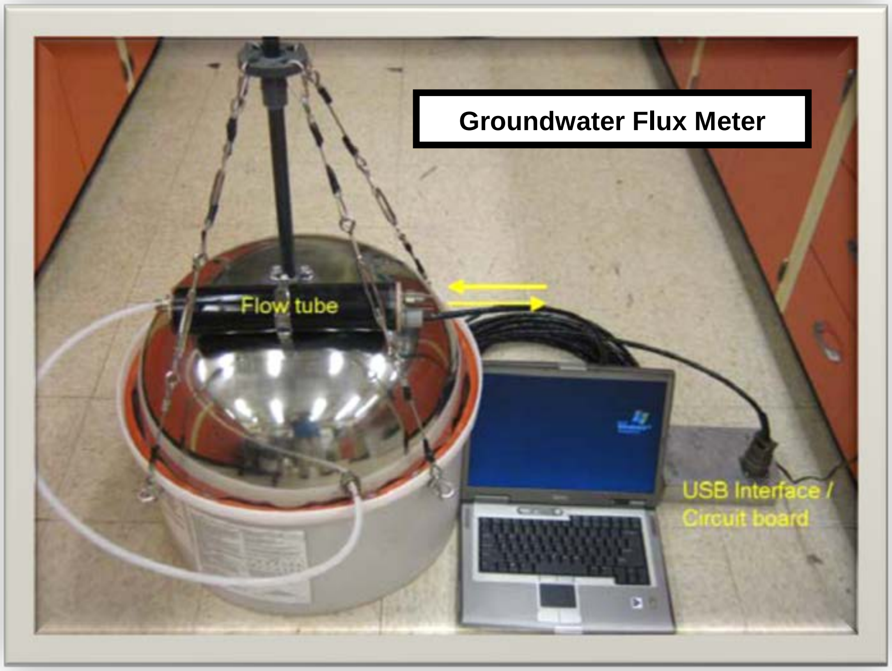
INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

FLUX METER ASSESSES THE EFFECTS OF GROUNDWATER, SURFACE WATER, AND CONTAMINATED SEDIMENT INTERACTIONS ON ECOSYSTEMS



Research Value

Land use decisions made by people affect the type and amount of contaminants that enter groundwater (GW) and surface water (SW). The interactions of contaminants with GW and SW affect aquatic ecosystems. Contaminants are often transported and transformed in these GW/SW interactions. To diagnose the effects of GW/SW interactions on contaminants and ecosystems, first the movement of water must be measured.

Measuring the movement of water and contaminants between GW and SW presents its own set of issues compared to measuring surface water flow in a stream, for example. Three major issues in measuring the flow between GW and SW are that the water is flowing through and interacting with sediments, flow can change direction throughout the year, and the rate of flow is typically very slow.

The slow flow of water between GW and SW is often referred to as seepage, or in scientific terms, advective flux. Though seepage is relatively slow, over time it can add a significant amount of water and dissolved chemicals to a lake or other SW ecosystem. The slow flow presents a challenge in getting reliable measurements over short time periods. With more accurate measurement and an enhanced understanding of GW discharge into SW ecosystems, scientists can generate better long-term estimates of levels and chemical changes of the contaminants in sediments.

Another difficulty in measuring GW/SW flow is that the flux of contaminants entering sediments via GW discharge may vary in space and time. EPA research is addressing these issues by 1) developing methods that make use of relatively inexpensive self-contained, off-the-shelf devices (Ford et al, 2012) and; 2) developing better metering devices that can achieve continuous long-term remote monitoring of flow or flux.

Research Details

This project was conducted to develop a durable advective flux meter capable of unattended long-term remote monitoring of the sediment-water interfacial flux. To allow monitoring and control over the internet, a remotely controlled monitoring module was developed as part of the system.

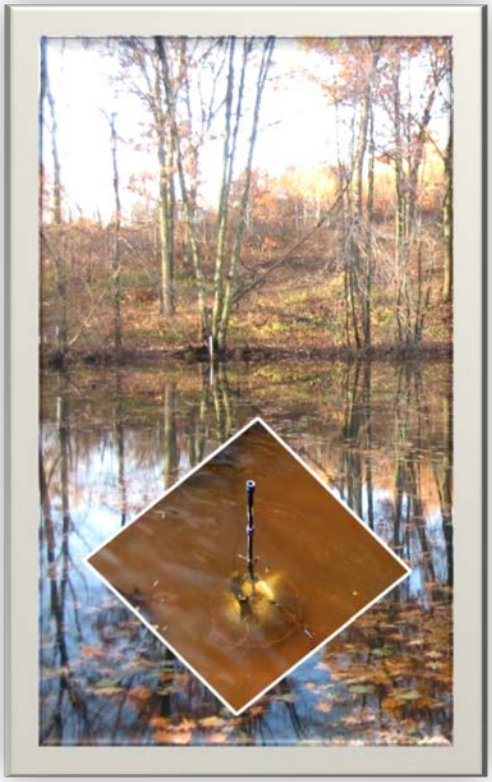
An associated aim of this research was to develop an instrument that will better capture the time-dependent variability in flow that is commonly encountered in GW/SW interactions in natural systems. Due to the number of changes that continuously occur, such as seasonal flow fluctuations and changing land management practices, collection of continuous flow data over longer periods of time provides better data to differentiate the relative effects of these varied influences. Improvements in the ability to differentiate between natural and man-made variations can lead to more sustainable improvements to ecosystem health.

If the difficulties in measuring GW/SW flow can be overcome, these data can be combined with aquatic chemical measurements to help decide on the most effective strategies to make lakes and streams safer and more sustainable for humans and wildlife.

Outcomes and Impacts

The flux meter was useful at a wide variety of sites. The meter was first tested in a turbulent stream at Santo Domingo, Nicaragua. Additional tests of the meter were conducted in the Grand Calumet River in Indiana and Lake Hartwell in South Carolina. The Grand Calumet is a slow moving river with fine texture organic rich sediment, while Lake Hartwell is a deeper water reservoir with sandy sediment.

Based on results of these tests, refinements were made and an improved advective flux meter design was deployed for an extended period in its remotely operated configuration at a Superfund site at Ft. Devens, MA. The long-term GW flux data from this study was to help pinpoint the source of sediment contamination, leading to selection of a more reliable and sustainable remediation strategy.



Flux meter being used to measure GW flow into SW at Red Cove, part of the Ft. Devens Superfund Site

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