FISP: What's New in Samplers and Sediment Measurement Technologies

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Abstract

The Federal Interagency Sedimentation Project (FISP) is an example of effective interagency cooperation a cross-cutting science issue. The FISP was created in 1939 to research and standardize fluvial sediment science methods and instruments. That mission remains relevant today as research continues on emerging tools and technologies for measurement and analysis of sediment properties.

Introduction

FISP instrumentation and research encompasses suspended sediment, bedload sediment, bed material, bed topography, and water quality. The currently active FISP agencies are the U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, U.S. Department of Agriculture-Agricultural Research Service, U.S. Forest Service, and U.S. Geological Survey (USGS). Sponsoring agencies and the public benefit from the cooperative action that leads to comparable, meaningful sediment information obtained using common instruments, standards, and procedures.

The FISP was created in 1939 to research and standardize fluvial sediment science methods and instruments (Gray and Landers, 2015). The 20th century focus was on designing and building physical samplers with an emphasis on the mechanical and hydraulic aspects. Prior to 1939, samplers for both suspended sediment and bedload were non-isokinetic (velocity of water going into the sampler was not the same as the undisturbed velocity of water at that sample location) which biased the sample concentration and made results non-comparable. The FISP developed

a series of samplers that could be used to collect point and depth integrated suspended sediment, bedload, and bed material (Davis, 2005). The results from samples collected in these samplers are comparable within the conditions referenced in Davis (2005) if equivalent techniques are followed. Starting in 1981, a transition in the development of the samplers ensured that they were capable of sampling for trace constituents without introducing contamination (Davis, 2005).

In 2005 there was a logistical change to the FISP, with sampler supply, testing, and maintenance support duties transferred to the USGS Hydrologic Instrumentation Facility (HIF) (2019) at Stennis Space Center, Mississippi. The HIF now manages all contracts with manufacturers, inventory, orders, testing of equipment prior to shipping, and conducts repairs on equipment that is returned. From 2005 to present, the focus of FISP activities has shifted from the development and support of physical samplers towards research, development, and evaluation of sediment surrogate technologies.

Current or Recent FISP Sponsored Research

Information on the recent and current FISP research can be found on the FISP website (Federal Interagency Sedimentation Project, 2019). Although the primary focus in recent years has been on sediment surrogate technologies, physical samplers have also been researched. These research topics have included suspended sediment sampler efficiency and accuracy, and bedload sampler efficiency while varying mesh size and type.

Numerical modeling analysis was used for both the efficiency and accuracy studies involving suspended sediment samplers while laboratory testing was used to test the hydraulic efficiency of pressure difference samplers while varying mesh size and type. More information on the

setup and results of the testing can be found in the research section of the FISP website (Federal Interagency Sedimentation Project, 2019).

The FISP website highlights more than ten sponsored sediment surrogate technology research projects and topics, including:

- Acoustics for suspended-sediment concentration (SSC) monitoring
- Laser diffraction for particle-size monitoring and concentration
- Close-range remote sensing for SSC monitoring
- Density difference for SSC monitoring
- Passive-acoustic bedload monitoring

Acoustic technology is increasingly used for velocity measurements, and the FISP has and continues to invest in testing and developing methodologies for using this same technology as a surrogate for estimating SSC. The testing includes the use of point and profiling acoustic instruments. The profiling instruments measure the backscatter of sound waves in either the horizontal or vertical directions in a river. A techniques and methods document has been published for estimating SSC using the horizontal methodology, and testing continues on the vertical methodology (Sediment Acoustic Leadership Team, 2019).

Another technology getting increased use is laser diffraction. This instrumentation is being used in both the laboratory and field. The methodology is advancing the ability to more quickly obtain particle-size distribution and volumetric sediment concentration. The FISP is helping support the development of laboratory standards and continues to support field testing of in-situ laser diffraction instruments at multiple sites across the United States (Czuba and others, 2015).

The FISP has also supported the evaluation of spectral imagery from commercially-available cameras as a non-contact surrogate for SSC at a field site where samples and turbidity readings also were collected.

The density difference methodology for SSC monitoring is an option at sites where concentrations above 20,000 mg/L are observed because these concentrations are high enough to be outside the measurement range of most if not all other surrogates. The FISP supported testing at a site where these conditions exist (Brown and others, 2015).

Lastly, passive-acoustic bedload monitoring uses hydrophones to listen to collisions of gravel particles, as a surrogate for bedload. The FISP has supported testing of this methodology in both the lab and the field (Wren and others, 2015; Federal Interagency Sedimentation Project, 2019-Research Tab).

The FISP plans to continue research on emerging tools and technologies for measurement and analysis of sediment properties into the future. The public will continue to benefit from the effective interagency cooperation that leads to comparable and meaningful sediment information.

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