Proceedings of the Federal Interagency Sediment Monitoring Instrument and Analysis Research Workshop, September 9-11, 2003, Flagstaff, Arizona

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Executive Summary

The Advisory Committee on Water Information's Subcommittee on Sedimentation sponsored the Federal Interagency Sediment Monitoring Instrument and Analysis Research Workshop on September 9-11, 2003, at the U.S. Geological Survey Flagstaff Field Center, Arizona. The workshop brought together a diverse group representing most Federal agencies whose mission includes fluvial-sediment issues; academia; the private sector; and others with interests and expertise in fluvial-sediment monitoring – suspended sediment, bedload, bed material, and bed topography – and associated data-analysis techniques. The workshop emphasized technological and theoretical advances related to measurements of suspended sediment, bedload, bed material and bed topography, and data analyses. This workshop followed and expanded upon part of the 2002 Federal Interagency Workshop on Turbidity and Other Sediment Surrogates, which initiated a process to provide national standards for measurement and use of turbidity and other sediment-surrogate data.

This executive summary provides a description of the salient attributes of the workshop and related information, major deliberations and findings, and principal recommendations. This information is available for evaluation by the Subcommittee on Sedimentation, which may opt to develop an action plan based on the recommendations that it endorses for consideration by the Advisory Committee on Water Information.

Background

The need for reliable, cost-effective, spatially and temporally consistent data on sediment content and clarity of our Nation's waters has never been greater. Ironically, the amount of daily-value sediment data being collected by the U.S. Geological Survey – which has the national mandate for collecting and archiving Federal water data, including fluvial sediment – has declined by two-thirds over the last two decades. Production of these data by standard techniques originating in the 1940s tends to be manually intensive and time consuming, and hence, costly, and safety risks may be associated with manual data-collection techniques. Although the data produced are widely considered to be the best such data available that describe the sedimentary character of our Nation's waters, their accuracy is largely unquantifiable.

Over the last decade, there has been a marked increase in the availability, measurement capabilities, and research and testing of instruments that purportedly produce continuous and (or) quantifiably accurate sediment-surrogate data that are safer and (or) less expensive to obtain, and (or) more robust than those obtained by traditional techniques. At the same time, data-analysis capabilities have improved or are being developed for converting surrogate measurements and selected ancillary information into estimates of suspended-sediment concentration, bedload transport rates, bed topography, or particle-size distribution statistics.

This convergence of advanced instrument technologies and analytical capabilities represents an unprecedented opportunity to evaluate the capacity to cost-effectively measure and (or) monitor selected characteristics of one or more phases of fluvial sediment with a heretofore unprecedented continuity, temporal density, and (or) known accuracy. If sediment-surrogate data can be shown to meet codified accuracy criteria and appropriate sediment-record computation techniques are applied, then these technologies have the potential to revolutionize the way fluvial-sediment data are collected, analyzed, and made available in the United States. Such was the impetus for holding the workshop.

Workshop

The workshop theme was, "What are the Nation's fluvial-sediment-data needs, and how can those needs be met with:

- substantially increased temporal and (or) spatial resolution,
- a better and quantifiable accuracy,
- an expanded suite of measurement characteristics,

- reduced costs, and (or)
- a greater margin of safety

compared with traditional, manually intensive data-collection techniques?"

The overarching goals of the workshop were to exchange information and provide a forum in which to develop a vision on how to attain the critical fluvial-sediment-data needs of the Nation. Based on these results, the workshop groups were to make recommendations to the Subcommittee on Sedimentation on steps needed to make this vision become a reality. The scope of the workshop focused on the means for measuring, storing, analyzing, and disseminating data for the following sedimentary phases: suspended sediment, bedload, bed material, and bed topography. The degree of uncertainty in the production of fluvial-sediment data was considered with respect to each of the sedimentary phases, including their storage and computational treatment.

Most of the workshop's outcomes emanated from the closing plenary session and from the four breakout sessions, entitled:

- Suspended-Sediment Measurement: Data Needs, Uncertainty, and New Technologies
- Bedload-Transport Measurement: Data Needs, Uncertainty, and New Technologies
- Bed-Material and Bed-Topography Measurement: Data Needs, Uncertainty, and New Technologies
- Sediment Data: Management, Sediment-Flux Computations, and Estimates from New Technologies

An opening session served to introduce the theme, scope, and general goals of the workshop, and to outline workshop expectations. A field trip to sites of fluvial-sediment interest in northern Arizona took place on September 10, 2003.

Overarching Findings and Recommendations

The following information reflects the broad-scoped deliberations, findings, and recommendations from the workshop. They were culled from the more notable findings and recommendations that were largely or fully shared across the sediment and data management categories. Additional detailed information can be found in the breakout sessions summaries, and in appendix 1, a matrix summarizing selected information gleaned from the breakout and plenary sessions.

Summary of Findings:

I. **Data Issues**:

A. All breakout sessions expressed the need for time-series data—in greater quantities and increased temporal density—for all sedimentary phases and for computational purposes. Ancillary data on similar timescales are need, as are calibration data obtained concurrently by traditional techniques.

B. Protocols for data collection, analysis, computation, and storage, which for the most part are available for traditional technologies, must be developed for sediment-surrogate technologies. A clearinghouse for procedures and data standards is needed for bedload data and for data management.

C. Although some criteria for data accuracy on suspended sediment are available, there is a need for this information to be developed and codified for all sedimentary phases.

D. Information regarding uncertainty associated with measurements is needed for all sedimentary phases and for data storage and computations, with the potential exception of bed material. The need for elucidating the uncertainty associated with bedload data was considered paramount.

E. The accuracy (uncertainty) of data produced by all technologies needs to be quantified, with emphasis on the quality of bedload data, and on the quality of data being stored and used for computational purposes.

II. **Traditional Data-Collection and Data-Computation Techniques**:

A. Protocols for traditional data-collection and computational techniques exist across the categories with deficiencies noted for some bedload conditions and for bed material in unwadeable coarse-bedded conditions.

B. The accuracy of bedload data was considered largely uncertain. The accuracy of computational results, considered the best information available, may be inferred in some cases but is rarely quantified.

III. **Surrogate Techniques**:

A. Several relatively mature and commercially available surrogate techniques are in use for monitoring suspended-sediment concentration. Some surrogate technologies are available for bed-material and bed topography characterization. The few that are available for bedload are either in the research phase or their use is limited to a research setting and none are widely operationally deployed. The performance of techniques for measuring bedload transport remains largely unverified and few are routinely used for monitoring by the Federal government.

B. All techniques have applications in fluvial systems. Selected applications are suitable for other freshwater, marine, coastal zone, and estuarine

settings. Computational procedures may be limited to fluvial systems, at least in the short term.

C. For suspended-sediment and bedload measurements, emphasis should be placed on the development of robust technologies that provide measurements representing a substantial proportion of the material in transport streamwide, as opposed to measurements at a single point in a cross section.

IV. **Models**:

A. Although the workshop focused on data collection, applications for improved modeling accuracy were recognized, particularly for models describing bedload transport. The potential for accurate times-series data to increase the usefulness and range of model application in transport computations was highlighted.

V. **Research and Oversight**:

A. Unanimity was expressed regarding the need for basic research in all of the sedimentary categories, but particularly with bedload transport. Each breakout session indicated that formation of a formal Sediment Monitoring Instrument and Analysis Research Program, as described in "Attributes of a Sediment Monitoring Instrument and Analysis Research (SMIAR) Program," by Gray and Glysson (listed in appendix 4), was needed to oversee and coordinate the evaluation of both surrogate and traditional technologies.

B. Unanimity also was expressed regarding the need for organizational oversight and coordination associated with all categories of sediment-surrogate technologies, data storage, and computational procedures. The Federal Interagency Sedimentation Project (FISP) represents an organization with the necessary background for managing a SMIAR Program.

Summary of Recommendations:

1. **Research:** Coordinated research in all sedimentary phases, but particularly on bedload transport and for storage and computational techniques, is recommended. This includes basic process-based research, along with research on collection, analysis, and computational procedures.

2. **Fluvial-Sediment Time-Series Data:** Emphasis, effort, and funding should be directed toward collection of time-series data in each of the fluvial-sediment categories for computation of flux and other sedimentation characteristics. The data need to be supported by protocols for their collection, analysis, and storage and by comparative accuracy criteria, including quantitative uncertainty values. The data should be evaluated against traditional technologies, where feasible. These data should be used to improve estimates of fluxes, particle-size distributions, and other sediment characteristics derived from models. Clearinghouses for data, tools, methods, and models are needed.

3. **Sediment-Surrogate Technologies**: Several of the technologies presented at the workshop were considered sufficiently compelling and potentially tractable to warrant additional research, testing, and calibration. These technologies should be prioritized and those ranking high in priority should be further evaluated. Evaluations should be made against absolute standards where possible, but also against traditional data-collection techniques, where feasible. These efforts should be done as part of a formal program such as that described by Gray and Glysson, "Attributes for a Sediment Monitoring Instrument and Analysis Program," as listed in appendix 4 of this report.

4. **Sediment Monitoring Instrument and Analysis Research (SMIAR) Program:** Formation of a SMIAR Program (Gray and Glysson, listed in appendix 4), or a program that contains its major elements, should be formalized. The Federal Interagency Sedimentation Project, or another sufficiently capable organization, should oversee and coordinate the SMIAR Program.