TURBIDITY THRESHOLD SAMPLING: INSTRUMENTATION AND METHODS

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Abstract: Traditional methods for determining the frequency of suspended sediment sample collection often rely on measurements, such as water discharge, that are not well correlated to sediment concentration. Stream power is generally not a good predictor of sediment concentration for rivers that transport the bulk of their load as fines, due to the highly variable routing of sediment to the channel from hillslopes, roads, and landslides. A method, such as Turbidity Threshold Sampling, that employs a parameter well correlated to suspended sediment concentration can improve sampling efficiency by collecting samples that are distributed over a range of rising and falling concentrations. The resulting set of samples can be used to estimate sediment loads by establishing a relationship between concentration and turbidity for any sampled period and applying it to the continuous turbidity data. All river systems, particularly smaller watersheds that respond very quickly to rainfall, benefit from automated data collection.

A data logger, under direction of the Turbidity Threshold Sampling program, collects stage and turbidity data at 10 or 15-minute intervals, depending on the drainage size, then triggers an automatic pumping sampler to collect a sample whenever the turbidity passes selected thresholds, if the stage is above a specified minimum and temperature is above freezing. The program distinguishes rising from falling conditions and uses different sets of turbidity thresholds for each. When the measured turbidity exceeds the calibrated range of the sensor, the program collects pumped samples at a fixed rate specified by the operator. At each recording interval, the program records the median of 60-100 high-frequency turbidity readings. To avoid over-sampling, the program logic attempts to distinguish brief spikes caused by fouling from true rises in turbidity. Future improvements in program logic will provide a mechanism to limit the number of occurrences and frequency at which thresholds can be triggered without user intervention.

The turbidity probe, mounted inside a housing, and the sampler intake are usually attached to the end of an articulated sampling boom. Booms are most suited to sites that have adequate depth of flow. The boom and housing reduce contamination from organics by shedding debris, protecting the sensor from direct impacts by woody material, and when properly designed they reduce hydrodynamic noise caused by turbulence and the entrainment of air or re-suspension of sediment close to the sensor. Field personnel can retrieve the bank or bridge-mounted boom to remove debris during high flows. The boom controls the depth of the turbidity probe and sampler intake in the stream to maintain their position above bedload transport and below the water surface.