Monitoring the characteristics of suspended sediment in river systems using multiple sensor devices

Thomas Hoffmann[1], Yannik Baulig[2], Sven Hudeg

[1]Department of Hydromorphology, Sediment Dynamics and Management, Federal Institute of Hydrology, Am Mainzer Tor 1, Koblenz, Germany

Phone: +49-(0)-261-1306 5592
E-mail: thomas.hoffmann@bafg.de

Introduction: Measuring and understanding sediment transport in rivers is a major challenge due to its large spatial and temporal variability. Surrogate technologies provide a great opportunity to yield new insights into fluvial sediment dynamics with a high temporal resolution [1]. These technologies operate on bulk optic properties (turbidity and transmission), laser diffraction and acoustic back scatter and measure various properties of the suspended sediment, such as bulk suspended sediment concentration, particle size distribution, and organic matter. Surrogate technologies show promise to replace cost-intensive traditional monitoring techniques that require routine sampling collection and analysis [2]. Yet, these technologies require sound calibration strategies to minimize the uncertainty related to the calibration of the surrogate properties and to achieve, for instance, SSC with a high level of confidence [3].

Methods: Here we represent results from a suspended monitoring station at the Rhine river in Koblenz. The Federal Institute of Hydrology equipped the station with an ISO 7027 turbidity sensor, an acoustic backscatter sensor, an UV-VIS spectrolyser and an insitu-laser analyzer. The selected devices allow to monitor the color, grain size, mass concentration, organic content and various other biogeochemical properties of the suspended matter with a high temporal resolution. To calibrate the sensors for the various properties, water samples are takes that are analyzed in term of the suspended matter concentration, grain size distribution and organic content.

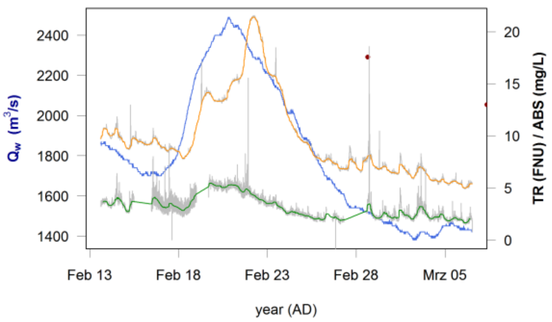

Fig. 1: Time series of discharge (blue), turbidity (orange), and acoustic back scatter (green) during a medium flood of the River Rhine at Koblenz in 2018.

The station setup allows to evaluate the sensitivity of the applied sensor to a multitude of suspended sediment characteristics.

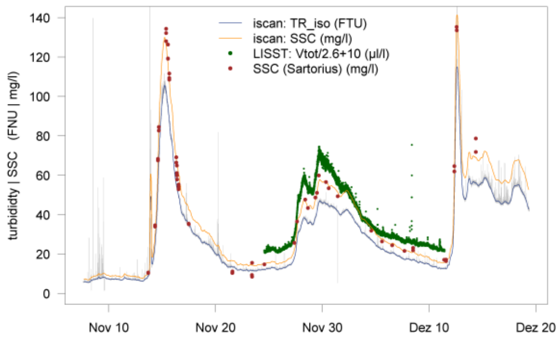

Fig. 2: Time series of turbidity (blue), sensor-based suspended sediment concentration (orange), volume concentration (green) and suspended sediment concentration from water samples (red dots) at the monitoring station at the River Rhine at Koblenz.

Results: First results from the multi-sensor monitoring at Koblenz are shown in Fig. 1 and 2. Fig. 1 shows a specific response of turbidity TR and acoustic backscatter ABS to increases in discharge: while TR increases strongly during the medium flood, ABS stays more or less constant during the peak Q. At lower Q TR and ABS show similar patterns. Fig. 2 shows a good accordance of calibrated TR values, SSCs and volumen Concentration based on insitu laser analyzer.

Discussion: The results indicate the great potential of multi sensor applications. Various sensor responses to changing conditions of suspended sediment are likely a result of changing characteristics of suspended sediments. E.g., increasing TR in Fig. 1 indicates a strong increase of the suspended fines, while the coarser fraction of suspended sediment (e.g. fine sand) remains unchanged as expressed by the constant ABS values.

At the SedNet meeting we will detail sensor specific sensitivities due to changing characteristics of SSC and discuss the results in the light of improved monitoring techniques.

References: [1] Czuba et al. (2015) *WaterResReas* **51**:320-340; [2] Downing (2006) *ContShelfReas* 26: 2299-2318; [3] Minella et al. (2008) *Hydr Proc* **22**:1819-1830.