OBS CALIBRATION AND FIELD MEASUREMENTS

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ABSTRACT

INTRODUCTION

Several major engineering projects and their components are related to water. These include cooling water intakes and hot water outfalls for thermal and nuclear power station, dams and irrigation canals, flood control and river bank stabilization works, navigation channels for harbors, and so on. The engineering design challenges may include design of sediment-free water intakes, avoiding local scour, estimation of siltation in navigation channels etc. The design problems and determination of counter measures are tackled through numerical or physical modeling, analytical methods or desktop studies. Field measurement of suspended sediment concentration is an essential requirement in all such problems. The data are used for validation of models or for drawing conclusions based on data analysis. Suspended sediment also has adverse environmental impact. A high concentration of fine sediment in suspension may clog fins of fishes resulting in their death. Deposition of fine sediment on leaves of aquatic plants reduces photosynthesis and hinders generation of new biomass. Suspended fine sediments cause substantial reduction in the amount of natural sunlight reaching sediment beds, which adversely affects growth of submerged aquatic vegetation and if it occurs over a large area, it may adversely affect the local ecosystem. Here again, data on suspended sediment concentration in the field is essential for evaluating the level of environmental impact and taking mitigation measures.

The traditional method consists of collection of field water samples in bottles, filtering them to separate out the suspended matter and determine its percentage with respect to the quantity of water sample used for analysis. Although this method is reliable and accurate, it has several disadvantages. The method is cumbersome, time-consuming, expensive, labor-intensive, and the results are not available quickly. Additionally, the water samples need to be preserved at low temperatures until they are analyzed in the laboratory. These disadvantages are overcome by using an Optical Backscatter Sensor, which is used for determining total suspended matter or turbidity. In addition, there is minimum disturbance to flow due to its small size. The sensors are commercially available. Pratt (1990) has described these sensors, their operating principles and the measuring system. He has also provided sensor thresholds and sensing limits to ensure accurate data collection.

OBS CALIBRATION

One of the major limitation for the use of OBS for obtaining reliable data is the requirement of their frequent calibration using the sediment that is present in the area of measurement. It is essential for the field group to have a facility for calibrating OBS sensors. Pratt (1990) conducted a study to offer operational guidelines and calibration techniques for using OBS. He has described the laboratory set-up and procedure to be followed for a satisfactory calibration of OBS sensors. Since different materials absorb and scatter light differently, calibration curves need to be developed for each sediment type because the calibration is material-specific. It may be noted that in addition to suspended sediment, other suspended substances such as diatoms, algae, and organic detritus cause turbidity in water column. The OBS cannot distinguish these substances from sediment. If the concentration of organic matter is high, measured turbidity does not give concentration of suspended sediment. It is advisable to always collect some water samples and determine the amount of organic content by standard ignition method.

FIELD MEASUREMENTS

Measurement of suspended sediment concentration alone is seldom done in the field. These measurements are invariably coupled with measurement of other field parameters. These include the sample positions, tidal water level, local water depth, magnitude and direction of current, depth of submergence of sensor, date and time of measurement and so on. It is quite common to obtain a time series of data on suspension concentration over a long duration extending to several weeks along with simultaneous time series data on other related parameters. Several instruments are attached to a mooring string, which is anchored to the bed with a floating buoy at the surface to mark its position. Sometimes a series of instruments may be attached alongside of a fixed platform. Fagerburg and Pratt (1998) collected extensive field data for the Upper Mississippi River Project. The objective was to measure increase in concentration of sediment suspension over the background resulting from passage of a vessel. An example of data is given in Figure 1. Such data are extremely useful in offering solutions to engineering problems. Field observations using OBS were also conducted for monitoring sediment plume of deposited dredged material in Delaware River. The data were analyzed and plotted on the relative acoustic intensity measured over a river cross-section as shown in Figure 2.

REFERENCES

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Pratt T. C., 1990, Near-bed optical backscatter sensor and vector-measuring velocity meter calibration, Technical Report HL-90-10, Department of the Army, Waterways Experiment Station, Vicksburg, MS, 39180.

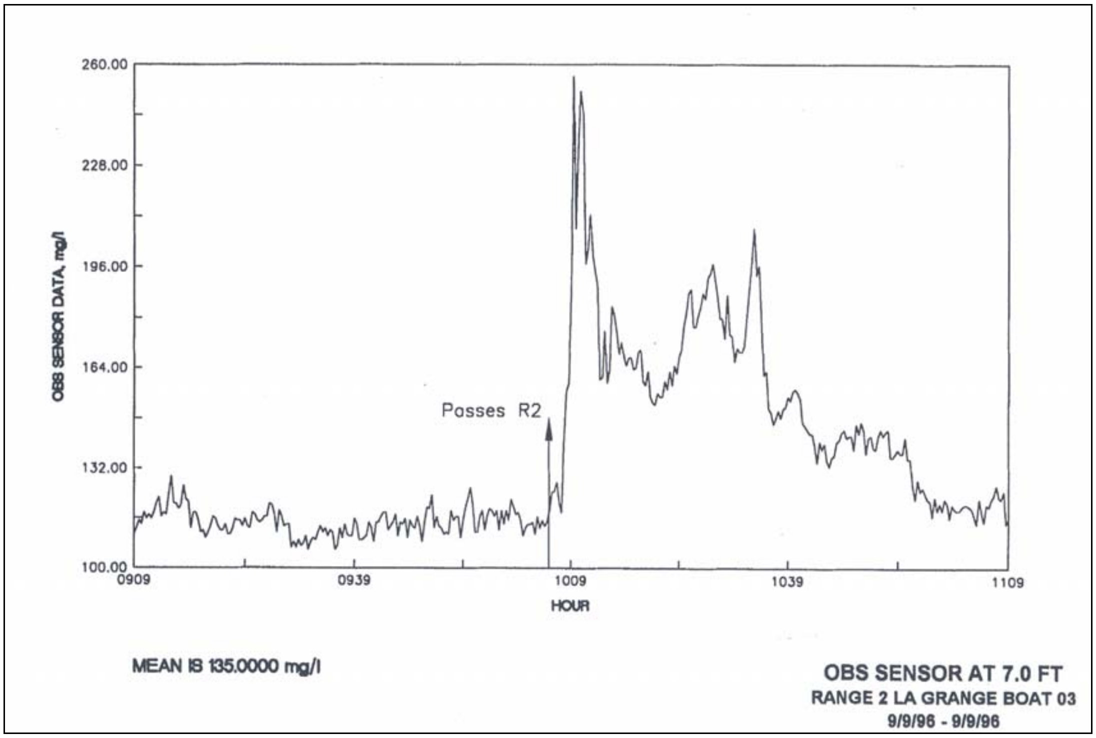

Figure 1: OBS measurement of sediment resuspension caused by passage of vessel in Upper Mississippi River

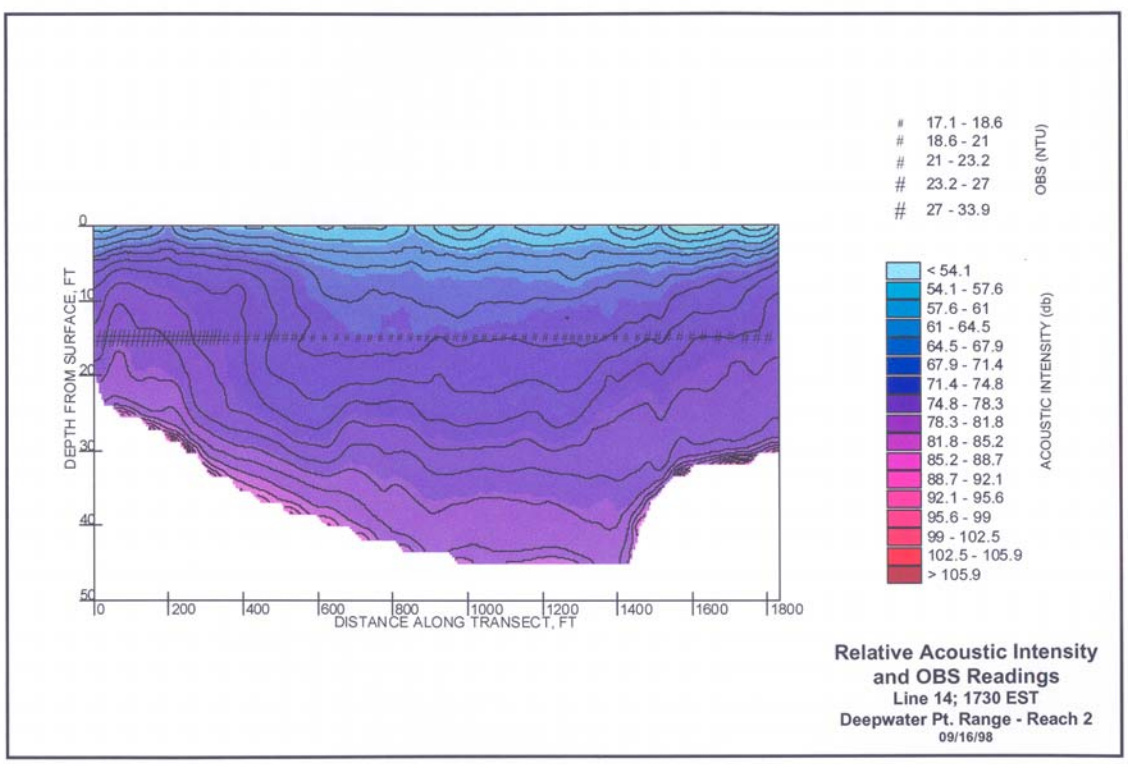

Figure 2: Relative acoustic intensity and OBS readings in Delaware River