



Experimental research of the Multi-frequency Acoustic Backscatter System using the field sediment

wenxiang Zhang

Wenxiang Zhang*, Qin Zhu, Rushen Wang, Yie Shi

State Key Laboratory of Estuarine and Coastal Research, East China Normal University, 3663, Zhongshan Road North, Shanghai, 200062, China.

*Corresponding author: wxzhang@sklec.ecnu.edu.cn

The measurements of suspended sediment concentration and particle size profiles are very important to the engineering and environmental applications, especially in the estuarine and coastal areas. In recent years acoustic method has obtained increasing acceptance by many researchers. The theory of this method for measuring them is based on the acoustic backscattering and attenuation properties of the sediment in suspension. The Multi-frequency Acoustic Backscatter System (MABS), which has four acoustic sensors with different frequencies, can be measuring the profiles in the shallow water environment (no more than 10 meters).

The experiments were conducted for AQUAscat1000 (MABS) (Made in UK) by the “test tower” ($\phi 600\text{mm}$ by 1500mm) in Laboratory. The frequency of the acoustic transducer is 0.5MHz, 1MHz, 2MHz and 4MHz, respectively. Two different places sediment were obtained from the Yangtze estuary. The average particle size is about $15\mu\text{m}$ and $115\mu\text{m}$, respectively. Suspended sediment concentration in the “test tower” was relatively constant during each phase of the sampling. The experimental procedures were as follows: (1) obtaining the background value of the instrument system; (2) add the field sediment to the tower according to the weight and allowing the mixture to homogenize; (3) obtaining water samples in different depths from the “test tower”; (4) analyzing the water samples.

These preliminary results show that (1) the MABS sensors are estimated from a complex function, depending on the receiving information (Voltage), measured at range, the speed of sound in water and the attenuation of sound by water, the sediment density and radius, and backscattering property of the sediment; (2) the appropriate calibration and regression approaches should be selected so as to obtain the reliable results of suspended sediment concentration($**R^2 > 0.7$) and particle size($**R^2 > 0.5$) measurements; (3) the MABS could be applied in the relative fine sediment condition, and indicates that the potential of acoustic technology could be used for monitoring the suspended sediment concentration and particle size profiles in the estuarine and coastal environments. Further works are required to model different environments sediment, such as flocculation, aggregation, various distributions of the particle size, and mud. The uncertainty of the various particle size and air bubble in the water column need also to further research.

($**R^2$: the correlation coefficient between the results of MABS and water samples)