ACOUSTICS2008/51
Measurements of the scattering characteristics of sediment suspensions having broad particle size distributions

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Profiles of suspended sediment concentration and mean size can be measured in underwater environments using Acoustic Backscatter Systems (ABS). Inversion of ABS measurements into sediment size and concentration requires knowledge of the backscattering form function, f, and the total normalised scattering cross section, χ. Previous studies have measured these parameters for sediments sieved over narrow size ranges only. Narrow size ranges are unrealistic compared to the broad Particle Size Distributions (PSD) that typically occur in nature however, and it is known that f and χ are significantly altered by changes from narrow to broad PSDs. Theoretically, these changes can be accounted for in ABS inversions by taking values of f and χ obtained from narrow size ranges, and integrating them over the suspended PSD, though this theory has not been validated for real suspended sediments. Here, we compare the results of this integration with measured values of f and χ for suspensions of (irregularly shaped) sandy sediments having broad PSDs. The results show that as the standard deviation of the size distribution increases, acoustic scattering is increased in the Rayleigh regime whilst being reduced in the geometric regime. These changes significantly affect acoustic estimates of suspended sediment concentration and size.