COMPARISON OF DIRECT AND INDIRECT MEASUREMENTS OF COHESIVE SEDIMENT CONCENTRATION AND SIZE

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During July 2002, suspended-sediment concentration and size were measured using two indirect methods (LISST-100 and OBS-3 instruments) and one direct method (ISCO pump sampler) at Threemile Slough, California. Comparison of the pumped water samples and the LISST-100 size distributions indicated significant flocculation. For the pump samples, which were disaggregated, the percent of sediment by mass finer than 62.5 microns ranged from 95 to 99. The in-situ size distributions from the LISST-100, on the other hand, had fines fractions ranging from only 34 to 58 percent. The signals from both the LISST-100 and OBS-3 correlated with mass concentration from the pump samples. For the OBS-3, a linear relation was fitted to mass concentration versus backscatter using least squares regression (R^2=0.37, p=0.001). For the LISST-100, a density of 1190 kg/m^3 provided the best fit between volume concentration and mass concentration (R^2=0.32, p=0.002), again indicating the presence of flocculation. The time series of mass concentration from the three instruments, as well as the median size, D_{50}, from the LISST-100, for the 24-hour period are shown in Figure 1.

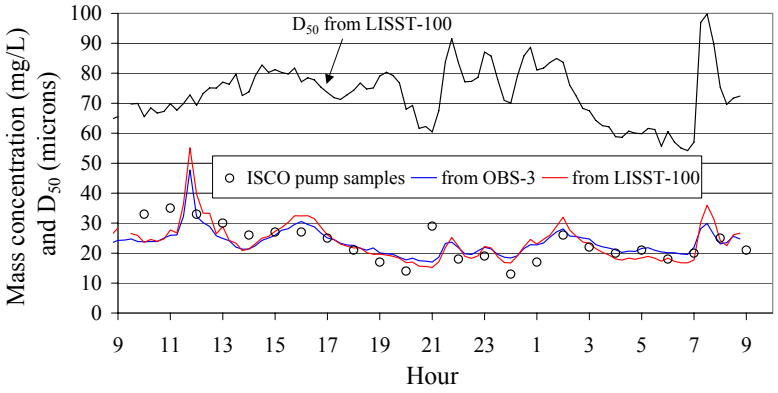

Figure 1. Time series of sediment concentration and median diameter, D_{50}, during July 25-26, 2002.

Sediment size affects the relation between concentration and backscatter. This effect is apparent in Figure 1: when D_{50} is large, the LISST-100 concentration tends to be greater than the OBS-3 concentration, and the opposite is true for small D_{50}. This is also shown in Figure 2, where the ratio of LISST-100-derived mass concentration (which should not be affected by size) to OBS-3-derived mass concentration is plotted versus D_{50}. The ratio is seen to vary by a factor of about 1.5 over a range in D_{50} from 50 to 100 microns, and is consistent with previous studies in that backscatter (and thus, C_{OBS-3}) decreases with increasing size for a given concentration. Without the use of the LISST-100, the limited number of pumped water samples and disaggregation would have precluded detection of the size effect. This reinforces the need to test backscatter calibrations for systematic size effects, particularly when flocculation may be present.

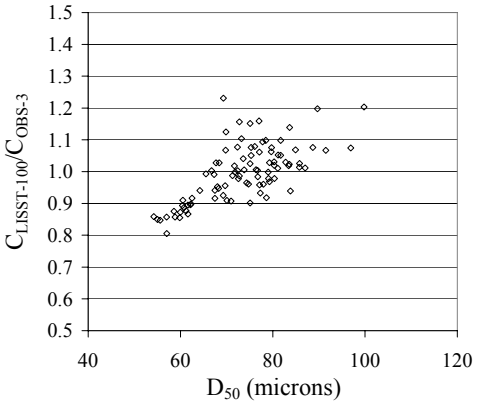

Figure 2. Effect of size on backscatter calibration.