

Subject: Review of UCSC TSS/SSC special mini-study
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In summer of 2005, UCSC performed a mini-study to compare TSS to SSC measurements, given that a change was made in measurement in 2002 without any split sample comparison. Three replicate measurements of TSS and SSC samples were made for four sites. In results below (*Table 1*) UCSC notes the high variability of the TSS measurements relative to those for the SSC. That is borne out by the data, as RSDs among TSS replicate measurements range 1% to 39%, while those for SSC only range between 2 and 4% .

Although UCSC noted that the high variability led to insignificant differences between TSS and SSC in the fourth site (SPB013), if their low point is an outlier as they hypothesize (in the UCSC study note), the result is not any better, and perhaps worse with respect to the whole data set. Even though SSC and TSS would then be significantly different for all sites, the bias would be inconsistent; three of four sites would show lower TSS than SSC, while the fourth would show significantly higher TSS than SSC, which is also contrary to the usual conceptual model of the bias and variability in TSS (coarse particles being undersampled in subsampling and thus $TSS < SSC$).

Because the data set is small and there are some methodological questions (e.g. were the TSS replicate samples collected alternately with SSC samples at a site? If collected sequentially, variability in water quality over time at a station could compound variability from the analytical methodology), it would be hard to state conclusively on the basis of this data alone whether TSS as collected for RMP previously is typically consistently biased low relative to SSC.

Although plotting all the data in this mini study, the bias appears to be in the expected general direction ($SSC > TSS$), there is a very low correlation coefficient, in part because of the SPB013 data going counter to the general trend (*Figure 1*).

USGS publications on these matters generally recommend using site specific studies of the TSS/SSC relationship to determine the bias of measuring TSS instead of SSC (Gray et al 2000, Glysson & Gray 2002- SFEI internal note: copies of those reports are in the lab SOPs folder R:\RMP\RMP References\Lab SOPs\UCSCDET\TSS_SSC). That would require multi-year effort to measure by both methods over a wide range of conditions at or near many of the RMP historical bay sites.

Because the RMP switched to a random sampling scheme around the time SSC was started as the water particulate measurement (summer 2002), resolving the relationship of TSS to SSC at the historical sampling stations drops in priority, as only the deeper new stations would be comparable in suspended sediment characteristics to those of the old stations. The change in methodology will be apparent from the parameter name, and those attempting to use TSS and SSC data combined in a dataset will need sensitivity analysis to explore the uncertainty and likely bias in the TSS data relative to SSC.

If there is to be a long term effort to reconstruct the TSS to SSC relationship, it should be done for channel stations in the new RMP sampling scheme over a wide range of flow conditions. The utility of such an exercise depends in large part on whether there are needs to incorporate historical RMP sampling data (fixed stations with TSS) with those under the new sampling scheme (random stations with SSC). One such need could be to generate historical trends at the few remaining legacy RMP sites (Dumbarton, Yerba Buena, Sacramento).

Rather than taking a separate grab to analyze TSS, a subsample of the SSC sample used for TSS would eliminate the possibility of field variability during collection influencing results; all differences would result from lab subsampling methodology in a combined TSS/SSC method.

COMBINED TSS/SSC METHODOLOGY:

1. Take as many grabs as is typical, at deeper stations in the RMP (including any legacy sites- Sacramento, YBI, Dumbarton) for SSC.
2. For each of those samples, run as many TSS analyses as was typical (one or two) by subsampling the SSC sample. (e.g. 1 or 2 subsamples of 100 ml)
3. Measure the remainder of the sample by the SSC methodology (e.g. ~300+ ml for a 500ml SSC bottle)
4. Sum the sediment masses and volumes from steps 2 and 3 to generate a whole sample SSC measure.

There would be more subsamples with smaller volume and sediment mass, with a compounded decrease in precision from multiple measurements being put into a sum. However, if the measurement uncertainty is small relative to the typical SSC (e.g. ~5 mg/L) then the impact will be minor. The TSS subsamples in the past analyses would have needed to be large enough given instrument sensitivity to get quantitative results, so although the additive uncertainty will be larger (e.g. if measurement precision is .01mg, cumulative uncertainty on a sum of 3 measurements is ~.02mg), the effect is likely small relative to total mass (a 0.5L sample of 5mg/L would have masses of around 0.5mg, 0.5mg, and 1.5mg, for 2x100mL TSS subsamples plus 300+mL remainder by SSC).

Again, IF it is to be undertaken, this effort would need to be spread over a range of flow years and incorporate both winter and summer sampling to capture the range of river transport, wind, wave, and tidal mixing of suspended sediments. Given that other program elements (e.g. station distribution) have simultaneously changed to hinder any direct comparisons between pre and post 2002 data sets, this does not appear to be a high priority need for the RMP.

References:

G. Douglas Glysson, John, R. Gray (2002). TOTAL SUSPENDED SOLIDS DATA FOR USE IN SEDIMENT STUDIES. Turbidity and Other Sediment Surrogates Workshop, April 30 – May 2, 2002, Reno, NV

