

Studies of the relationship between suspended sediment concentration and light attenuation

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A relationship between suspended sediment concentration (SSC) and light attenuation is not a direct relationship. The relation depends on numerous parameters including sediment grain size distribution, sediment colour and organic content (e.g. Davies-Colley and Smith, 2001). Yet, for many studies and projects, light attenuation is the desired measure when assessing effects of e.g. sediment spill. In this study a measurement campaign was set up with continuous measurements of, among other things, suspended sediment concentration, light attenuation and suspended sediment grain size distribution. Relationships between the individual parameters were obtained.

Introduction

Suspended sediment has impact on the biological communities in near-coastal waters. This is especially true when the concentration range is changed by artificial impacts e.g. dredging. A large part of the impact is related to the light attenuation. Light in the water column and at the sea bed is of major importance for plants ability to undertake photo synthesis, for fish migration and for food seeking by birds. As forecasts for human activities tend to focus on the change in turbidity rather than light attenuation a reliable estimate for a relation between these parameters is desirable.

Monitoring data

In connection with a project in a non-tidal coastal lagoon in Denmark a large data set was collected. The data set consist of numerous parameters including: suspended sediment concentrations, sediment grain size/floc size distributions, light attenuation coefficients and organic content. The data are collected with optical instruments and all was documented by water samples collected in a range of weather conditions. This data set allows for studies of a range of relationships between sediment and light.

Discussion

In order to convert the turbidity data collected in NTU to SSC in mg/l an analysis of the data must be carried out. This is done by comparison of NTU data and concentrations obtained through water samples collected in calm and rough weather. In Fig. 1 an example of such a conversion is provided. The graph clearly shows different classes or populations of sediment with clearly separated conversion formulas. This is dependent on the energy levels. One of the conversions is valid in rough weather (coarse sediment) and one is valid in calm weather (fine sediment). The aim is to introduce a measure of the sediment grain size in the conversion formula and thereby obtaining a more valid measurement of SSC.

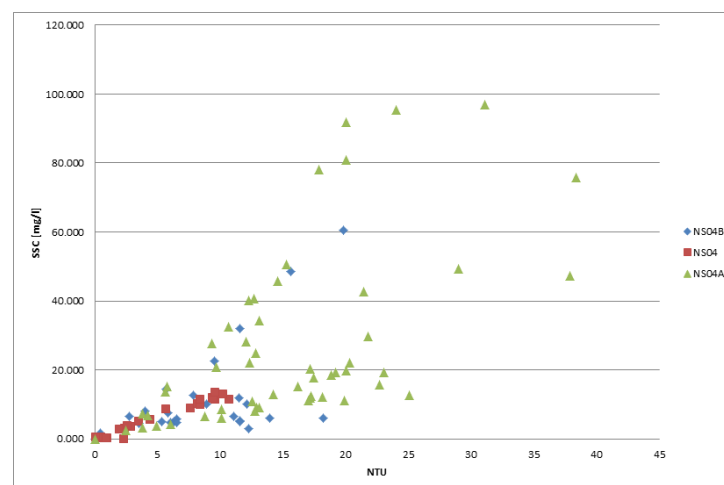


Fig. 1. Obtained conversions between NTU and SSC divided by station.
Note the different populations found during different energy levels.

The data set similarly allows for a study of how light attenuation varies with different physical parameters. An example is shown in Fig. 2 where a correlation between NTU and K_d for three sites is provided. It is clear that for one site there is a clear relationship between the two parameters whereas for the two other sites the light attenuation varies extensively while the turbidity is fairly constant. This is because of a variation in grain size distribution. The coarser sediment (non-cohesive) does not dampen the light as much as the finer fractions.

A total of 180 datasets of in situ water samples (SSC), NTU, light intensity and grain size distributions under various weather conditions were collected. The same parameters have likewise been studied in the laboratory. The laboratory tests have used artificial light and sediment collected in the study area. This extensive data set makes it possible to analyse and predict effects of suspended sediment – natural or artificial – with higher accuracy.

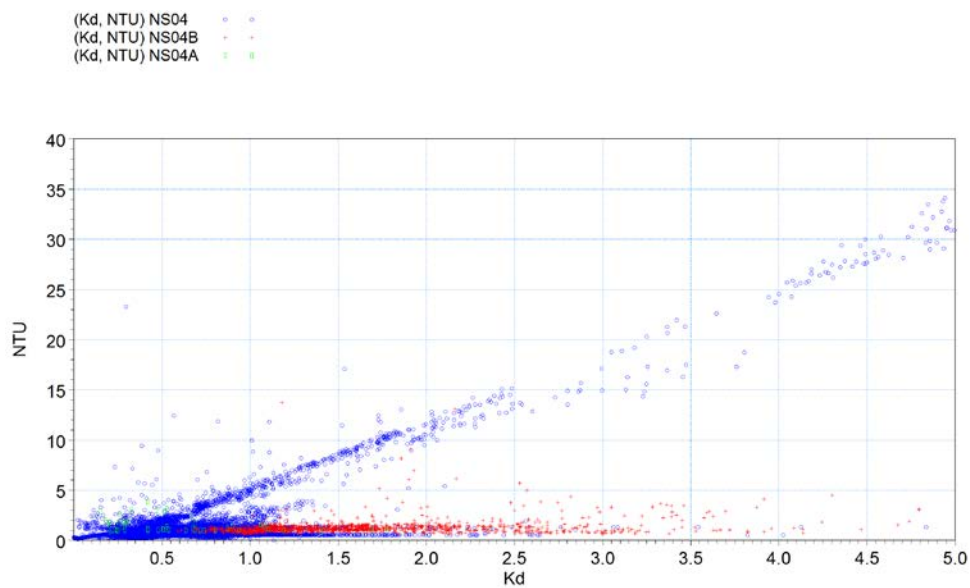


Fig. 2. Relationship between NTU and light attenuation at three different sites.

References

Davies-Colley R. and D. Smith 2001. Turbidity, suspended sediment, and water clarity: a review. *Journal of the American Water Resources Association* 37(5):1085–1101.