

## Background

Colored or Chromophoric Dissolved Organic Matter (CDOM) is present in fresh or marine waters primarily due to the release of tannins (polyphenols that bind to proteins and other large molecules) or lignins (polymers of phenolic acids) by decaying plant material. CDOM may also be characterized as byproducts from the decomposition of animals. Watercolor may range from pale yellow to brown as a result of varying concentrations and sources of CDOM. One of the most important properties of CDOM used in many research studies is fluorescence. CDOM absorbs ultraviolet light and emits visible blue light. The fluorescence of CDOM is used in many applications such as continuous monitoring of wastewater discharge, natural tracer of specific water bodies, ocean color research and the effect of CDOM on satellite imagery, and investigations of CDOM concentrations impacting light availability used for primary production.

## Cyclops-7 CDOM Submersible Fluorometer

There are many methods for the detection of CDOM in water but the simplest and most cost efficient way is *in situ* fluorescence. Turner Designs has developed an *in situ* Cyclops-7 CDOM fluorometer that uses ultraviolet (UV) excitation for CDOM detection. Realizing there are different CDOM sources that may emit a range of wavelengths, we have chosen a broad band emission filter that will detect various types of CDOM found in the natural environment.

The Cyclops-7 fluorometer can be integrated into a Turner Designs [C6 Multi-Sensor Platform](#) or any other third party data logger that can provide power and accept 0-5 volt analog output.

## Quinine Sulfate used as a Primary Standard

Quinine is a highly fluorescent alkaloid that is extracted from the cinchona tree. Because it absorbs UV light and has high quantum fluorescence yield it has often been used as a standard in fluorometric analyses. Maximum fluorescence yield can be achieved if diluted in weak acids. It has a maximum absorption wavelength of 350nm and a maximum emission wavelength of 450nm, similar to many CDOM compounds. This is why it is primarily used as a proxy for CDOM when calibrating or determining fluorometric specifications.

## Quinine Sulfate Performance Testing

### Linearity and Dynamic Range

Quinine Sulfate was diluted in a weak acid (0.05 Molar H<sub>2</sub>SO<sub>4</sub>) to various concentrations. These concentrations were analyzed using the Cyclops-7 CDOM fluorometer and plotted as concentration per response (Figure 1) to determine the instrument's linearity to 1000 parts per billion (ppb) Quinine Sulfate.

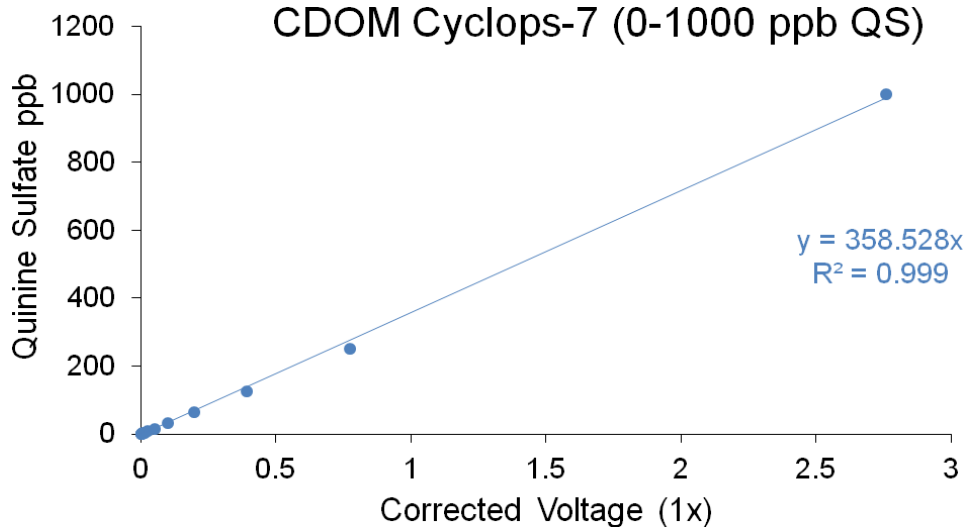


Figure 1: Coefficient of Determination for quinine sulfate dilutions from 0-1000 ppb ( $r^2 > 0.999$ ). All gains (100x, 10x, 1x).

### CDOM Cyclops-7 Sensitivity

The Cyclops-7 CDOM fluorometer is capable of detecting low concentrations of CDOM (**Minimum Detection Limit = 0.15 ppb quinine sulfate solution**). Quinine was diluted to low concentrations ranging from 0-8 ppb in weak acid (0.05 Molar  $H_2SO_4$ ) and analyzed using the Cyclops-7 CDOM fluorometer.

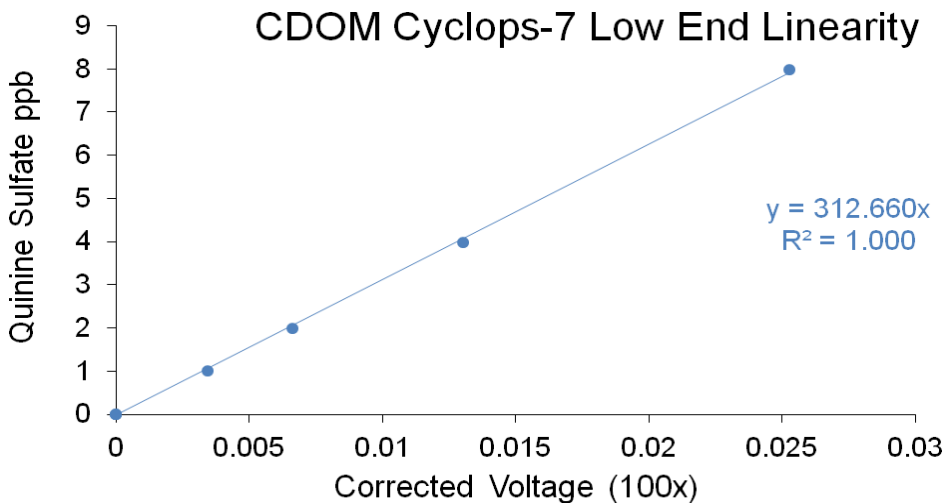
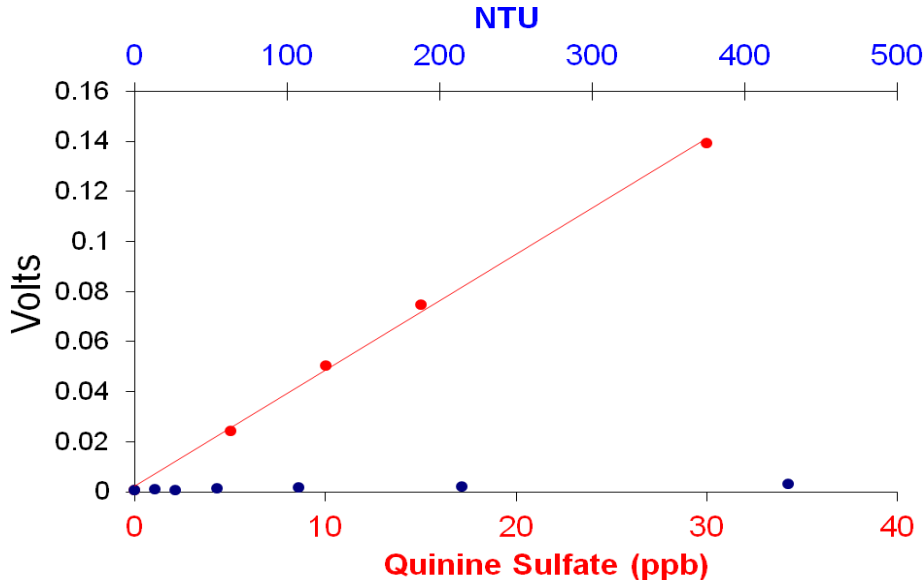


Figure 2: Coefficient of Determination for quinine sulfate dilutions from 0-8 ppb ( $r^2 > 0.999$ ). Most sensitive gain (100x) only.

### Turbidity rejection

Amco Clear Turbidity Standards were used to determine how well the Cyclops-7 CDOM fluorometer rejected light scatter. Solutions from 0-400 NTU were analyzed using the Cyclops-7 CDOM fluorometer (blue data points; figure 3). Results show that a 400 NTU solution, which represents highly turbid conditions, produced a response that was much less than 1 ppb quinine sulfate. These results indicate that this instruments detection of CDOM, even at low concentrations, isn't greatly impacted by highly turbid waters.



**Figure 3:** Cyclops-7 CDOM fluorometer response for varying turbidity solutions ranging from 0-400 NTU (Blue) compared to quinine sulfate low concentration solutions (Red). Results show good turbidity rejection.

### References

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