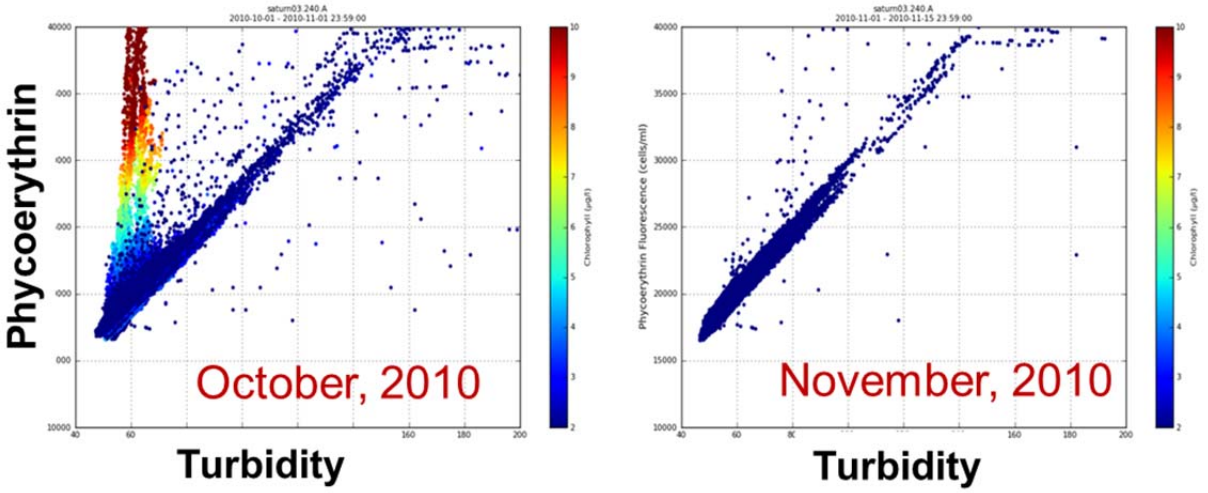
SATURN-03 Phycoerythrin

Turbidity Correction Details for: August 17, 2012 – February 2013

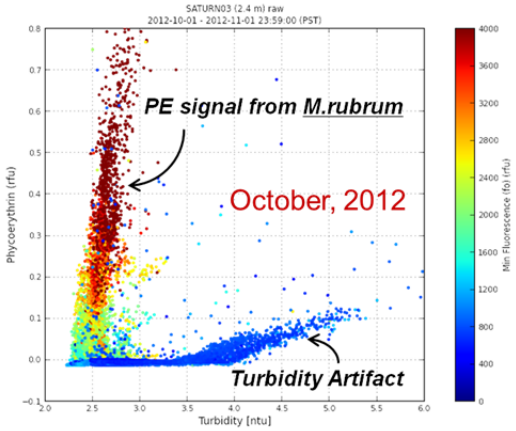
BACKGROUND

The Turner Designs Cyclops Phycoerythrin (PE) sensor previously deployed at SATURN-03 has a significant turbidity artifact. This artifact is so extreme that it often exceeds the signal due to PE containing cells. Without correction, the data from this sensor are difficult to interpret. In the two figures below, the PE data are plotted against the turbidity data and are colored by chlorophyll (all scales the same in both figures).



In November there is low chlorophyll and the linear relationship between the PE and represents the turbidity artifact. In October the same relationship is present but a second population associated with chlorophyll & PE containing cells can be seen. This second population is due to the presence of *M. rubrum*. The turbidity corrections aim to reduce/remove the signal due solely to the light scattering in turbid waters.

The Phycoerythrin sensor at SATURN-03 was replaced in mid-August, 2012 with a CyanoWatch, another model of phcoerythrin fluorometer from Turner Designs. This new sensor was selected because it has a better design for our flow through system at SATURN-03. It also has a much reduced turbidity artifact and no artifact at low turbidity levels, as can be seen in the following plot:



CORRECTION DETAILS

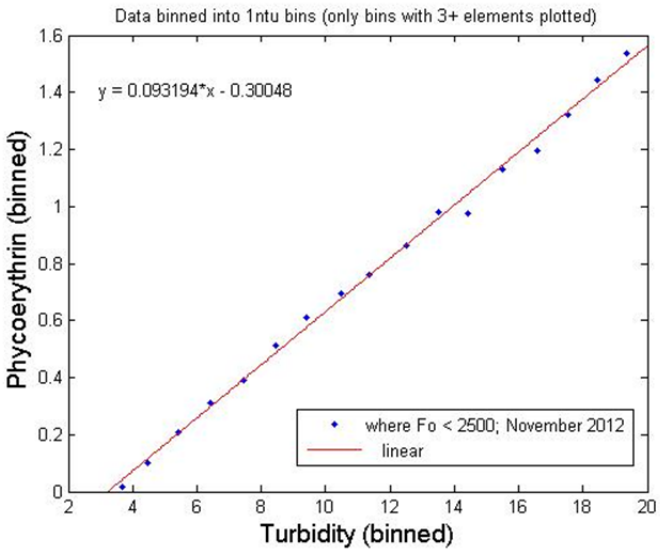
Examination of the data revealed that above approximately 3.4 RFU (on the turbidity sensor that was co-deployed with the CyanoWatch) there was no turbidity artifact. Above this level, there appears to be a linear relationship between phycoerythrin and turbidity, similar to the Cyclops sensor previously deployed, though less extreme.

The correction for this sensor was generated using data from November 2012. During this month, there were periods with higher turbidity levels to allow for a full evaluation, low chlorophyll levels and low PE sensor noise, which was an issue in later months (see QA/QC note s3-pe01).

Data Selection:

- Phycoerythrin: data during November 2012 that had been visually inspected. Outliers or other bad data were excluded from the analysis.
- Turbidity: the quality controlled turbidity data was used. Outliers or other periods of bad data were excluded and a period of turbidity sensor offset had been corrected for. Turbidity was then interpolated to the phycoerythrin time step and data where the interpolated turbidity was between 3.4 and 20 RFUs were included in the fit.
- Chlorophyll: Because different chlorophyll sensors were deployed, the minimum fluorescence (Fo) reading from the Phytoflash deployed at SATURN-03 was used as a proxy for chlorophyll. Data where Fo was > 2500 were not included.

Using the above selection criteria, the data were then binned into 1 RFU turbidity bins. Within these bins, the mean turbidity and PE values were calculated and then plotted (note: if a bin had less than three data points, the data from that bin were not included).



The linear fit of these points represents the artifact to be subtracted from the Raw PE signal:

- Corrected PE = raw PE - turbidity artifact
- Corrected PE = raw PE - (turbidity * 0.0932 – 0.3005)

The x-intercept for this fit was calculated as 3.224 RFU and this value was used as the threshold above which the turbidity correction is applied to the data. For PE data where the turbidity is less than 3.224 RFU, no correction is applied.

Another result of this correction is the zeroing of the data so that when there is no PE the signal is close to zero.

The following figure shows the CyanoWatch data before and after turbidity correction using the above fit. It can be seen that there is a small amount of 'over-correction' at times. Corrected data with negative values should be considered to have a value of 0.