Lecture 6

”Best Practices” for QA/QC of AC-S data collected from long-term un-attended deployments

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A few Issues that affect the AC-S data quality

1. Drift in the sensor
2. “Fouling” of the sensor
3. Changes in the flow-rate through the sensor
4. Bubbles or materials that get trapped in the flow cells

For long-term deployments, issues 1 & 2 are the most problematic typically. They can range from subtle to obvious, and are often difficult to correct for.

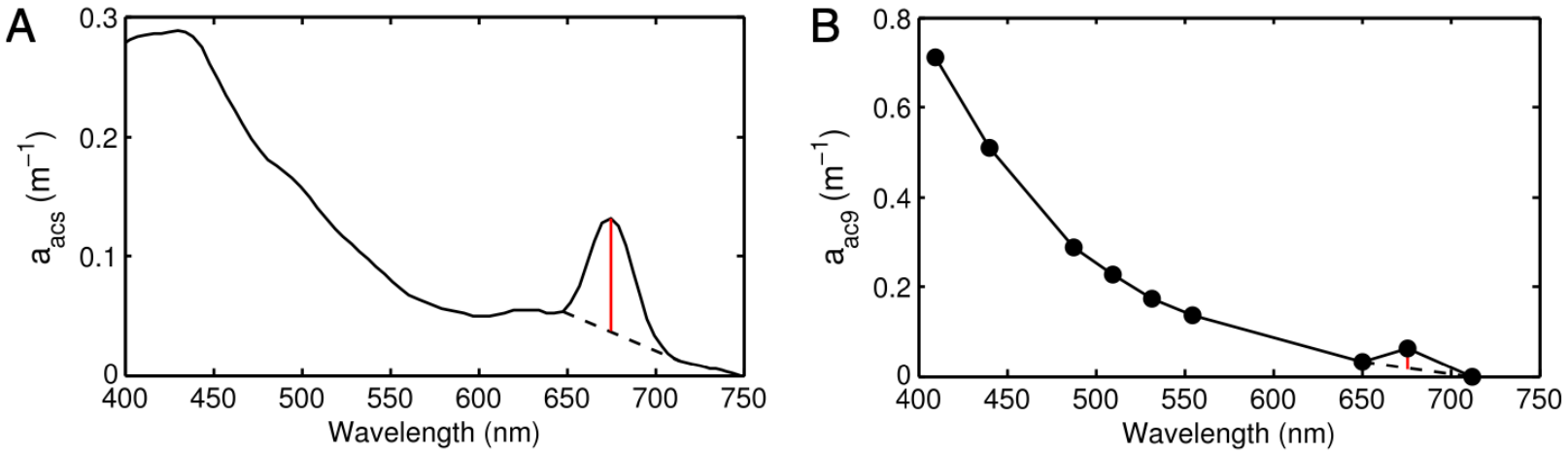
Some notes on assessing the AC-S data quality

- Basic first checks
  - Negative values: In the VIS region. Note that the instrument accuracy is ~0.005-0.01 m-1.
  - c > a. Recall c = a + b
  - In the NIR, spectra should be ”relatively” flat. T/S correction errors and scattering correction choice can affect this
  - Noisy data: Binning of data and computing standard deviations of the mean over bin size. High variations can often indicate issues with bubbles, fouling, things getting trapped in the flow cell

Some notes on assessing the AC-S data quality

- “Fouling” of the sensor
  - Increasing a and c values over time – Harder to detect at first, but can become more obvious over time (2-5 x increases across the spectrum). Is it real?
  - Comparisons with other optical measurements (e.g. chlorophyll fluorescence, backscattering)
  - Chlorophyll derived from the AC-S absorption line height can be useful.

Estimating the chlorophyll absorption line height using the absorption spectrum in the red wavelengths (Q-band peak)



$$a_{BL}(\lambda_{ref}) = \frac{a(715) - a(650)}{715 - 650} * (\lambda_{ref} - 650) + a(650)$$

Baseline

$$a_{LH}(676)(m^{-1}) = a(676) - a_{BL}(676)$$

Line height 676 nm

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Example from an AC-9 deployed on a surface mooring in the Gulf of Maine

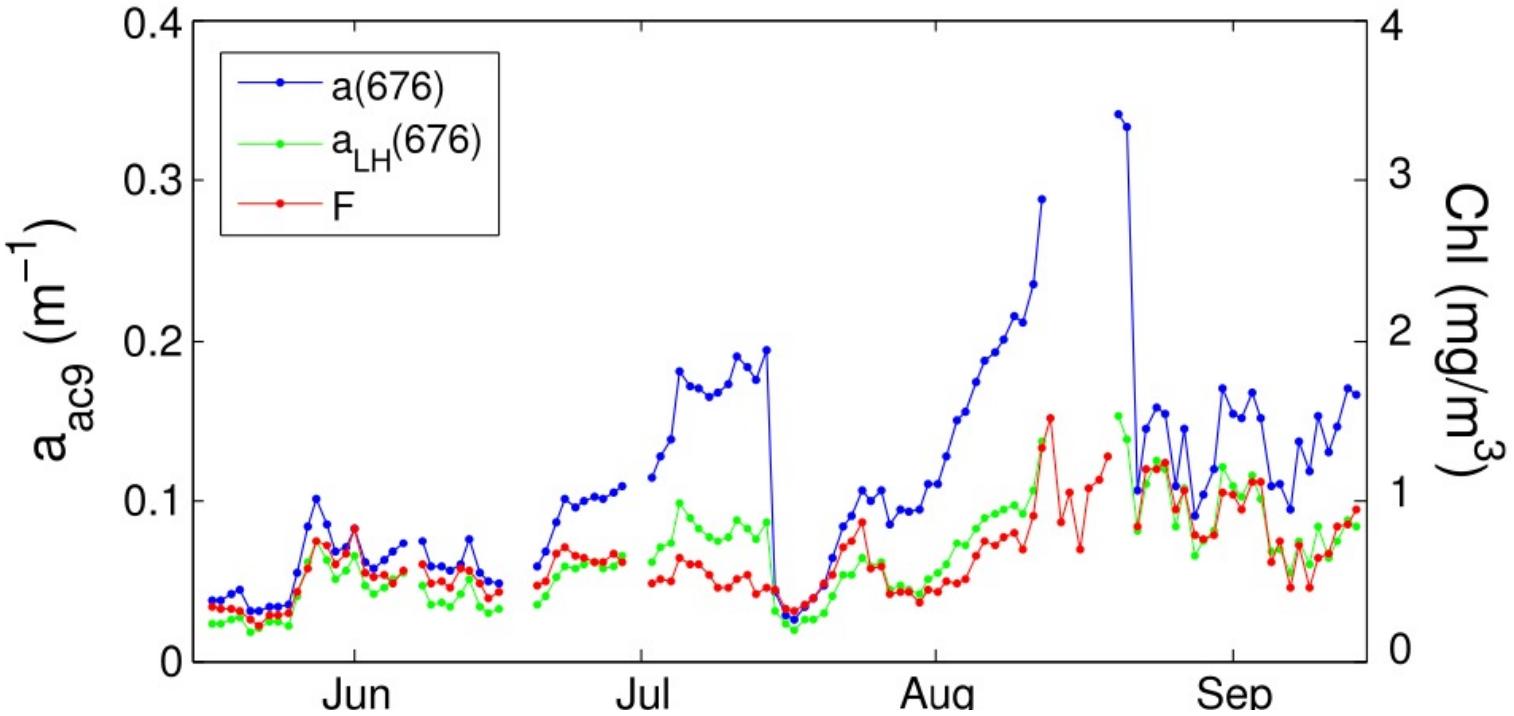

Fig. 7. Four-month time series measurements of WET Labs ac-9 and ECO chlorophyll fluorometers moored in the productive coastal waters of Harpswell Sound, Maine, in 2008 (GoMICOOS buoy DO2). The absorption coefficient at 676 nm is corrected for scattering by subtraction of 715 nm absorption (blue; Zaneveld et al. (1994)); absorption line height is computed from Eq. (1) (green, left axis) with the corresponding scale for chlorophyll concentration shown on the right axis. The two sharp decreases in absorption in mid-July and late August indicate times of diver servicing for bio-fouling removal. For comparison, the time series of midnight observations of calibrated chlorophyll fluorescence is also shown (red), right axis scale. Midnight fluorescence values are not sensitive to NPQ variations inherent in the chlorophyll fluorescence time series. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Note the large increases in blue line as compared to the green line

The absorption line height is less sensitive to biofouling

This is due to the baseline subtraction. Assumes less spectra shape change in absorption in the red bands

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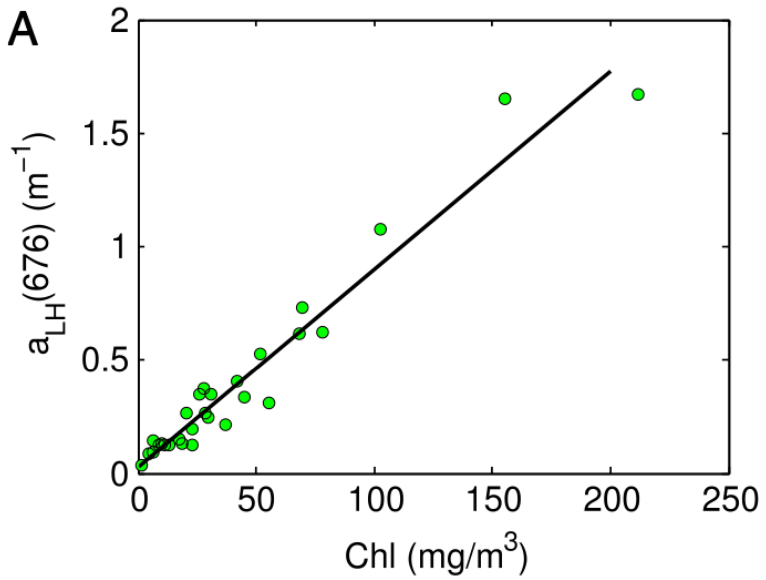
Converting absorption line height to chlorophyll concentration

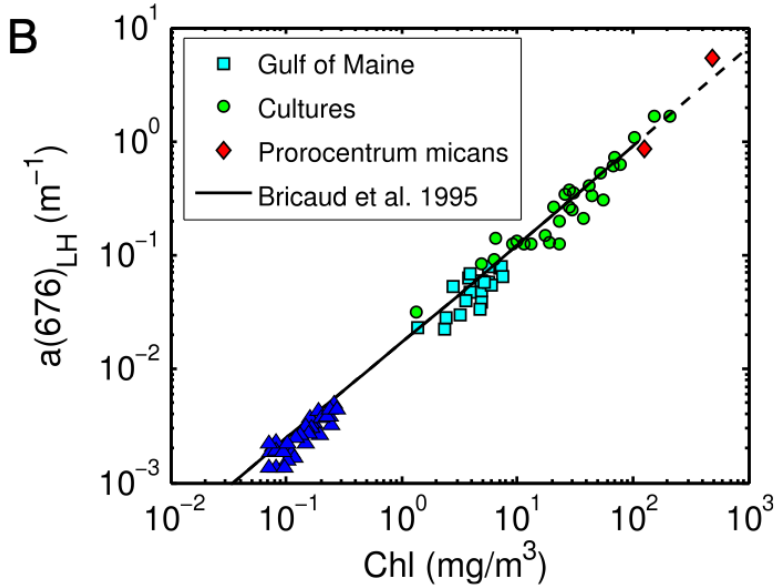
To do this you need to estimate the chlorophyl (Q-Band) absorption coefficient (a^*_ϕ): Absorption per unit chlorophyll: units of m^{-1} $(mg\ m^3)^{-1}$

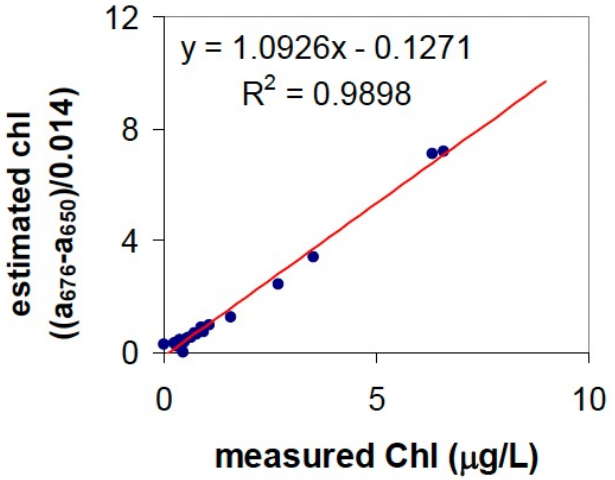
(a^*_ϕ) is varies with phytoplankton type, photophysical status, light history.
Can be determined from chlorophyll extractions of phytoplankton cultures

$CHL_{abs} = a_{LH}\ (676) / a^*_\phi$

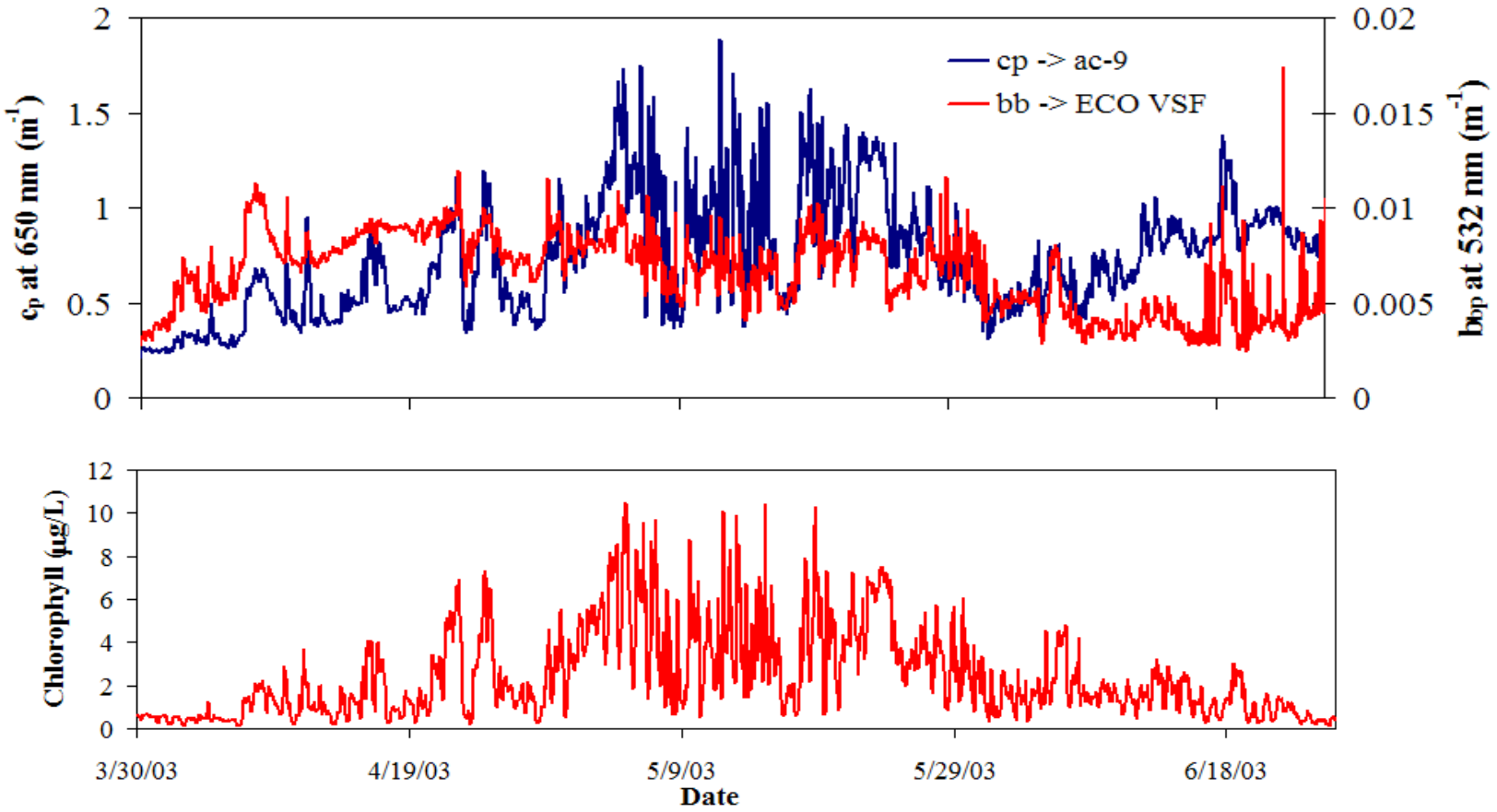
Good starting values 0.014 to 0.02







Beam attenuation and backscattering evaluations



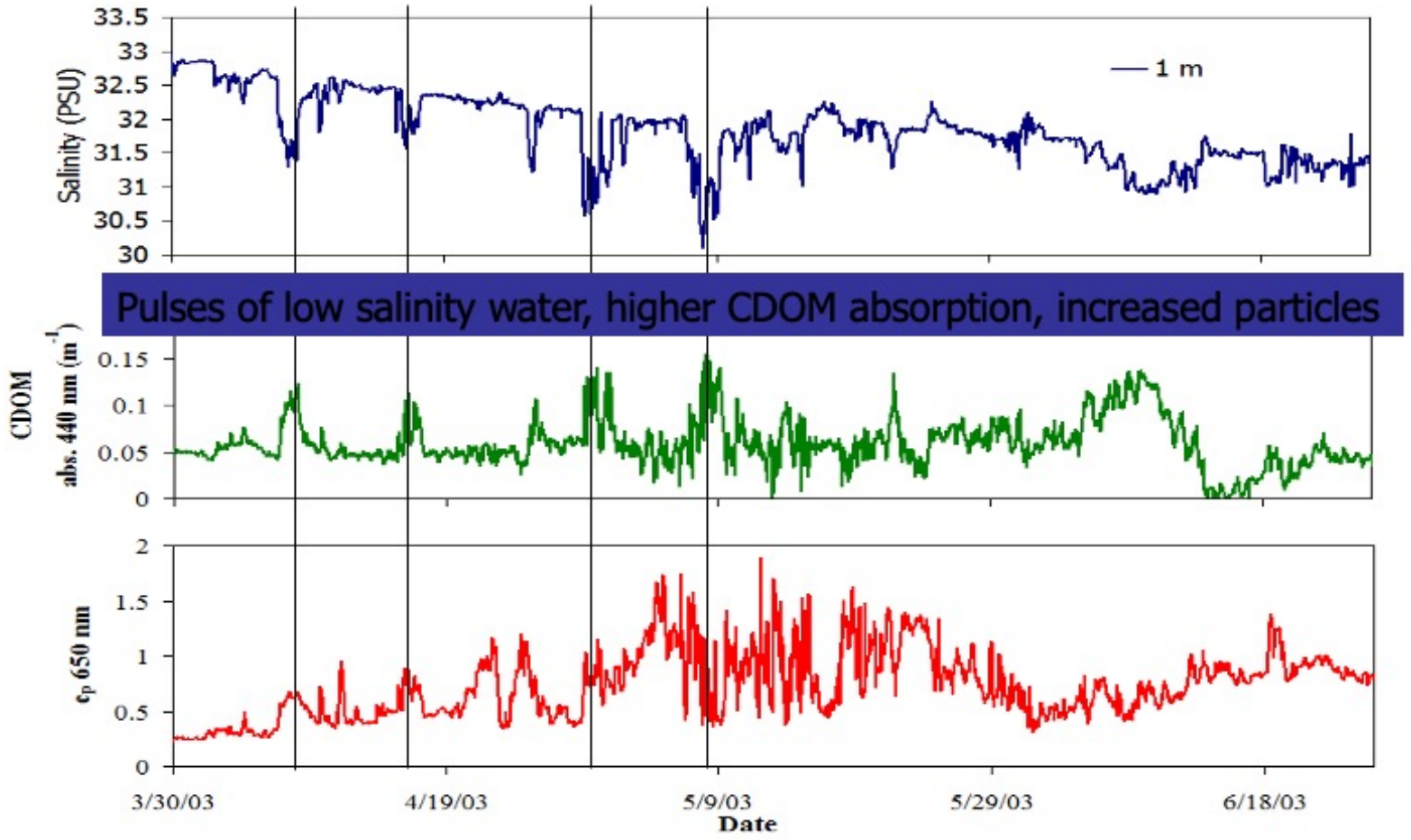
Do I see similar and reasonable changes in the bio-optical parameters that capture the natural variability?

OR

Are they due to biofouling of the instrument

Comparing with several bio-optical measurements (instruments) can help identify issues

Use several parameters to evaluate data quality



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Questions?