Estimating Phytoplankton Absorption Spectra with
the Bricaud and Stramski Model:
How Robust is the Model?

Andy Canion
July 16, 2004
Spectral Decomposition

\[ a_{tot} = a_w + a_{CDOM} + a_\Phi + a_{NAP} \]

These can all be determined with Spectrophotometry
Spectrophotometry

- Cary 50 Spectrophotometer
- Single Beam
- Measures in Optical Density (OD) not absorption coefficient \(a(m^{-1})\)

- Corrections:
  Null, Blank, OD conversion, \(\beta\)

\[
a(\lambda) = \frac{2.303 \times 100}{\text{pathlength} \times \beta} \left[ \text{ODfilter} - \text{ODblank} - \text{ODnull} \right]
\]
Spectral Decomposition

\[ a_{\text{tot}} = a_w + a_{\text{CDOM}} + a_{\Phi} + a_{\text{NAP}} \]

Only These Can Be determined with an AC9

How do we decompose particulate absorption?
Spectral Decomposition

\[ a_{tot} = a_w + a_{CDOM} + a_\Phi + a_{NAP} \]

Only These Can Be determined with an AC9

How do we decompose particulate absorption?

Modeling!
Model From Bricaud and Stramski (1990)

\[ \text{aNAP}(\lambda) = \text{ap}(\lambda) - \text{a} \Phi(\lambda) \]

\[ \text{aNAP}(\lambda) = \text{A}e(-S \lambda) \]

1) \[ 0.99\text{A}e(-380 \text{ S}) - \text{A}(-505 \text{ S}) = 0.99\text{ap}(380) - \text{ap}(505) \]

2) \[ \text{A}e(-580 \text{ S}) - 0.92\text{A}e(-692.5 \text{ S}) = \text{ap}(580) - 0.92\text{ap}(692.5) \]

-Two Equations with two unknowns

-You only need the particulate absorption spectrum
My Approach:

The variability in phytoplankton absorption spectra measured in the spectrophotometer using the Kishino methanol extraction method vs.

The variability for calculated phytoplankton absorption spectra using different slopes for the non-algal particle spectrum (S = 0.012, 0.011, 0.009, 0.007)
Measured $a\Phi$ spectra (normalized to total $a\Phi$) with Standard Deviation (red). Standard Deviation $\sim 3.16 \times 10^{-4}$
Calculated aΦ spectra using different values of aNAP slope with Standard Deviation (red).
Standard Deviation ~5.05x10^{-4}
Calculated aphi (cruise 4m sample, sd in red)

-What the previous graph actually looks like-
Percent Error for changes in aNAP slope

Percent Error for Changes in aNap slope

Highest curve is dock sample A
Calculated aphi from ac9 cruise data compared to spectrophotometer
Calculated aphi from ac9 cruise data compared to spectrophotometer
Conclusions

-Problems with AC9 Cruise Data are likely the cause of big differences in aΦ

-Model is robust for spectrophotometer data

-Assumptions of the Model:

  Minimal absorption by accessory pigments at 380nm, 505nm, 580nm, 692nm
  380:505 ratio and 580:692 ratio are both ~1 for aΦ
  Wavelength pairs are far enough apart to estimate slope of a_p accurately

How could these be broken?

-Even though this model was developed for the open ocean, it still works in a tidal estuary.
A Pretty Picture for Curt