Information content of Rrs spectra using forward and inverse modeling

Dall’Olmo Giorgio
University of Nebraska-Lincoln
Objective (1)

• Identify in Rrs spectra of productive turbid water regions maximally sensitive to variations in Chl, $a_{\text{CDOM}}$, mineral concentration ($[\text{min}]$) and solar zenith angle (SZA).
Method

• Hydrolight simulation in three “trophic regimes”

Chl=5-30-70 mg m$^{-3}$,

\[ a_{\text{CDOM}}(440)=1 \text{ m}^{-1} \]
\[ [\text{min}] = 1 \text{ g m}^{-3} \]
SZA=30°
Only elastic scattering

• Calculate \( [R(p)-R(p+\delta p)]/R \ast p/\delta p \)
NO Chl fluorescence was included in simulations.
Chl = 5 mg m$^{-3}$

- $\Delta R/R \times p/\Delta p$
- $a_{CDOM}$
- Chl
- min
- SZA

Wavelength, nm
Chl=30 mg m$^{-3}$

![Graph showing absorption coefficients and Chl concentration over wavelength.](image)
Chl=70 mg m^{-3}
Conclusions

• 400-500 nm region is maximally sensitive to $a_{\text{CDOM}}$
• 600-750 nm region is maximally sensitive to Chl

• As Chl increases, the sensitivity to $a_{\text{CDOM}}$ decreases in the blue-green region and the sensitivity to Chl increases in the NIR

• Variations in SZA and mineral concentration appear to be negligible
Inverse problem

OBJECTIVE (2):

• Apply the Roesler and Perry (1995) technique to fit R spectra collected in NE productive lakes

• Compare the retrieved Chl and aCM(440) with measured values using different spectral ranges
$a_\phi$ basis vectors
From 400 to 700 nm
R&P $a_\phi$ basis vectors

Chl

aCM(440)
From 400 to 700 nm
R&P $a_\phi$ basis vectors + PE and CPC

Original $a_\phi$ Basis Vectors

Original $a_\phi$ Basis Vectors + CPC + PE
From 400 to 650
R&P $a_\phi$ basis vectors + PE and CPC

Chl

aCM(440)
From 650 to 700 nm
R&P $a_\phi$ basis vectors + PE and CPC

Chl

aCM(440)
Conclusions

• Original basis vectors are insufficient for fitting spectra from productive freshwater environment
• However, by including additional absorption peaks \textit{(independent of Chl)} Chl prediction can be improved
• aCDOM+aNAP was poorly fitted due probably to a “transfer of variance” with bb
• The technique can be used to study the information content of R spectra
• A similar method was applied by Gege (1995) to derive from Rrs spectra phytoplankton composition