Hyperspectral Hallucinations

Michael Behrenfeld

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“Threshold Requirement:” 5 nm spectral resolution from 350 to 800 nm, in addition to spectral bands identified in section 3.2.7 for atmospheric corrections. Downlink of the complete 5 nm resolution (or finer) data from the spacecraft to ground and archival of all data.”

“Goal:” Spectral subsampling at ~1-2 nm resolution from 655 to 710 nm for refined characterization of the chlorophyll fluorescence spectrum.”
Examples of measured spectral remote-sensing reflectance ($R_n$) used in this study. Overlaid are spectral bands (location and width) of CZCS, SeaWiFS, MODIS, and MERIS.

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Determinination of Primary Spectral Bands for Remote Sensing of Aquatic Environments

ZhongPing Lee, Kendall Carder, Robert Arnone and MingXia He

*Sensors 2007, 7, 3428-3441*
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(left) Spectral distribution of the frequency where the second-order derivative of \( R_s(\lambda) \) equals 0.

(right) Spectral distribution of the frequency where the second-order derivative of \( R_s(\lambda) \) equals 0.

Determination of Primary Spectral Bands for Remote Sensing of Aquatic Environments
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“Making Paint Approach”
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- Chlorophyll-a
- Chlorophyll-b
- Chlorophyll-c
- Carotenoids
- Particulate backscatter
- CDOM

Net Spectrum
Reconstruction

Ocean Color
Wavelength
400 700
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Figure 4. Example Gaussian component functions and their sum (thick blue line); black line shows particulate absorption measured independently with an in situ spectrophotometer (AC-S instrument).

Figure 5. Magnitude of component Gaussian functions ($a_{\text{gaus}}(\lambda)$, y-axes) compared to pigment concentrations from HPLC analysis (x-axes).

Decomposition of in situ particulate absorption spectra

Alison Chase\textsuperscript{a,}\textsuperscript{*}, Emmanuel Boss\textsuperscript{a}, Ronald Zaneveld\textsuperscript{b}, Annick Bricaud\textsuperscript{c}, Herve Claustre\textsuperscript{c}, Josephine Ras\textsuperscript{c}, Giorgio Dall'Olmo\textsuperscript{d}, Toby K. Westberry\textsuperscript{c}

Methods in Oceanography 7 (2013) 110–124
How are temporal variations in ‘color’ distribution partitioned into ‘advective’ and ‘lagrangian’ drivers?

What is the sequence of ‘color’ changes and how does this succession vary spatially?

How is ‘color’ succession partitioned into ‘physical’ and ‘ecological’ drivers?

Is ‘color’ related to predator-prey disequilibria? (....explain...)

What do trends in ‘color’ distributions tell us that bulk signals do not?

... of course, we might also try to relate ‘color’ to specific phytoplankton groups and infer implications on carbon fluxes...
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Colored dissolved organic matter and its influence on the satellite-based characterization of the ocean biosphere

Siegel et al.,

GEOPHYSICAL RESEARCH LETTERS
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Loisel et al. [2007] JGR-Oceans
Kostadinov et al. [2009] JGR-Oceans
Kostadinov et al. [2010] Biogeosciences

Do this as questions -

Slope of particle size spectrum
Other on photoacclimation
Maa’s
New study showing photoacc is most of chl anoma
Photosynthesis per chlorophyll
\[
\left( \text{mol} \ O_2 \text{ or } C \times (\text{mg Chl-a} \times \text{h})^{-1} \right)
\]

Photosynthesis per absorbed light
\[
\left( \text{mol} \ O_2 \text{ or } C \times \text{mol photons}^{-1} \right)
\]

Nutrient limited specific growth rate (d⁻¹)

A common partitioning strategy for photosynthetic products in evolutionarily distinct phytoplankton species
Halsey et al.,
*New Phytologist* (2013)
doi: 10.1111/nph.12209
What else might we do...?
Satellite data live longer than satellites

Historically, we have designed sensors according to the state of the science during mission concept development. It would be preferable in the future to design for the future.
Massive cyanobacterial bloom in the **Baltic Sea** (July 2002) as seen by the Advanced Land Imager. Cyanobacteria have high concentrations of phycocyanin which gives an absorption peak near **625 nm** that can be used as a bloom marker.

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Kutser et al. 2004
Simis et al. 2005
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Detecting Iron Stress with Fluorescence

- Detached chlorophyll complexes
- Altered ratio of PSI:PSII


Hyperspectral Hallucinations: What could we do?