Novel Ocean Color Products

Ryan Vandermeulen

ryan.a.vandermeulen@nasa.gov

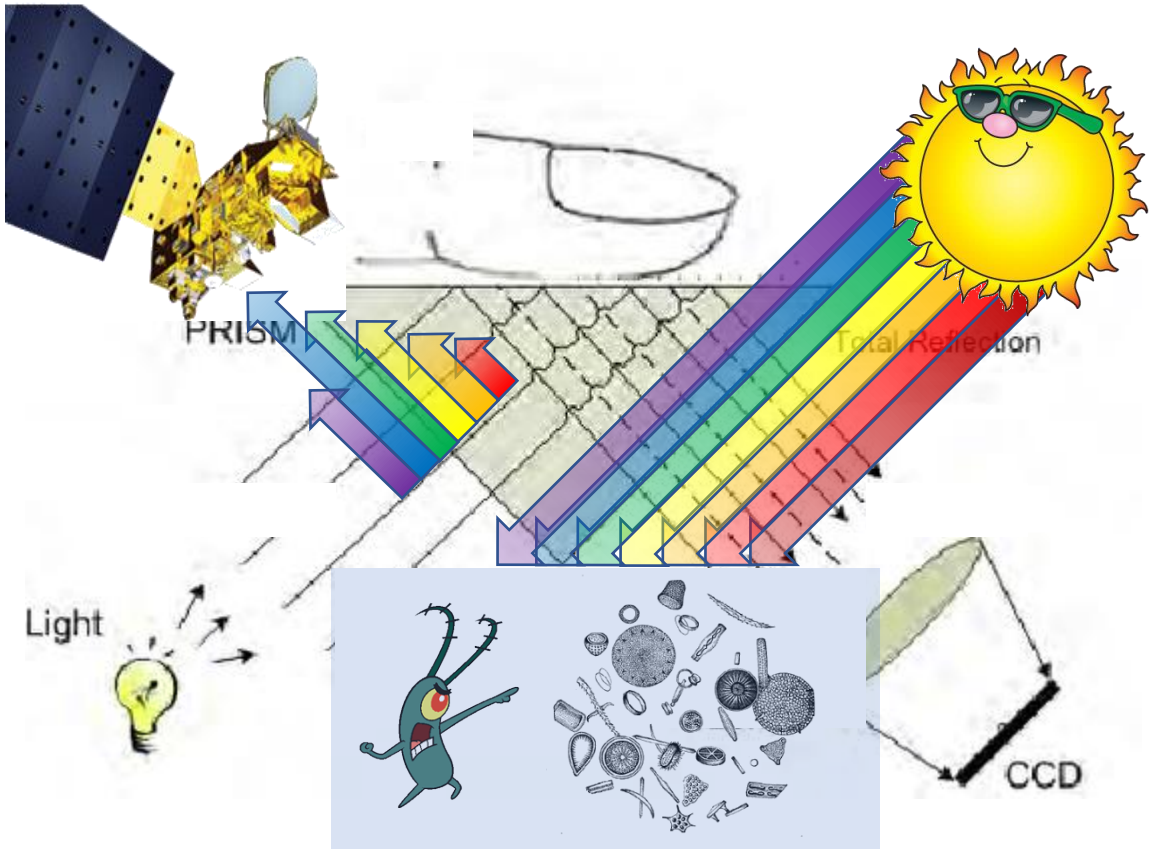
NASA Goddard Space Flight Center

Ocean Ecology Laboratory [Code 616.1]

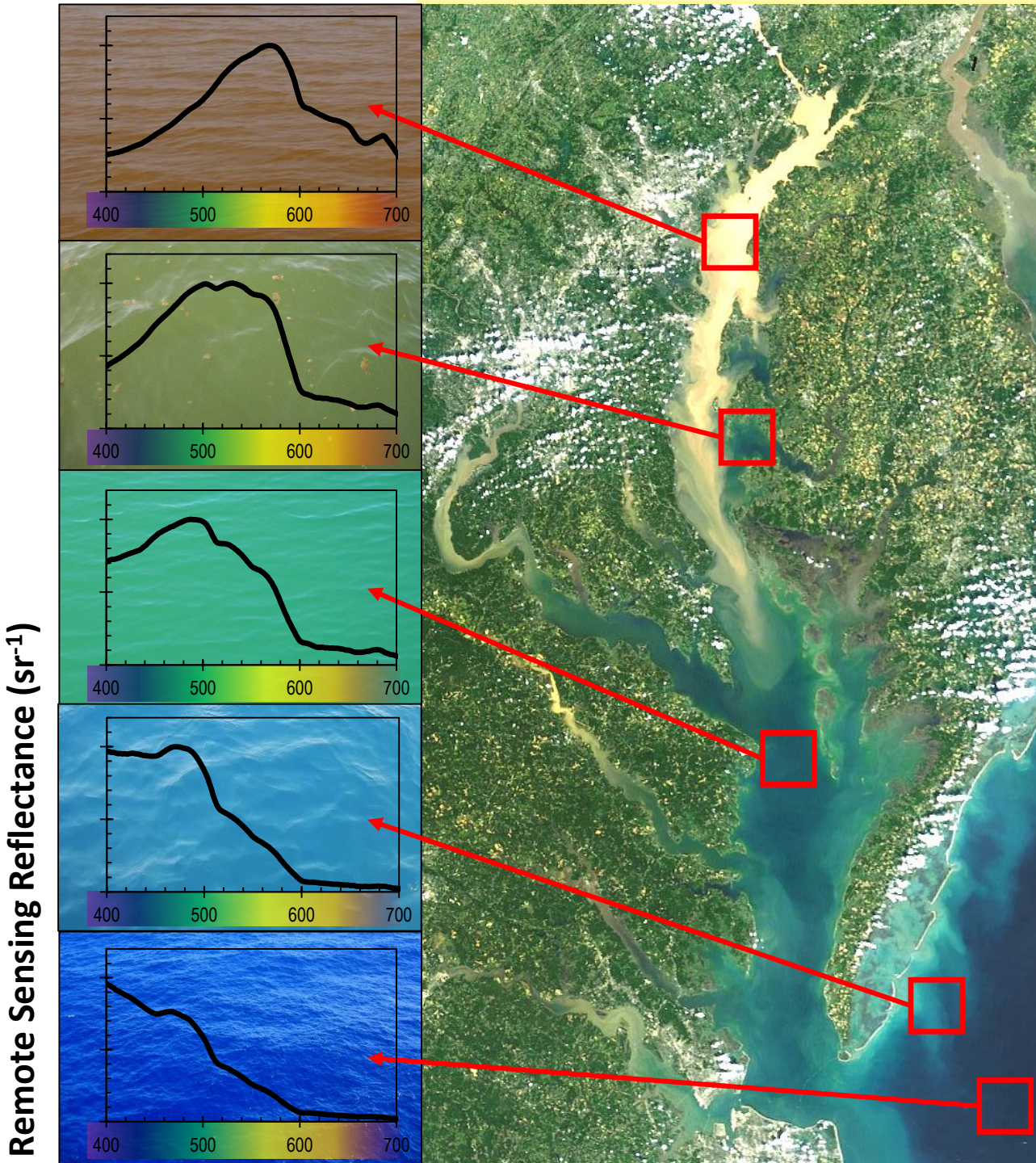
Fingerprints of the Chesapeake:

An intuitive, simple, and effective optical fingerprinting tool for coastal monitoring

Optical “Fingerprints”



How can quantify, display, and analyze the differences between these fingerprints?

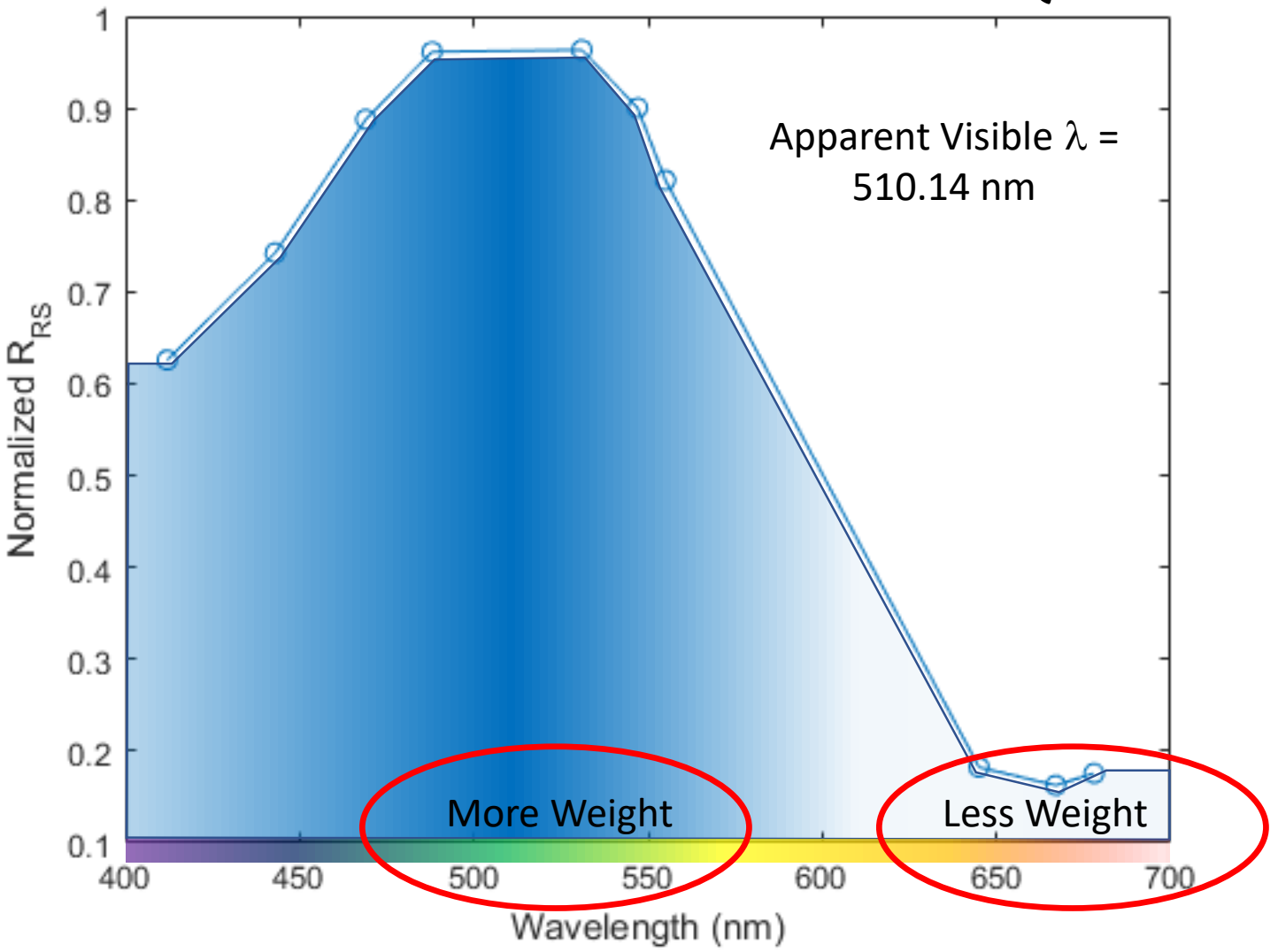


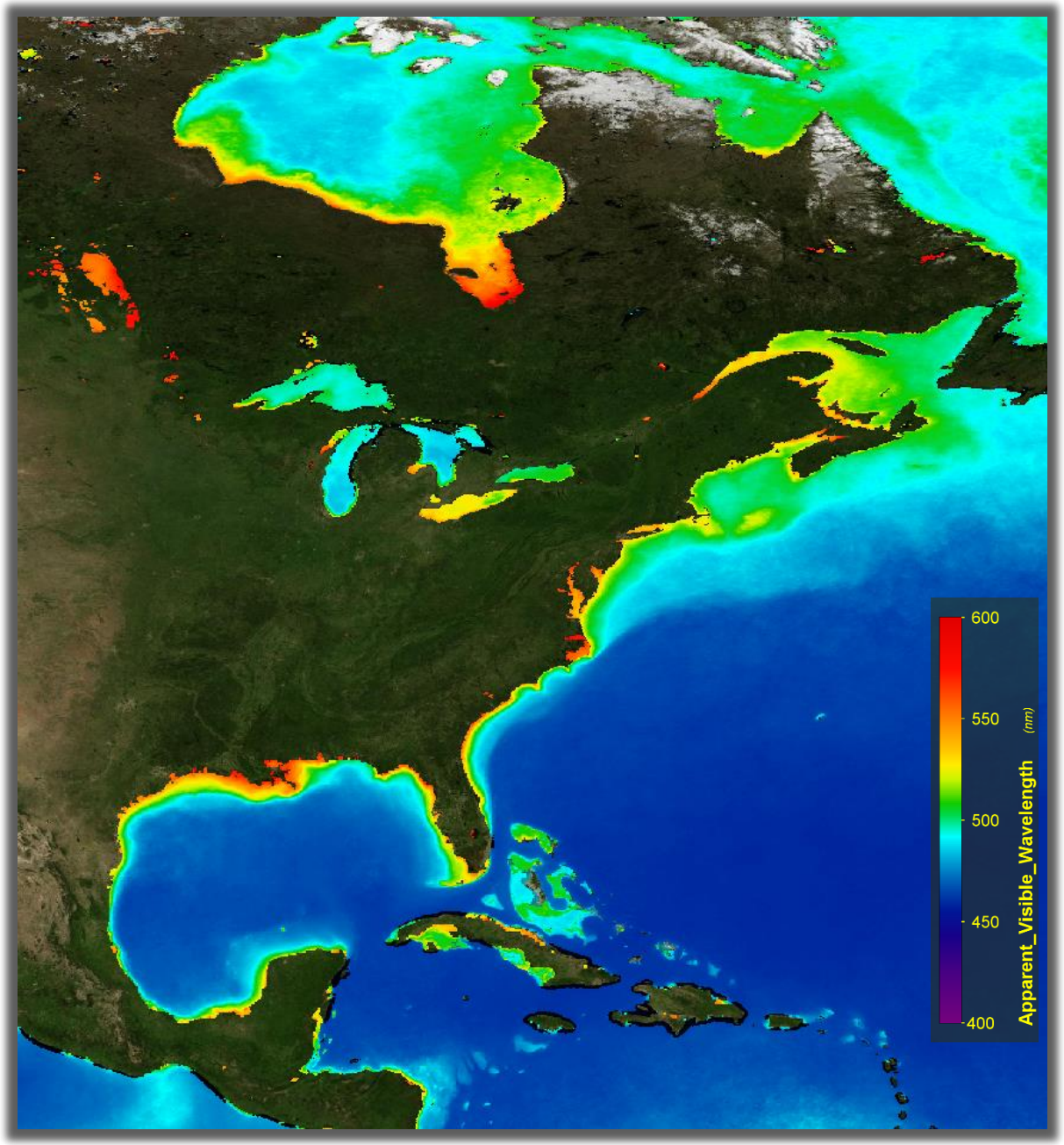
SOLUTION:
KEEP IT SIMPLE

$$AV(\lambda) = \frac{1}{\sum R_{RS}} \sum R_{RS}(\lambda) \times \lambda$$

The simple weighted average of the Remote Sensing Reflectance (R_{RS}) wavelengths, constrained by the relative intensity of each channel, outputs an ***Apparent Visible Wavelength*** *, a number that describes the color of the ocean.*

MODIS-AQUA



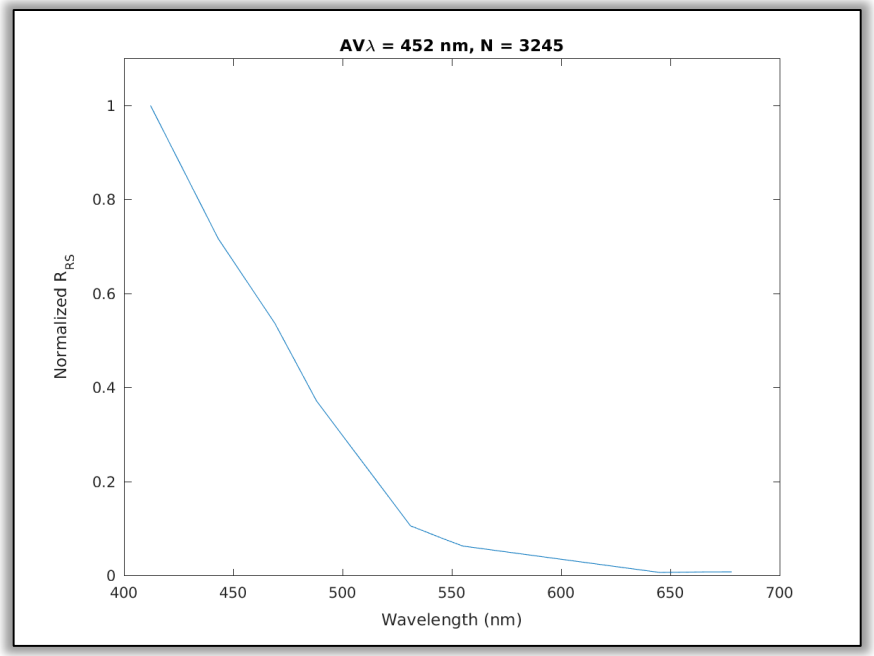


Every R_{RS} spectral shape/fingerprint appears to fit nicely into a specific Apparent Visible Wavelength "cluster."

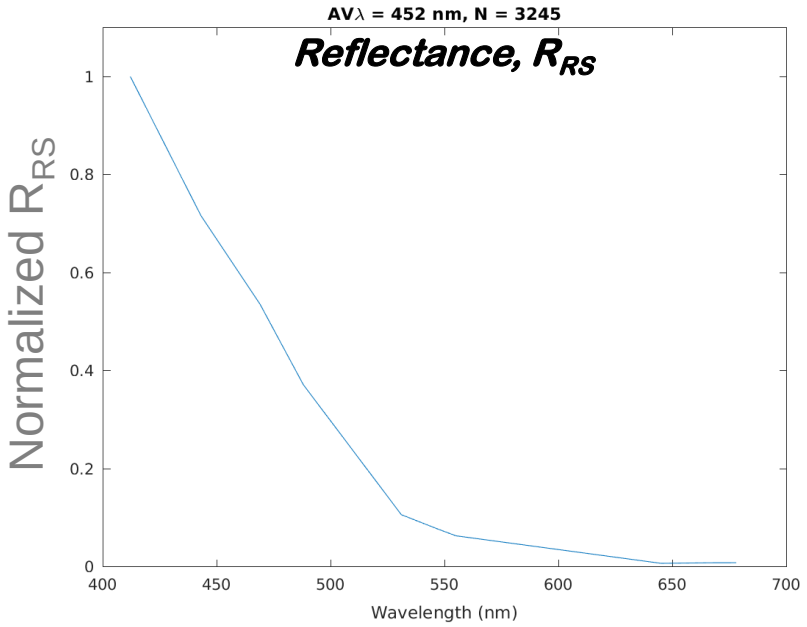
This tool is a simple and robust way for users to visualize and quantify trends in spectral R_{RS} in terms of its apparent dominant color, which, inherently relates to a specific spectral shape and a unique combination of absorption and scattering properties.

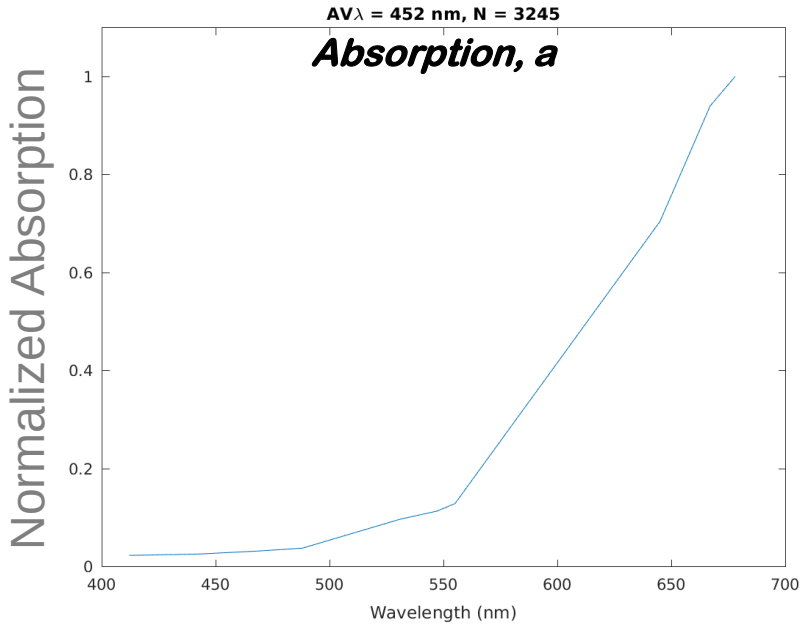
AV(λ)

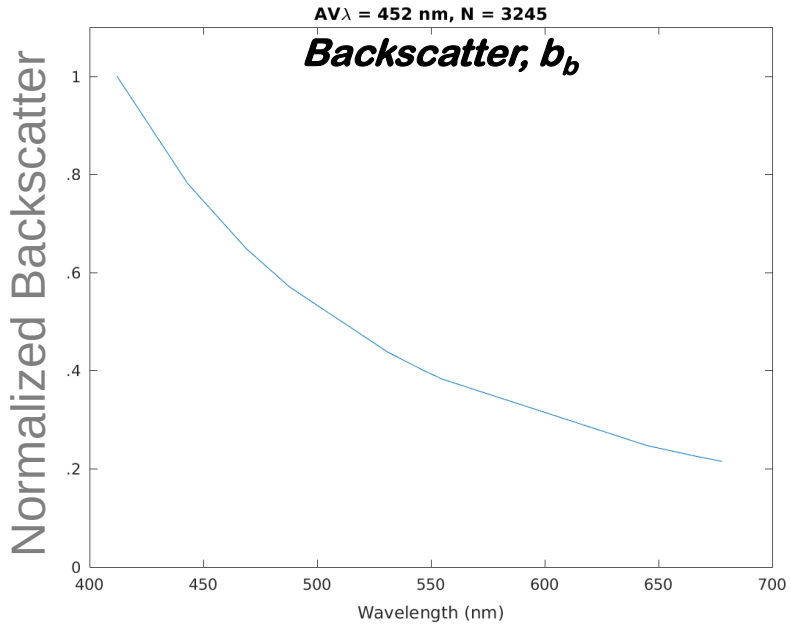
450 – 465
465 – 480
480 – 490
490 – 500
500 – 510
510 – 520
520 – 530
530 – 540
540 – 550
550 – 560
560 – 570
570 – 580
580 – 595
595 – 605



Absorption and Backscatter make up the valleys and ridges of any optical fingerprint





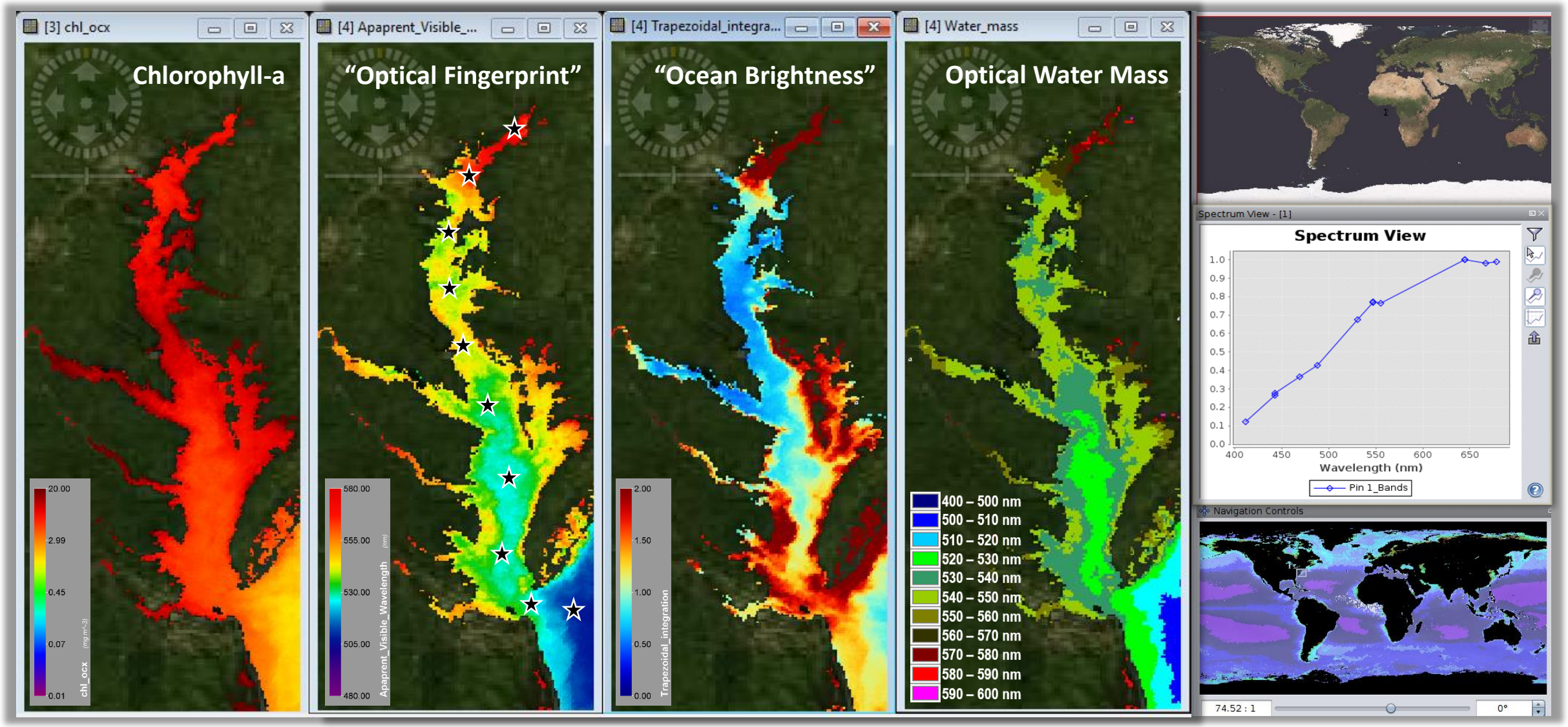


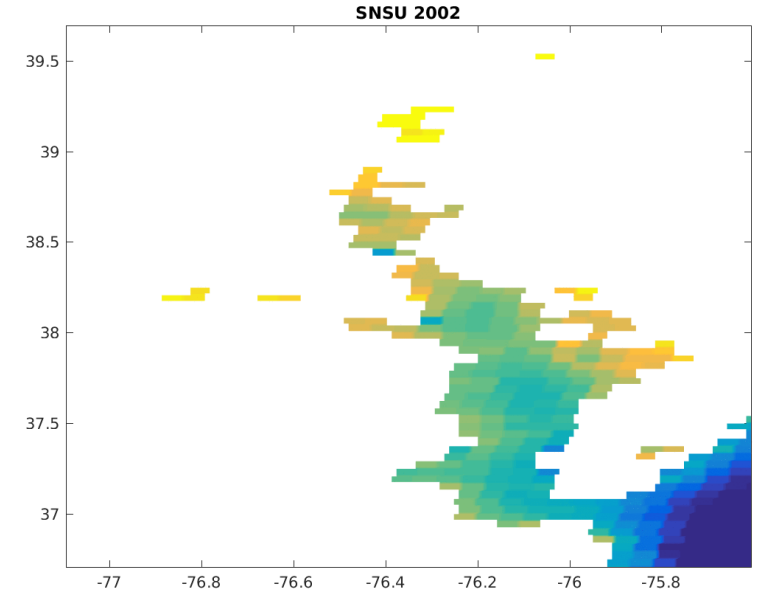
*There are only so many combinations of **absorption** and **backscatter** that can make a specific color*

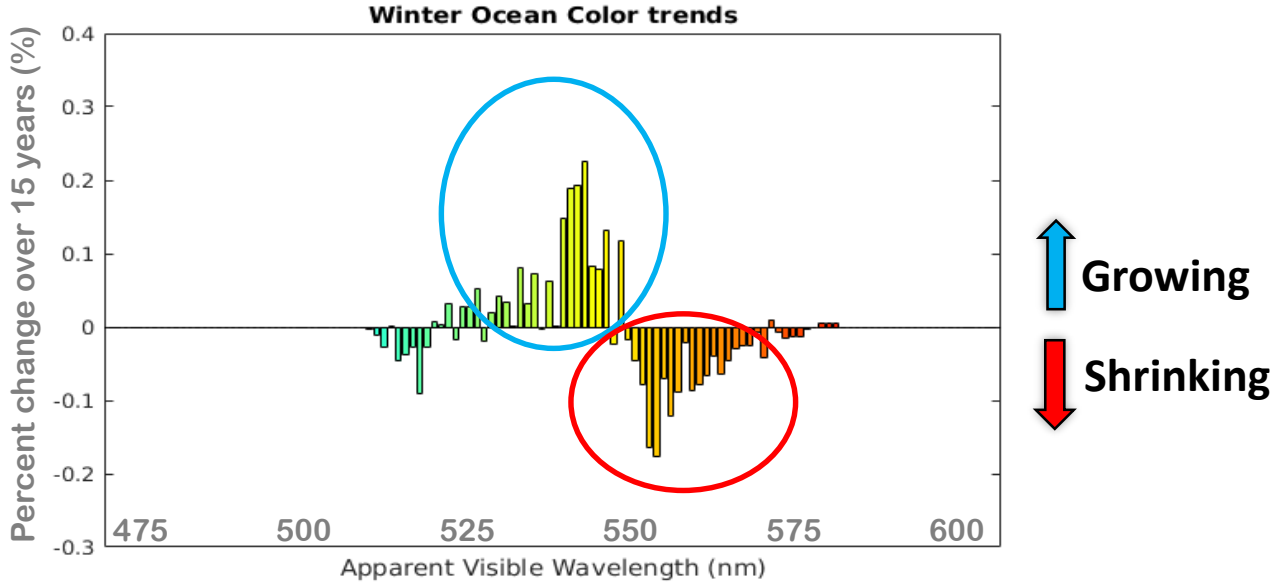
$$R_{RS}(\lambda) \sim b_b(\lambda) / [a(\lambda) + b_b(\lambda)]$$

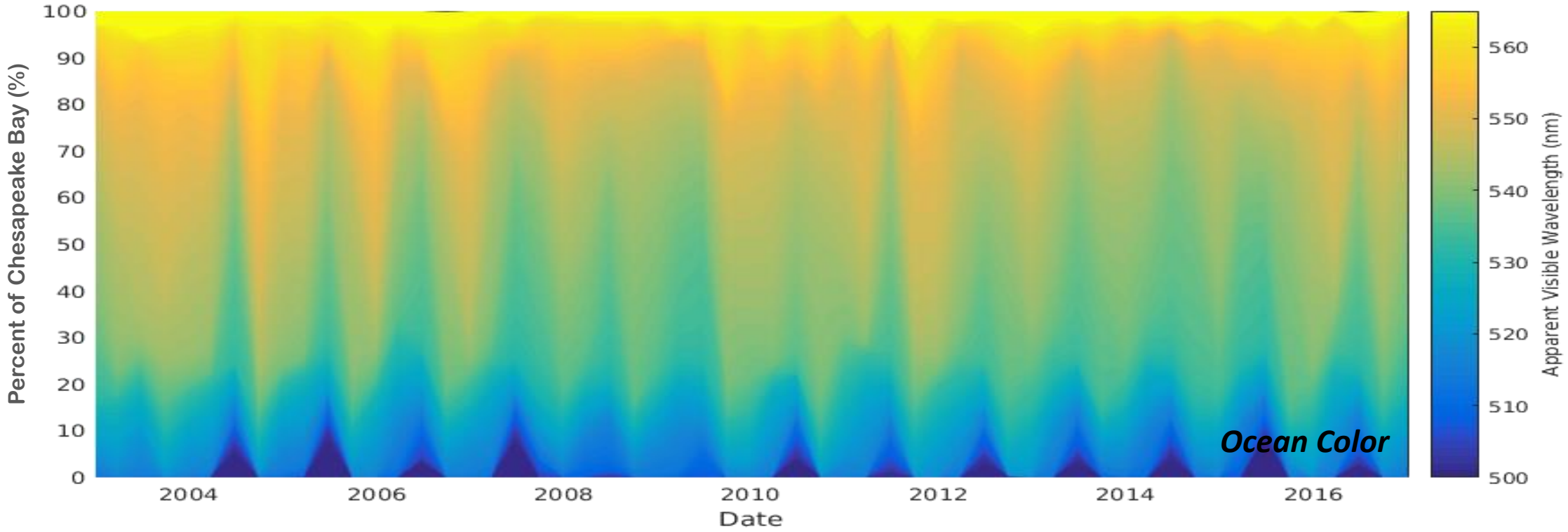
SeaDAS

Easy integration into SeaDAS enables the statistical analysis of spectral, spatial, and temporal trends

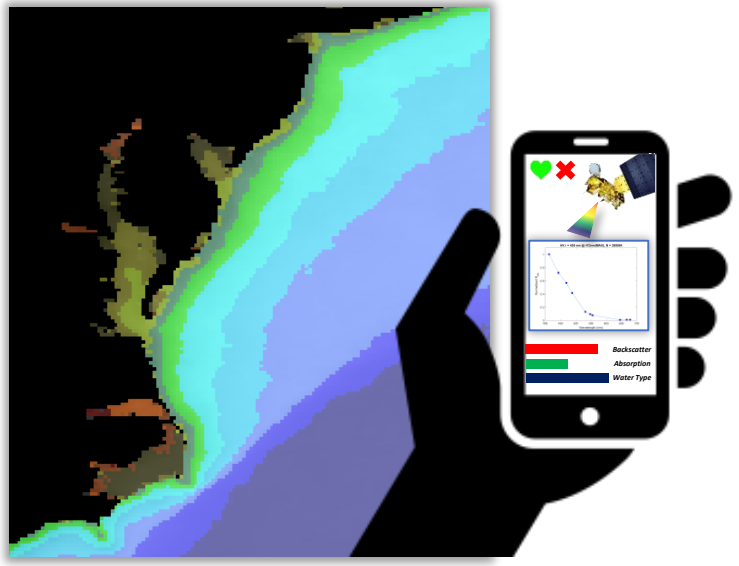



SNSU 2002
39.5
39
38.5
38
37.5
37
-77
-76.8
-76.6
-76.4
-76.2
-76
-75.8


Winter Ocean Color trends
Percent change over 15 years (%)
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
475
500
525
550
575
600
Apparent Visible Wavelength (nm)
Growing
Shrinking


Percent of Chesapeake Bay (%)
100
90
80
70
60
50
40
30
20
10
0
2004
2006
2008
2010
2012
2014
2016
Date
Ocean Color
560
550
540
530
520
510
500
Apparent Visible Wavelength (nm)

Applications for Chesapeake Bay:



- Dynamic definition of water boundaries in the Bay
- Point-source detection with product anomalies
- Development of water-type specific algorithms
- Phytoplankton functional type distinction (?)
- Maps of optical variance for targeted sampling
- A useful climatological metric of change
- Correlation of similar water types on global scales
- Useful for display of multi/hyperspectral *in situ* data
- Implementation of decision tree approaches for algorithm development
- More inclusive (full spectral) data input for Bay models (*Vibrio*, SAV, and Hypoxia?)

Continuous monitoring of radiometric/optical parameters may be a point of mutual interest between agencies, enhancing the ability to remotely sense water quality.