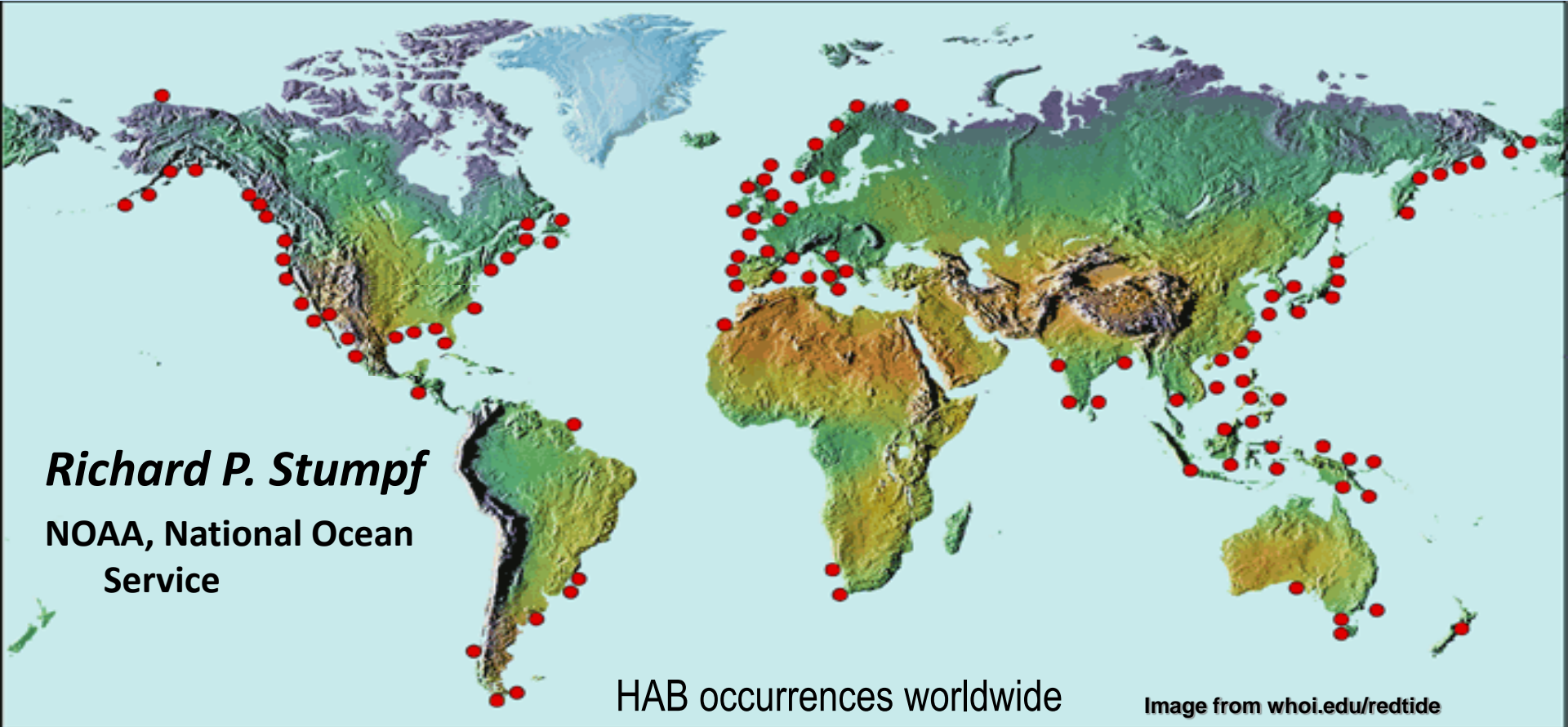


Harmful Algal Blooms (HABs) 3 Limitations



What are limitations

Recall operational component: need an answer “today”, not for last year.

Obvious ones? (Should be some insights from the last two weeks)

Limitations

Obvious limitations:

Clouds

Frequency

Sun glint

Spectral Bands (algorithm)

aerosols

Resolution

Others:

algorithm robustness

water turbidity

CDOM

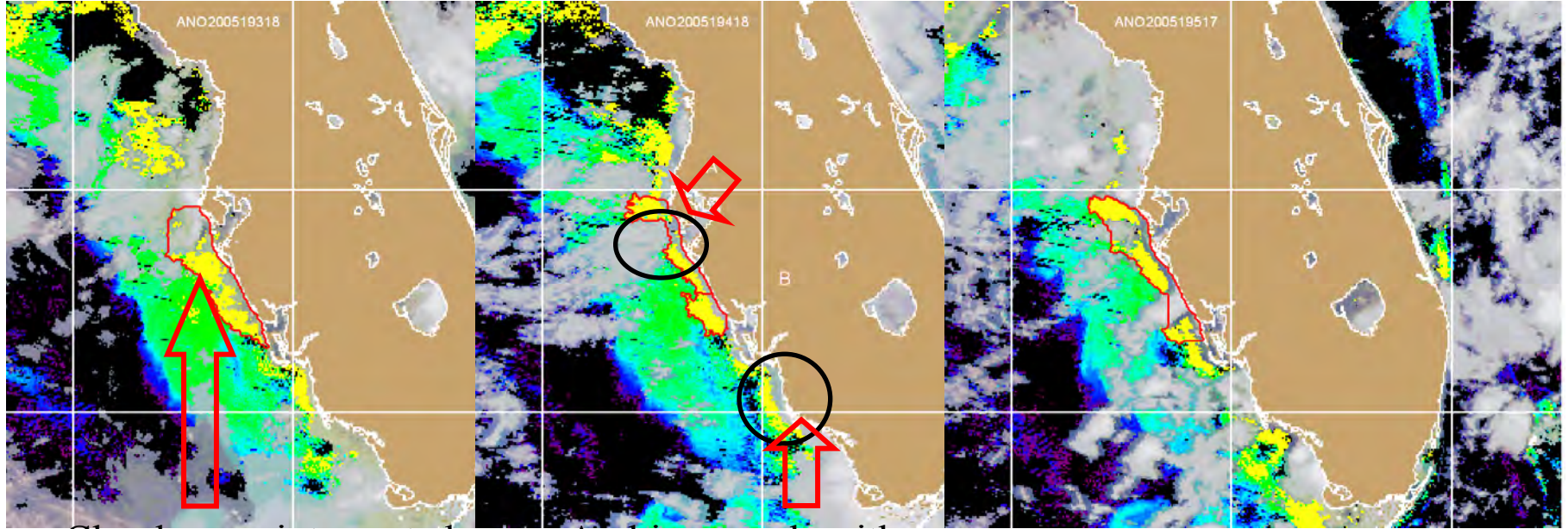
Clouds are a problem and unknown in classification

Yellow indicates potential HAB, eastern Gulf of Mexico, 2005, worst event in 30 years

Aug 12

2005 Aug 13

Aug 14



Cloudy area interpreted
using “persistence”
(from a previous day)


Ambiguous algorithm,
requires manual
correction

Sunglint (at 42N a
problem for 2
months around
solstice).



MERIS, Northern Gulf of Mexico 15 June 2011

This satellite image shows a large, bright, yellowish-white area in the Northern Gulf of Mexico, which is the result of sunglint reflecting off the water's surface. The surrounding ocean is a darker, mottled green and blue.



MERIS, Lake Erie
25 June 2010

This satellite image shows Lake Erie with a prominent, bright, white area along its eastern shore, indicating sunglint. The lake's water is a mix of dark blue and green, with some white clouds visible to the east.



Red reflectance
15 June 2011

This is a false-color map showing red reflectance in the Northern Gulf of Mexico. The map uses a color scale where red and orange indicate higher reflectance, while blue and green indicate lower reflectance. The bright areas seen in the sunglint image are represented in red and orange.

Satellite Comparison for HAB applications

Satellite	Spatial	Temporal	Key Spectral
MERIS	300 m <i>OK</i>	2 day <i>good</i>	10 (5 on red edge) <i>good</i>
MODIS high res	250/500 m <i>OK</i>	1-2 day <i>good</i>	4 (1 red, 1 NIR) <i>marginal</i>
SeaWiFS, MODIS low res	1 km <i>poor</i>	1-2 day <i>good</i>	7-8 (2 in red edge) <i>OK</i>
Landsat	30 m <i>good</i>	8 or 16 day <i>poor</i>	4 (1 red, 1 NIR) <i>marginal</i>
Very high res (IKONOS, etc.)	1-4 m <i>good</i>	Variable (must be ordered) <i>marginal</i>	4 (1 red, 1 NIR) <i>marginal</i>

Clouds take out 1/2 to 2/3 of imagery

Sun glint impacts ratio or semi-analytic algorithms

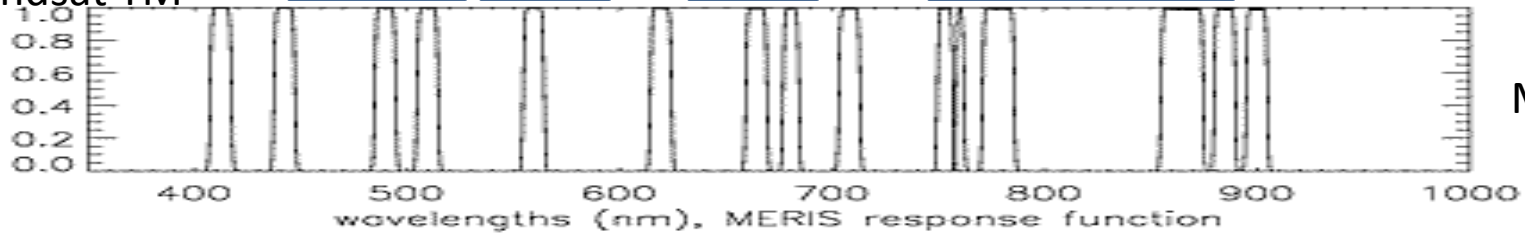
Minimum resolution, 3 pixels across (2 mixed land/water)

Satellite spectral bands & turbid blooms

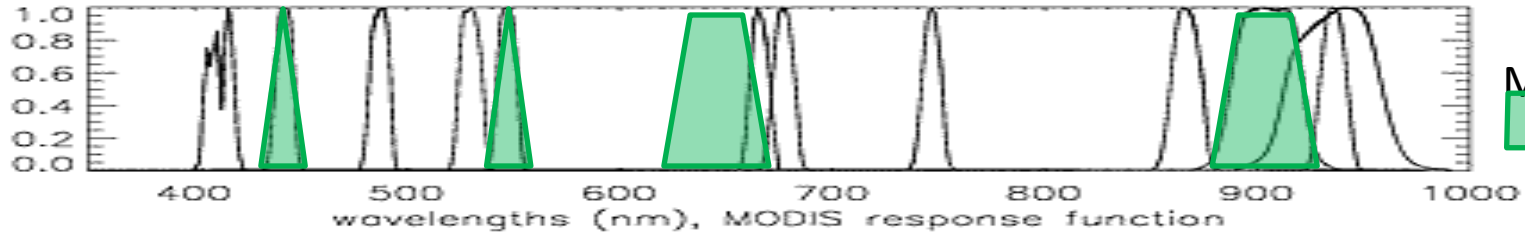
Landsat TM



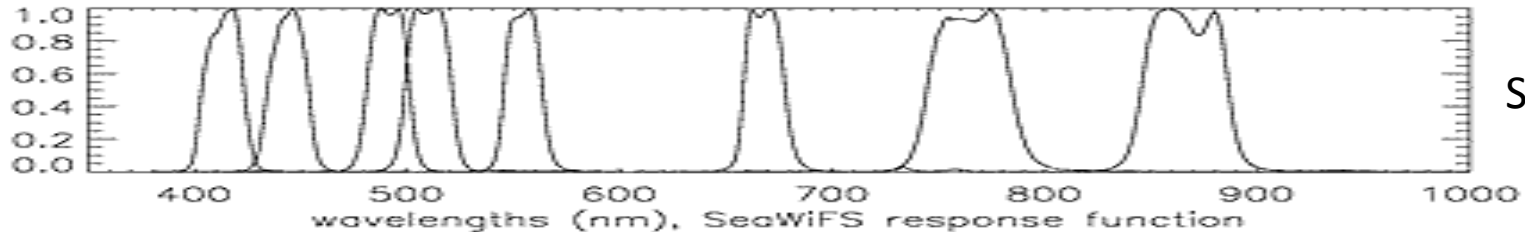
Landsat



MERIS



MODIS
250/500m



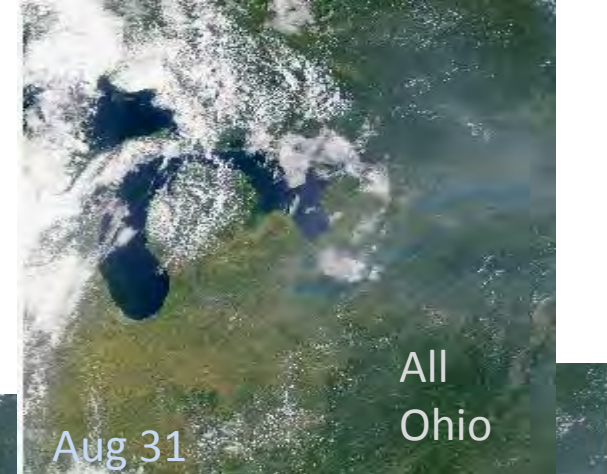
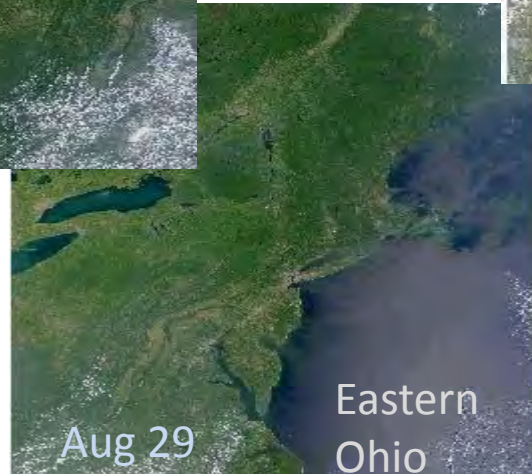
SeaWiFS

“Swaths” move around **Satellite Coverage**

Full Swath
1150 km

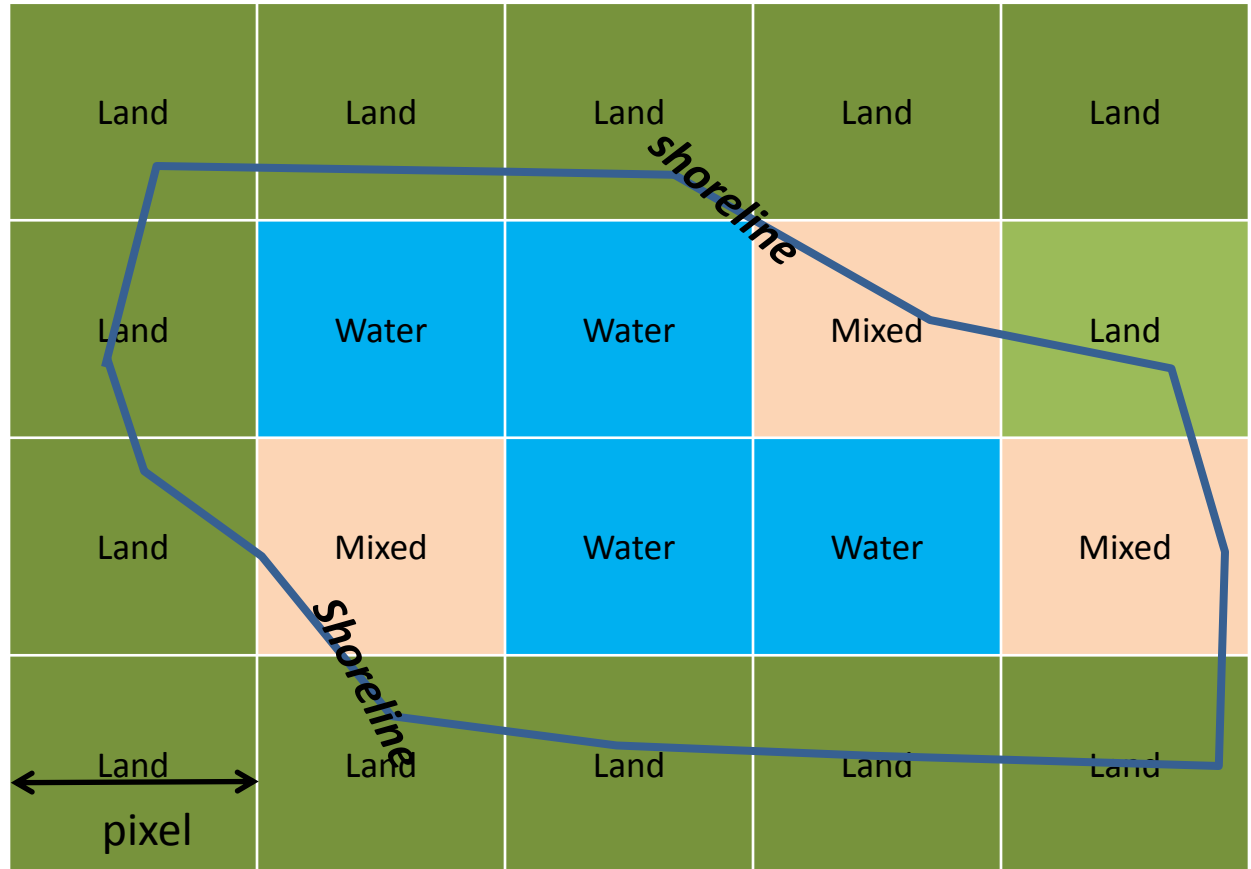


No Coverage
Aug 30



Usability right in lakes or at the coast

My experience is that “adjacency” (atmospheric scattering) is not a noticeable beyond the mixed pixel.



Glint as an issue. Mild to Moderate glint can be treated with spectral shape

CI/
SS681

MCI/
SS708



Spectral shape algorithms are superior for operational use

Derivatives do not depend on the absolute magnitude.

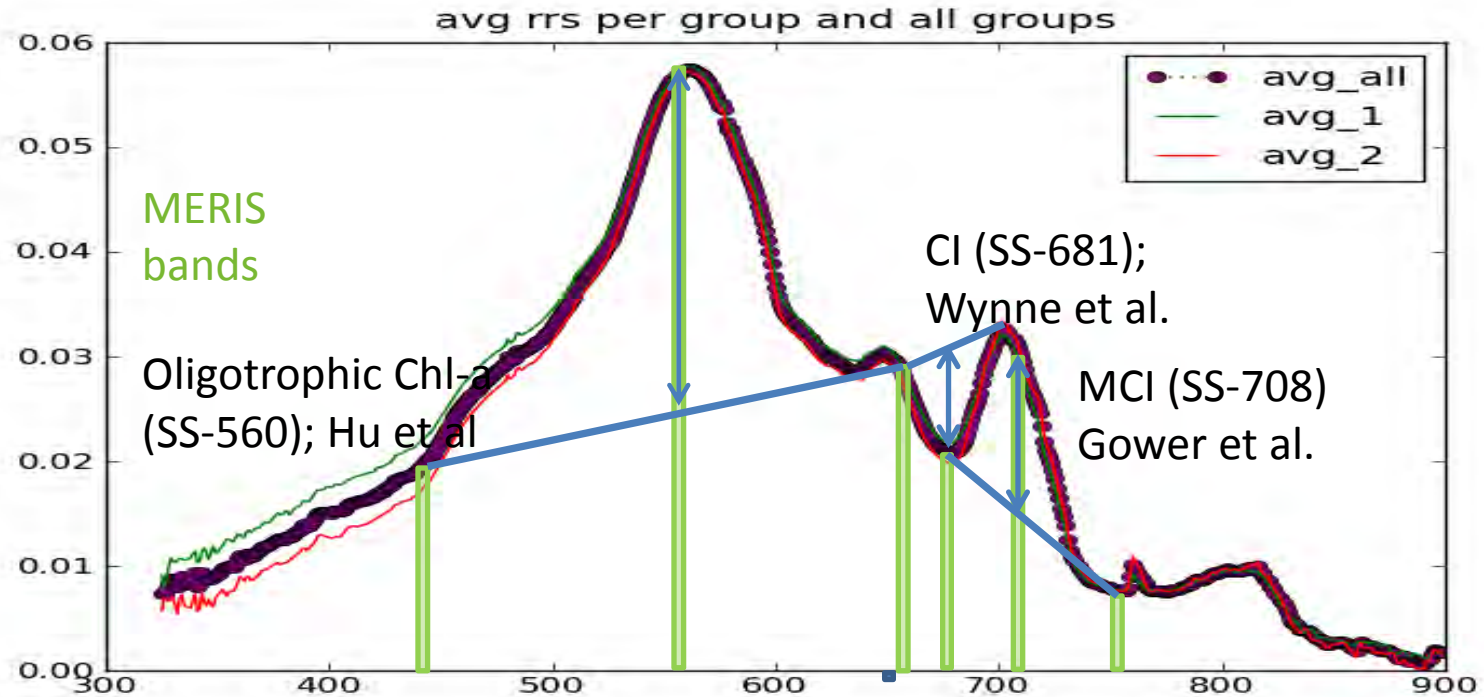
They can:

work without atmospheric correction

“see” through moderate glint

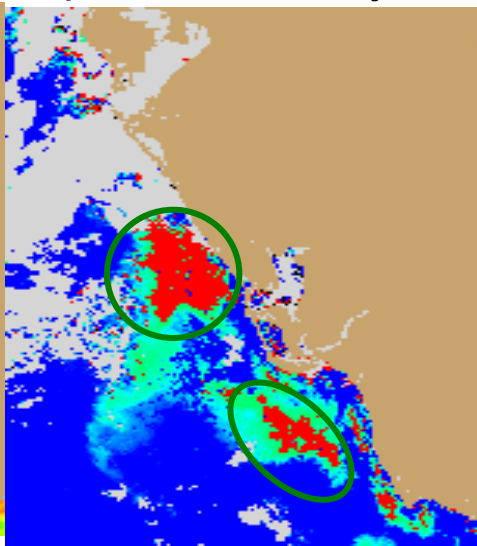
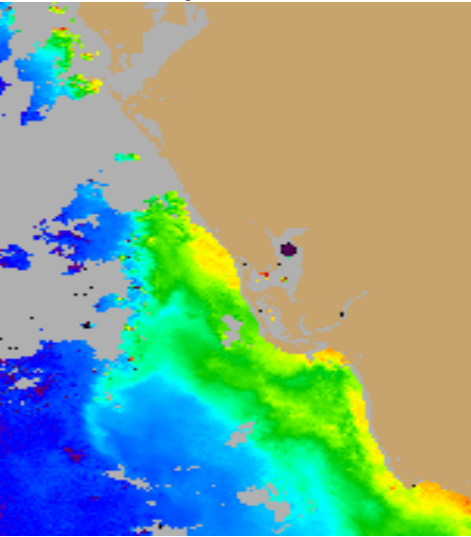
However, algorithms require a difference, which is influenced by sediment concentration (the degree of influence depends on the bands) (Gordon & Morel, 1983).

Some published shape algorithms

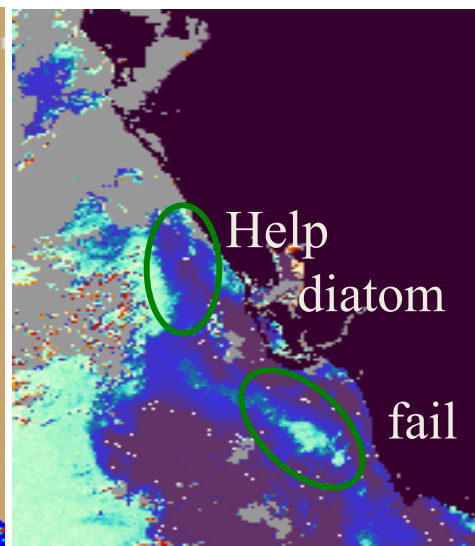


Challenges, no *Karenia* after Hurricane Charley: Optical
technique allow ID of diatom bloom, but falsely flagged
2nd bloom as *Karenia*

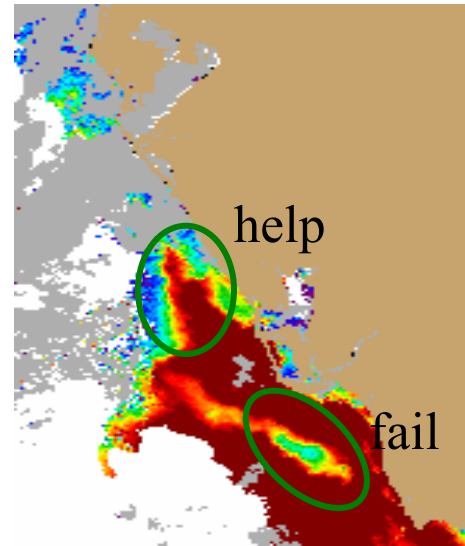
Chl (insufficient) anomaly



2nd der

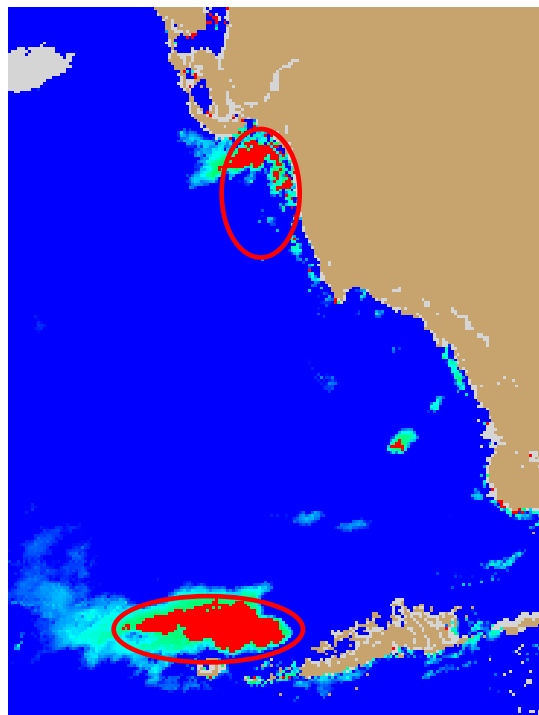


bb/a

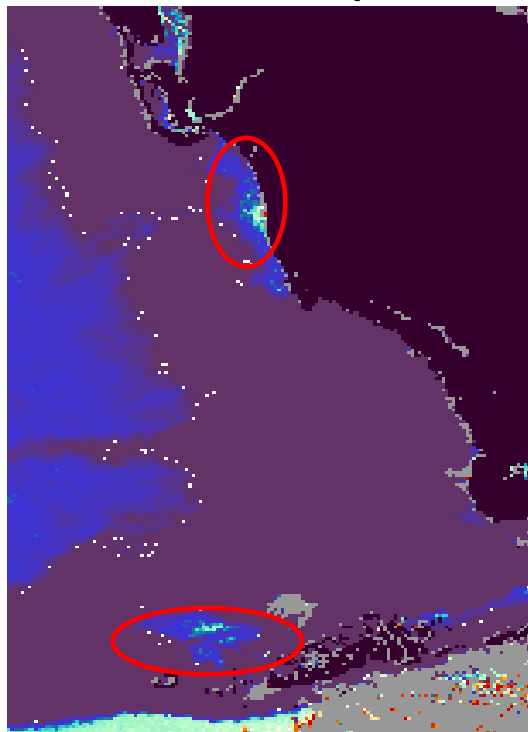


Optical methods, while useful, need optically deep, case 1 water. Not the case in Florida Keys

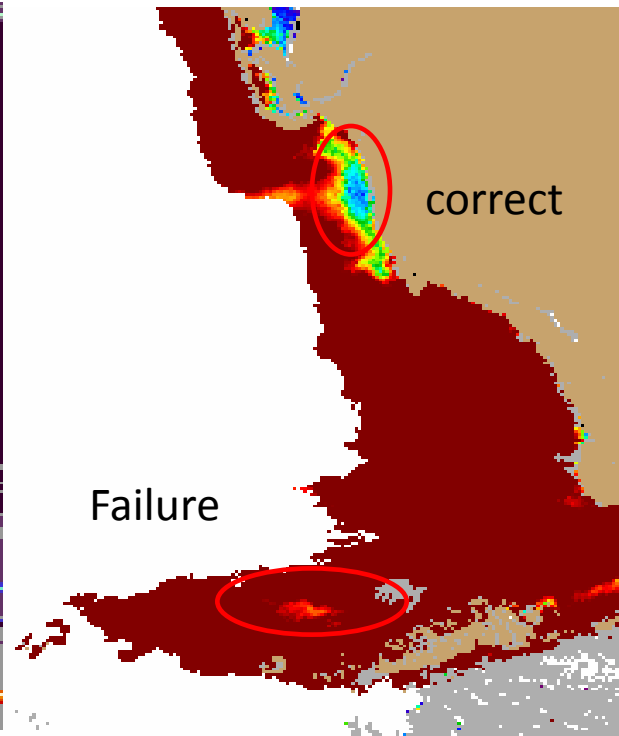
Anomaly



curvature (2^{nd} der.)



bb/a



Algorithm Robustness

Algorithm conceived with radiometry (or developed elsewhere)

Two sources of problem:

- 1) Algorithm is not valid for the HAB
- 2) Algorithm will break
 - 1) satellite limitation
 - 2) Atmosphere limitation

All of these have been used for HABs.

Give two examples of what can “break” or invalidate each (either won’t work, or inappropriate)

- | | |
|----------------------------|---|
| 1. Chl-a blue:green | 6. CI (SS-681) |
| 2. Chl-a NIR:red | 7. Bb/a ratio |
| 3. FLH | 8. Brightness |
| 4. anomaly | 9. Multi-band empirical relationship |
| 5. MCI (SS-708) | |