Comparison of MODIS and VIIRS in detecting a harmful algal bloom in the NE Gulf of Mexico

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MODIS and VIIRS ocean bands

MODISA has two more bands than VIIRS at 531 and 678 nm

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Res. (km)</th>
<th>Swath</th>
<th>Revisit</th>
<th>Ocean Bands*</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODISA</td>
<td>1.1 x 1.1</td>
<td>2330 km</td>
<td>1-2 day</td>
<td>9, 412-869 nm</td>
<td>2002 – now</td>
</tr>
<tr>
<td>VIIRS</td>
<td>0.75 x 0.375</td>
<td>3300 km</td>
<td>1 day</td>
<td>7, 410-862 nm</td>
<td>2011 – now</td>
</tr>
</tbody>
</table>
Cross-sensor comparison for Tampa Bay

NASA OBPG reprocessing 2013.0
Cross-sensor comparison for Tampa Bay

NASA OBPG reprocessing 2013.0
Cross-sensor comparison for Tampa Bay

NASA OBPG reprocessing 2013.0
Question: How does VIIRS perform in detecting HABs?

One case study in CDOM-rich dark waters
A Karenia brevis bloom in NEGOM

Red Tide Status
09/03/2014
A satellite image from 09/02/14 shows an offshore bloom of algae, including the Florida red tide organism, between Dixie and northern Pinellas counties. The hotter colors in the image show the bloom and the gray represents cloud cover.

Karenia brevis scale (cells/liter)
- NOT PRESENT – BACKGROUND (0 to 1,000)
- VERY LOW (>1,000 to 10,000)
- LOW (>10,000 to 100,000)
- MEDIUM (>100,000 to 1,000,000)
- HIGH (>1,000,000)
ERGB image series showing dark waters

(a) MODISA 6/4/2014
(b) MODISA 6/20/2014
(c) VIIRS 7/5/2014
(d) VIIRS 7/18/2014
Similarity and contrast between MODIS and VIIRS
Similarity and contrast between MODIS and VIIRS

(a) R^2 = 0.89
Slope = 0.960
 Intercept = 0.00014
 URMS = 24.7%
 Mean ratio = 0.998

(b) R^2 = 0.94
Slope = 0.926
 Intercept = 0.00030
 URMS = 15.7%
 Mean ratio = 1.008

(c) R^2 = 0.97
Slope = 0.883
 Intercept = 0.00012
 URMS = 15.7%
 Mean ratio = 0.922

(d) R^2 = 0.94
Slope = 0.825
 Intercept = 0.00008
 URMS = 32.2%
 Mean ratio = 0.960
Similarity and contrast between MODIS and VIIRS
Validation using field measurements

MODISA nFLH 7/23/2014
Validation using field measurements

(a) St. 1
K. brevis = 0 cells L$^{-1}$

(b) St. 2
K. brevis = 0 cells L$^{-1}$

(c) St. 3
K. brevis = 333 cells L$^{-1}$

(d) St. 4
K. brevis = 2 $\times 10^7$ cells L$^{-1}$
Validation using water sample analysis
Validation using water sample analysis
nFLH:
July 23
*K. brevis*:
July 18-24

Chla:
July 23
*K. brevis*:
July 18-24

nFLH:
July 30
*K. brevis*:
July 24 – Aug 1

Chla: July 30
*K. brevis*:
July 24 – Aug 1

Validation using water sample analysis
Validation using water sample analysis

**nFLH: Aug 8**

**K. brevis:**

- July 31 – Aug 8

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**Chla: Aug 8**

**K. brevis:**

- July 31 – Aug 8

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**nFLH: Aug 18**

**K. brevis:**

- Aug 14 - 21

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**Chla: Aug 18**

**K. brevis:**

- Aug 14 - 21
Conclusions

- VIIRS and MODISA show consistent Rrs retrievals in Tampa Bay and NEGOM
- However, VIIRS shows some deficiency in detecting *Karenia brevis* HABs in dark waters due to its lack of a fluorescence band
- New approaches need to be developed to overcome such a deficiency for HAB detection
To be continued...

MODIS nFLH     VIIRS Chl_OC3     VIIRS HAB index

All images taken on 8/27/2014