Ocean Color Product Stability using VIIRS Orbital Overlaps Monthly Trends

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Abstract:

The VIIRS Orbital overlap was used to examine the stability of the VIIRS ocean color products over a 10 month period. Satellite product stability was evaluated using product differences between overlapping orbits of the ocean normalized water leaving radiance (nLw) products within ~ 100 minutes. We assume that the difference in nLw products within 100 minutes overlaps should be minimal. By monitoring the short term difference on ocean color, we can define the consistency and seasonal trend of the sensor and products. Additionally, the stability of nLw color products was evaluated for different water types including coastal , shelf and open ocean waters. The differences in the overlap products, provides an overall assessment of the entire sensor and processing used to define the products which include the sensitivity to senor calibration, algorithms using the solar and spacecraft angles, left and right side of nadir, atmospheric correction, BRDF, and ocean color algorithms. By examining how ocean products difference changes each month for different water types, we can more accurately track the sensor response and processing algorithms. The results indicate the 410 channels show the greatest differences, (earlier orbit is greater than second) in winter months and reverses in the summer months. This is more prevalent in the open ocean than in the coastal waters and can possibly be linked to the solar elevation and azimuth angle. The VIIRS orbital overlap product difference provides a highly sensitive capability to assess the products stability and track the sensor and processing trends required for ocean color sensor calibration.

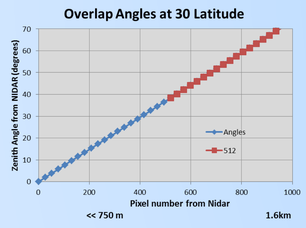
Objective :

- **Define short 100 minute orbital changes in VIIRS Orbital Color products.**
- **Examine the monthly differences in the overlap color products.**

Questions to Answer:

- **What is the spectral difference in the M bands in the overlap?**
- **Do different water masses (types) show differences in the overlap?**
- **Should we assume the ocean color response is not changing within the 100 minutes?**
- **Should we expect coastal waters to have more variability and difference than open waters?**
- **How do the differences in overlap change through the seasonal months?**

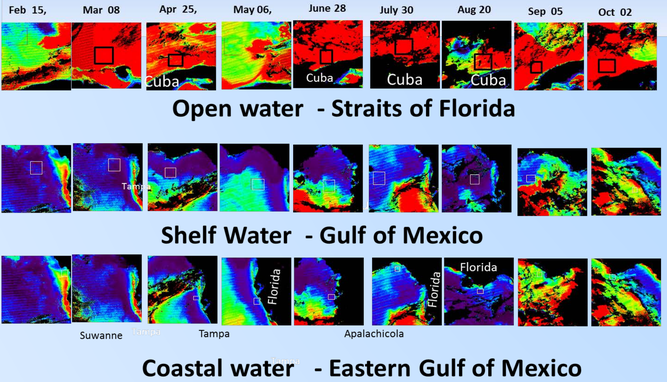
Data Set of Orbital Overlaps



Orbital overlap-
In Gulf there is ~512 pixel overlap at this latitude. This occurs on 5 day intervals. The overlap occurs at 40–70 degrees for the left and right side of swath.

Ocean color processing for overlaps requires:
1) Solar and Spacecraft Angles (Zenith and Azimuth)
2) Impacts of Atmospheric Correction, BRDF etc.
3) Sensor characterization (polarization, calibration

Location of the Regions .



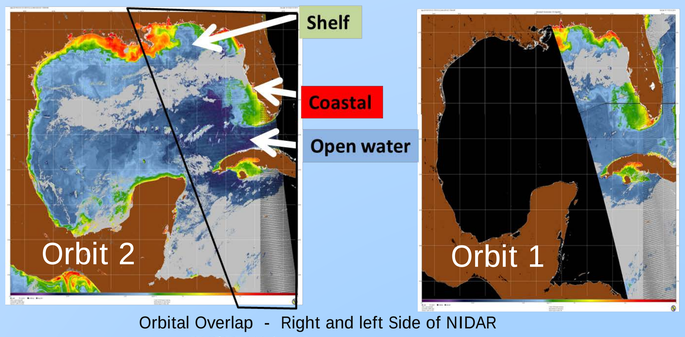
Dates are where 100 minute Overlaps occurred and have "pair" of VIIRS products. Selected – Cloud free areas in Similar water types .

Selected overlap scenes used to evaluate color products for different water types - open ocean, shelf and coastal waters

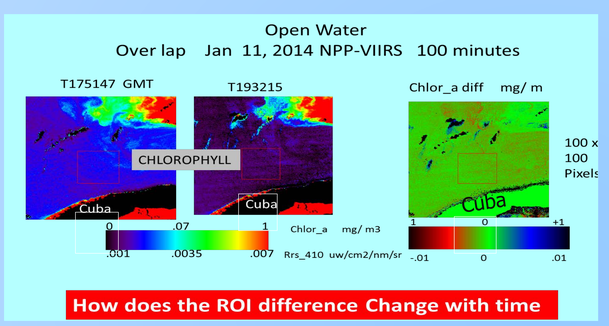
Arnone, R., S. Ladner, G. Fargion, P. Martinolich, R. Vandermeulen, J. Bowers, and A. Lawson, "Monitoring bio-optical processes using NPP-VIIRS and MODIS-Aqua ocean color products," *Proc. SPIE* 8724, Ocean Sensing and Monitoring V, 87240Q (June 3, 2013), http://dx.doi.org/10.1117/12.2018180.

100 Minute VIIRS Product Overlap

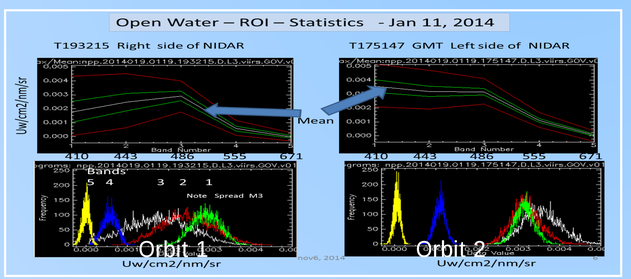
Time 19:3215 — Jan 14, 2014 — Time 17:5147 GMT



Orbital Overlap - Right and left Side of NIDAR
THREE Water Types
The different water types can influence the processing.
This can influence the difference in the over laps retrievals.

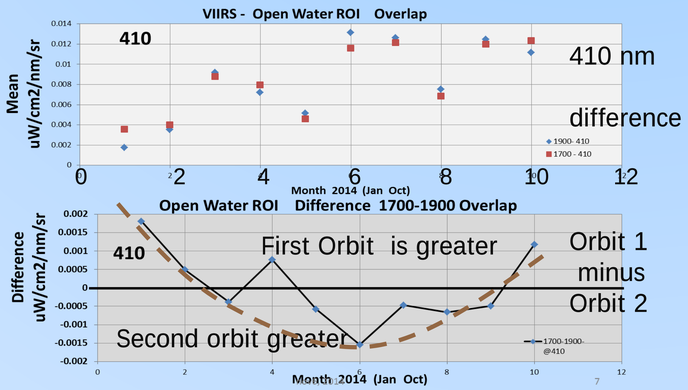


An example site is shown for the open water.
A Region of Interest (i.e. clear area) was selected for each overlap image.
The difference is shown for chlorophyll (Orbit 1 minus(-) Orbit 2).

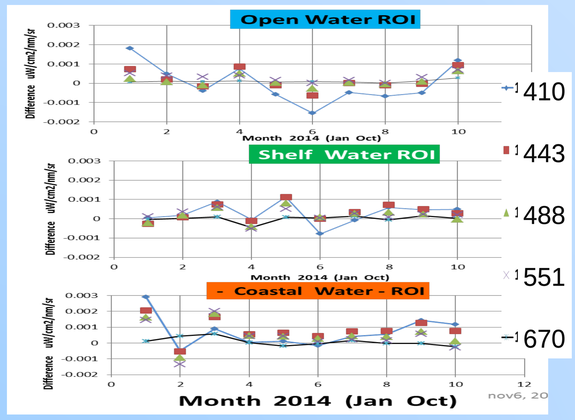


The example of open water site shows the spectral mean and variance for each orbit. We assume the average regions are not changing in color within the 100 minutes between orbits. Assume no advection or biological production.

- Overlap Monthly Differences in Open Ocean waters

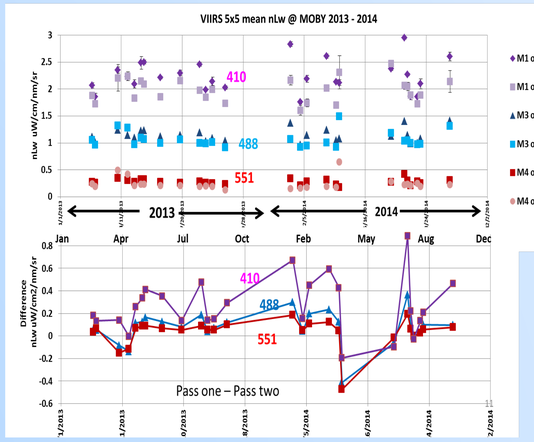


Orbit 1 minus(-) Orbit 2



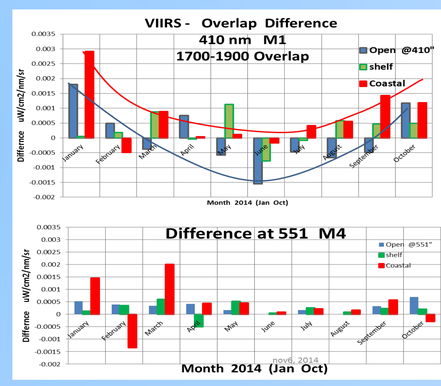
Differences in orbital overlaps for each month
For three different water types for all channels

At MOBY – over lap Difference



Open water site at MOBY, Hawaii
2 year Cycle,

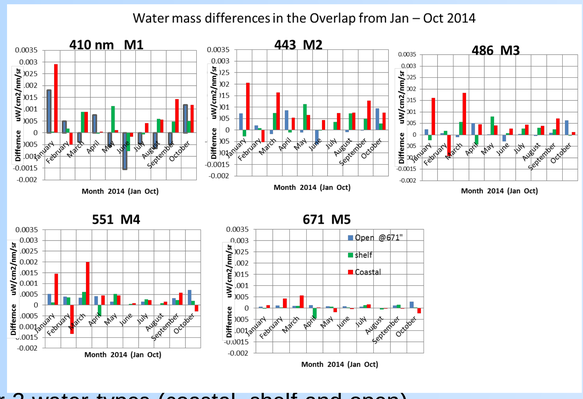
Trends in the Overlap Difference



Early - Later Time

Inconsistency – Note:
1) **Jan very High**
2) **Coastal Minimal – April- July**
3) **Open Larger that Coastal**
4) **M1 went positive to Negative**

The different of earlier to later can be related to the solar angle Changes through season .



10 month trends for 2014 for the differences in the nLw for 3 water types (coastal, shelf and open)

Open and coastal waters show the greatest differences between the first and second orbit.
The nLw differences show the first orbit is typical higher than the second, especially in the winter months.
The influence of water advection and biological changes with the 100 minutes is not addressed here.

Summary:

1. **VIIRS orbital overlap provides a new capability to track trends in VIIRS ocean products !!**
   - **Overlap 'nLw' differences provides very sensitive ability to track the trends in both Sensor response calibration and processing techniques .**
   - **-The color products in regions were assumed to be constant within 100 minutes .**
   - **This is dependent on diurnal changes ! See other Poster !**
2. **VIIRS products 'nLw' showed consistency in the orbital differences even in different water types!**
3. **Trend observed in nLw differences in the winter and summer months. Continue to monitor trends.**
   - **The nLw 410 nm channel showed the largest differences between orbit one and two for the 10 month period.**
   - **The nlw 551 and 671 channels had smaller differences.**
   - **Winter months showed the first orbit to be greater than the second.**
   - **Summer months showed the second orbit to be greater than the first.**
   - **Could result from the solar elevation being higher in the second orbit in the summer!**
   - **During the winter months, the elevation and nLw is higher in the earlier orbit compared to the second.**
4. **Winter months with low sun angles have higher differences which may be associated with lower nLw and higher SNR.**
5. **The color changes that occur during the daily cycle can influence sensor calibration and stability.**
6. **The stability of the VIIRS color can be defined through the differences providing a method to estimate the uncertainty.**