Comparing SeaWiFS and MERIS Products off the Northeast U.S. Coast

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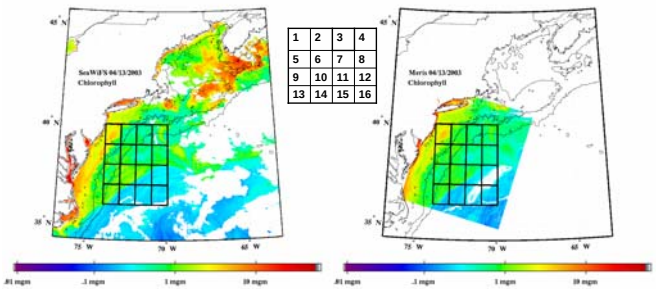
Introduction

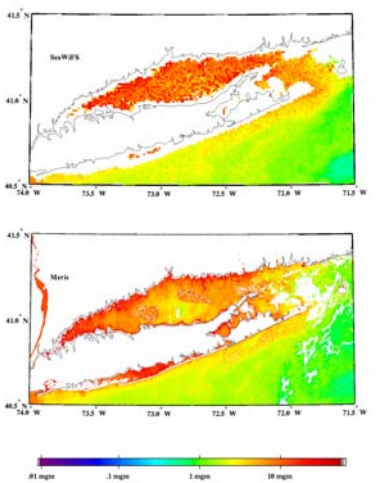
The objective of this study is to compare SeaWiFS and MERIS (MEdium Resolution Imaging Spectrometer) products for a region off the Northeast U.S. coast using coincident images acquired on 13 April 2003. SeaWiFS standard products are normalized water leaving radiances (nLw), while MERIS are normalized surface reflectances (π nLw/F0). For this study, both data sets were converted to remote sensing reflectance (RRS= nLw/F0). F0 is the nominal band extraterrestrial solar irradiance.

Spectral Bands of the SeaWiFS and MERIS Sensors

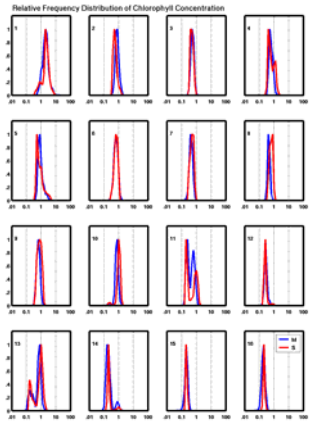
SeaWiFS	412	443	490	510	555		670			765		865	
MERIS	412	443	490	510	560	620	665	681	708	753	778	865	885



Level 3 SeaWiFS (reprocessing version 4) products at 1 km resolution (LAC) and Level 2 MERIS (processing version 4.10) products at 300 m resolution (FR) taken approximately 2 hours earlier were used in this study. SeaWiFS (above, left) and MERIS (above, right) chlorophyll images show the high spatial variability encountered for waters off the Northeast U.S. coast. Contours delineate the 100 and 2500 m bathymetry. The grid was assigned to areas of overlapping coverage for which box means were calculated.

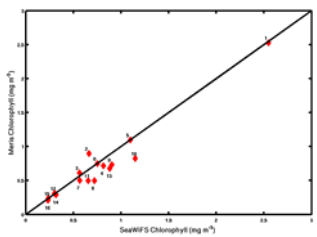


300m vs. 1 km resolution. Comparing Long Island Sound SeaWiFS (top, left) and MERIS (bottom, left) chlorophyll images shows how the 300-m resolution of **MERIS reveals much more spatial detail in coastal waters** compared to 1-km SeaWiFS imagery.



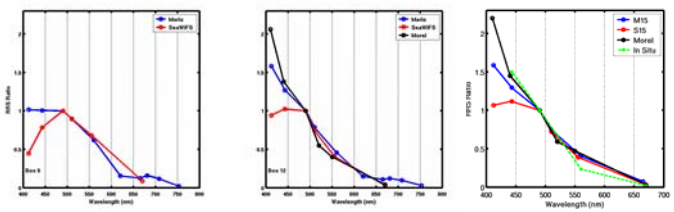
Chlorophyll

The relative frequency distributions of chlorophyll concentration for SeaWiFS (red) and MERIS (blue) show **good agreement for the 16 boxed regions**. The SeaWiFS OC4v4 algorithm uses the maximum band ratio (443/555, 490/555 or 510/555) to calculate Chl concentration. MERIS's algorithm uses the 443, 490, 510 and 560 nm wavebands to calculate Chl.

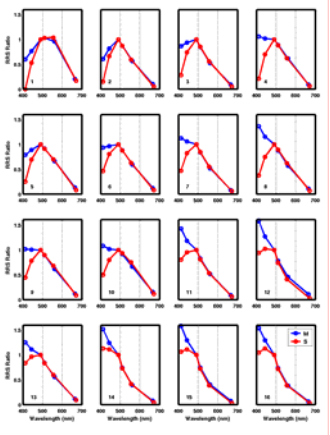


Mean Chl Agreement. Scatter plot around the 1:1 line of mean chlorophyll concentrations for SeaWiFs versus MERIS for the 16 boxed regions.

Remote Sensing Reflectance



Spectral Differences. Comparison of reflectance ratio [RRS(λ)/RRS(490)] spectra for coastal (left, box 9) and offshore (middle, box 12; right, box 15) areas. In the left and middle frames, note the 620, 681 and 708 nm bands in MERIS (blue) which are not present for SeaWiFS (red). Reflectance spectra based on the Morel Case 1 model (using mean Chl) are shown for the two offshore areas (black). *In situ* data (green) acquired October 1999 at 36.4° N, 71.98° W are from the SeaBASS archive. **The short wavelength component of the SeaWiFS spectra differs significantly from MERIS, *in situ* and Morel Case 1 calculations.**



Spectra of reflectance ratio [RRS(λ)/RRS(490)] for the 16 boxed regions. All pixels where Chl is valid are used to calculate the average reflectance spectrum. While there are no negative SeaWiFS nLws at 490, 510 or 555 nm, some of the pixels used in averaging are negative at corresponding 412, 443 and 670 nm bands. MERIS reflectances at 443, 490, 510 and 560 nm are all positive, while some of the corresponding 412 and 665 bands are negative.

MERIS reflectance (blue) is higher than SeaWiFS (red) in the blue part of the spectrum at 412 and 443 nm for all boxed regions.

Conclusions

- **MERIS and SeaWiFS chlorophyll agreement is good, probably because the SeaWiFS OC4 algorithm is using primarily 490 or 510 nm in the Chl calculation, rather than 443 nm.**
- **MERIS and SeaWiFS differ significantly at 412 and 443 nm, particularly in "blue" offshore waters, with MERIS more similar to model calculations and *in situ* data.**
- **The results imply that SeaWiFS is not providing accurate reflectances (water-leaving radiance) at 412 and 443 nm.**
- **If the above is true, then inversion algorithms applied to SeaWiFS data are SIGNIFICANTLY overestimating the amount of CDOM, even in open ocean waters.**
- **GIVEN THE INCREASING USE OF INVERSION ALGORITHMS, WE NEED TO DETERMINE WHY THE SEAWIFS BLUE BANDS ARE APPARENTLY INACCURATE AND FIX THE PROBLEM!!**

Acknowledgements

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