Will SeaWiFS and MODIS/Aqua products be different if $L_w(\lambda)$ is perfectly retrieved?

Let's assume for the moment that the atmospheric correction for SeaWiFS and MODIS/Aqua is perfect; that it accounts perfectly for varied meteorological and atmospheric conditions and diverse viewing and solar geometry. In other words, let's assume that we can perfectly retrieve $L_w(\lambda)$. Further, let's ignore coverage differences due to cloud cover and orbit and consider only common pixels and bins – those locations observed by both instruments. Considering all of this, can we expect the radiance and chlorophyll *a* data products produced by SeaWiFS and MODIS/Aqua to be the same? Sometimes, but not always. The following table lists a few known inherent differences in the data products. It also lists the ways the data are treated to address these differences.

DIFFERENCE	DISCUSSION	SOLUTION(S)
Normalization of L_w *The normalization allows radiances collected at different times of day, or by different sensors, to be compared.*	The traditional correction adjusts for varying sensor and solar geometry and changing sky conditions (e.g., Gordon and Clark 1981). Several additional BRDF corrections are available. The Wang Fresnel correction accounts for the reflection and refraction effects that occur when $E_d(0^+)$ and $L_u(0^-)$ propagate through a flat surface (Franz et al. 2002). The Morel Gothic-R correction is similar to the latter correction, but accounts for a wavy sea surface. The Morel f/Q correction adjusts for a spectrally dependent, non-isotropic subsurface light field (Morel et al. 2002).	Operational SeaWiFS processing currently incorporates the Wang Fresnel correction. MODAPS Aqua processing incorporates the Morel Gothic-R and f/Q corrections, while ODPS Aqua processing incorporates only the Wang Fresnel correction. The ODPS science team is currently studying the effect of using both the Morel Gothic-R and f/Q corrections for both operational SeaWiFS and MODIS/Aqua processing.
Available wavebands *While 488 and 490 nm are close, they are not the same thing.*	The only shared wavebands are 412 and 443 nm (SeaWiFS bands 1 and 2, MODIS/Aqua bands 8 and 9). Very slight differences are still expected in these bands because of their different spectral response functions. Other common visible wavebands include 490/488 (SeaWiFS band 3 and MODIS/Aqua band 10, respectively) and 555/551 (SeaWiFS band 5 and MODIS/Aqua band 12, respectively). The shift in nominal waveband results in different radiance retrievals for these blue-green bands.	All operational SeaWiFS and MODIS/Aqua processing includes an out-of-band correction to normalize for differences in their spectral response functions (see the next section). Otherwise, not much can be done about these inherent instrument differences. The 412 and 443 nm bands have differences on the order of 1 to 3% in Case 1 water. The 555/551 nm bands may have differences of up to 11% (Figures 1 and 2).

Out-of-band correction *The normalization allows common radiant bands with difference spectral response functions to be compared.*	This normalization is applied to remove spectral band-pass effects in $nL_w(\lambda)$. Essentially, it adjusts for out-of-band contributions in the derived radiances, leaving nominal $nL_w(\lambda)$ values. The normalization, however, assumes Case 1 spectral dependence, so waveband differences may increase in turbid conditions.	As mentioned above, all operational SeaWiFS and MODIS/Aqua processing includes an out-of-band correction. After normalization, the 412 and 443 nm bands are nearly identical in Case 1 water. The 555/551 nm differences are reduced to around 8% (Figures 3 and 4).
Chlorophyll *a* algorithms *While the operational maximum-band-ratio algorithms are created equally, their results may be different.*	OC4v4 makes use of a maximum-band-ratio that incorporates 443, 490 and 510 nm. Likewise, OC3M makes use of a maximum-band-ratio, but only incorporates 443 and 488. As turbidity increases, the selected maximum-band migrates from shorter (blue) to longer (green) wavelengths. In the most turbid water, OC4v4 selects 510, while OC3M remains at 488. This results in differences in the functional form of each algorithm, which leads to differing estimated chlorophyll concentrations in turbid water.	SeaWiFS operational processing makes use of OC4v4, while MODIS/Aqua makes use of OC3M (O'Reilly et al. 2000). Even after the normalizations described above, differences in the chlorophyll *a* retrievals can approach 25%, particularly in more turbid water (Figures 1 – 6).

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Figure 1. Ratios of SeaWiFS and MODIS/Aqua nL_w's for a variety of water types. Radiances were modeled using the Case 1 model described in Morel and Maritorena (2001) and adjusted using sensor-specific spectral response functions. The out-of-band correction was not applied.

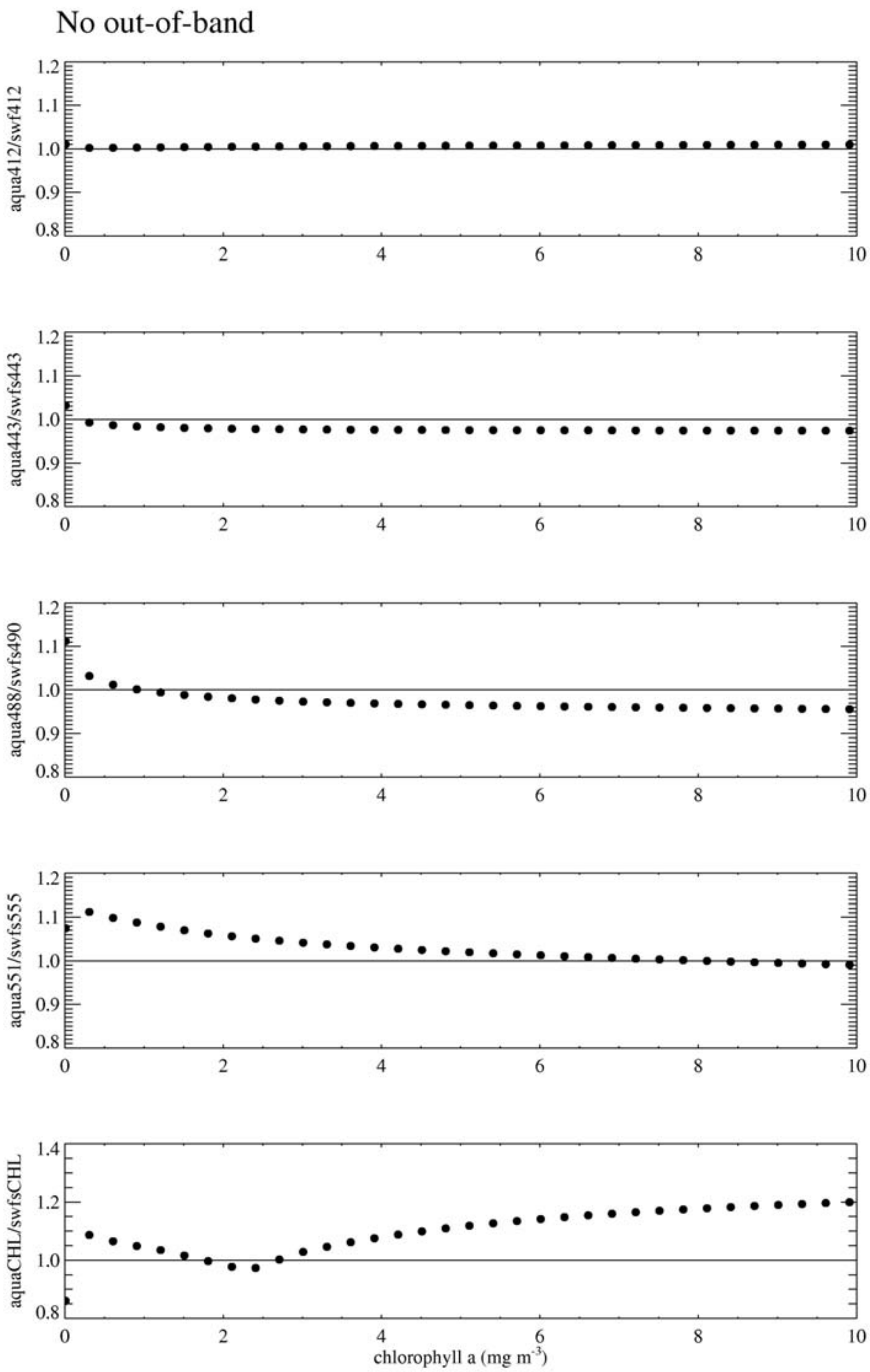


Figure 2. Same as Figure 1, but limited to chlorophyll *a* concentrations of 0.01 to 1.0 mg m^{-3}.

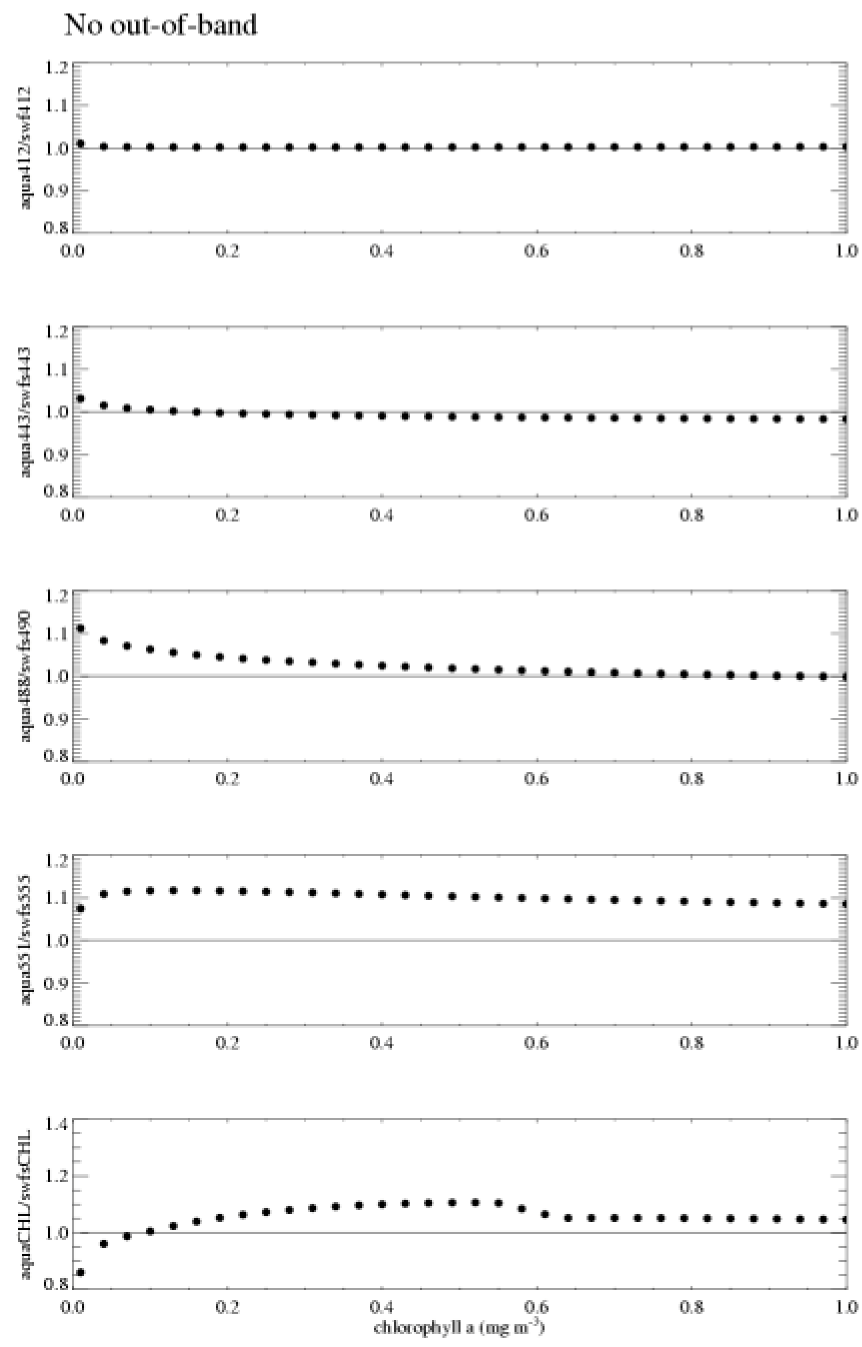


Figure 3. Ratios of SeaWiFS and MODIS/Aqua nL_w's for a variety of different types. Radiances were modeled using the Case 1 model described in Morel and Maritorena (2001) and adjusted using sensor-specific spectral response functions. The out-of-band correction was applied.

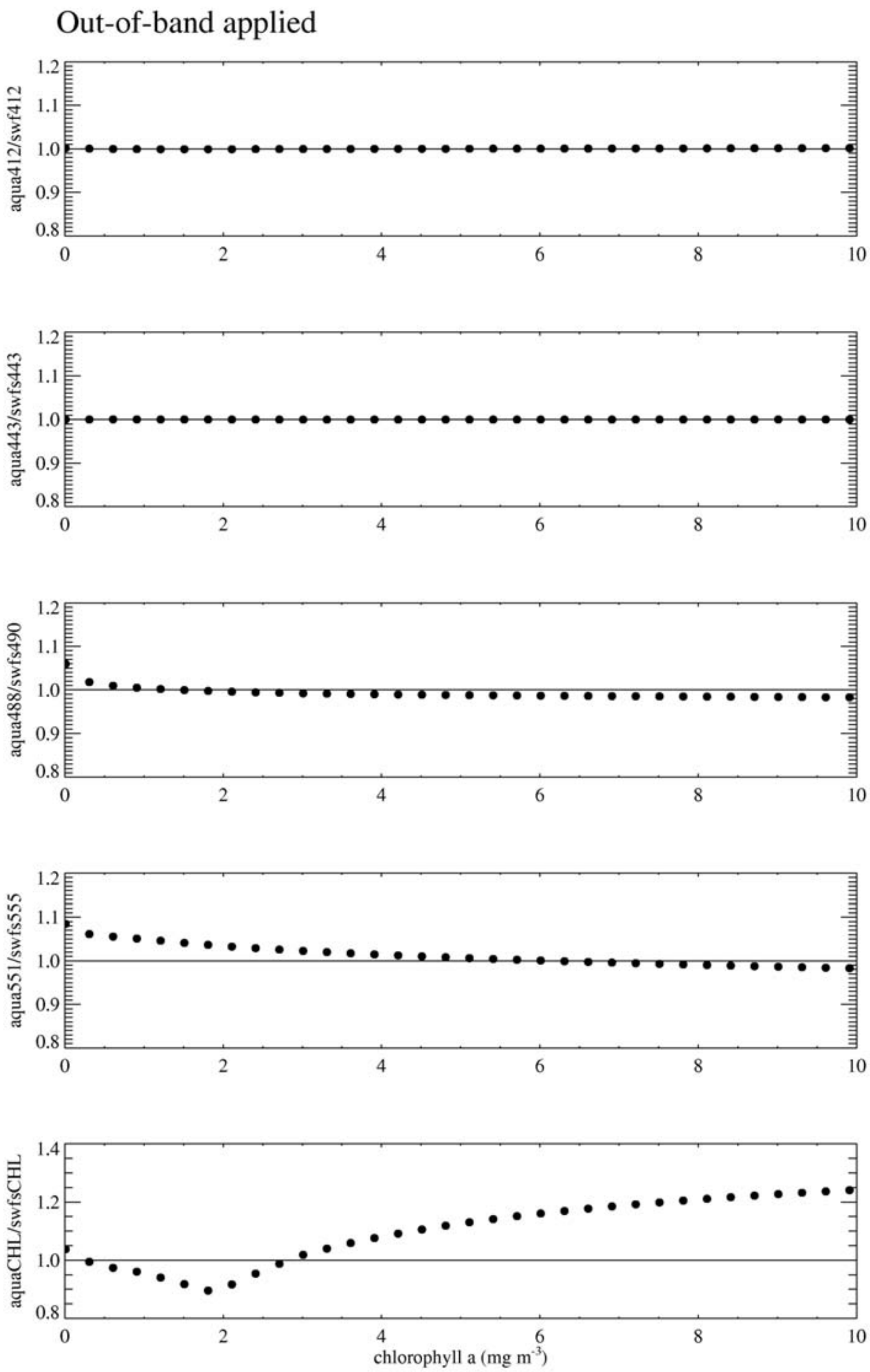


Figure 4. Same as Figure 3, but limited to chlorophyll *a* concentrations of 0.01 to 1.0 mg m^{-3}.

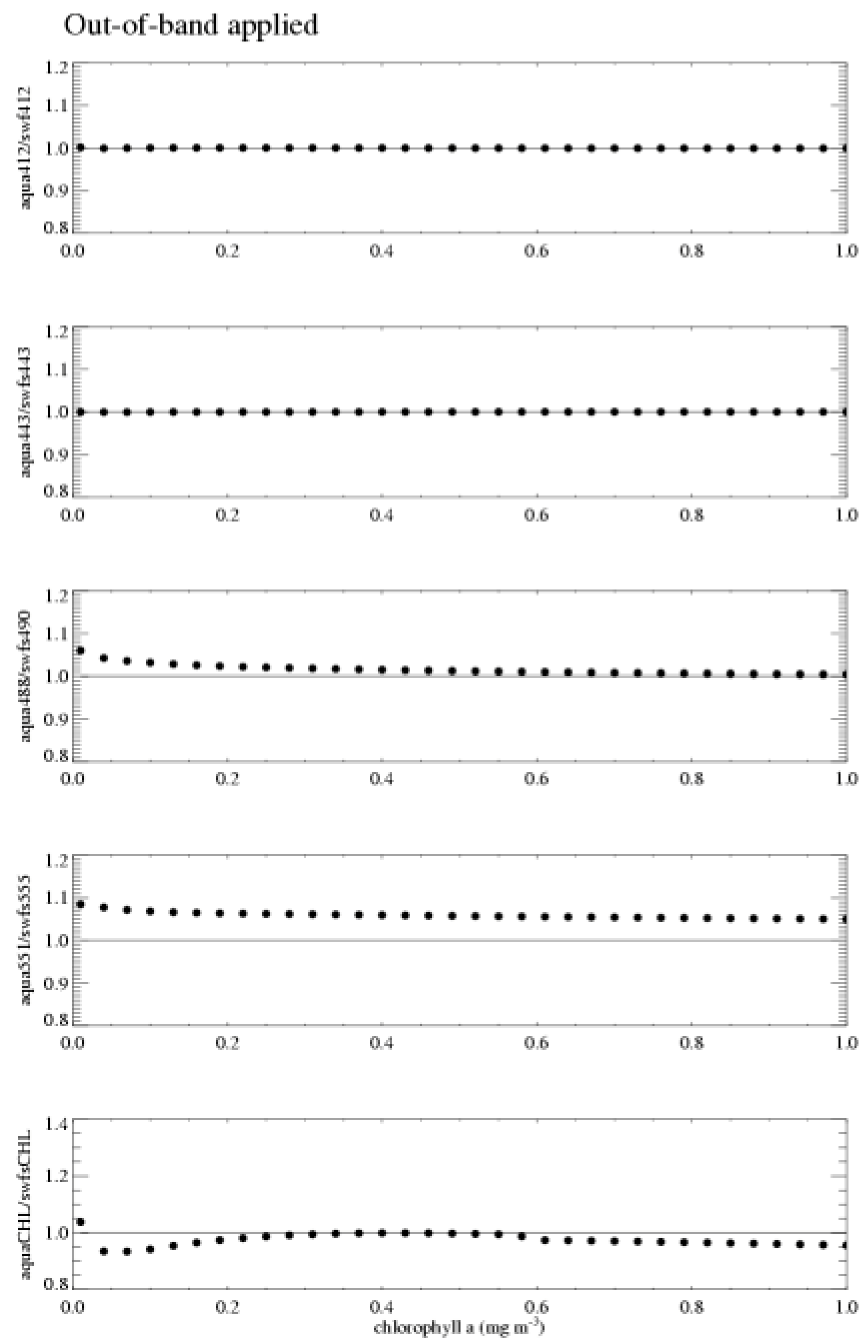


Figure 5. Comparison of OC4v4 and OC3M maximum-band-ratio chlorophyll *a* algorithms for a variety of water types. Input radiances were modeled using the Case 1 model described in Morel and Maritorena (2001).

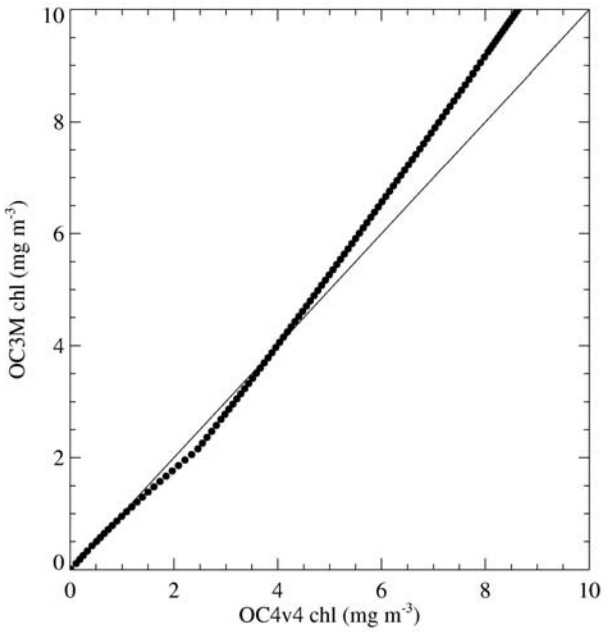
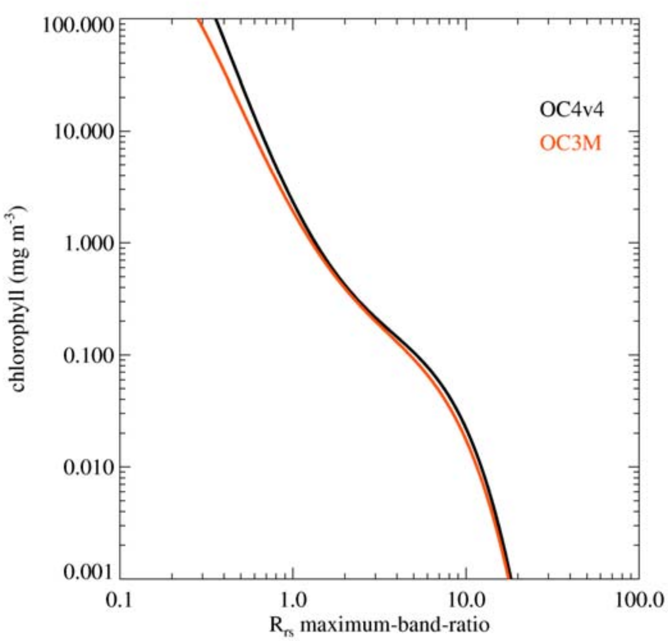


Figure 6. Comparison of the functional forms of the OC4v4 and OC3M maximum-band-ratio chlorophyll *a* algorithms. The R_{rs} maximum-band-ratio calculation for each is described in the main text.



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