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Error introduced by wavelength correction schemes relating reflectance data from different satellite ocean colour missions

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Ocean colour remote sensing gives access to global mapping of marine reflectance RRS, which is considered as an Essential Climate Variable. Its record of continuous coverage has now exceeded 14 years and relies on essentially 4 global satellite missions, SeaWiFS, MODIS on-board Terra and Aqua, and MERIS. Climate studies require that reflectance measurements from different missions are consistent, and particularly that inter-mission biases are minimized. But the quantification of those biases for reflectance is in itself an issue, considering that the wavelength set of the satellite missions differ significantly, with differences between closest neighbouring bands of up to 20 nm. The direct comparison of reflectance data from different missions thus requires an initial first step in which band shift corrections are applied. Band shift can also be used in the context of data merging.

Band shift correction has been typically performed using a bio-optical model. Inherent optical properties (IOPs) are first derived from RRS at specific wavelengths associated with a satellite mission, and then expressed at the wavelengths of another mission using assumed spectral shapes. Finally, output RRS at these wavelengths are computed applying the bio-optical model in forward mode. This study investigates the errors on output reflectance spectra that can be introduced by such band shift corrections.

This assessment requires a hyper-spectral reflectance data set which is here generated using the Hydrolight radiative transfer model at a 1-nm resolution. The simulated conditions are defined by the test cases of the International Ocean Colour Coordinating Group (IOCCG) algorithm inter-comparison working group, which represent a broad range of optical water types. The algorithm adopted to derive IOPs is the Quasi-Analytical Algorithm (QAA). The error associated with the band shift correction is quantified by comparing corrected and simulated RRS for all cases of spectral shifts required to relate the fore-mentioned satellite missions. The error can be significantly higher than 1%, and depends on the optical conditions and the wavelength pair considered. The error also tends to be higher in conditions usually found in coastal waters, which underlines that band shift is particularly relevant for these regions. The source of these errors is analysed and the implications for the generation of a consistent multi-mission data record are discussed. This work contributes to the Ocean Colour Climate Change Initiative of the European Space Agency.