Development and validation of an optically-based technique for merging water leaving radiances from ocean colour remote sensing

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In recent years, the ocean color data record has gained in quality and time span. Moreover, concurrent missions have been available, making the merging of products from various sensors a necessary step to create a long term consistent time series with an optimal spatial and temporal coverage. Here, an optically-based technique is presented that produces merged spectra of normalized water leaving radiance L_{WN}, the primary geophysical ocean colour product. The technique is based on a two-step procedure. First, the spectra of concurrent L_{WN} from the available sensors are ingested into a bio-optical model. Then, the model is applied in forward mode using the inherent optical properties obtained from the inversion. The assumption that the final output L_{WN} does not depend significantly on the parameters selected in the bio-optical model is checked. There are several advantages to the method. It combines all spectral information available from different sensors in a spectrally consistent way, and the set of output wavelengths can be selected to match the sensor specific channels or the wavelengths of field radiometers for validation purposes. By producing a merged spectrum of L_{WN}, this technique keeps the door open to the subsequent application of any bio-optical model deemed suitable for a given region.

The technique is first applied to SeaWiFS and MODIS-Aqua data selected and intercompared for the site of the Acqua Alta Oceanographic Tower in the northern Adriatic Sea, where a 3-year time series of L_{WN} field measurements has been derived from autonomous above-water radiometry. More than 200 match-ups between sensor specific and field L_{WN} have been obtained for both satellite products. Moreover, this data set allows the validation analysis of the merging technique to rely on a unique set of 91 match-ups for which SeaWiFS and MODIS data are available together with field measurements. The mean relative absolute difference is 24%, 17% and 25% for L_{WN} at 413, 440 and 674 nm, respectively, and around 10% for L_{WN} at 500 and 555 nm. These uncertainties are comparable to those obtained for sensor specific match-ups, underlining the validity of the method. Examples merging products from additional sensors, namely MERIS and GLI, are also presented. Finally, the method is applied to derive maps of merged L_{WN} for the Adriatic Sea.