

Variability of Photosynthetically Usable Radiation in River-Dominated Coastal Waters

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Abstract: The present study considers, through the implementation of an optical river typology, the effect of the optical characteristics of different river plumes on estimates of Photosynthetically Available and Usable Radiation (PAR and PUR).

The global distribution of waters influenced by the input of rivers is determined through the use of an Index of Fluvial Influence (IFI), which uses climatological salinity fields and hydrograph data for the world's 60 largest rivers.

This IFI map is used as a template to extract spectral radiance data from ocean colour sensors. The radiance data is then analyzed using a fuzzy logic based classification scheme where the resulting classes are intended to represent the optical water types of globally distributed rivers. Each dataset of spectra clustered through the above classification, are inverted based on a non-linear optimization routine and a multi-component reflectance model including bi-directional effects. A second non-linear optimization method using a published reflectance model was also included for comparison.

The retrieved variables (backscattering coefficient at 555 nm, absorption of detrital material at 443nm and the concentration of chlorophyll) provide the "typical" optical

characteristics of the different water types to be used in the subsequent analysis.

Typical Inherent Optical Properties (IOP) distributions and representative surface PAR distribution for sub-polar, temperate and tropical regimes are used to estimate euphotic zone integrated PAR and PUR for the differing river optical water types.

The effects of the IOPs in the differing water types affect two main aspects of PAR and PUR determination. The first influence is through the diffuse attenuation coefficient and thus the estimated euphotic depth itself, the second is the effect the relative proportions of different IOPs have on the conversion of downwelling irradiance to scalar irradiance (the relevant quantity for photosynthesis). Under certain, demonstrated, condition these two influences actually can counteract each other. Examples of high-resolution imagery, processed to retrieve derived PAR and PUR for three specific river plumes (Mississippi, Yangtze and Po), are also presented. Finally based on the above described sensitivity analysis, and using generic formulations for photosynthetic parameters, the impact of erroneously not accounting for the optical properties of river plumes in global calculations of primary production are estimated.