Marine chlorophyll fluorescence from high spectrally resolved satellite measurements

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When chlorophyll molecules absorb light, most of this energy is transformed into chemical energy in a process of photosynthesis. However, a fraction of the energy absorbed is re-emitted as fluorescence. Hence, as a result of its relationship to photosynthetic efficiency, information about chlorophyll fluorescence can be used to assess the physiological state of phytoplankton.

Here, we present a satellite remote sensing approach to observe marine chlorophyll fluorescence, based on the Differential Optical Absorption Spectroscopy (DOAS) technique applied to the hyperspectral data from SCIAMACHY and GOME-2. Since fluorescence, as a trans-spectral process, leads to the shift of the wavelength of the radiation, it can be observed in the filling-in of Fraunhofer lines. In our retrieval, we evaluate the filling-in of the Zeeman triplet Fraunhofer line Fe I at 684.3 nm, which is located very close to the emission peak of marine fluorescence (~685 nm).

Our fluorescence results from SCIAMACHY show similar spatial patterns when compared to the MODIS nFLH. It demonstrates that it is feasible to detect the weak fluorescence signal from the oceans within hyperspectral data from satellite measurements. The method presented is generic and can be applied to other spectral windows and instruments in the future.