**Chlorophyll fluorescence lifetimes in the ocean and phytoplankton physiology inferred from space**

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Variable chlorophyll fluorescence is the most sensitive, non-destructive signal detectable in the upper ocean that reflects instantaneous phytoplankton photophysiology. Over the past two decades, many hundreds of thousands of discrete *in situ* measurements of variable fluorescence have been made using active ship-based fluorometers. These instruments have been used to follow phytoplankton photophysiology in response to iron fertilization, across eddies along meridional transects, and many other phenomena. With the launch of the MODIS and MERIS satellites, which possess the capability of detecting solar induced chlorophyll fluorescence signals from the global ocean, it became theoretically possible to calculate the quantum yield of chlorophyll fluorescence from space. However, it is impossible to directly verify the relationship between solar induced fluorescence yields retrieved from satellite-based observations and the photophysiological status of phytoplankton based on the signals obtained from conventional active fluorometers. One solution to this problem is to measure chlorophyll fluorescence lifetimes *in situ*. Fluorescence lifetimes are inherently related to the absolute quantum yield of fluorescence. Here we provide the first extensive measurements of chlorophyll fluorescence lifetimes *in situ* in the global ocean and compare them with satellite-based retrievals to understand the variability in phytoplankton physiology in the global ocean.

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