Detection of Inhibition of Photosynthesis in Natural Assemblages of Lake Erie Phytoplankton by Short Exposures to Sunlight using Chlorophyll Fluorescence.

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The kinetics of inhibition and recovery of photosynthesis were examined in Lake Erie phytoplankton exposed to sunlight. Natural assemblages of phytoplankton from 5m depth were collected from several different sites on Lake Erie and exposed to sunlight for up to two hours. To estimate the relative effectiveness of PAR, UVA and UVB wavelengths, sunlight was filtered through plastic films with different cutoff wavelengths to create three light treatments (PAR, PAR+UVA, PAR+UVA+UVB). Following exposure to sunlight, samples of phytoplankton were either analyzed immediately or incubated in low light conditions to allow recovery. The parameters Fv/Fm, the maximum efficiency of PSII electron transport, and * F/Fm', the yield of steady-state photosynthetic electron transport, were measured rapidly from phytoplankton using pulse amplitude modulated chlorophyll fluorescence. Exposures to full sunlight resulted in almost complete inhibition of electron transport within 30min. The kinetics of inhibition and the relative contributions of PAR, UVA and UVB were quantified by fitting the observed inhibition to a model describing photoinhibition as a function of the weighted cumulative irradiance received by phytoplankton. For each of the Lake Erie stations sampled, the model predicted the observed inhibition well (R2 > 0.8). The broadband weighting coefficients estimated by the model attributed most photoinhibition to UVB in two of the three stations. UVA was also responsible for a substantial portion of the observed inhibition. PAR wavelengths inhibited electron transport less than 25% in all cases. The data were best described by a model incorporating rapid inhibition kinetics and slower recovery kinetics. Thus, UVB which accounts for only 1% of the total fluence of sunlight, accounted for most of the photodamage.