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Relationship of trophic and chemical conditions to photobleaching of dissolved organic matter in lake ecosystems

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Abstract. Dissolved organic matter (DOM) is a major light-absorbing substance, responsible for much of the color in water bodies. When sunlight energy is absorbed by DOM, some color can be lost by the process of photobleaching. We measured rates of DOM photobleaching in thirty lakes that varied greatly in color, trophic status and ionic composition. Loss of color (measured as absorbance at 440 nm and expressed as absorption coefficients) was a first order function of sunlight dose, and rates were nearly identical for 0.2 μm- and GF/F-filtered samples suggesting that the process was predominantly abiotic. Photobleaching rates were rapid (color loss of 1–19% d^{-1}) and varied about seven-fold among lakes. Our method underestimated the actual rate by 15–20% based on comparisons between the glass bottles we used in the survey and quartz containers. The large variation in photobleaching rates was examined in relation to lake trophy and chemical conditions. The best predictor of this variability was acid-neutralizing capacity (ANC) ($r^2 = 0.94$; $p < 0.001$) such that photobleaching was most rapid in the most alkaline lakes. The relationship between ANC and photobleaching suggests that differences in ionic conditions among lakes may influence the solubility and configuration of humic and fulvic acids and hence their susceptibility to photobleaching.