Lake Erie and the Potential Consequences of Enhanced Levels of Ultraviolet Radiation for Phytoplankton Production.

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Recent observations of decreasing concentrations of stratospheric ozone in the northern mid-latitudes have heightened concerns about the potential impacts of elevated ultraviolet radiation (UV-R) on temperate freshwater ecosystems. These decreases in stratospheric ozone levels coupled with the changes in water clarity Lake Erie has experienced due to nutrient loading restrictions and Dreissena sp. invasion, may reduce primary production in this large lake and have cascading effects up the food chain. In this study, the impact of UV-R on phytoplankton primary production was investigated in Lake Erie in 1997 and 1998 to explore the kinetics of photoinhibition by UV-R and assess the validity of current predictive radiation models. Carbon incorporation rates were monitored over time in lake water samples exposed to different spectral radiation treatments and biological weighting functions (BWF) were derived that quantify biological effects of UV-R as a function of wavelength. The inhibition response of photosynthesis was typically a non-linear function of weighted cumulative radiation rather than weighted instantaneous irradiance. However, in some experiments neither cumulative exposure or irradiance was very successful in describing the photoinhibitory response of the phytoplankton community. We propose here a new radiation model that incorporates both weighted UV-R dose and dose rates and allows the statistical estimation of damage and repair constants. The impacts of UV-R on Lake Erie phytoplankton communities will be estimated for a variety of UV scenarios using the predictive radiation models in conjunction with water column mixing models.