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Experimental assessment of UV effects on temperate marine phytoplankton when exposed to variable radiation regimes

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Abstract

Phytoplankton samples were collected at Bahía Engaño, Chubut, Argentina (43°S, 65°W) at different times of the year to assess the combined effect of ultraviolet radiation (UVR, 280–400 nm) and vertical mixing (i.e., the depth of the upper mixed layer, UML) on photosynthesis. Samples were exposed to fixed and fluctuating radiation regimes in an illuminated chamber at 15°C (photosynthetically available radiation [PAR] = 66 W m^{-2}; UV-A = 15.3 W m^{-2}; UV-B = 0.7 W m^{-2}), receiving either PAR + UVR or PAR only. A comparison between fixed and rotating systems showed that when $Z_{UML}/Z_{Eu} = 0.6$ (i.e., 60% of the euphotic zone [Eu] was mixed), only postbloom assemblages (codominated by nanoplanktonic flagellates and diatoms [*Chaetoceros* spp.]) were affected significantly by UVR. Integrated carbon fixation values during pre- and postbloom periods were higher under mixed conditions than under fixed irradiances. However, during the bloom (dominated by the microplanktonic diatom *Odontella aurita*), phytoplankton exposed to fluctuation radiation regimes had lower integrated carbon fixation. When postbloom samples were exposed to different mixing conditions, integrated UVR-induced inhibition reduced carbon fixation by 11–13% when $Z_{UML}/Z_{Eu} = 0.6$, whereas when $Z_{UML}/Z_{Eu} = 0.91$, carbon fixation increased by 7–12%. The differences in responses observed between prebloom, bloom, and postbloom samples can be attributed to a number of factors, such as the light history of cells, taxonomic composition, and size structure of the community and most probably reflect the different inhibition kinetics of these assemblages.