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# Impact of Solar Ultraviolet Radiation on Marine Phytoplankton of Patagonia, Argentina¶

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## ABSTRACT

**Patagonia area is located in close proximity to the Antarctic ozone "hole" and thus receives enhanced ultraviolet B (UV-B) radiation (280–315 nm) in addition to the normal levels of ultraviolet A (UV-A; 315–400 nm) and photosynthetically available radiation (PAR; 400–700 nm). In marine ecosystems of Patagonia, normal ultraviolet radiation (UVR) levels affect phytoplankton assemblages during the three phases of the annual succession: (1) prebloom season (late summer–fall), (2) bloom season (winter–early spring) and (3) postbloom season (late spring–summer). Small-size cells characterize the pre- and postbloom communities, which have a relatively high photosynthetic inhibition because of high UVR levels during those seasons. During the bloom, characterized by microplankton diatoms, photosynthetic inhibition is low because of the low UVR levels reaching the earth's surface during winter; this community, however, is more sensitive to UV-B when inhibition is normalized by irradiance (*i.e.* biological weighting functions). *In situ* studies have shown that UVR significantly affects not only photosynthesis but also the DNA molecule, but these negative effects are rapidly reduced in the water column because of the differential attenuation of solar radiation. UVR also affects photosynthesis *versus* irradiance (P *vs* E) parameters of some natural phytoplankton assemblages (*i.e.* during the pre- but not during the postbloom season). However, there is a significant temporal variability of P *vs* E parameters, which are influenced by the nutrient status of cells and taxonomic composition; taxonomic composition is in turn associated with the stratification conditions (*e.g.* wind speed and duration). In Patagonia, wind speed is one of the most important variables that conditions the development of the winter bloom by regulating the depth of the upper mixed layer (UML) and hence the mean irradiance received by cells. Studies on the interactive effects of UVR and mixing show that responses of phytoplankton vary according to the taxonomic composition and cell structure of assemblages; therefore cells use UVR if >90% of the euphotic zone is being mixed. In fact, cell size plays a very important role when estimating the impact of UVR on phytoplankton, with large cells being more sensitive when determining photosynthesis inhibition, whereas small cells are more sensitive to DNA damage. Finally, in long-term experiments, it was determined that UVR can shape the diatom community structure in some assemblages of coastal waters, but it is virtually unknown how these changes affect the trophodynamics of marine systems. Future studies should consider the combined effects of UVR on both phytoplankton and grazers to establish potential changes in biodiversity of the area.**

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*Abbreviations:* α, light limited slope; ß, photoinhibition parameter; BWF, biological weighting function; chl *a*, chlorophyll *a*; CPD, cyclobutane pyrimidine dimer; DOC, dissolved organic carbon; DU, Dobson unit; $E_k$, light saturation parameter; $K_d$, attenuation coefficient; MAA, mycosporine-like amino acid; PAR, photosynthetically available radiation; $P_{max}$, maximum rate of carbon fixation; P *vs* E, photosynthesis *versus* irradiance; TOMS, Total Ozone Mapping Spectrometer; μ, growth rate; UML, upper mixed layer; UV-A, ultraviolet A radiation; UV-B, ultraviolet B radiation; UVR, ultraviolet radiation; $Z_{EU}$, depth of the euphotic zone; $Z_{UML}$, depth of the upper mixed layer.