Comparative responses of two dominant Antarctic phytoplankton taxa to interactions between ocean acidification, warming, irradiance, and iron availability

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ABSTRACT: We investigated the responses of the ecologically dominant Antarctic phytoplankton species *Phaeocystis antarctica* (a prymnesiophyte) and *Fragilariopsis cylindrus* (a diatom) to a clustered matrix of three global change variables (CO_2, mixed-layer depth, and temperature) under both iron (Fe)-replete and Fe-limited conditions based roughly on the Intergovernmental Panel on Climate Change (IPCC) A2 scenario: (1) Current conditions, 39 Pa (380 ppmv) CO_2, 50 μmol photons m^{-2} s^{-1} light, and 2° C; (2) Year 2060, 61 Pa (600 ppmv) CO_2, 100 μmol photons m^{-2} s^{-1} light, and 4° C; (3) Year 2100, 81 Pa (800 ppmv) CO_2, 150 μmol photons m^{-2} s^{-1} light, and 6° C. The combined interactive effects of these global change variables and changing Fe availability on growth, primary production, and cell morphology are species specific. A competition experiment suggested that future conditions could lead to a shift away from *P. antarctica* and toward diatoms such as *F. cylindrus*. Along with decreases in diatom cell size and shifts from prymnesiophyte colonies to single cells under the future scenario, this could potentially lead to decreased carbon export to the deep ocean. Fe : C uptake ratios of both species increased under future conditions, suggesting phytoplankton of the Southern Ocean will increase their Fe requirements relative to carbon fixation. The interactive effects of Fe, light, CO_2, and temperature on Antarctic phytoplankton need to be considered when predicting the future responses of biology and biogeochemistry in this region.

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