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Chlorophyll time series in response to ozone, visible and ultraviolet irradiance in Antarctic coastal waters

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The western Antarctic Peninsula is a region with rapid climate warming during the last 60 years and which has been exposed to low stratospheric ozone concentrations since the mid 1980's. The combination of these factors is known to change spring sea ice distribution and increase meltwater from glaciers. Marine phytoplankton growth is sensitive to these factors that affect water column stability and light penetration. Growth starts in austral spring at the time of decreasing stratospheric ozone concentrations. What is the response of phytoplankton to these changing environmental factors? Is the higher exposure to increased Ultraviolet Radiation (UVR) affecting its annual cycle? To answer these questions we analyzed phytoplankton data (as chlorophyll a, chla) from a 13-year time series (1995 - 2007) at Arthur Harbor, Anvers Island, Antarctica (64.5^{o} S, 64.5^{o} W) obtained weekly at 6 m depth. The annual cycle is characterized by a maximum at the end of January (3.14 mg chla m^-3) and a minimum in July (0.08 mg chla m^-3). There is a lag between irradiance and chla accumulation in spring that could correspond to slow phytoplankton growth, characteristic of low temperature. Based on daily irradiances, a significant negative correlation is observed for phytoplankton abundance with ozone for lags between 4 and 21 days, while the response is positive to UV-B and UV-B/UV-A irradiances and maximum daily water temperature. Not all responses are related to localized conditions. A significant negative correlation is observed in response to planetary indices, such as the El Niño 1.2 Index, with a lag of 4 - 6 months. These results suggest that in time scales of weeks, lower stratospheric ozone conditions could have a positive effect on phytoplankton growth in Antarctica.