The effects of temperature and ultraviolet radiation (UVR; 280–400 nm) on seasonal succession in phytoplankton assemblages of Patagonia (Argentina) were studied in the context of global change. Samples collected during pre-bloom, bloom onset, bloom, and spring were exposed to in situ and increased (+4°C) temperatures and solar radiation with and without UVR. Daily cycles of effective photochemical quantum yield exhibited a pattern of high values in the morning, decreasing towards noon, and increasing in the afternoon. The decrease in yields towards noon as the season progressed increased from 30% in the pre-bloom to 80% in the spring; in the latter there were significant differences between radiation treatments under both temperature conditions. The highest inhibition rates were during the bloom, whereas the highest recovery rates were during the spring. Inhibition rates were generally higher in treatments exposed to UVR in comparison to photosynthetically active radiation–only treatments and some stages of the succession exhibited an additional temperature effect. Increasing temperatures had little effect on pre-bloom communities but helped to counteract the magnitude of the yield decrease during the bloom onset. However, during the bloom and in the spring, temperature and UVR acted synergistically, increasing the overall photochemical inhibition. Feedback mechanisms of increased temperatures causing a shallower mixing depth will expose phytoplankton to higher radiation, which will have a negative effect on the bloom and on spring assemblages. Due to the differential effects of solar UVR and increased temperature on phytoplankton, future studies should consider the repercussions on higher trophic levels.