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The potential macroalgae habitat shifts in an Antarctic Peninsula fjord due to climate change

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The Western Antarctic Peninsula (WAP) region is one of the most rapidly warming on earth since the last 50 yr. The WAP glaciers currently contribute one third of the melt water to global sea level rise. Climate warming is supposed to induce important changes in polar ecosystems, from microbial communities to apex predators' levels. Macroalgae are the main biomass producers in Potter Cove located at King George Island, the biggest island of the South Shetland Arc. They are sensitive to climate change factors such as suspended particulate matter (SPM). Macroalgae presence and absence data were used to test SDMs suitability and, simultaneously, to assess the environmental response of macroalgae as well as to model four scenarios of distribution shifts by varying SPM conditions due to climate change.

Species distribution models (SDM) predict species occurrence based on statistical relationships with environmental conditions. The R-package 'biomod2' which includes 10 different SDM techniques and 10 different evaluation methods was used in this study. According to the averaged evaluation scores of Relative Operating Characteristics (ROC) and True scale statistics (TSS) by models, those methods based on a multitude of decision trees such as Random Forest and Classification Tree Analysis, reached the highest predictive power followed by generalized boosted models (GBM) and maximum-entropy approaches (Maxent). The final ensemble model (EM) used 135 of 200 calculated models (TSS > 0.7) and identified hard substrate and SPM as the most influencing parameters followed by distance to glacier, total organic carbon (TOC), bathymetry and slope. The modeled current status of macroalgae distribution results in only 18.25% of earlier estimated areas populated by macroalgae in Potter Cove. The climate change scenarios show an invasive reaction of the macroalgae in case of less SPM and a retreat of the macroalgae in case of higher assumed SPM values.