Quantifying the potential predictability of Arctic marine primary production

Phytoplankton in the Arctic Ocean and sub-Arctic seas support a rich marine food web that sustains Indigenous communities as well as some of the world's largest fisheries. As sea ice retreat leads to further expansion of these fisheries, there is growing need for predictions of phytoplankton net primary production (NPP), which will likely allow better management of food resources in the region. Here, we use perfect model simulations of the Community Earth System Model version 2 (CESM2) to quantify the potential upper limit short-term (month to 2 year) predictability of Arctic Ocean NPP. Our results indicate that NPP is potentially predictable during the most productive summer months for at least two years, largely due to the highly predictable Arctic shelves where fisheries in the Arctic are projected to expand. Sea surface temperatures, which are an important limitation on phytoplankton growth and also are predictable for multiple years, are the most important physical driver of this predictability. Finally, we find that the predictability of NPP in the 2030s is enhanced relative to the 2010s, indicating that the utility of these predictions may increase in the near future. This work indicates that Earth system models may provide skillful predictions of NPP in the Arctic, possibly aiding in the management of Arctic marine resources.

Courtney Payne, Nicole Lovenduski, Marika Holland, Kristen Krumhardt, Alice DuVivier