NASA MUREP/SMD Ocean Biology and Biogeochemistry Awards (OCEAN)

Title: Enhancing Ocean color remote sensing tools to better constrain fisheries forecasting models in a critical subarctic system

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Summary: Phytoplankton represent the fundamental food source for higher trophic level marine animals. As ocean warming continues, certain areas are likely to become increasingly stratified, which is linked to phytoplankton communities dominated by smaller cells. These communities create longer food chains, and ultimately, decreased biomass at higher trophic levels (i.e., fish). These threats are amplified in the Northern Gulf of Alaska (NGA), which hosts one of the richest fisheries in the nation, while also exhibiting a warming trend nearly twice the global average, and rapid freshening due to glacial melt. Recent studies also point to alterations in the NGA's spring phytoplankton bloom, which may have cascading impacts to higher trophic levels. Despite these concerns, creating links between long-term changes in the phytoplankton community and recruitment of important fish species like salmon and groundfish, remains a significant challenge. Preliminary satellite analyses and long-term records of phytoplankton size data reveal evidence of recent climate-driven shifts in both phytoplankton community composition (PCC) and spring bloom phenology. Building on these findings, and leveraging our team's collective resources and expertise, the goal of this project is to integrate shipboard observations and ocean color remote sensing into quantitative analyses of climate-driven variability at the base of the marine food chain and assess the potential impacts of these changes to groundfish and salmon stocks.

The proposal is based on several hypotheses related to the food chain: with ocean warming certain areas in the ocean are likely to become increasingly stratified, which is linked to phytoplankton communities dominated by smaller cells, longer food chains and ultimately decreased fish stocks; these threats are amplified in the Northern Gulf of Alaska (NGA) with a warming trend twice as strong as the global average; there are also alterations to spring phytoplankton blooms; size fractionated chlorophyll (Chl) dataset will be evident in ocean color (OC) records. Thus, the project objectives include the development of regional bio-optical relationships for Chl, carbon to chlorophyll (C:Chl) and productivity, assessment of uncertainties in OC algorithms for the NGA, evaluation of patterns and drivers of variability in phytoplankton community composition and spring bloom phenology and incorporation of these metrics into fisheries forecast models, specifically for fish species like salmon and groundfish. The project includes bio-optical field measurements and analysis of the satellite data, which will be compared with size – fractionated Chl record. The project will have opportunities for graduate and undergraduate students, including a partnership with Tamamata, a program led by Indigenous fisheries experts to train the next generation of Indigenous fisheries scientists. One high school classroom of Indigenous will be engaged in Students Observing Sikuliaq Satellite Information (SOSSI), with activities that track the spring Sikuliaq cruise and include matchup analyses between satellite imbio-optical data. The Tamamta fellow will lead this engagement.