

A key role for DON remineralization in Arctic sea ice primary production

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Sea ice (sympagic) algae provide a key source of primary carbon production in Arctic waters, particularly during winter and early spring. In addition, there is growing evidence that this primary production (PP) is tightly coupled with seafloor biogeochemical processes and may be integral in the survival of many polar species, including fish, marine mammals and seabirds. During the current period of rapid climate change, understanding the dynamic role of sympagic algae will provide key insights into the ecological integrity and stability of polar regions. In version 1 of the Energy Exascale Earth System Model (E3SM), we incorporated vertically resolved algal dynamics in MPAS-seaice to better understand coupled constraints on sympagic PP. We confirmed that nitrate plays a key role in driving variability in Arctic sea ice PP. However model biases in ocean surface nitrate and structural biases in the assumed sea ice nitrogen cycle greatly limited our model's predictive capability (Jeffery et al. 2020). In version 2 of E3SM, we have improved the sympagic nitrogen cycle by adding remineralization of dissolved organic nitrogen (DON) and nitrification of ammonium. Preliminary model results show significant improvements in the magnitude and timing of Arctic sea ice algal PP over the v1 model and indicate that these additional sources of remineralized nitrogen may be critical drivers of sympagic PP throughout the Arctic.