Analysis of initial results of coupling ocean and sea ice biogeochemistry in the high-resolutions Regional Arctic System Model

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Arctic marine biogeochemistry (mBGC) is strongly dependent on the local processes and dynamics of both the sea ice and the upper ocean as well as their interaction. However, high-resolution coupled modeling of Arctic climate and biogeochemistry has been limited so far. This has been due partly to model limitations in representing small-scale processes relevant to mBGC in sea ice and upper ocean, and partly to large computational requirements needed to explicitly resolve such features and their coupling. The Regional Arctic System Model (RASM) has been recently expanded with mBGC components in the ocean and sea ice models to address some of these limitations. In particular, the latest "Column Package" version of the Los Alamos National Laboratory sea ice model (CICE), including sophisticated representation of mBGC, has been implemented in RASM, while an mBGC component has also been added to the Parallel Ocean Program (POP) of RASM. The Column Package includes two options of sea ice mBGC parameterizations: (i) a skeletal layer (SKL) version, which assumes that biology is restricted to a thin layer at the bottom of ice; and (ii) a multi-layer version (ZBGC), which allows for biological activity throughout the ice column.

We will present results from RASM-mBGC simulations, using ocean and sea ice model configurations at increasing spatial resolution and with varying mBGC parameterizations. The relationship between sea ice mBGC, the upper-ocean stratification and nutrient content will be discussed. Water mass and nutrient distributions in the upper ocean will be presented and compared against observations. Finally, we will summarize near-term plans for further RASM-mBGC simulations and expanded areas of inquiry.