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Sensitivity of a one-dimensional, multi-layer, sea ice-microalgae model

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Microalgae grow in brine inclusions in sea ice. Previous sea ice micro-algal models neglect brine-microalgae interactions, prescribing the location of the microbial communities.

In this study, a 1D sea ice model with explicit brine dynamics coupled to a simple nutrient-phytoplankton (N-P) module (diatoms and dissolved silicates) is introduced. The model naturally predicts bottom and surface micro-algal populations. In fall, brine convection in cooling ice supplies nutrients, which favors microalgal growth. In early summer, the vertical brine density profile in warmer ice stabilizes, nutrient supply shuts off, which prevents further biomass building.

Simulated micro-algal growth episodes are strongly sensitive to parameters. Hence, sensitivity of maximum summer biomass to standardized parameter changes are conducted in order to find the main parameters of the model. It is shown that the main parameters involve microalgal growth and decay rates, light adaptation of micro-algae and nutrient quota in micro-algal cells. Physical parameters involving radiative transfer, particularly under snow, are also important. Other parameters are of smaller importance, in particular those involving the absorption of radiation by micro-algae.