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Modeling of small scale processes in Antarctic sea ice - a bio-physical coupled bi-scale approach

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With the established model insight is provided into the small-scale coupled physical processes of freezing and melting sea ice, the connection to the size and distribution of the enclosed brine channels and, furthermore, the coupling to algal growth and the unavoidable impact on the biological carbon pump. However, these dependencies and the porous microstructure of sea ice may be influenced by climatic changes.

The coupled model of an Antarctic sea ice floe mathematically describes the complex coupled relationships between ice formation, nutrient transport, salinity and brine channel distribution, and prospectively photosynthesis and carbonate chemistry. Different scenarios of sea ice formation, its effects on the growth of sea ice algae and their impact on vertical carbon export will be simulated.

For that, the well-established Theory of Porous Media (TPM) provides a suitable tool to formulate a macroscopic continuum-mechanical model of multi-phase, multi-component fluid-saturated porous media, cf. [2], which will be coupled with the phase field model for the early phase of brine entrapment in sea ice by [1].

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