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RIMBAY – A multi-physics 3D ice-sheet model for comprehensive applications: Model-description examples

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Glaciers and ice caps are currently the largest cryospheric contributions to sea level rise. Modelling the dynamics and mass balance of the major ice sheets is therefore an important issue to investigate the current state and the future response of the cryosphere to changing environmental conditions, namely global warming. On the other hand, the Earth's climate history is determined by the evolution of southern and northern hemisphere ice sheets which vary between glacial and interglacial extent during the last million years. For all these demands, a powerful high resolution multi-physics ice sheet model is needed.

Based on the well-known and established ice sheet model by Pattyn (2003) we developed the Higher-Order/Full-Stokes physics thermomechanic ice model RIMBAY, in which we improved the original version in several aspects like a shallow-ice – shallow-shelf coupler and a full 3D grounding-line migration scheme based on the Schoof's analytical approach. Further capabilities address the incorporation of basal hydrology as well as crustal adjustments by viscoelastic processes due to ice loads on long time scales. Different grid representations, a netdcf data-exchange interface, and plug-and-play GMT visualization tools make the RIMBAY package applicable to all conceivable tasks of ice-sheet modeling. Example model-setups and reference models cover almost any order of scales in time or space.

Here, we present results from a variety of model projects investigating, e.g., the flow across subglacial lakes, ice-shelf-ocean interaction with grounding-line migration, and results from coupling RIMBAY to the earth system model COSMOS and to a viscoelastic isostatic adjustment model.