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Challenges in sea ice mechanics research – experimental investigation, theroretical description and numerical simulation Track Number 3000 (Computational Natural Sciences)

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ABSTRACT

The complexity of interacting processes and driving forces within sea ice in the Arctic and Antarctic Oceans poses major challenges in understanding its influence on and interaction with global climate and anthropogenic forcings. The temporal and spatial distribution of sea ice, its mechanical, biological, physical, and geochemical properties are directly related to oceanic and atmospheric variations.

There is a pressing need for experimental studies of sea ice considering the limited data availability. The design of new and improvement of existing experimental methods suitable to validate and verify numerical schemes are of fundamental importance. Moreover, the experimental study, both in the laboratory and in the field, goes hand in hand with satellite data analysis, buoy tracking, and in situ observations.

Likewise, in the area of computational mechanics, the arising challenges are the description of the mechanical, biochemical and physical processes across space and time scales, as well as the treatment of the governing coupled differential equation systems. Moreover, capturing the highly nonlinear material behavior together with all its influencing variables is challenging for both experimentalists as well as thermodynamics experts, demanding their interdisciplinary collaboration. Almost all Earth System Models are based on an (elastic)-viscous plastic rheology. However, solving the model with refined spatial resolution becomes increasingly difficult with progressing sea ice drift and deformation. It has been shown that the numerical convergence of the solver significantly affects the obtained state of deformation. To date, the development of fast and numerically convergent solvers remains a major challenge.

Consequently, determining the characteristic physical, mechanical, and morphological sea ice properties utilizing suitable experiments and accurate reliable computer models predicting the dynamics of the sea ice necessitate a multidisciplinary effort by natural and material scientists as well as engineers. This mini-symposium invites scientists to present their research ideas and developments for characterization, modeling, simulation, and validation of sea ice processes.