First-Order System Least Squares Methods for Sea Ice Models

Steffen Münzenmaier[1], Fleurianne Bertrand[2]

[1] Faculty of Mathematics, University of Duisburg-Essen, [2] Faculty of Mathematics and Natural Sciences, Humboldt-Universität zu Berlin, Germany

In this talk a viscoplastic sea ice model is considered. Sea ice is modelled as a generalized Newtonian compressible fluid, which satisfies a power law. The nonlinearity caused by the power law for the viscosity is severe and requires careful treatment. The talk considers a first-order system least squares method (FOSLS), where the velocity, ice height, ice concentration and the stress are approximated. This approach leads to a nonlinear system of partial differential equations and for the least-squares finite element method to a discrete non-quadratic minimization problem.

The talk addresses the numerical challenges that arise while solving this system. After deriving a proper linearization and discussing fitting approximation spaces, numerical experiments will be presented. Furthermore theoretical results considering the well posedness of the problem will be discussed. The talk also examines the advantages of adaptive refinement in this setting.