A new Finite Elements Framework for Fjord-Iceshelf Interaction (FEFFII)

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May, 2022

Framework goal

- Study dynamics at interface between ice sheets and ocean.

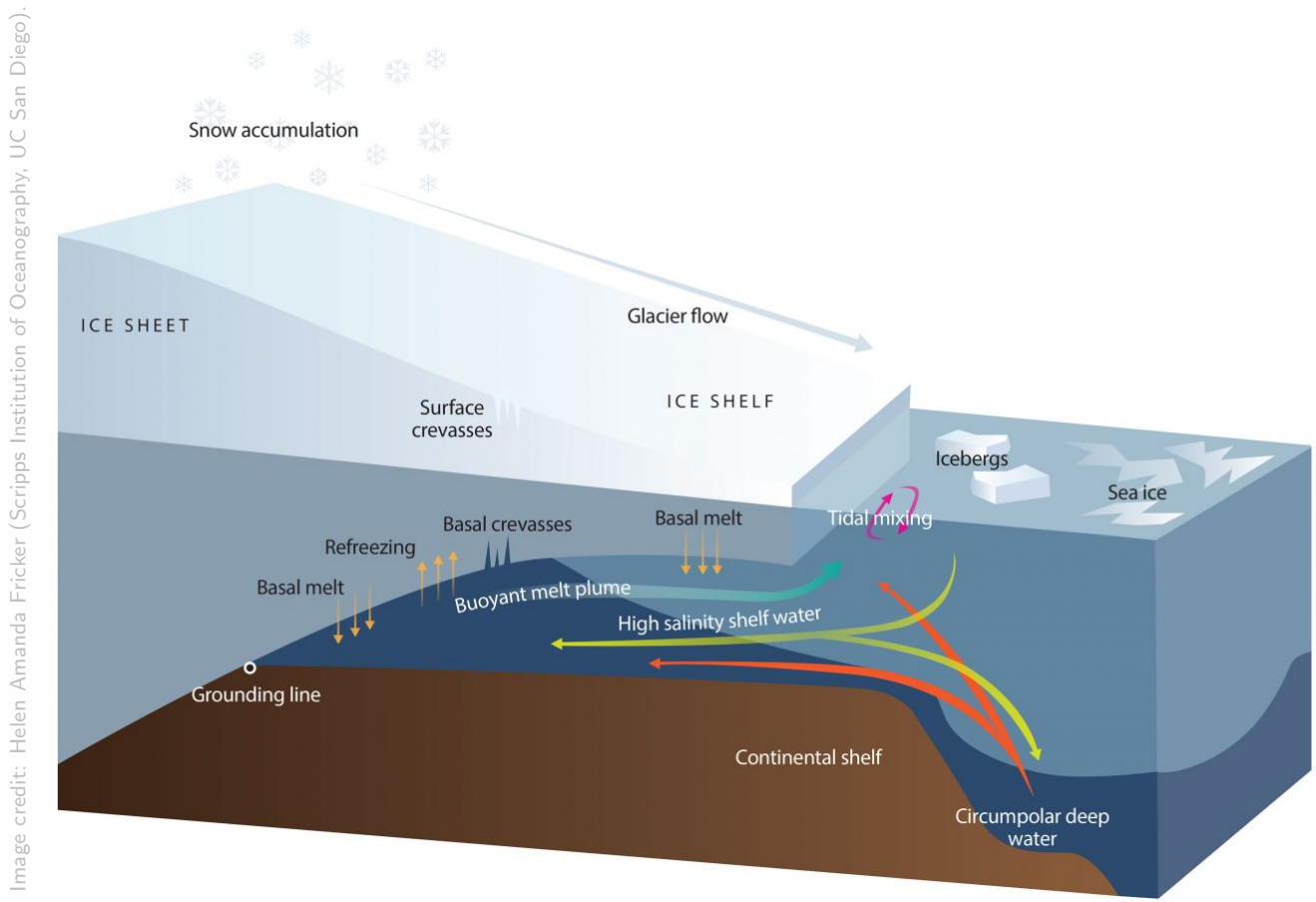


Image credit: Helen Amanda Fricker (Scripps Institution of Oceanography, UC San Diego).

- Project in collaboration with:
  J. Ahlkrona, J. Wiskandt, C. Helanow, I. Koszalka.

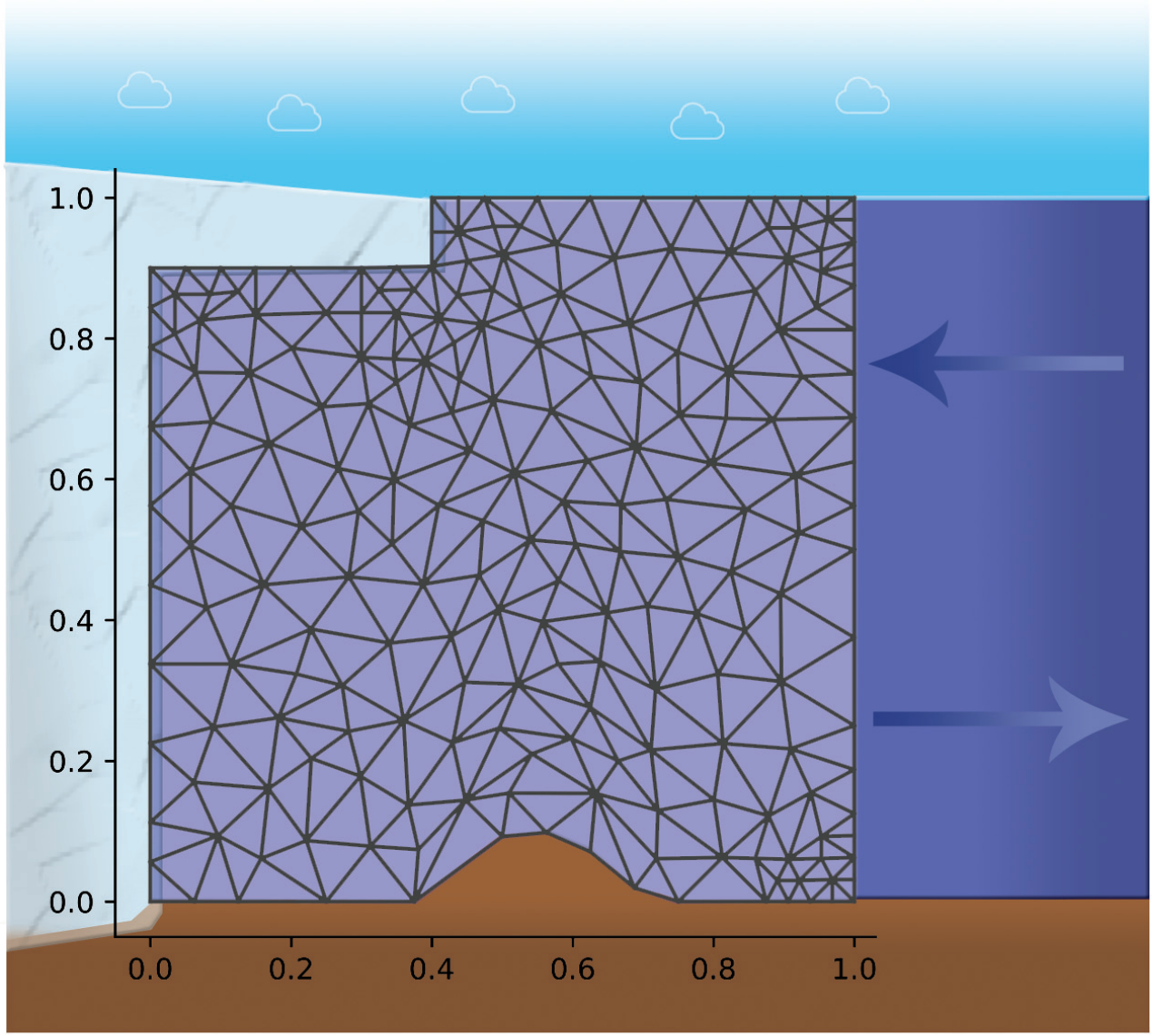
Model equations

- Bousinessq approximation of Navier-Stokes equations with temperature and salinity coupling.
- Ice shelf is enforced through the 3 equations system.

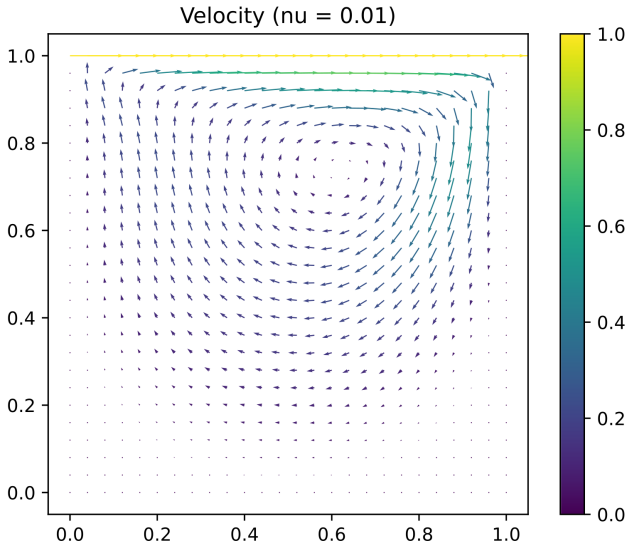
The FEFFII framework

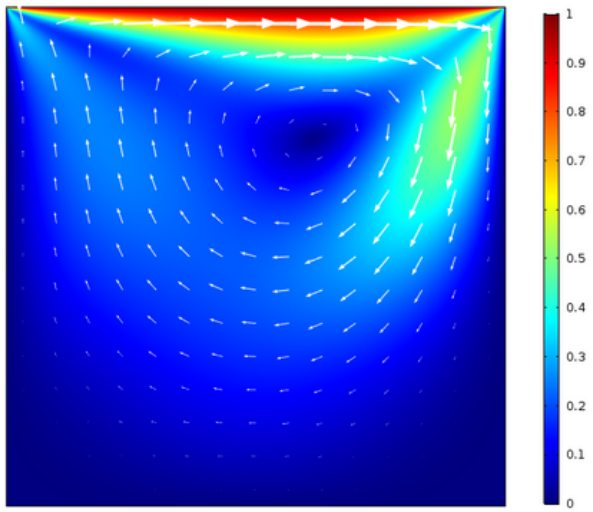
- A Python package (feffii) based on FEniCS
- Use it interactively or with config files
- Stabilization techniques (GLS for Navier Stokes; SUPG for T/S equations) to run lower viscosity/diffusivity scenarios
- Mesh deformation to account for evolving boundaries
- Store solutions and reload them back in afterwards

Domain example



Lid driven cavity, $\nu = 0.01$

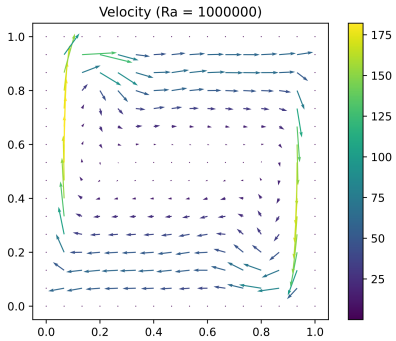


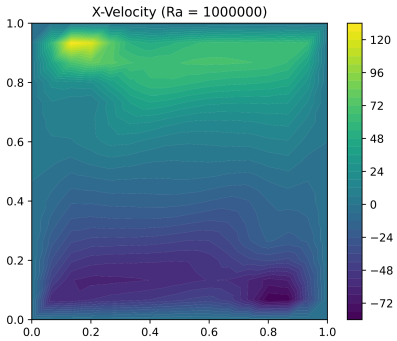


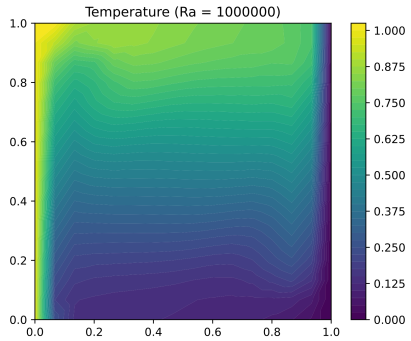
Left: our results.

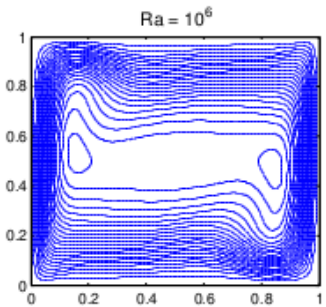
Right: How to Solve a Classic CFD Benchmark: The Lid-Driven Cavity Problem.

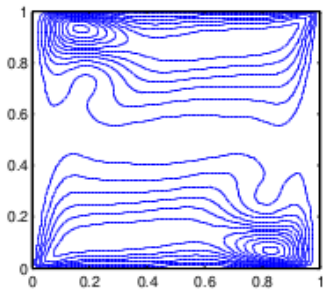
Buoyancy driven cavity, Ra = 10^6

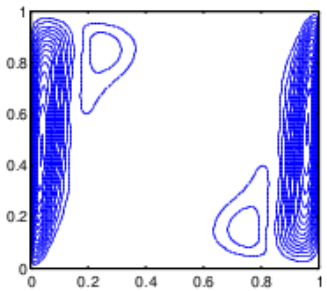


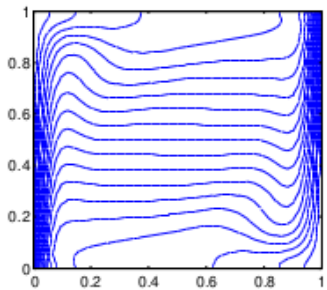








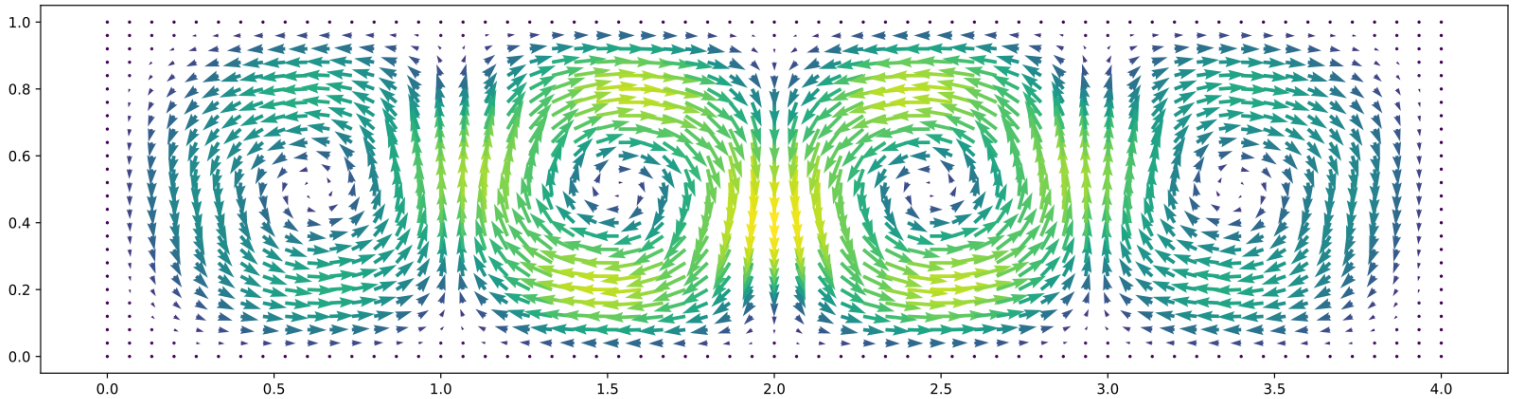




Top: our results.

Bottom: Numerical solution of buoyancy-driven flow problems.

Rayleigh-Benard Convection, Ra = 2000



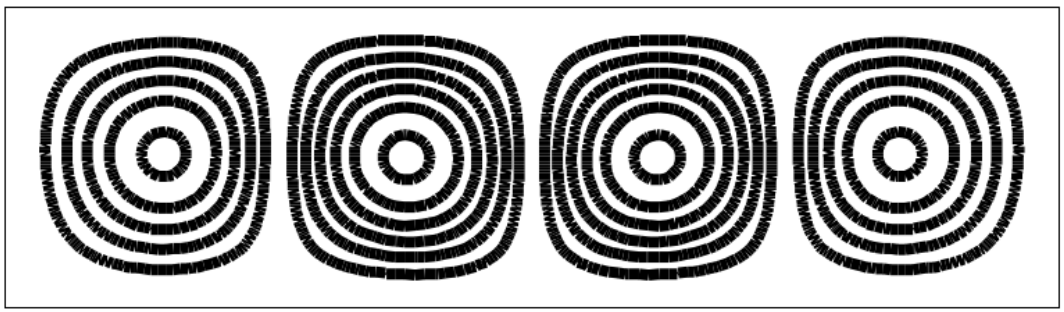


Figure 5.9: Computed steady state streamlines of Rayleigh–Bénard convection with pure homogeneous Dirichlet boundary conditions for both velocity components. The parameters used are Ra = 2500, $L_x = 2\lambda_c$ and $L_y = 1$.

Top: our results.

Bottom: Numerical solution of buoyancy-driven flow problems.

A small fjord, with ice parametrization