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Block-preconditioning of variable-viscosity flows in ice-sheet modeling

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The linear system arising in ice-sheet modelling is poorly conditioned. Ice is modeled as a non-Newtonian singular power-law fluid and the discrete system results from linearizing the non-linear p-Stokes equations. Factors impacting the system are the regularization of the shear-thinning rheology and the in ice-sheet modelling often used anisotropic elements and complex boundary conditions. Block preconditioners have been explored numerically for ice-sheet simulations in [2, 3] and studied in a more general non-Newtonian setting, in particular for Bingham fluids, in [1]. In the current study, we explore in detail how the type of block preconditioner used in [1] performs for ice-sheet problems and how this is related to material parameters, shape of the computational domain and boundary conditions. We also explore methods to speed up the assembly of block preconditioners.

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