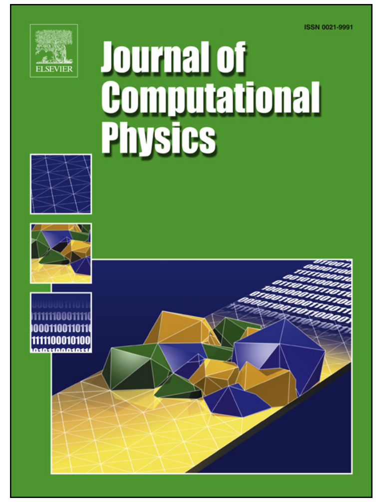

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The effects of plastic waves on the numerical convergence of the viscous-plastic and elastic-viscous-plastic sea-ice models

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Abstract

The plastic wave speed is derived from the linearized 1-D version of the widely used viscous-plastic (VP) and elastic-viscous-plastic (EVP) sea-ice models. Courant-Friedrichs-Lewy (CFL) conditions are derived using the propagation speed of the wave. 1-D numerical experiments of the VP, EVP and EVP* models successfully recreate a reference solution when the CFL conditions are satisfied, in agreement with the theory presented. The IMplicit-EXplicit (IMEX) method is shown to effectively alleviate the plastic wave CFL constraint on the timestep in the implicitly solved VP model in both 1-D and 2-D. In 2-D, the EVP and EVP* models show first order error in the simulated velocity field when the plastic wave is not resolved. EVP simulations are performed with various advective timestep, number of subcycles, and elastic-wave damping timescales. It is found that increasing the number of subcycles beyond that needed to resolve the elastic wave does not improve the quality of the solution. It is found that reducing the elastic wave damping timescale reduces the spatial extent of first order errors cause by the unresolved plastic wave. Reducing the advective timestep so that the plastic wave is resolved also reduces the velocity error in

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