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Hyperbolic Serre-Green-Naghdi equations? Only semi-implicit schemes

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The Serre-Green-Naghdi (SGN) equations provide a valuable framework for modelling fully nonlinear and weakly dispersive shallow-water flows. However, their elliptic formulation can considerably increase the computational cost compared to the Saint-Venant equations. To overcome this difficulty, hyperbolic models (hSGN) have been proposed that replace the elliptic operators with first-order hyperbolic formulations augmented by relaxation terms, which recover the original elliptic formulation in the stiff limit. Nevertheless, although explicit treatments of such models are relatively easy to implement, they suffer from severe time-step restrictions induced by the relaxation parameter, thereby making semi-implicit techniques necessary to achieve computational efficiency.

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