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A family of generalized predictor-corrector time-stepping schemes for shallow water equations

Mats Bentsen
Uni Research Climate, Bjerknes Centre for Climate Research, Bergen, Norway (mats.bentsen@uni.no)

Generalized predictor-corrector time-stepping schemes, suitable for shallow water equations with rotation, have been explored. The schemes are based on Shchepetkin and McWilliams (2005) but their analysis has been extended to include rotation and the possibility of temporal staggering of height and velocity in the discretized equations. The schemes do not have any computational mode and are intentionally dissipative of the fastest and poorly resolved frequencies. Stable schemes exist with both implicit and explicit discretization of the Coriolis term. With implicit discretization of the Coriolis term, suitable when velocity components are co-located, third order accurate schemes are obtained. By utilizing alternating order of velocity component updates, explicit, stable and second order accurate schemes can be constructed. The explicit schemes are particular suitable for quadrilateral C-grid spatial staggering. By allowing for temporal staggering of height and velocity, schemes can be found with higher accuracy and up to 60% longer maximum stable time step compared to schemes without temporal staggering.