A mass-conservative semi-implicit semi-Lagrangian limited area shallow water model on the sphere

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A locally mass-conservative shallow water model using a two-time-level, semi-implicit semi-Lagrangian integration scheme is presented. The momentum equations are solved with the traditional semi-Lagrangian grid-point form. The explicit continuity equation is solved using a cell-integrated semi-Lagrangian scheme and the semi-implicit part is designed such that the resulting elliptic equation is on the same form as for the traditional semi-Lagrangian grid-point system.

The accuracy of the model is assessed by running standard test cases adapted to a limited area domain. The accuracy and efficiency of the new model is comparable to traditional semi-Lagrangian methods and is not susceptible to noise problems for high Courant number flow over orography.