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An Energy Backscatter Model For The Shallow Water Equations On The Sphere

James Kent (1), Christiane Jablonowski (1), John Thuburn (2), and Nigel Wood (3)

(1) University of Michigan, AOSS, Ann Arbor, United States (jdkent@umich.edu), (2) University of Exeter, Exeter, UK, (3) Met Office, Exeter, UK

Many atmospheric dynamical cores conserve total energy through the use of energy fixers. These energy fixers replace dissipated kinetic energy with temperature. A more accurate method could conserve energy by adding back both temperature and kinetic energy, with the kinetic energy added at the large scales to represent the inverse energy cascade (backscatter).

We focus on the shallow water equations on the sphere which are a common building block of dynamical cores. We present an energy backscatter model that replaces dissipated energy with both kinetic and potential energy. We apply the backscatter model to two shallow water schemes, both based on semi-Lagrangian numerics, and perform a series of tests using well known shallow water equation test cases. The results show that the application of the backscatter model successfully conserves total energy without affecting the conservation of other quantities (such as mass).