On the development of variational integrators for geophysical fluid dynamics

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We present structure-preserving numerical schemes for several fluid models used in oceanic and atmospheric circulations, such as the Boussinesq, anelastic, and shallow water equations. The numerical schemes are based on finite dimensional approximations of diffeomorphism groups and are derived via a discrete variational principle. The resulting variational integrators allow for a discrete version of Kelvin circulation theorem, are applicable to irregular meshes and exhibit excellent long term energy behavior. We present a series of preliminary tests for these numerical schemes.