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On the derivation of variational integrators for the rotating shallow-water equations

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We present a structure-preserving discretization of the rotating shallow-water equations. This novel numerical scheme is based on a finite dimensional approximation of the group of diffeomorphisms and is derived via a discrete version of the Euler-Poincaré variational formulation of rotating compressible fluids. The resulting variational integrator, currently derived for regular triangular meshes, provides the first successful derivation and implementation of a compressible two-dimensional model by this discrete variational principle. We illustrate on various test cases that this variationally derived scheme exhibits excellent long term energy behavior, shows a second order convergence rate in space, and respects conservation laws such as geostrophic balance and mass conservation.