A revised potential vorticity diagnostics package for MPAS-Atmosphere

Manda Chasteen, May Wong

Ertel's potential vorticity (PV) is an important quantity in atmospheric dynamics that succinctly encompasses the principles of mass, momentum, and energy conservation and is applicable to all scales of motion. In this paper, we describe the implementation of a PV diagnostics package into the atmospheric component of the Model for Prediction Across Scales (MPAS), a fully compressible nonhydrostatic global model that enables regional mesh refinement to convection-permitting resolutions and is highly suited for studies on multiscale process interactions and forecast error-growth dynamics.

The version of the PV diagnostics package emphasized herein will be included in an upcoming MPAS release and significantly improves upon an original version that was introduced in MPAS v5.0. Specifically, this revised version enables the calculation of the full Eulerian PV budget at each time step Δt (i.e., the instantaneous budget) and the accumulation of PV tendencies throughout the model integration (i.e., the accumulated budget). Through the formulation of the discretized PV budget equation and global simulations conducted on a 15–3-km variable-resolution mesh, we demonstrate that the PV budget closes down to machine roundoff in both single- and double-precision when using the revised version.