Abstract View

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Gulf Stream Simulations and the Dynamics of Ring and Meander Processes

Allan R. Robinson, Michael A. Spall, and Nadia Pinardi

Center for Earth and Planetary Physics, Harvard University, Cambridge, Massachusetts

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ABSTRACT

We present here a regional, eddy resolving, numerical study of the dynamics of Gulf Stream Meander and Ring (GSMR) interaction processes. We initialize the Harvard quasi-geostrophic open-boundary model with realistic meander and ring locations as indicated by remotely sensed sea surface temperature (SST) data and predict the flow evolution for the period 23 November to 19 December 1984. The methodology of Feature-Model initialization is introduced to extend the surface information to the thermocline and deep levels in terms of climatological structures, which are then dynamically adjusted by the model. Six numerical simulators are carried out to explore the influence of initial and boundary conditions on the flow evolution. All of the major events observed in the SST data are simulated, including the birth of new warm and cold core rings. The results show the relevance of quasi-geostrophic dynamics for the GSMR region on these time scales in the thermocline. A set of parameter and sensitivity experiments then elucidate the dependence on physical parameters; ring births are nonlinear baroclinic processes. The dynamics of these realistic cold and warm core formation events are quantified via local energy and vorticity budget analyses (EVA). The cold core case involves a process of nonlinear baroclinic cascades that convert available gravitational energy to kinetic energy and vice versa. The warm core case involves a differential horizontal advection process.