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Dynamics of Agulhas Retroflexion and Ring Formation in a Numerical Model. Part II. Energetics and Ring Formation

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ABSTRACT

An energetics analysis of several numerical experiments on an idealized South Atlantic-Indian Ocean basin is presented. The model used in the experiments is the quasi-isopycnic coordinate model of Bleck and Boudra forced by wind and configured with two or three layers. The region of focus is the most dynamically active one, the Agulhas Current retroflexion south of Africa, and the dynamical mechanisms associated with formation of Agulhas rings are given special attention.

Whether rings form in the model and their frequency depend on two primary factors: the shape of Africa and southward inertia/baroclinicity in the overshooting Agulhas. The boundary condition on Africa (no-slip/free-slip) and horizontal resolution are also important. Experiments in which rings form exhibit considerably larger values of K_M to K_E transfer than those in which no rings

form. In three of the experiments, ring formation is studied in detail with the help of instantaneous top and bottom layer flow patterns and time series

energetics. In a low Rossby number experiment with a rectangular Africa, rings are formed almost continuously, and basin mode resonance plays a significant role in ring formation. Whether a form of instability (barotropic or baroclinic) play an important role as well is unclear. In two high Rossby number experiments, one with rectangular and the other with triangular African geometry, basin mode resonance is not a factor, and, it is suggested that ring formation is associated with release of mixed barotropic-baroclinic instability.

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