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Numerical Modeling of Meander and Eddy Formation in the Azores Current Frontal Zone

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ABSTRACT

Numerical experiments with an 11-level primitive equation, finite-difference model in a periodic channel are performed to analyze the properties of unstable finite-amplitude disturbances in an idealized Azores Current. Release of available potential energy due to baroclinic instability occurs preferentially on scales of about 100 km with a theoretical growth time of 8 days. At larger times, the combined effect of friction and nonlinear transfer between internal and external (depth integrated) mode and the distribution of energy among different wavenumbers of the initial disturbance determine the scale of the meandering jet. Cold water tongues with a meridional scale of several hundred km found in satellite images and hydrographic surveys east of the Azores are prescribed as initial disturbances. They develop into pairs of troughs and ridges dominated by cyclonic vortices on the poleward flank of the jet. Phase propagation is downstream at $2\text{--}4 \text{ km day}^{-1}$. Extremely strong frontogenetic enhancement of temperature occurs on the downstream side of the ridges, which gives rise to vertical velocities of order 10 m day^{-1} . Phase relations for baroclinically unstable waves indicate a mean poleward heat flux similar to observations in the Azores Current region.

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