Abstract View

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Meandering and Eddy Detachment According to a Simple (Looking) Path Equation

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ABSTRACT

Nonlinear meandering and "pinching off" process are investigated by solving the path equation As shown by Pratt and Stern, this dimensioned equation determines the center line latitude l of a slowly-varying, equivalent barotropic, quasi-geostrophic, f-plane jet with cusped velocity profile and center line curvature $\kappa = l_{xx}/(1 + l_x^2)^{/}$. A class of exact solutions consisting of steadily propagating meanders is found having wavelength $2\pi/k$ and amplitude a. The meanders form a wave train which can be single-valued (for $ak < 2.61$) or multivalued (for $2.61 < ak < 8.30$) with respect to the x (eastward) coordinate. For $ak = 8.30$ grazing contact occurs between neighboring meanders and a type of vortex street is formed. The amplitude-dependent dispersion relation for the meanders shows that phase propagation is eastward with speed that increases with decreasing wavelength and/or amplitude, trends observed for Gulf Stream meanders near 72 W by Vazquez and Watts.

Numerical solutions are presented for isolated, single-valued initial disturbances having a characteristic wavenumber k_0 and amplitude a_0. When a_0k_0 is less than a critical value between 1.5 and 2.0, the disturbance disperses. For larger values of a_0k_0, the evolution leads to a "pinching off" phenomenon in which meanders begin to detach from the main portion of the jet and form roughly elliptical eddies.