Dobrokhotov, S. Yu.

Hugoniot-Maslov chains for solitary vortices of the shallow water equations. I: Derivation of the chains for the case of variable Coriolis forces and reduction to the Hill equation. (English) Zbl 1059.76506

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Summary: The dynamics of solitary weak point singularities (vortices) is studied for the system of shallow water equations with variable Coriolis force. According to Maslov's viewpoint, this dynamics can be described by an infinite chain of ordinary differential equations similar to the Hugoniot conditions arising in the theory of shock waves. In the first part we show that a physically reasonable truncation of the chain results in a system of sixteen nonlinear ordinary differential equations which is equivalent to a family of Hill equations. In other words, in some approximation the vortex in question can be treated as a rigid body whose trajectory is determined by the Hill equation. Part II (to be published later) deals with the study of various trajectories of vortices, the influence of the Coriolis force depending on latitude (in the b-plane approximation), and the relationship between the behavior of the trajectories and the characteristics of solutions of the Hill equation. Applications to the problem on the typhoon eye trajectory will also be considered.

MSC:

76B47	Vortex flows for incompressible inviscid fluids
35Q35	PDEs in connection with fluid mechanics
35Q51	Soliton equations
76B15	Water waves, gravity waves; dispersion and scattering, nonlinear interaction
76U05	General theory of rotating fluids
86A10	Meteorology and atmospheric physics