Geophysical Research Abstracts
Vol. 12, EGU2010-6799, 2010
EGU General Assembly 2010

Steady waves in stratified flow over topography

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An analytical model of weakly stratified fluid flow over the topography formed by isolated group of hills is considered. In this paper we focus on the wave patterns and wave trains generated downstream the obstacles. Our method involves asymptotic analysis of the Dubreil-Jacotin – Long (DJL) equation via the perturbation procedure using two dimensionless parameters. One of them is the Boussinesq parameter which characterizes small slope of the density profile, and another parameter gives typical dimensionless height of single obstacle. Quite recently, Humi (NPG, 2009, V.16, P.533) derived a new formulation of the DJL equation using the transformation of independent variables to the terrain coordinates. This transformation incorporates the shape of obstacle immediately into the coefficients of basic differential equation. By that, the solutions corresponding to different topographies become to be easily compared. We develop an alternative analytical approach involving von Mises transformation of the DJL equation to the independent (x, psi)-variables. This method allows satisfy exact boundary condition at the bottom topography by solving approximate equations at leading order. As a consequence, resulting model takes into account the influence of fine-scale perturbation of the domain geometry. The wave solutions for the chain of finite number obstacles are obtained and analyzed. This work was supported by the grants of the Education Department of Russian Federation No. 2.1.1/4918, Program RAS No.17/4 and RFBR No. 09-01-00427.