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Stratification and Dissipation Effects in Running 2D Surface and Internal Gravity Waves

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Problem of 2D gravity wave propagation inside and along a free surface of a deep viscous stratified fluid is analyzed analytically basing on set of fundamental governing equations that are continuity and Navier-Stokes neglecting by compressibility effects. Conventional boundary conditions taking into account solid films on the free surface where used. In a limit of clean fluid surface the set is transformed into partial differential equation of the fourth order for a stream function. The sense of applied approximations is discussed. In infinitesimal limit the equation is split on independent sub-equations with characteristic dispersion relations describing propagating independent surface and internal waves. Waves are supplemented by fine flow components. Relations between amplitude of regular waves and singular perturbed components corresponding of a fine structure are derived and discussed. Expressions for vorticity and rate of baroclinic generation of vorticity are presented. Waves of finite amplitudes are investigated in the limit of non-viscous fluid. Two kinds of the running surface wave forms for different values of the wave steepness were calculated and discussed. New approximate non-linear equations was solved and a set of solutions for stratified and homogeneous fluids describing running waves of small finite and large steepness of the waves are constructed. Received expressions for drift velocity are transferred into well-known Stokes solutions in limit of small steepness. Calculations of running periodic internal waves are compared with data of laboratory experiments performed on USU “HPC IPMech RAS” under support of Ministry of Education and Science of the Russian Federation (Goscontract No. 16.518.11.7059. Extrapolation results of calculations on the environmental conditions are speculated.