

Mathematical methods for deriving Viscous Boussinesq equations

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For both undergraduate and graduate students who are interested in fundamental theories of earth science, mathematical tools play an important role for understanding basic equations in many academic fields. In this paper, mathematical tools applied to derive the Boussinesq equations with viscous effects are introduced to elucidate the relation between applied mathematics and earth science. Mathematical techniques used are the scale analysis, the perturbation method and the Pade approximation. Parameters for measuring nonlinearity, dispersion effects, density ratio and viscous effects are also defined. Based on these definitions as well as mathematical methods, viscous Boussinesq equations for internal waves are derived and analyzed. Strong connections between mathematics and earth science are also demonstrated.

Keywords: scale analysis, perturbation method, Pade approximation, viscous Boussinesq equations