Nonlinear Plane Waves in Rotating Stratified Boussinesq Equations

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Abstract: In this paper we have built special exact solutions to rotating stratified Boussinesq equations in the form of nonlinear plane waves. We also conclude that these solutions grow exponentially in unstable stratifications. Whereas, in the special case of stable stratification these waves are oscillatory in nature. Consequently, we determined internal gravity waves and some sinusoidal wave forms.

Keywords: *plane waves; rotating stratified Boussinesq equation; sinusoidal waves.*

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1 Introduction

The stratified Boussinesq equations form a system of PDEs modelling the movements of planetary atmospheres. It may be noted that the Boussinesq approximation in the literature is also referred to as the Oberbeck-Boussinesq approximation for which, the reader is referred to an interesting paper of Rajagopal et al [1] providing a rigorous mathematical justification of use of these equations as perturbations of the Navier-Stokes equations. Majda & Shefter [2] have chosen certain special solutions of this system of PDEs to demonstrate onset of instability when the Richardson number is less than 1/4. In their study of instability in stratified fluids at large Richardson number, Majda & Shefter [2] have obtained the exact solutions to stratified Boussinesq equations neglecting the effects of rotations and viscosity. Further, in the absence of strain field Srinivasan et al [3] have shown that the reduced system of ODEs is completely integrable. Desale and Dasre [4] have obtained the numerical solutions of this reduced system of ODEs. For the similar kind of work the reader may refer to Maas [5,6]. In his monograph Majda [7] has

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