Nonlinear Processes
in Geophysics
Discussions

Interactive comment on "Time dependent Long's equation" *by* M. Humi

Anonymous Referee #1

Received and published: 23 December 2014

This paper derives equations governing the non-hydrostatic dynamics of stratified flow in two dimensions. It is a generalization of Long's equation (steady state) and of 2D Bousinesq dynamics (Tabaei, Akylas, and Lamb JFM 2005). The presentation is straightforward and comprehensible. What the paper lacks is a Discussion and Conclusion section to put the paper into context and outline future work. Instead, the paper abruptly ends with plots of the solutions in a particular limit.

Minor issues and observations:

1. Equations 1-4 are not incompressible, as stated (density derivatives are taken later). However, the continuity equation (Eq. 1) is not fully compressible either, so it appears to be a weakly compressible formulation.

2. The final pair of equations (Eq. 14 and 23) reduce to the 2D Bousinesq equations (Tabaei, Akylas, and Lamb, JFM 2005, Eq. 2.4-2.5) if the density derivatives associ-

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ated with the momentum terms are neglected. The same stream function formulation, derivation procedure, and Jacobian formalism is used in this previous work; the only obvious difference is that the present paper keeps the derivatives of ρ in the momentum terms, rather than only in the gravity term. The author should comment on the significance of these additional terms, and particularly why it is valid to retain these derivatives but not the density derivatives in the full continuity equation (Eq. 1).

3. Equation 26 is essentially a Bernoulli equation, with η playing the role of a velocity potential. It would be worth commenting on the analogy between the $\nabla^2 \psi = 0$ case and potential flow.

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 1673, 2014.