Abstract Submitted
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Stability sensitivity to gravity and base flow density modifications[1] KEVIN CHEN, GEOFFREY SPEDDING, University of Southern California — We present the novel theory of Boussinesq stability sensitivity to the gravitational force and to base flow density modifications. Given a steady-state flow with small density variations, the sensitivity of the stability eigenvalues is computed from the direct and adjoint modes of the linearized Boussinesq equations. Various combinations of the density and velocity components of these modes reveal multiple production and transport mechanisms that contribute to the eigenvalue sensitivity. This sensitivity theory is largely inspired by the study of stable density stratification, which can have seemingly contradictory effects on flow stability. On one hand, stable stratification increases the coherence and persistence of turbulent wakes; on the other hand, it can destabilize vortex structures, such as vortex pairs and rings. We present an application of the sensitivity theory to a stably density-stratified flow around a flat plate at a 90 degree angle of attack. The global mode analysis reveals lightly damped lee wave undulations, and the sensitivity theory shows that regions both immediately upstream and immediately downstream of the plate contribute most significantly to the stability sensitivity.

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