Yalim, Jason; **Welfert, Bruno D.**; **Lopez, Juan M.**

Parametrically forced stably stratified cavity flow: complicated nonlinear dynamics near the onset of instability. (English) Zbl 1419.76203

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Summary: The dynamics of a fluid-filled square cavity with stable thermal stratification subjected to harmonic vertical oscillations is investigated numerically. The nonlinear responses to this parametric excitation are studied over a comprehensive range of forcing frequencies up to two and a half times the buoyancy frequency. The nonlinear results are in general agreement with the Floquet analysis, indicating the presence of nested resonance tongues corresponding to the intrinsic $m : n$ eigenmodes of the stratified cavity. For the lowest-order subharmonic $1 : 1$ tongue, the responses are analysed in great detail, with complex dynamics identified near onset, most of which involves interactions with unstable saddle states of a homoclinic or heteroclinic nature.

MSC:

76D50 Stratification effects in viscous fluids
76E17 Interfacial stability and instability in hydrodynamic stability
76E20 Stability and instability of geophysical and astrophysical flows

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