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Multistability for nonlinear acoustic-gravity waves in a rotating atmosphere. (English)

Zbl 1458.76047
Chaos 31, No. 2, 023108, 11 p. (2021).

Summary: The multistable states of low-frequency, short-wavelength nonlinear acoustic-gravity waves propagating in a small slope with respect to the vertical ones are explored in a rotating atmosphere. The bifurcation patterns en route to irregular behaviors and the long-term dynamics of the low-order nonlinear model system are studied for varying air Prandtl number σ between 0.5 and 1. In contrast to non-rotation, the transition to the unsteady motion occurs both catastrophically and non-catastrophically due to the Earth's rotation. The connections between the Prandtl number and the slope parameter on the stabilities of the system are highlighted. The model system exhibits hysteresis-induced multistability with coexisting finite multi-periodic, periodic-chaotic attractors in certain parameter spaces depending on the initial conditions. Studies revealed that the rotation parameter instigates these heterogeneous coexisting attractors, resulting in the unpredictable dynamics. However, the relevance of this study is strongly restricted to a very small vertical wavelength, a small slope, and a weakly stratified atmosphere.

MSC:

76E20 Stability and instability of geophysical and astrophysical flows
86A10 Meteorology and atmospheric physics
76U60 Geophysical flows
76B15 Water waves, gravity waves; dispersion and scattering, nonlinear interaction

Full Text: DOI

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