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Resonant continuum modes in the Eady model

J. Jenkner (1) and M. Ehrendorfer (2)

(1) Institute for Atmospheric and Climate Science, ETH Zürich, Switzerland (johannes.jenkner@env.ethz.ch), (2) Institute for Meteorology and Geophysics, University of Innsbruck, Austria

The conventional (linear) Eady model with rigid upper lid is considered and the interaction of boundary thermal anomalies (BTAs) and interior potential vorticity (PV) is investigated in detail. In a short wave Eady setting, it is shown that the flow pattern is strongly dependent on the height at which the PV anomaly resides. The steering level of the neutral Eady modes divides the vertical domain into different parts. If the PV anomaly is within the sphere of influence of the BTAs, individual parts are able to interact with each other. If it is located beyond the steering level, existing perturbations cannot affect each other and the resulting structure looks completely different. In the special case of the PV anomaly being situated precisely on the steering level, there is a phase–locked situation and linear amplification occurs. These resonant continuum modes are explicitly derived and their properties are discussed elaborately. To this end, the entire structure is partitioned into nonzero–PV and zero–PV contributions and PV–inversion is applied. Along the way the flow field is interpreted in terms of both the meridional energy transport and the vertical circulation pattern. Hence it is shown that continuum modes reflect properties of a growing baroclinic structure very well. The partitioning clearly demonstrates the existence of modal growth in the Eady model beyond the short–wave instability cut–off and proves that cyclogenetic features can be associated with short–wave perturbations which are advected uniformly with the basic current.