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The global stability of almost adiabatic geo-convection

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Almost adiabatic states are typical for the deep convective interiors of all the known planets and moons. E.g., the deviations from the adiabatic state in the Earths' outer core are about or less than $10^{-5}\%$. Thus, we approximate the equations governing planetary convection in order to obtain sufficiently accurate system of equations comparing to the traditional Boussinesq system. Choosing almost uniform entropy and non-uniform pressure as basic thermodynamics parameters we investigate convective instabilities in the Earth's type (terrestrial) planets and moons. As it is showed by Soward (1977), the Rossby wave-type convection solution with the critical Raleigh number close to the value determined by local theory do not exist. Consequently, the critical parameters for the onset of convection cannot be predicted on the basis of the Roberts-Busse local linear theories. The critical Rayleigh number required for the instability of convection is much underestimated by local theory, while the frequency of oscillation is much overestimated, particular for small Prandtl number. Accordingly, to determined critical parameters for the onset of an almost adiabatic convection we use global WKBJ theory developed by Jones et al. (2000).