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Shallow moist Rayleigh-Bénard convection with piecewise linear equation of state[1] JOERG SCHUMACHER, THOMAS WEIDAUER, TU Ilmenau, OLIVIER PAULUIS, Courant Institute, New York University — An idealized framework to study the impacts of phase transitions on atmospheric dynamics is presented. Condensation of water vapor releases a significant amount of latent heat, which directly affects the atmospheric temperature and density. Here, phase transitions are treated by assuming that air parcels are in local thermodynamic equilibrium, which implies that condensed water can only be present when the air parcel is saturated. This reduces the number of variables necessary to describe the thermodynamic state of moist air to three. It also introduces a discontinuity in the partial derivatives of the equation of state. A simplified version of the equation of state is obtained by a separate linearization for saturated and unsaturated parcels. When this equation of state is implemented in a Boussinesq system, the buoyancy can be expressed as a piecewise linear function of two buoyancy variables, D and M, and height z. Numerical experiments in this setting allow then to study transitions from cumulus to stratocumulus clouds.

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