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Analysis of the physical mechanisms responsible for the self-aggregation of convection in a GCM run in Radiative-Convective Equilibrium

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In this work, we investigate the mechanisms controlling the initiation of convective self-aggegation in a General Circulation Model (GCM). We run the LMDZ GCM in the Radiative-Convective Equilibrium (RCE) configuration, in a non rotating framework, forced with a uniform and constant insolation, and a globally-uniform prescribed sea surface temperature (SST). In certain conditions, this model predicts an unstable RCE.

We first assess the dependence of this instability on surface temperature and initial conditions. Then, following Wing and Emanuel (2013), we investigate the physical mechanisms responsible for the RCE instability by analyzing the spatial variance of the column-integrated moist static energy budget. Based on this analysis, we show that the physical feedbacks that seem to play the most important role in the initiation of convective aggregation are those associated with radiation and surface fluxes, Finally, we demonstrate the actual role of these feedbacks in the RCE instability through a series numerical experiments in which we artifically desactivate the individual feedbacks. The implication and the generality of these findings will be discussed.