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A continuous buoyancy based convection scheme

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A new and consistent convection scheme, providing a continuous treatment of this atmospheric process, is described. The main concept ensuring the consistency of the whole system is the buoyancy, key element of any vertical motion. The buoyancy constitutes the forcing term of the convective vertical velocity, which is then used to define the triggering condition, the mass flux, and the rates of entrainment-detrainment. The buoyancy is also used in its vertically integrated form (CAPE) to determine the closure condition. The continuous treatment of convection, from dry thermals to deep precipitating convection, is achieved with the help of a continuous formulation of the entrainment-detrainment rates (depending on the convective vertical velocity) and of the CAPE relaxation time (depending on the convective over-turning time).
A Single Column Model (SCM) validation of this scheme is shown, allowing detailed comparisons with observed and explicitly simulated data. Four cases covering the convective spectrum are considered: over ocean, deep convection (TOGA), trade wind shallow convection (BOMEX) and strato-cumulus (FIRE), together with a entire continental diurnal cycle of convection (ARM). The emphasis is put on the characteristics of the scheme which enable a continuous treatment of convection.
A General Circulation Model (GCM) 23-year simulation is also presented in order to assess the model climate against the observed one.