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A parameterization of convective dust storms for models with mass-flux convection schemes

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Cold pool outflows, generated by downdrafts from moist convection, can generate strong winds and therefore uplift of mineral dust. These so-called "haboob" convective dust storms occur over all major dust source areas worldwide and contribute substantially to emissions in northern Africa, the world's largest source. Most large-scale models lack convective dust storms, because they do not resolve moist convection, relying instead on convection schemes. We suggest a parameterization of convective dust storms to account for their contribution in such large-scale models. The parameterization is based on a simple conceptual model, in which the downdraft mass flux from the convection scheme spreads out radially in a cylindrical cold pool. The parameterization is tested with a set of Unified Model runs for June and July 2006 over West Africa. It is calibrated with a convection-permitting run, and applied to a convection-parameterized run. The parameterization successfully produces the extensive area of dust-generating winds from cold pool outflows over the southern Sahara. However, this area extends farther to the east and dust generating winds occur earlier in the day than in the convection-permitting run. These biases are due to biases in the convection scheme. It is found that the location and timing of dust-generating winds are weakly sensitive to the parameters of the conceptual model. The results demonstrate that a simple parameterization has the potential to correct a major and long-standing limitation in global dust models.