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Modelling Convective Dust Storms in Large-Scale Weather and Climate Models

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Recent field campaigns have shown that convective dust storms – also known as haboobs or cold pool outflows – contribute a significant fraction of dust uplift over the Sahara and Sahel in summer. However, in-situ observations are sparse and convective dust storms are frequently concealed by clouds in satellite imagery. Therefore numerical models are often the only available source of information over the area. Here a regional climate model with explicit representation of convection delivers the first full seasonal cycle of convective dust storms over North Africa. The model suggests that they contribute one fifth of the annual dust uplift over North Africa, one fourth between May and October, and one third over the western Sahel during this season. In contrast, most large-scale weather and climate models do not explicitly represent convection and thus lack such storms.

A simple parameterization of convective dust storms has recently been developed, based on the downdraft mass flux of convection schemes. The parameterization is applied here to a set of regional climate runs with different horizontal resolutions and convection schemes, and assessed against the explicit run and against sparse station observations. The parameterization succeeds in capturing the geographical distribution and seasonal cycle of convective dust storms. It can be tuned to different horizontal resolutions and convection schemes, although the details of the geographical distribution and seasonal cycle depend on the representation of the monsoon in the parent model. Different versions of the parameterization are further discussed with respect to differences in the frequency of extreme events. The results show that the parameterization is reliable and can therefore solve a long-standing problem in simulating dust storms in large-scale weather and climate models.