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Relevance of convective turbulent dust emission (CTDE) in the Earth system

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Convective turbulence generates localized and intermittent surface shear stress and can effectively entrain dust into the atmosphere. This mechanism is referred to as "Convective Turbulent Dust Emission" (CTDE) and is considered as the most important form of direct aerodynamic dust entrainment. CTDE occurs predominantly at weak mean wind conditions, when the buoyancy production of atmospheric turbulence is most pronounced. CTDE is a stochastic process and does not need to involve the saltation of sand-sized grains. An improved parameterization for CTDE is presented, which represents both aerodynamic lifting and inter-particle cohesive forces as probability distributions. The dust emission scheme therefore accounts for the stochastic nature of CTDE. The scheme was evaluated against field data recorded in the Horqin Sandy Land area in China and during the Japan-Australia Dust Experiment (JADE) in Australia. Coupled to the regional model WRF/Chem, the calibrated dust emission scheme was used to assess the long-term regional contribution of CTDE to the overall dust budget for Australia. We show that a persistent background dust concentration can be generated by CTDE. The modeled dust concentrations were compared to PM10 measurements monitored by the DustWatch Australia network. An estimate on the relevance of CTDE compared to saltation bombardment at the local and regional scales is given and implications for climate are highlighted.