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Parametrization of convection with wind shear effect in global climate models

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Convection is a fundamental process in the climate system and remains one of the major uncertainties in our understanding and numerical modeling of the atmosphere. It manifests itself as cumulus clouds that are parameterized in global climate models due to their subgrid scale nature. Wind shear affects entrainment and plays a key role in the formation and growth of cumulus clouds. Strong wind shear inhibits the growth of cumulus clouds by disrupting or weakening the conditional instability. The Convective Cloud Field Model (CCFM) is a spectral mass flux parameterization, consisting of a one-dimensional entraining parcel model for individual convective clouds and a calculation of the cloud spectrum for the number of convective clouds. The wind shear effect can be parameterized by the entrainment rate. The entrainment rate in a windy environment is calculated in three dimensions in which the motion of parcel, ambient air and the plume angle are considered. The horizontal dynamics of cumulus clouds is introduced in the entraining parcel model based on the conservation of horizontal momentum. CCFM with wind shear effects has been successfully implemented and tested within the ECHAM6 climate model. We will presents the parameterization of wind shear effects and discuss their impact within ECHAM6, with a particular focus on tropical precipitation distributions.

Keywords:
convection, entrainment, wind shear effect