Geophysical Research Abstracts
Vol. 17, EGU2015-6482, 2015
EGU General Assembly 2015

A new stochastic Eddy-Diffusivity/Mass-Flux model: A step towards unified parameterization

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We develop a new parameterization scheme for climate and weather prediction models. The new parameterization represents the boundary layer, non-precipitating and precipitating convection processes in a unified and physically consistent manner and builds on a stochastic eddy-diffusivity/mass-flux (EDMF) approach described in our previous work (Sušelj et al., 2013; J Atmos Sci 70, pp. 1929-1953). The parameterization includes a realistic model for microphysical processes as a part of the mass-flux parameterization, and parameterization for convective downdrafts. A method to solve the mass-flux dynamics and microphysics simultaneously is developed. This method avoids the need for iterative solution of the equations and is numerically stable. The new EDMF parameterization is implemented in a single-column model (SCM) and we show that the model is able to capture essential features of moist boundary layers, ranging from stratocumulus to shallow and precipitating cumulus regimes. Detailed comparisons of a few important cases with large eddy simulation (LES) results are shown to confirm the value of the present approach. This new parameterization provides an important step towards a fully unified parameterization of the boundary layer as well as shallow and deep convection.