Parametrizing cloud cover in large-scale models

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Abstract

The cloud cover parameterization of large-scale models is reviewed. The two leading approaches, prognostic cloud fraction/condensate and statistical cloud fraction/condensate are contrasted. The relative advantages and disadvantages of each approach are discussed. Following this, simulations of a large-scale model (the GFDL climate model) which use these two approaches are contrasted. The largest sensitivity of the climate to the cloud parameterization lies in the upper tropospheric humidity in tropical regions. The prognostic cloud fraction approach has much reduced upper level cloud cover and cloud fraction as compared to the statistical cloud fraction approach. This difference is attributed to the higher effective precipitation efficiency during convective detrainment in the prognostic cloud fraction/condensate approach. In addition, the differences in cloud feedback to climate change that result from these approaches are contrasted. Finally some remarks are presented which discuss the need for the cloud fraction parameterization in the ECMWF model, where the horizontal resolution is very fine and is expected to continue to decrease in the near future.