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Evaluation of the subgrid-scale variability scheme for water vapor and cloud condensate in ECHAM5 using satellite data

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The horizontal variability of clouds contributes to the uncertainties of modelled climate scenarios because grid-cell mean of variables, such as water vapor, are commonly used to calculate the cloud cover (e.g. Pincus and Klein, J. Geophys. Res., 2000). This assumption introduces biases to all nonlinear cloud processes, such as precipitation formation and radiation. A new prognostic parameterization for the subgrid-scale variability of water vapor and cloud condensate introduced by Tompkins (J. Atmos. Sci., 2002) potentially reduces the above mentioned biases. The scheme uses a probability density function (PDF) of the total water mixing ratio to calculate the horizontal cloud fraction in the ECHAM5 model. The PDF assumes a beta-function shape whose parameters are prognostic variables in the model and evolve as a function of atmospheric processes such as turbulence, convection, and large-scale cloud microphysical processes. Results will be presented on the evaluation of this new parameterization with satellite observations. For this, PDFs of the spatial distributions of the combined vertically integrated water vapour and cloud condensate as derived from spatially high-resolved satellite data are compared to the simulated PDFs. Data is taken from the MODerate Resolution Imaging Spectroradiometer (MODIS) at about 1 km horizontal resolution and compared to the model-computed PDF at the resolution of about 250 km.