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Towards a scale (in)dependency of statistical cloud cover parameterizations

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The parameterization of cloud processes and cloud cover, which differs among models, is known to be a weak point in the representation of the climate system. The central problem can be cast in terms of the determination of the subgrid-scale variability of total water mixing ratio, which implicitly or explicitly all cloud cover parameterizations rely on. One approach for the representation of subgrid-scale variability is to calculate a probability density function. Novel statistical parameterizations use prognostic equations for the higher moments (e.g. variance and skewness) of total water mixing ratio for this calculation. This approach is in principle independent of any grid size information and should be able to adapt to different resolutions. For the use of novel methods like grid refinement it is important to have a consistent representation of the subgrid-scale variability at different grid sizes. Therefore we use high-resolution model data to evaluate a statistical cloud cover parameterization with respect to scale adaptivity. An analysis of the variability of total water, as a function of scale, as derived from different models at different domain sizes - from Large Eddy Simulations and a numerical weather prediction model up to a general circulation model - is presented. The evaluated power density spectra of total water mixing ratio in those models show a consistent behaviour across scales, thereby providing guidance as to how sub grid variance should depend on the size of the grid. Ideas for incorporating these results into existing parameterization schemes will also be presented.