Geophysical Research Abstracts
Vol. 13, EGU2011-11213, 2011
EGU General Assembly 2011

Evaluating cloud schemes in global circulation models – what can we gain from ground based remote sensing and high resolution modeling?

Verena Grützun (1), Maximilian Voigt (2), Felix Ament (3), and Johannes Quaas (1)

(1) Max Planck Institute for Meteorology, Atmosphere in the Earth System, Hamburg, Germany (verena.gruetzun@zmaw.de), (2) Freie Universität Berlin, Germany, (3) University of Hamburg, Germany

The correct representation of clouds in global circulation models (GCMs) is a challenging and yet a crucial task to estimate the development of the future and present climate (Randall et al., 2007). Clouds have great influence on both, the hydrological cycle and also the radiation budget of the earth. However, due to the large horizontal scales of GCMs in the range of 100 km, the evaluation of cloud schemes is not an easy task. While satellite data give comprehensive horizontal information about the overall cloud cover, they lack accurate retrievals of cloud related quantities and, above all, the vertical resolution necessary to gain information about the cloud scheme's shortcomings on the process level.

Ground based remote sensing measurements have the needed high vertical resolution and might therefore be a valuable tool for improving large scale cloud schemes. We investigate the opportunity of using long term ground based remote sensing measurements, e.g. from lidars, to assess cloud related quantities, especially their statistical distribution moments, for the evaluation of statistical cloud schemes in GCMs. The idea behind this is that these long term point measurements are representative for the respective gridbox of the GCM. However, while these measurements have a great vertical resolution, their horizontal extension differs very much from the horizontal scales of GCMs, and the statistics is likely contaminated by the time evolution of the observed quantities.

By using high resolution modeling as a virtual reality, we show that while mean values seem to be represented well by ground based remote sensing measurements, the representation of the higher moments of the statistical distributions is a challenging task, which might only be accomplished by a combination of measurements and high resolution modeling. Also, we use large eddy simulation data to investigate in detail the performance of the statistical cloud scheme by Tompkins (2002). The model data thereby gives the opportunity to extract the source and sink terms of the prognostic variance and skewness in the scheme and thus test them against the terms we find in the GCM.

Randall, D.A., et al., in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007.

Tompkins, A., A prognostic parameterization for the subgrid-scale variability of water vapor and clouds in large-scale models and its use to diagnose cloud cover, J. Atmos. Sci. 59, 1917 – 1942, 2002.