Geophysical Research Abstracts
Vol. 13, EGU2011-8453-1, 2011
EGU General Assembly 2011


# Evaluation of ice and snow content in the global NWP model GME with CloudSat

Sonja Eikenberg (1), Kristina Fröhlich (2), Axel Seifert (2), Susanne Crewell (1), and Mario Mech (1)

(1) University of Cologne, Institute of Geophysics and Meteorology, Cologne, Germany (seiken@meteo.uni-koeln.de), (2) German Weather Service DWD, Offenbach, Germany

Ice clouds have a large impact on the Earth's climate system due to their effects on the global radiation budget. A good description of ice clouds is therefore a major challenge for both climate and NWP models. The CloudSat Cloud Profiling Radar offers the so far unique opportunity to vertically resolve clouds from space – in contrast to the numerous passive satellite-based sensors. Due to its high resolution and the near-global coverage it is predestined for the evaluation of global models and finally offers an observational constraint for the water constituent ice. Especially for NWP models, which are subject to ongoing enhancements, the development of a continuous evaluation technique is of major interest. First steps in the design of such a technique are made within the evaluation of a novel ice microphysical parameterization of the global NWP model GME of the German Weather Service DWD.

Since the radar reflectivity factor is not a direct model parameter, two principal evaluation approaches are possible: Observation-to-model and model-to-observation. We undertake both approaches, with the goal of exploiting the full informational content and determining the pros and cons of each approach. For the observation-to-model approach the ice water content (IWC) retrieval (*Austin et al., 2009*) is utilized, for the model-to-observation approach the radar simulator QuickBeam (*Haynes et al., 2007*) is applied. The first approach is easy to compute and the actual model parameters are compared. However, the uncertainties of this approach are not easily assessed; three parameters of the particle size distribution (PSD) are retrieved from one measurement and several assumptions are included. The second approach to some extent avoids the problem of the retrieval uncertainties and is closer to the actual physics by simulating the reflectivity factor from the model forecast of the gaseous and hydrometeor component, including the model's assumptions on PSDs . However, ice crystals are modelled as soft spheres in QuickBeam, and not as the actual particle habit.

To improve the comparability between model and observations, we develop criteria which are applied to each matching pixel: (1) only temperatures lower than -10°C to avoid liquid and part of mixed phase, (2) top of convection below 1 km height to reduce sub-grid and mixed phase effects, (3) cloud cover larger than 50 % to ensure homogeneous conditions, and (4) total column attenuation not larger than 3 dBz to avoid attenuation. Because CloudSat cannot distinguish between cloud ice and snow, model IWC also includes both, with snow contributing on average 85 % of total mass.

The evaluation shows that in comparison to CloudSat the new prognostic precipitation scheme of GME performs better than the old diagnostic scheme concerning the magnitude of IWC and reflectivity factors and the shape of the frequency distributions. As a consequence, the new scheme became operational on 2 February 2010. Furthermore, the applied evaluation technique enables the assessment of processes within clouds, benefiting from the vertically resolved CloudSat data, and thereby the identification of possible sources of error in the model parameterizations. For example, the results indicate an overestimation of ice water path (IWP) in the new GME version, which might be due to a too long residence time of snow in the air. Changes in snow fall speed successfully reduce IWP by up to a factor of two. This additional improvement became operational on 1 December 2010.

*References:*

*Austin, R.T., Heymsfield, A.J., and Stephens, G.L. (2009) Retrieval of ice cloud parameterizations using the CloudSat millimeter-wave radar and temperature. J. Geophys. Res. 114.*

*Haynes, J.M., Marchand, R.T., Luo, Z., Bodas-Salcedo, A., and Stephens, G.L. (2005) A multipurpose radar simulator package: QuickBeam. Bull. Am. Met. Soc., 131, 1997-2017.*