EMS Annual Meeting Abstracts
Vol. 8, EMS2011-687-2, 2011
11th EMS / 10th ECAM

Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Evaluation of modelled ice and snow water content with satellite observations

S. Eikenberg (1), K. Fröhlich (2), A. Seifert (2), S. Crewell (1), and M. Mech (1)

(1) University of Cologne, Institute of Geophysics and Meteorology, Cologne, Germany (seiken@meteo.uni-koeln.de), (2) Deutscher Wetterdienst, 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 (CPR) 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. The ice microphysical parameterizations of the NWP models of Deutscher Wetterdienst (DWD) are evaluated and improved with CloudSat CPR observations, complemented by Meteosat Second Generation (MSG) Spinning Enhanced Visible and InfraRed Imager (SEVIRI) and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) Cloud-Aerosol LIdar with Orthogonal Polarization (CALIOP) observations.

Two approaches – observation-to-model and model-to-observation - are undertaken, since the combination captures the full informational content. For the observation-to-model approach the standard CloudSat 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*). To improve the comparability between model and observations, criteria are applied to each matching pixel in order to (1) avoid the liquid phase, (2) reduce sub-grid effects, (3) ensure homogeneous conditions, and (4) 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 study shows that in the global NWP model GME a new prognostic precipitation scheme is able to capture the magnitude of IWC and reflectivity factors better than the old diagnostic scheme. As a consequence, the new scheme became operational on 2 February 2010. The remaining overestimation of ice water path (IWP) is successfully reduced by adjustments in the snow fall speed. This became operational on 1 December 2010. Finally, an overestimation of high clouds by COSMO-DE is identified with MSG and is sought to be further investigated with the help of CloudSat and CALIPSO.

In general, the evaluation shows that errors in the ice microphysical schemes of a model can be detected and successfully improved with the help of satellite observations. Especially the vertically resolved CloudSat observations help assess cloud processes.

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.