Which error is introduced by forward model assumptions when evaluating a numerical weather prediction model with MSG SEVIRI?

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Satellite data play an important role for numerical weather prediction (NWP) models, be it for assimilation or evaluation purposes. However, the comparison of satellite to model data is somewhat difficult, because remote sensing instruments measure other variables than a model predicts. Two possible approaches – model-to-observation and observation-to-model – exist. Both approaches introduce errors into the comparison by making assumptions. Consequently, when evaluating a NWP model with satellite data, the biases found cannot be assigned to model shortcomings alone, but also to the method of approach.

The regional NWP model COSMO-DE of Deutscher Wetterdienst (DWD) is known to produce a positive bias concerning the occurrence of low brightness temperatures at the 10.8 µm channel of Meteosat Second Generation (MSG) Spinning Enhanced Visible and InfraRed Imager (SEVIRI). This window channel is very sensitive to the presence of clouds – in particular to their height. A novel two-moment cloud ice microphysical parameterization developed by C. Köhler and A. Seifert, with a much improved parameterization of ice nucleation, performs distinctly better with respect to this bias. The question remains, to what extent the brightness temperature bias is due to model shortcomings in microphysical parameterizations or are rather introduced by the chosen approach. Both the fast radiative transfer model RTTOV (Radiative Transfer for TOVS), which is operationally used at DWD, and the diagnostic tool SynSat (Synthetic Satellite Imagery), which couples model output to RTTOV, can contribute to this bias. To test this, experiments are set up, comparing the operationally simulated COSMO-DE brightness temperatures to those obtained with the more sophisticated radiative transfer code MOMO (Matrix Operator Model) developed at Freie Universität Berlin (FUB).