

Interactive comment on “Non-Gaussian Bayesian retrieval of tropical upper tropospheric cloud ice and water vapour from Odin-SMR measurements” by B. Rydberg et al.

Anonymous Referee #1

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General comments:

An improved algorithm was reported for the Odin-SMR retrieval of upper tropospheric water. By combining Odin-SMR measurement with accurate a priori CloudSat data and other complementary data, the new algorithm can retrieve humidity and cloud ice mass simultaneously. It also takes the cloud inhomogeneity into consideration, and thus removes the systematic retrieval error introduced by the uniform cloud assumption. The retrieval algorithm uses the Bayesian Monte Carlo integration, which is based on a pre-calculated retrieval database of atmospheric states. The current manuscript presented the construction of such a database for 3-D atmospheric states by extending

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a 1-D database the authors reported in 2007. As a test, the model generated radiance distribution is in good agreement with Odin-SMR measurements, and the minor difference is properly explained. Then global pictures of the retrieved RHi and IWC are shown. The retrieved products are in good agreement with Odin-SMR observations, which indicate that the database used in the retrieval is a good representation of the real condition. Finally, retrieved RHi from the improved algorithm (v2) is compared with previous retrieval, and is found to give a better representation of the actual Odin-SMR measurement. Possible reasons for the differences are discussed, and a compensation is proposed to address the a priori contamination. The v2 retrievals are also compared with Aura-MLS results. The retrieved IWC v2 is compared with CloudSat data, and possible reasons for the observed differences are discussed. The topic falls in the scope of AMT. The manuscript is well written, and the algorithm and results reported are of interest to the community. Therefore, I recommend that the manuscript be accepted for publication. I only have a following specific comments and technical corrections.

Specific comments:

1. Typically, simulation of a 3-D system will be much more time-consuming than that of a 1-D system. How much does the computational time increase when the inhomogeneity is considered in the retrieval algorithm?
2. Fairly large systematic errors are seen in the retrieved relative humidity (Fig. 7). The authors explained (page 1596, line 24) that “This is an effect of that the measurements do not provide complete information and the BMCI method favours more likely states”. Is it possible to remove or to reduce the errors coming from these sources?
3. To explain the systematic errors in the retrieved IWC (Fig. 9), the authors stated that (page 1597, line 28) they are “caused by incomplete measurement information in the same manner as for RHi”. However, one can see that for the RHi, the 15–16.5 layers has the largest error, but for the IWC the 10.5–12 layer has the largest error. Is there a reason for this?

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4. To compare the retrieved RHi from the improved algorithm with that from previous algorithm, the authors showed the retrievals from both algorithms in Fig. 10. However, in this figure, it is not obvious that “the v2 results give a fairer representation of the actual measurement information found in Odin-SMR spectra” (page 1599, line 19) compared with the previous algorithm. It would be helpful if the authors can plot the RHi retrieved from the previous algorithm against the “True RHi”, and then compare these plots with Fig. 7.

Technical corrections:

1. Page 1597, line 27: There is a misprint. “True RHi” should be “true IWC”.

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