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Atmospheric Measurement Techniques Discussions

Interactive comment on "Study of cloud effect on the tropospheric temperature retrievals" *by* F. Navas-Guzmán et al.

Anonymous Referee #2

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The study presents a method to include clouds in the retrieval of tropospheric temperature profiles from ground based microwave measurements in the range from 50 to 60 GHz. The effect of clouds on passive microwave measurements of water vapor and temperature is an important topic and the presented paper makes a valuable contribution. I recommend to accept the paper after major revisions.

General comments
The chosen title promises a more general and in depth study of the effect of clouds on microwave measurements and the retrieved temperature profiles. However, the paper presents a straight forward method to represent clouds in the forward model using cloud base and ILW data and a comparison of the method with a reference method

(retrieval with channels $f > 53$ GHz) and radiosondes. The authors may consider to change the title into something like "Integrated approach to represent clouds in the temperature retrieval from microwave measurements".
Based on the presented material the authors conclude that their method to include clouds in the retrieval leads to a general improvement, though the improvement is relatively modest. This is illustrated by Figure 8. They further highlight that the major improvement is for thick clouds ($ILW > 0.1$ mm) with a cloud base between 1 and 3 km above ground and that for the other cases the improvement is not clear. However, in the case of thin low and high clouds the method performs equal or worse than the reference method (retrieval with channels $f > 53$ GHz) as it is illustrated in figure 9 and 10. Possible explanations are insufficiently good representation of the clouds coming from the simple assumption of the LWC profile or the fact that cloud information is only known under one zenith angle while 9 zenith angles are used for the retrieval (inhomogeneous cloud cover) or systematic errors in modeling the clouds or biases in the measured brightness temperatures in the transparent channels. The authors need to provide a more thorough discussion of these possibilities. The paper would further benefit from some comparisons on the level of the brightness temperatures instead of retrievals.

Specific comments
P1307,l10: The authors claim that clouds are not properly addressed. However, regression or neural network retrievals do consider clouds in the calculation of the coefficients. This should be mentioned here. See also p1311,l15; p1317,l3.
P1308,l24: The geometry of the TROWARA instrument should be given here and I strongly assume it looks under the same zenith angle as the ceilometer. In general, it should be discussed what the consequences are from the fact that TEMPERA ($za =$ 30 - $70°$) and TROWARA / ceilometer ($za = 40°$) do not observe under the same zenith angle (za). Are the cloud cases chosen such that the cloud layer was homogeneous?
P1311,l7: Specify the assumptions for the LWC profile in Figure 3. Since in this study

a LWC value of 0.26 g/m^3 has been assumed for all clouds, it would make sense to show the absorption coefficient of liquid water for a constant profile (from ground up to 10 km).
P1312,l13: the paper concludes that the presented method to include clouds improves the retrievals for thick clouds with a base between 1 and 3 km agl. For high and low clouds no improvement could be shown. My first conclusion would be that the chosen LWC profiles are not valid for thin high and low clouds. The text states, that fog shows LWC values one order of magnitude smaller than the chosen value. It has to be shown here in a more convincing way that different LWC profiles (values and shapes) do not significantly affect the results. A comparison on the level of the brightness temperatures would be more appropriate than on the level of the retrieved profiles.
P1313,l16: What are the ILW values for figures 5 to 7?
P1314,l23: "This example ..." this statement is a lot too general, it would be more appropriate to say that the presented method is too simple to represent low and high clouds. I appreciate the following statement about the difficulty to characterize clouds and their variability. But here the authors should show, or at least mention provided the necessary tests have been made, that other assumptions on the LWC profile do not lead to different results.
P1315,l5: Comment here also the difference in the standard deviation, which indicates that the presented method reduces the variability in the differences.
P1317,l18: "In these ..." It is dangerous to draw conclusions on the brightness temperatures from the retrievals. It would be more appropriate to show directly the difference in brightness temperatures.
P1318,l10: It is positive that the presented method performs well for thick mid layer clouds and that this corresponds to almost 50% of the cases. However, it has to be discussed in more depth why the method does not perform better for thin low and high clouds and how the method could be improved in future work.
Figure 3: In the caption is says that Rosenkranz 1998 has been used. This is not in agreement with the statements on p1310,l22.

Technical corrections
P1309,l19: replace "as a function of" by "in terms of"
P1309,l21: Equation (1) -> α must be height dependent.
P1310,l7: replace "just knowing" by "from".
P1311,l25: repeat here the geometry of the ceilometer and TROWARA.
P1313,l11: replace "case of study" by "Case studies"
P1315,l23: "We observe..." this phrase is not correct, there are significant differences between radiosonde and microwave radiometer. It should say that there are no significant differences between the two retrievals.
P1318,l3: replace "where" by "were".

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 1305, 2014.