

Anonymous Referee#1:

Response: I am very grateful that the referee gave me a lot of valuable advice, the following is my understand and reply, the black font is the comments from Referees, and the red font is my reply, please review it.

Comment: The paper presents a method to retrieve temperature and relative humidity profiles by using microwave radiometer, cloud radar and radiosonde data. In order to retrieve the atmospheric parameter, a neural network approach is used. The topic is of high interest for the scientific community and fits well the scope of the journal.

Nonetheless, I cannot recommend the paper in its current form for publication on AMT. I identify some general problems, which are discussed in the following.

First, the background knowledge and state of the art description is very poor, which leads to an imprecise contextualization of the work. If the authors claim to present an improved method for the retrieval of thermodynamic profiles, they should also provide a more extensive overview of the different methodologies applied so far.

Response: I have to agree that the background knowledge is poor, According to the literature I found, In the past researches, retrieval of cloud liquid water content from combined MWR and radar is more attention, and for the improvement of humidity profiles, more research combine MWR and wind profiler radar. I have added the content of “introduction”, please review it.

Comment: In addition, there is in general a strong lack of references. Continuously, the authors state affirmations but no source is cited. For example: page 2, line 5; page 3, line 5; page 7, line 25-26; page 7, line 18, etc.

Response: This is my fault, I have add the reference on the revise manuscript.

Comment: Moreover, the scientific methodology is often neither clear nor precise. Strong assumptions and/or simplifications are performed, e.g. the calculation of the liquid water content from relative humidity, the cloudy/clear detection and cloud geometry estimation from relative humidity, etc. Those simplifications are not completely justified and/or discussed.

Response: It is no doubt that this manuscript used some assumptions, but we have to assumpt it by referring to other studies. Following is my reply:

There are some uncertainty in the manuscript:

1. Cloud base height and cloud thickness estimated by relative humidity from radiosonde;
2. liquid water content calculation from relative humidity;
3. The deviation between BT calculated by MonoRTM and BT measured by radiometer.

But in this experiment, the training dataset must have the cloud parameters corresponding with every radiosonde profile. The cloud base height and cloud thickness have to be estimated by radiosonde data, because the samples of cloud

detection by cloud radar are very limited, we could not get nearly a decade of detecting cloud data corresponding the radiosonde. And this part of the study was referred by previous studies{wang and Rossow 1995 Journal of applied meteorology} (Wang and Rossow,1995) have proposed a method which us rawinsonde data to estimate cloud vertical structure, maximum relative humidity in a cloud of at least 87%,minimum relative humidity of at least 84%, and relative humidity jumps exceeding 3% at cloud-layer top and base. Cai et.al 2014 have described that setting the relative humidity at 81% as the threshold, the TS score is 0.66 as the highest score. Thought observation, relative humidity from radiosonde increases rapidly on the cloud layer, the error discriminating cloud base and thickness is small caused by the relative humidity of 84% as the threshold. In order to verify this method, I compared the cloud from radiosonde with the result of cloud radar. The 21 samples comparison is actually little, so I increased the number of samples comparison in the revised manuscript. It is undeniable that this approach have some error, I should be improve it in the follow-up work.

The profiles of cloud liquid water as required in the calculation of brightness temperatures are not available in the conventional upper-air ascent data, so some researchers{Tan et al 2010} assume it by relative humidity. This method have described in Wang et al(1995){Wang Z. P. 1995 Simulation of atmospheric vapor, liquid water content, and excess propagation path length based on 3-channel microwave radiometer sensings J.Nanjing Inst. Meteor}. In the current condition, I can not verify this part very clearly as the liquid water content could not be measured as the standard. And the liquid water content estimated is used to the MonoRTM, so I compared the result of MonoRTM with the measured by microwave radiometer.

With the increasing of the radiometer and cloud radar samples, this part will be greatly improved.

Hope my reply could let experts satisfied.

Comment: Also, there is important information missing in the description of the algorithm and instrumentation used in the retrieval. An example of this is section 3.2, which aims to provide an explanation of the neural network method applied. Here, a description of “what is indeed a neural network algorithm” or references to another source explaining it are missing. Because of that, many points remain incomplete, e.g.: what is a layer, why using 3 layers, what is a hidden layer or why using a tansig transfer function. Another example is the reduced description of the instrument used in the study. I would encourage the authors to work also on this part and cite useful references like Rose et al. 2004, which provides a complete and detailed description of the HATPRO instrument.

Response: I'm sorry that the description of the algorithm and the instrument may be not clear. The neural network algorithm has been clearly described in the reference, In the revised manuscript, I have added the references and the description of the network.

I have read Rose et al. 2004 and some other reference about the HATPRO, in the

revised manuscript, I increased the description and references of the instrument.

Comment: Finally, I personally would expect the use of the language to be more accurate: nonscientific opinions are used frequently. For example, in line 16 in page 6: I would not say they are the most popular methods. Other methods, e.g. iterative methods such as optimal estimation, are widely used in the scientific community. Indeed papers using the later are cited by the authors in the introduction.

Response: This is my neglect, I have revised this part, and modified the language described in the full manuscript, please review it.

Comment: For the reasons discussed above, I think that the paper is not mature enough to be published in its current form and thus I recommend its rejection.