Atmos. Meas. Tech. Discuss., 7, C3141–C3145, 2014
www.atmos-meas-tech-discuss.net/7/C3141/2014/

Atmospheric Measurement Techniques Discussions

Interactive comment on "A cloud detection algorithm using the downwelling infrared radiance measured by an infrared pyrometer of the ground-based microwave radiometer" *by* M.-H. Ahn et al.

Anonymous Referee #2

Received and published: 12 October 2014

The manuscript describes an algorithm for discriminating clear-sky from cloudy-sky scenes using an infrared thermometer (IRT). The objective of the study is to distinguish sky scenes in the field of view of a microwave radiometer (MWR) to improve the calibration of the MWR and better quantify uncertainties in MWR retrievals, both of which are influenced by the presence of clouds. The described algorithm utilizes both temporal and spectral approaches, both of which have been used by previous studies. The algorithm is validated qualitatively using satellite imagery and case studies, and quantitatively using a co-located ceilometer. The results suggest the algorithm

performance is similar or better than previous studies.

The manuscript is appropriate for AMT because it presents a practical method that is broadly applicable to the global network of MWRs that are not necessarily installed alongside a sophisticated suite of sensors that can provide detailed cloud observations. However, I have a number of general and specific comments that should be addressed.

General Comments:

(1) The main point of general interest is that the method is broadly applicable. Thus, the authors should show that it is valid in other environments, which may be colder and drier, warmer and wetter, cloudier or clearer. For example: How do the detection limits of the IRT influence its usefulness elsewhere?, How does the fractional cloud cover of a location influence the amount of time required to build enough statistics for calculating coefficients?, Are locations that are distant from reanalysis assimilation sources susceptible to error because of uncertainties in local representation of the atmospheric state?

(2) The introduction points out deficiencies in techniques similar to the proposed method (e.g., false positives from aerosols, and false negative for scenes containing thin cirrus). The authors state that the new algorithm performs as well or better than similar methods from previous studies. It would be helpful for the authors to describe what characteristics of the new method are responsible for the improvement and whether they have made any advancement from the problems faced by previous methods.

Specific Comments:

Introduction

(1) 9415L10-12: Is there a reference for these uncertainties?

(2) 9416: I believe the IRT is an optional accessory for RPG MWRs. If this was the case for the IRT used by the study, the authors might consider pointing this out in the

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introduction, as it highlights a very practical reason for focusing on the IRT and the method's applicability for future studies.

(3) RPG software may (??) provide some cloud detection information using the IRT (if installed). If this is so, can you clarify why the proposed algorithm is preferred over RPG cloud flags?

(4) 9416L27: It isn't clear if the study adopts one or more previous methods for use with the IRT or improves upon previous work. Is the scope of the manuscript to improve upon previous work or to draw from previous work in order to develop a method applicable to the network of MWRs?

Section 3

(5) 9421L18: I don't understand the use of "extensive" here. Please remove or clarify.

Section 3.1

(6) °C are used sometimes (e.g., Fig. 3) and Kelvin is used at other times (e.g., discussion of Fig 3). Please choose one or the other for clarity.

(7) TbKLAPS is from the reanalysis, while Tsfc and e are measurements. (a) How were the KLAPS data representing the location of the measurements acquired (e.g., linear interpolation) and what is the native spatial resolution of KLAPS? (b) How do Tsfc,KLAPS and eKLAPS compare to Tsfc and e, as this could be responsible for some of the RMSE in Figs. 4 and 5, or potentially, a bias later on (Eq. 4 may account for potential discrepancies between the reanalysis and surface meteorology – please clarify).

(8) 9422L24-25: The subscript "KLAPS" needs to be added to the appropriate variables in Fig. 4 and caption.

(9) TbPclr and TbEKLAPS appear to be used interchangeably in this section (e.g., Fig. 5 labels vs. Fig. 5 discussion 9423L9-18). Please ensure they are clearly distin-

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guished.

(10) Figure 6: (a) Please consider showing the one-to-one line for the clear-sky. This will help show the range of Tb where KLAPS and IRT are in agreement. (b) Please make the x-limits the same in Figs. 6a and 6b.

(11) 9424L17-18 & Fig. 6: The fact that there is an increasing systematic difference between TbKLAPS and TbIRT with decreasing temperature for the clear-sky condition (i.e., they don't fall along a 1-1 line) seems important. Could this suggest error in the IRT at low sky brightness temperatures (not just the mirror, but also maybe poorly suited calibration at low values)? Could it instead be an expression of potential systematic differences between KLAPS and the surface meteorology (i.e, Tsfc,KLAPS and eKLAPS compared to Tsfc and e), which were not discussed (see comment #7)?

(12) The fact that the IRT does not measure below -50 C is very important for this section, but this problem is not discussed. (a) How does the algorithm classify scenes when the TbIRT limit is reached? (b) For TbKLAPS $< \sim$ -60 C (corresponding to the IRT limit) there is a loss of sensitivity to optically thin clouds, but there is not enough information to determine how severe this loss of sensitivity is, or any discussion of how it might impact the use of the algorithm for better characterization of MWR data.

Section 3.2

(13) 9425L17-21: The temporal standard deviation is sensitive to the time duration over which it is calculated. The optimal time span is related to the time span over which spatial variability within clouds and between clouds is expressed in time (i.e., how fast are the moving, and what are their spatial characteristics) and cloud height (the spatial footprint in the field of view of the IRT). How sensitive are the results to the choice of the time span?

(14) 9426L6: What is meant by "compactness"?

Technical Corrections:

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9419L26: “To have an enough number of”

9420L3: “. . .profiles are cloudy free. . .” to “. . .profiles are cloud free. . .”

9420L16: “fog, density” to “fog, and density”

9422L20: “interested variable” to “variable of interest”

9424L23: “relationship” to “the relationship”

9425L10: “condition” to “conditions”

9425L13: “are” to “is”

9426L20: “One of plausible cause of this. . .”

9430L5: “cloud based” to “cloud base”

9424L18: Perhaps replace “spreadness” with “variability”

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 9413, 2014.