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Comment on amt-2022-12

Anonymous Referee #2

Referee comment on "Passive ground-based remote sensing of radiation fog" by Heather Guy et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-12-RC2, 2022

Comments to AMT-2022-12: Passive ground-based remote sensing of radiation fog

By H. Guy et al.

Overview:

The paper discusses the ability of an IR ground-based sensor (AERI) to detect the onset of radiation fog in Greenland and compares it with a microwave radiometer. A dataset of measurements from microwave and infrared sensors, ceilometer, radiosondes, and a cloud radar is selected, retrievals of temperature and humidity profiles and liquid water path are developed and used to identify times of fog and results are presented and discussed.

General comments:

I found the paper interesting and well written, and I recommend it for publication. The figures are of good quality and the presentation is clear. If I may put forward a general comment for a minor modification, in my opinion the discussion part would benefit from a more balanced approach where, instead of trying to prove that the AERI is "better" than the MWR to detect radiation fog (which was not so clear to me at the end of the discussion), the advantages of using both instruments to improve fog forecast under a broad range of conditions are discussed.

To explain better this point, I'll mention here the 3 criteria used in the paper: Accurate temperature and humidity retrieval, characterization of shallow surface inversions, detection of small changes in LWP.

The temperature and humidity retrievals (section 3.2), at least in the dataset analyzed, appear reasonable from both instruments. I agree that the bias in the MWR channel is an issue that needs to be addressed, even in assimilation, but it can be addressed. The problem of detecting surface inversions (0-10 m) from the MWR (section 3.3) is easily overcome with the help of surface temperature measurements. Obviously, if using only brightness temperatures, the MWR won't be able to resolve the two heights because measurements at 0 and 10 m are highly correlated (that's why you get a constant difference in Fig. 6a). However, that is the reason why the instrument is equipped with surface sensors.

It therefore appears that the only real advantage of the IR measurements is the higher sensitivity to small changes in LWP (section 3.4). Even here however, this advantage is true in very controlled conditions such as those carefully selected for this specific comparison, i.e. when the sky is clear, no ice, LWP < 40 g/m^2, and the cloud (fog) base is accurately known (as shown is section 3.1). It is not entirely obvious to me that a correct identification of all these conditions is easily achieved in NWP models and how the mischaracterization of any of these conditions could affect the results. When everything is put together therefore it almost seems that the advantages of using IR are not that clear.

I understand that this paper is an initial step and that a more holistic assessment of fog detection with both instruments is out of its scope, but perhaps some ideas on how to use the synergy of both instruments to obviate shortcomings in each single one would be useful. For example, could having both estimates of fog (MW and IR) help identify cases when one of the two is not acceptable for any reason? Or to identify false positives or missed cases?