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Atmospheric Measurement Techniques Discussions

Interactive comment on "Can machine learning correct microwave humidity radiances for the influence of clouds?" *by* Inderpreet Kaur et al.

Anonymous Referee #1

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Kaur et al. manuscript, entitled "Can machine learning correct microwave humidity radiances for the influence of clouds?", investigates the use of machine learning toward the better detection of cloud-affected radiances from passive space-borne microwave radiometer. The manuscript is very well written and structured, interesting to read, and highly relevant to the climate community (from production to climate data record to reanalysis) and the NWP community (for the assimilation of microwave radiances). The authors demonstrate that a well-tuned quantile regression neural networks can detect and correct the impact of scattering from hydrometeor on microwave radiances with minimum data loss (compared to traditional cloud filter rejecting a large number of potentially useful information) while providing individual uncertainties. This is tested on simulations existing and future instruments.

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Discussion paper

I certainly recommend the publication of this work. Before that, I do have few minor comments that need clarification (see below) as well as some open questions whose response could be integrated to the manuscript or not, I leave that to the authors discretion.

Minor comments:

L28: "precipitation and most dense clouds" I think the hydrometeor size is an important factor.

L66: "only using measurements (no “background” data involved)" My understanding is that the method is in theory model-free, but for the demonstration in this study, simulations (e.g. background simulated at MWHS2 frequency) are used. Am I correct? Maybe this should be stressed here. Why not try with real MWHS2 observation for the all sky dataset?

L137 "Simulations for all three sensors are noise free, so to incorporate the measurement uncertainties, whenever needed, Gaussian noise is added according to the channel NEDT (Table 1 – Table 3)." Are the errors arising from the radiative transfer calculation accounted for?

L159: "for all selected quantile fractions " by quantile fraction, do you mean the n th amongst the 7 selected (from 0.2 to 99.8%)? Also, 16, 50 and 85% are not symmetric (rounding?)

L163: Pfreundschuh uses an indicator function I (=1 or 0) in the CRPS, the authors here use y, can they explain the difference?

L173: " The input data is all-sky brightness temperature" the simulated one, even for MWHS2, right?

L301: "0.15 K" should be -0.15

L453: "Among these four channels, 150 GHz has the highest peaking function around 4

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km (Chen and Bennartz, 2020)" Could you please clarify what you mean here, 150GHz is neither the highest nor the lowest peaking channel nor it peaks at 4km. Channel 89, 118+/-1.1, 118+/-2.5, and 150 GHz peak at 0.1, 9.6, 2.9, 1km, respectively (according to Chen and Bennartz, 2020), this can also be seen in Lawrence et al. (2018) Fig. 1 through the Jacobians of channels 6 and 7.

L460: "but such information would be not be completely orthogonal" duplicate "be"

Table 1: NEDT are constructor specifications, the real noise is lower, see

Fig 5 Guo, Y., J. Y. He, S. Y. Gu, and N. M. Lu, 2019: Calibration and validation of Feng Yun-3-D microwave humidity sounder II. IEEE Geoscience and Remote Sensing Letters, doi:10.1109/LGRS.2019.2957403.

Tab 5 Carminati, F., Atkinson, N., Candy, B., Lu, Q.: Insights into the Microwave Instruments Onboard the Feng-Yun 3D Satellite: Data Quality and Assimilation in the Met Office NWP System. Adv. Atmos. Sci. (2020). https://doi.org/10.1007/s00376-020-0010-1

Questions:

Is this method applicable to IR e.g. to an ATOVS system?

The authors explain that it could benefit the all-sky assimilation systems indirectly for the analysis increment. Instead (or in addition) could it be used to model the variable observation error (when and by how much to be inflated)? This would be, in my view, the most valuable.

Could the uncertainty use for weak constraint 4dvar?

What is the resource cost of this method (is this fast enough to be used in 1-h regional nwp with 30min window)?

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