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Atmospheric Measurement Techniques Discussions

Interactive comment on "Evaluation of VIIRS Neural Network Cloud Detection against Current Operational Cloud Masks" *by* Charles H. White et al.

Anonymous Referee #2

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1 General comments

The paper compares a neural network cloud mask trained with 2D features to two operational cloud masks. The algorithm is trained with CALIOP data and uses a pseudo labeling method to deal with the issue that sunglint areas are not covered by the co-location dataset. The neural network cloud mask uses a large network but few sources of traditionally used ancillary data (most notably surface temperature is not included). Performance is very good except for small broken clouds; which given the 2D features is a bit counter-intuitive. The same network gives similar results for a large variety of surfaces.

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2 Specific comments

1. The introduction is missing an important reference. The ESA cloud CCI algorithm also uses a neural network trained with CALIOP data for the cloud mask but with a different network structure, training, imager etc.

2. Line 61-65: *Our approach aims to improve upon existing literature in several ways. Rather than relying on precomputed spectral, or textural features, we allow a neural network to learn relevant features from a local 3 pixel by 3 pixel image patch from all 16 moderate resolution VIIRS channels.* The section is missing a motivation as to why it might be good to let the network learn the relevant feature itself. If the relevant features can be precomputed then the network can be made smaller and faster (fewer variables, fewer layers).

3. Line 70-75: Include short descriptions of the MVCM and ECM cloud mask methods. (Does not have to be here.)

4. Line 185-210: Did you use any available software for training the network?

5. Line 234: Could the slightly overestimated cloud fraction in day time for MVCM be due to thin clouds not detected by 1km CALIOP data, but detected in the 5km CALIOP data and the MCVM? The chance of detecting these very thin clouds should be larger during day time.

6. Table 1: Add also at least TPR, TPN and CALIOP cloud fraction to a table. It is the 2019 data that is used for the table, right? Add info in the caption. Include also a table with results for the unfiltered data.

7. Line 265: I find this surprising, I would have expected the 2D feature to be most useful for fractional clouds.

8. Line 306: You mention that Bayesian algorithms might be affected by climatological means. Considering that your method includes latitude could it not be that it too uses the latitude mean cloudiness from the two years of training data? Have you tested how much the network depends on latitude?

9. Line 357: Can the latitude combined with sun zenith angle give a rough estimate of surface temperatures? Very impressive results for temperatures close to surface temperature.

10. Line 390: I agree it is not bad with a consistent TPR dependent only on the cloud. But optimizing TPR differences might mean making the TPR lower in easy conditions to match the performance in more difficult conditions. Is it not equally important to keep TPN as constant as possible? I think this is what is more traditionally aimed at.

11. Line 425: For the validation data do you have sea ice cover to the north west of Greenland? Can the shrinking sea ice cover in the arctic be part of the explanation. If MVCM is trained on older data and assumes it to be sea ice, and the new NN approach trained on more recent data expects more water?

12. Line 433: *The averages across space are weighted by the cosine of latitude expressed in radians.* I do not understand what you mean here.

13. Line 457: *The pseudo-labeling model likely has low skill in such conditions due to the low contrast between a low-level fractionally cloudy pixel and the background.* Did you consider using the ECM for the pseudo-labeling?

14. Line 537: *Additionally, we have not evaluated how the neural network performs specifically in cloud-free scenes with high aerosol loading. We expect that this could depend largely on the ability for CALIOP to distinguish cloud from aerosol layers.* Even if it does depend on CALIOP's ability should it not depend mostly on the VIIRS capabilities?

15. Figure 6: Consider adding figures also for the BACC.
16. Figure 8: Is this filtered or unfiltered data?
17. Have you tested to applid the NN on older data (2013) and was there a difference in performance?
18. Is execution time comparable with the operational cloud masks? Is it feasible to use for nowcasting?
19. A name of the method would be useful.
20. From my experience with NN cloud masks results often look less realistic close to the swath edges when comparing results to the RGB. In Figure 12 results look realistic also closer to the edges. Is this normally the behavior?

3 Technical corrections

- Line 53: Häkansson should be Håkansson (several places)

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