

## ***Interactive comment on “Retrieval of liquid water cloud properties from POLDER-3 measurements using a neural network ensemble approach” by Antonio Di Noia et al.***

### **Anonymous Referee #1**

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This manuscript presents a neural network algorithm developed for retrieval of water cloud microphysical quantities. While such an approach has limitations common to all machine learning algorithms (ie no direct connection between physical model and retrieval results) it also has some distinct benefits. Of particular importance is the ability to retrieve cloud effective radius and optical thickness at the pixel level, whereas the standard approaches must aggregate over many pixels, thereby significantly coarsening spatial resolution.

This is an excellent manuscript that should be published after only minor revisions. The scientific significance of this work is excellent, as well as the scientific quality and

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presentation quality.

Specific comments:

Abstract: It is good that you have highlighted upfront the limitations of the algorithm in the abstract. I would also like an indication of the sign of the bias, so that is is obvious that, for example, -2 bias in COT means NN > MODISstandard

Page 2, line 20: probably want to indicate ‘liquid’ cloud

Page 3, line 3: By LUT do you mean training set?

Page 3, line 27: I think I understood but I was a little confused at this point – the effective radius retrieval is an entirely separate NN, right?

Section 4.2, page 17, line 20: Now that you have binned to a 1x1 degree grid, we would expect polarimetric and bispectral retrievals to have greater biases, right? Please discuss.

Page 18, line 5: Aerosols above clouds will have a specific impact on cloud optical property retrievals with the bispectral approach, that would presumably not be present in the polarimetric approach (I recall a paper by Kerry Meyer about this). Is the bias you’re seeing consistent with this potential issue?

Page 21, line 19: Based on your figure 10, it looks like the assumptions of POLDER-2 level 2 COT are problematic, right? Over land the peak is much lower than 9microns, and both of the distributions are quite large (and thus hard to approximate with a single value).

Figure 16-18: It looks like the POLDER-CDR algorithm clusters at the edges of the LUT, can this be discussed more?

Conclusions: It might be nice to have more speculation how the NN algorithm is even able to retrieve properties at the inherent pixel resolution, where presumably the cloud-bow is not always observed and there is no information about the cloud microphysical

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properties. I think I get it, but more detail would be nice.

Page 24. Line 1, Would this algorithm be feasible for another instrument in your group, SPEXone?

Page 24, line 20-25: regarding ice clouds, could a NN be created that doesn't retrieve size, but the parameters van diedenhoven does mention (ie aspect ratio and roughness)?

Finally, it would be nice to have the data and code archived somewhere and not just available upon request.

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-345, 2018.