

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.

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We thank Reviewer 2 for his/her comments. Below are our replies. Reviewer’s comments are in bold, our replies are in plain text.

1) In introduction or in section 3-1, a discussion about the advantages and disadvantages of using neural network should be added comparing to classical method (LUT) or more recent method such as variational method that should be able to handle multiangular measurements without database constraints.

We have revised our manuscript by discussing some disadvantages of NN retrievals

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with respect to other techniques (no direct indication of goodness of fit, cost function defined statistically and not per retrieval). This is done on page 3 in the revised manuscript, lines 9 to 14. A discussion of the advantages (high speed, modest memory demand) was already provided in the original manuscript.

2) In section 3-1 can the authors give elements on which data give which information. For example, what is the information provide by the degree of linear polarization (DoLP) for the cloud optical thickness retrieval

We have revised this part of the manuscript by specifying that information about COT mostly comes from radiance (and, for small COTs, from DoLP), whereas information about cloud effective radius and effective variance comes from the angular (and spectral) dependence of polarized radiance provided that the cloudbow angular range is sampled. The change can be found on page 5.

3) Page 5, line 29: I'm not agree: the saturation reflectance of the optical thickness is not "inherent to POLDER-3 measurements" but comes from the 1D homogenous cloud assumption.

We have changed this sentence according to your suggestion.

4) Overall, some explanations of the observed differences are missing. For instance, Figures 7 and 8, how do the authors explains the observed bias in optical thickness between POLDER-NN and MODIS retrieval given that the same cloud model is used for the retrieval?

We do not think it is correct to say that the same cloud model is used in COT retrievals from POLDER-NN and MODIS. In MODIS a fixed effective variance is used, whereas the POLDER-NN retrieval does not assume a specific cloud effective variance. In the reviewed manuscript we have placed more emphasis on this point, by adding a short section on page 22 in which we discuss the results of our effective variance retrieval. However, this is not likely to be the cause for the COT biases. These are

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most probably caused by the presence of broken clouds that the cloud fraction filter was unable to identify. This effect is known to cause biases between polarimetric and bispectral retrievals, and is already discussed in the manuscript.

5) I was also curious to know how the algorithm works in the sun-glint region. It can be an advantage of the multi-angular and neural network retrieval comparing to LUT with measurement in a single direction. Could the authors show analysis of results obtained for pixels including sun-glint directions?

Our preliminary impression is that the training of the NN would need substantial modifications before it becomes capable of properly handling glint cases. Unfortunately at the moment it is difficult to perform a complete analysis without a significant delay in the publication.

6) Figure 16 and Figure 17. you mentioned in the text that correlation with MODIS is better for POLDER CDR than for POLDER NN which is true. But, I would add that POLDER-NN does not retrieve as many Reff value limits (at $20\mu\text{m}$) than POLDERCDR, which appears to be a progress.

On page 24 in the revised manuscript we have added a sentence that mentions this point. It is possible, though, that this just results from the fact that the choices we made in the generation of the NN training dataset may be different from those made in the generation of the tabulated values from which the CDR retrievals are derived.

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