

## ***Interactive comment on “Use of neural networks in ground-based aerosol retrievals from multi-angle spectropolarimetric observations” by A. Di Noia et al.***

**Anonymous Referee #1**

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This manuscript presents an application of neural networks to aerosol retrieval algorithms from ground based, multi-angle, polarization sensitive sky radiometer. When used to find the first guess of an iterative retrieval algorithm, neural networks offer an improved likelihood of convergence, fewer iteration steps, and in some cases more accurate retrievals compared to traditional algorithms that use a Lookup Table to determine the first guess.

This is an excellent paper. The topic is well thought out, descriptions clear and well structured. The results of this analysis are useful to the scientific community and described in a manner that is easy to replicate.

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I struggled to find fault with this manuscript. If the comments below seem trite, it is because I was doing my best to provide a complete critique.

Section 2.3, line 9 (grammar) Change to “The forward model provides a simulation of. . .”

Section 4, page 9057, lines 6-8: Were the tested noisy data real observations or simulated data with noise added?

Section 4, page 9057, line ~20: Were separate  $y$  vectors used for reflectance and DLP? If so, why? Isn't the retrieval algorithm really using a concatenated version of the two? Does this make the determination of the number of PC for reflectance and DLP simpler in some way?

Section 5, page 9060, line 15: Change the third to last word from “worth” to “worthwhile”.

Section 5.1, page 9061, line 27: The non retrieved aerosol parameters have been “randomly perturbed”. In what way, and by how much? This is a little vague.

Section 5.1, page 9062, 9063, Tables 4 and 5. I'm a bit overwhelmed by the all the ways in which error, bias, correlation, etc. are represented. Which parameter is the best metric for success, and are presenting all these values a bit of confusing overkill? For example, I originally compared RMSE in table 5, and was confused because this does not support the conclusions in item 1 on page 9062. I then realized that these conclusions were made with the correlation coefficient. Which is a better metric, and why?

Figure 4: perhaps it would be useful to indicate on this figure the chi-squared error threshold for a successfully converged solution? Also, considering the range of the results, is this better represented on a log-log plot? Section 5.2, general: The presumption in the comparisons to AERONET data is that AERONET represent the well calibrated best representation of truth. This is probably the case for total optical depth, but

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the retrievals actually have less information content than polarization sensitive ground-SPEX, right? This should probably be pointed out in some way – one explanation of differences between groundSPEX and AERONET could also be that groundSPEX is more accurately representing geophysical 'truth'. I would think this is most likely the case for the imaginary refractive index, which are shown (Dubovik et al JGR 2000, I think?) to be not particularly accurate.

Figures 5-9: I think the time series plots are useful, but it might also be useful to have a scatterplot of matching AERONET/groundSPEX data points. That way you can represent the entire retrieval dataset rather than just four days, and look for systematic differences. Of course, this does challenge my previous comments about the use of AERONET as truth, so that would need to be discussed as well.

Appendix A, page 9072, line 7 (grammar): change "worth" to "worthwhile"

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Interactive comment on Atmos. Meas. Tech. Discuss., 7, 9047, 2014.