

## ***Interactive comment on “Combined neural network/Phillips-Tikhonov approach to aerosol retrievals over land from the NASA Research Scanning Polarimeter” by Antonio Di Noia et al.***

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We are thankful to Dr. Alexei Lyapustin for his review. Below is our reply. The Reviewer's comments are highlighted in bold, our replies are in plain text.

**I have just one question which should be outlined, perhaps, in the Abstract or summary, and was not really clear to me after reading the paper. Of all field campaign data, what % of experiments did you process in the end? Paper says ~10% based on convergence to  $\chi^2 < 2$ . From  $\chi^2 > 2$ , what % is due to failure from the surface retrievals? You can evaluate  $\chi^2$  from the surface alone based on simulated experiments. My feeling is that adding surface spectral covariance**

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**as a constraint may not serve you well. Also, the retrieval accuracy of ~0.01 surface reflectance (perhaps larger since 0.01 is rmse) in the visible bands is not good enough for the land applications, e.g. vegetation studies, and it creates a considerable uncertainty for the aerosol retrieval, although of course, aerosol-surface parts are not separated in the described algorithm.**

After we applied our data filtering (based on scattering angle and cloud screening) we processed 2327 RSP measurements, and about 10% of these retrievals converged to a  $\chi^2$  less than 2, as you correctly mention. In the revised version of the paper we summarized this in the conclusions. We feel that the abstract is not the best part of the manuscript in which to include this information, as this is not part of the main message of the paper. At the moment we are unable to offer an quantification of the percentage of retrievals which fail to converge because of failures in the retrieval of the surface properties. Our simulated retrievals did not display major issues related to this point. We agree, however, that if, for instance, the BRDF models we use in our retrieval scheme fail to reproduce the angular behaviour of some real surfaces underlying RSP, this has the potential of leading to high  $\chi^2$ . Possibly, in order to evaluate how significant this effect is, we should generate synthetic data assuming surface BRDFs that deviate significantly from the Ross-Li model and try to perform the retrievals assuming the model is still valid. In our current simulation setup, though, this is not straightforward.

Regarding the accuracy of the retrieval of surface reflectance, in the revised version of the paper we added a sentence in which it is mentioned that an accuracy of 0.01 in surface reflectance is not sufficient for land applications, but may be still adequate for climate models (Wang et al., 2004, He et al., 2014, and references therein).

**P.5, Ln. 12: The backscattering azimuth is  $180^\circ$  (you have  $180^\circ + \phi$ ).**

Our impression is that this is not the case. In this sentence we explain the angular relationship between an RSP measurement made in the forward direction and one

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made in the aftward direction. Our modeling assumption is basically that all the RSP measurements lie on the same line. Figure 1, placed at the end of this document, gives an idea of the viewing geometry we assume in our model. The red dots represent angular measurements made in the forward direction at a given relative azimuth angle  $\varphi$ , whereas the blue dots represent measurements made in the aftward direction. It seems to us that for such measurements the relative azimuth angle is  $\varphi + 180^\circ$ .

**P.5, Ln.27: “This term is equivalent to the classically defined surface albedo.” This is incorrect – please remove here and correct everywhere in the paper. Surface albedo is “classically” defined as a ratio of reflected and incident surface fluxes. This ratio will equal  $f_{iso}$  ONLY if hemispheric integrals of terms containing  $K_{vol}$  and  $K_{geo}$  in the boundary condition of RT are zero, and they are not. For the same reason, surface albedo is a function of SZA (e.g., see Lyapustin, 1999, JGR).**

Thank you for making us aware of this. We have removed this statement from the paper, and we have changed the titles of the figures in which the term “surface albedo” appears. We have replaced “surface albedo” with “isotropic scattering coefficient”.

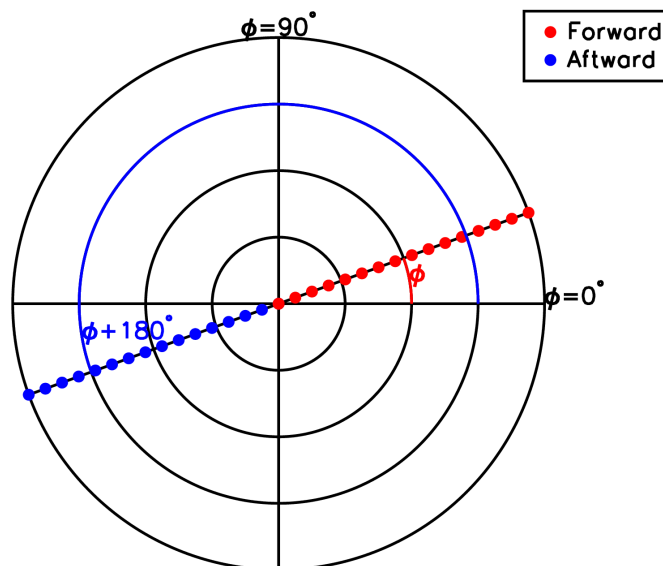
#### REFERENCES

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**Fig. 1.** Idealized viewing geometry assumed to model the angular dependence of RSP measurements. Each dot in the polar plot represents a single angular measurement.

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