We appreciate the effort and time the reviewer has invested in reviewing our manuscript. We are grateful for the constructive feedback, which have improved the quality of our research. Please find our response below with revision details.

This study by Gao et al. conducts the impact and estimation of the angular uncertainty correlation for multi-angle polarimetric remote sensing of aerosols and ocean color, through the development of various methods integrated into a practical framework. Theoretical and real retrieval uncertainties are derived based on error propagation and comparison of retrieved and true values, respectively. Overall, the methods used in this work are solid and important for the community, particularly, lots of previous studies neglected or simplified the angular uncertainty correlation for multi-angle retrieval. Also, the manuscript is well organized and presented. I have only a few minor concerns before it could be accepted by AMT.

Thanks for the positive comments.

- Eq.6, For the integrity of the article, I suggest authors specify the value of each element of the a priori error matrix, i.e, Sa, though details have been mentioned in Gao et al. 2022.

  Thank you for the suggestion. The value in the a priori error matrix is added to appendix Table A1.

  Original:

  > In this study, each retrieval parameter can only vary in a limited range as shown in Table A1, which imposes an implicit a priori constraint on the retrieval parameters.

  Revised:

  > In this study, each retrieval parameter can only vary in a limited range, which imposes an implicit a priori constraint on the retrieval parameters. **Both the parameter ranges and a priori values are listed in Table A1.**

- P6L11, Also, it is better to specify the equation on the calculation of theoretical uncertainty of variables which are not retrieved parameters directly but related to the state vector, e.g., remote sensing reflectance, Rrs.

  I believe the review refers to P7L11. We made the following revisions:

  Original:

  > The uncertainties of variables which are a function of the retrieval parameters can also be derived from S and their derivatives. Due to the large number of retrieval parameters used in the retrieval, the evaluation of the retrieval uncertainties can be time consuming. The speed to compute uncertainties is improved using

automatic differentiations based on neural network forward models (Gao et al., 2022).

Addition:

> … **For example, the uncertainty of remote sensing reflectance (Rrs) can be derived using the automatic differentiation applied on the neural networks for BRDF correction and atmospheric correction components (Gao et al., 2022, Appendix A: Speed improvement using automatic differentiation).**

P9L5, please correct the correlation angle and correlation parameter as, $\theta c = 60^\circ$ (r = 0.983)

Corrected.

We also identified a similar typo in P20L5, which are also corrected: r = 0.0992 is corrected as r = 0.992.

- Fig.2, what are three sets of error examples?

  We generated a total of 1000 cases, this is three random sets of error examples. It is used to demonstrate the longer range of correlations. Added more discussions:

  Original:

  > "…Three sets of error examples are shown in different colors."

  Revised:

  > "**A total of 1000 set of errors are generated and added to the simulation data.** Three error sets are shown as examples in different colors."

- P12L15, Table3.2 -> Table 3

  Corrected

- P13L3, Table -> Table 3

  Corrected.

- P14L5, Give -> Given.

  Corrected

- P14L22, how did authors explain why the real retrieval uncertainty increases until θc reaching 10◦ to 20◦ for C4?

  This is an interesting observation. Knobelspiesse et al 2012 also observe a similar behavior on RSP data. We added more discussions here:

  Original:

  > When the correct correlation angle is considered in the retrieval cost function (C4), the real retrieval uncertainty increases until θc reaching 10^{o} to 20^{o} and then slightly decreases at higher correlation angles, for most retrieval parameters.

  Addition:

  > ... **Similar behavior of the information content has been reported by Knobelspiesse et al. (2012) on the study of error correlation in RSP measurements. To understand how the correlation influences retrieval accuracy, we further analyze its impacts on the eigenvalues of the error covariance matrix with details discussed in Appendix B**.

  More discussions (in the Appendix B: Eigenvector decomposition in error covariance matrix) are here:

  > "…As shown in Fig. B2 , when the correlation strength is strong the SIC is increasing with theoretical retrieval uncertainties estimated from error propagation such as for fine mode refractive index, wind speed and Chl a decreasing. However, when the correlation is relatively weak, SIC decreases and uncertainties increase with the correlations. The correlation angles with maximum uncertainties are different with different retrieval parameters, but generally fall within 30 degrees. This behavior may relate how the measurement uncertainties are mapped to the retrieval parameters space through Jacobian matrix. Similar behavior of the SIC has been reported by (Knobelspiesse et al., 2012) for the RSP measurement."

- P16L12, it is confusing why the retrieved wind speed indicates a larger uncertainty. Did the authors conduct the retrieval in the sun glint condition?

  Thank you for the question. Since the NN used in this manuscript do not include the large magnitude glint signal, we have removed the glint angles in the retrievals (Fig 4), which contribute to a larger wind speed uncertainty. New NN including sunglint has been developed in our recent study and will be discussed in future works.

  Original:

  > "As shown in Fig. 8, the ratio is close to 1 for most parameters for $\theta_c = 10^{o}$, with slightly larger impacts for effective variance for both fine and coarse mode as well as for wind speed uncertainty."

Addition:

> "... **Note that sunglint has been removed in the retrieval as shown in Fig 4, which may contribute to a larger wind speed retrieval uncertainty."**

- Section 4, I suggest authors make a short discussion about why the reflectance at 670 nm inclines to have an over-fitting issue.

  Thank you for the suggestion. We believe that 670nm band is the major contributor to the overfitting as shown in the overall cost function (Fig 10). This is likely due to the large number of angles at 670 band (60 angles) comparing with other bands (10 angles). Therefore, the 670 band is more sensitive to the angular correlation. As discussed previously, larger correlation may lead to smoother angular variation and the retrieval algorithm may fit those smoother variations as the real signal, which lead to a smaller residuals and therefore strong overfitting. We have discussions as follows in the manuscript:

  > "The 670 nm band shows the largest reduction, where a ratio of 0.025 is observed for $\theta^c = 10^o$, reaching 0.015 for $\theta^c = 120^o$, which may be due to the large number of angles (60) in the 670nm bands versus the other bands (10 or 20). "

- P20L3, bans - > bands

  Corrected

- Figure 12, I suggest using different colors to indicate 670nm and 870nm.

  Thanks for the suggestion. Two different colors for 670 (red) and 870 (brown) are used in this study. We agree that these two colors can be difficult to distinguish. To provide more information for this plot, the brown and red color symbols are quite close to each other, and the red color symbol is mostly lower than the brown color one when they are different.

- In conclusion, I suggest authors discuss the promising of those methods used in coastal water retrieval.

  Thank you for the suggestion. We revised following discussions:

  Original:

  > "-Future retrieval algorithm development
  > The pixel-wise theoretical uncertainties achieve a reasonably good performance to represent real retrievals when no correlation is presented. Their performances on various retrieved geophysical properties are quantified by comparing with the real retrieval errors. The difference grows bigger when the angular correlation is

stronger, which suggests convergence to local minima and indicates that more development is needed to improve the retrieval optimization."

Addition:

"… **For the development of future algorithms with more retrieval parameters, such as aerosols with more complex shape and absorption properties, and coastal waters with more complex bio-optical properties, a better characterized error model, such as the one considering angular or spectral correlations, will be helpful to identify information useful for the retrievals, and therefore improve retrieval performance and uncertainty assessment."**