Response to Reviewer 1's comments:

The authors thank this reviewer for the helpful comments and strictly followed these comments in revision of the manuscript.

General comments: This manuscript reports the modeling results of light polarization in atmosphere-ocean coupled RT systems. This study is very useful for satellite remote sensing, especially for the corrections of unpolarized radiance measurements and for inter-satellite measurement calibrations. All major factors influencing RT and polarization have been discussed in depth. The method and results are sound. The reviewer hopes that after this publication the simulation model can be released to public for general usage of the science community. Based on these general comments and the specific comments listed below, a minor revision is recommended.

Thanks for the recommendation. However, due to NASA's export control policy, the publication of code may need a very lengthy process. This will be tried.

Specific comments:
1. Line 26 of page 17586 to line 8 of page 17587: It may be misleading to use the words 'polarization-sensitive solar imagers' to describe MODIS and VIIRS since those imagers are non-polarization imagers. It sounds like these imagers are polarimeters. Of course, the measured radiance values are polarization dependent. Did King et al (1992) discuss polarization? If not, it may not be suitable here. Also, this statement is too long and confusing. Please revise.

This is revised. MODIS's radiance measurement does have some sensitivity to polarization of light. However, saying it is a polarization-sensitive instrument overstates its problem. "polarization sensitive" is removed from before "MODIS".

2. Line 14 of page 17587: can PARASOL scan in cross-track direction? If yes, why cannot it scan to high sun (small solar zenith angle) locations? Does it only look at the principle plane? Please provide more information.

We add/revise the text "since PARASOL is in the A-train sun-synchronous orbit and its CCD array has no cross-track scan function, its solar zenith angle (SZA) and viewing angles are limited."

3. Line 18 of page 17588: Please define ïA¸s´ and ïA¸ł since vector operation is involved. Are they vectors? If yes, when and how are their magnitudes used or referred?

These are revised in the text by the unit vectors $\mathbf{e}_r$, $\mathbf{e}_\theta$, and $\mathbf{e}_\varphi$.

4. Line 19 of page 17589: What is the 'common intensity I'? Is it the value I of Stokes parameters or I – sqrt(Q2+U2+V2)?

We changed this to "total radiance", it is the value I of Stokes parameters.

5. Lines 6 and 7 of page 17590: What is the definition of AOLP for PARASOL? Why is it defined here differently? It is important since polarization parameters could confuse readers a lot if defined differently. Sometimes, even wrong definition could be seen in literature.

We removed the statement for the difference in the definitions of AOLP in PARASOL and in our report. Since PARASOL define AOLP from -45 deg to 135 deg, it is different from what we define in this report. However, in correction applications they are physically same.

6. Line 12 of page 17590: It is unclear what this 'which are the ratios of the sensormeasured intensity counts to the incidence intensity' meant. Which numbers are the ratios? 7. Next line: It may not be right to claim 'G0 can be obtained in calibration with natural solar light as incidence source' since solar lights could be slightly polarized at ground level due to atmospheric gas scattering. It would be true at TOA. Is the calibration done at TOA?

This paragraph has been revised as "… **G_0 and $G_p(AOLP)$ are sensor's gain factors for unpolarized radiation and linearly polarized radiation, respectively. $G_p(AOLP)$ is the ratio of the sensor-measured intensity count to the intensity of the linearly polarized incidence light source used for calibrating the instrument, and G_0 can be derived as a mean value of $G_p(AOLP)$ over all AOLPs."**

8. Line 10 of page 17591: The 'uncertainty' should be error.

"uncertainty" is changed to "error" here.

9. Lines 14 and 15 of page 17591: Could the authors highlight certain key factors here to let readers know the complexities, please?

This statement is modified as "The polarization correction could be more complicated for an imager with scan mirror optical system (Sun and Xiong, 2007; Lukashin et al., 2013), when the sensor's gain factors G_0 and $G_p(AOLP)$ are also the functions of scanning angle."

10. Line 22 of page 17591: 'to do the modeling of: : :.' It could be changed to 'to model

: : :.'.

This is revised as instructed by the reviewer.

11. Line 24 of page 17591: It would be better to delete the comma ',' and the word 'also'.

This is revised as instructed by the reviewer.

12. Line 26 of page 17592: the same as item 10.

This is revised as instructed by the reviewer.

13. Lines 15 to 18 of page 17593: The authors mentioned 'a long history: : :', but only cited Evans and Stephens (1991) later. Previous publications especially Hansen and Travis (1974) may be needed as references here.

This is revised as instructed by the reviewer.

14. Lines 25 and 26 of page 17593: It is a little bit odd that the authors did not use the profile of US standard atmosphere which is more or less the average atmospheric profiles. Why?

We aribrarily chose atmospheric profiles in the original report. We revised the report using US standard atmosphere for all results after Fig. 8.

15. Top of page 17595: Could the authors provide more information on the calculations of mixed single-scattering properties, please? Are these properties weighted by scattering amounts of individual agents at the layer, or by mass amounts, or something else? .

We add in the text "In calculation of the mixed values, single-scattering properties of individual agents are weighted by their optical thickness."

16. Line 22 of page 17597: The authors may provide more insights on 'each wave facet orientation'. For example, what are the slope angular resolutions? are there any shadows among different facets? and, how to deal with light incidence angle larger than 90 degree compared to facet orientation (this is for very large slope angle cases)?

Since this paper is aimed at more general purpose of making PDMs for CLARREO inter-calibration applications, we neglect the detailed technical stuff in RT. Actually, angle resolution is 5 deg in SZA, 5 deg in VZA, and 1 deg in RAZ in our calculation; shadows are considered and reported in Fig. 12; when light incidence angle is larger than 90 degree compared to facet orientation, this facet is in the shadow.

17. Line 23 of page 17599: did the authors mean 'incidence' only or general incidence reflection geometry? Also, it would be better to reword the phrase as 'the parameters of incidence-reflection geometry, surface, and/or atmosphere'.

The "incidence" is changed to "wavelength". The rewording is done following the instruction.

18. Line 11 of page 17602: 'Actually, the only significant effect of different atmospheric profiles on reflected solar radiance spectra is the gas absorption to the light.' This statement may be misleading. Were the authors talking about pristine clear profiles with constant winds only? Since sub-ocean layers, ocean states, aerosols, and very thin clouds could have spectral impacts on polarization, the authors may need to clarify this.

This is changed as "To build a comprehensive set of PDMs, we also need to check the dependence of DOP and AOLP on the profiles of pristine atmosphere. Actually, the only significant effect of different pristine atmospheric profiles on reflected solar radiance spectra is the gas absorption to the light. Therefore, the sensitivity of solar light's polarization to pristine atmospheric profiles can be examined by studying the dependence of the DOP and AOLP on the gas absorption."

19. Line 17 of page 17602: 'The total reflectance and DOP with the mid-latitude summer gas absorption (solid curves) and those with 4-times the mid-latitude summer gas absorption (black dots) are shown.' Why an atmospheric profile could have gas absorption 4-times as high as that of the mid-latitude summer profile? Different wavelengths? Please explain.

This is changed by using subarctic winter and tropical atmospheres to show the effect of different absorption.

20. Line 1 of page 17609: 'Also, since we assumed randomly-oriented ice crystal aggregates in the calculation, there is no specular reflection peak from horizontallyoriented ice columns or plates either.' This statement is confusing: were the ice crystals such as columns and plates randomly-oriented or horizontally-oriented?

We missed "aggregate" particle shape in the statement, this caused the confusion. The "aggregate" is added in the text.

21. There are certain presentation problems in the manuscript. Here the reviewer lists some of them. The authors should check the whole document to improve the presentation. a). Line 22 of page 17594: change the word 'modeling' to 'model' b).

Line 20 of page 17596: add a word 'obtained' or 'calculated' before 'based on : : :.' c). Line 6 of page 17600: The authors used the word 'modes' many times in various places. Are these 'modes' the harmonics of sinusoidal functions? If yes, why not use harmonics instead? If not, what do exactly these 'modes' mean? d). Line 9 of page 17601: It is unexpected to use 'respectively' here. Please explain. e). Line 19 of page 17608: change the phrase 'only cause as big as _ 10%...' to either 'cause as big as _ 10%...' or 'only cause _ 10%...' f). Line 27 of page 17609: change 'o' to 'of'

These errors are all corrected accordingly.