This paper presents the implementation of radiative transfer model SCIATRAN on snow, sea ice and ocean system with a great depth of technical details. I think in general the manuscript is well written and worth publication due to the scientific significance of the method and result it presents. Meanwhile, I have the following comments and would the authors to address before its publication.

Response: Thank you for the positive feedback.

Major comments:

1. The paper aims to cover a large number of topics, such as coupled atmospheric-ice-water surface, multi-layer snow and ice system, and polarization. The presentation of these many topics makes it hard for the reader to guess the technical details for specific topic. For example, Appendix A shows the implementation of a vector scheme of radiative transfer solver and all benchmark results in Section 4 are validated against vector radiative transfer models on relatively simple ocean scenes, which strongly suggest that we are seeing a vector scheme of coupled atmospheric-ice-ocean system. However, Section 5 validation is done with un-polarized measurements exclusively and makes me wonder whether it is done with the same vector radiative transfer scheme but under the scalar mode by setting all non-F11 elements of the scattering matrix to zero. I wish the paper can be clearer on that.

Response: The validation results presented in Section 4 compare different radiative transfer models, all of which provide simulations for the vector components. In contrast, the results in Section 5 are based on real measurement data. For these simulations, SCIATRAN was run using the same vector radiative transfer scheme but under a scalar model. This information has now been included in Section 5.

2. For the solving of minimization problem in Section 5, what are the *a priori* information used in each minimization? Also what is the measurement covariance being assumed? Also, what is the minimization solver used for these results?

Response: We employed an iterative non-linear least squares fitting approach, meaning that no a priori information was used.

Minor comments:

Line 65 reference with ?

Response: We have added the reference in the revised version.

Line 472 refferred -> referred

Response: Corrected

Line 481 show -> snow

Response: Corrected

Please increase the size of the polar plots of Fig. 8-11. They are too small and it is hard to pickup details from them.

Response: We have increased the size of polar plots in Fig. 8 – 11 in the revised vesion.