24 May 2020

Responses to the comments from referees and open discussion comments

Dear editors, referees and commentator,
Thank you very much for useful comments. We have made a large effort to improve our manuscript following your comments as specified each by each as follows. We believe the manuscript has significantly improved and is informative to the science community.

Teruyuki Nakajima on behalf of the co-authors

1. Referee-1 comments

C1-1. General comment: This paper presents in depth overview of SKYNET network of sun-photometers. It describes the hardware and many details of the network operation including calibration procedures, maintenance, atmospheric aerosol and gaseous property retrievals, as well as validation of the SKYNET products. The SKYNET has been founded about two decades ago and has been dynamically evolved since. In my opinion, the SKYNET together with AERONET is one of the bests established ground-based networks that provided extremely valuable information for validation of satellite observation and directly for aerosol science. It is difficult to overestimate the importance of this information provided by the ground-based networks for current understanding of properties of atmospheric aerosol and its impact on climate and environment. With no doubts this paper comprising many details of SKYNET operations is clearly interesting and important for the community and for the reader of Atmospheric and Measurement Techniques (AMT). Therefore, I think the paper should be published AMT and included AMT highlights. At the same time, the authors could try to clarify additionally certain aspects and improve the content of the paper even further. Below, I listed few suggestions for optional consideration by the authors.

A1-1. We added more information for improving the content of the paper as explained in answers to each comment.

Detailed comments;

C1-2. The abstract seems to be unusually short, probably it could be extended by adding some more essential information.

A1-2. We extended the abstract summarizing the results of the paper.

C1-3. In my opinion, the paper could be even more interesting if the authors put additional efforts in outlining even more the similarities and differences, as well advantages and

disadvantages of SKYNET observations and retrieval products with those from other networks, first of all compare to AERONET.

A1-3. We tried to put more comparisons in Sections 2 and 5 by adding measurement protocols, QC screening processes, and analysis algorithms with some comparison with those of AERONET to our knowledge. We have added new tables 3, 5, and 6 to quantify the discussion for calibration, AOT comparison, and SSA comparison.

C1-4. The paper seems to focus on the details of hardware description and acquisition of measurements. Probably, some more information about retrieval procedures could interest the readers.

A1-4. We added text in Section 5 to explain algorithms and performance of the analysis system with some comparison with those of AERONET.

C1-5. Some statements about accuracy of the retrieval, e.g. about size distribution and single scattering albedo are not justified in fully convincing way. The author just showed few figures and short explanations to them. The justification of retrieval products accuracy normally deserves more attention. For example, in AERONET activities many theoretical investigations and field campaigns are devoted to clarification of the retrieval accuracy of aerosol properties (SSA, etc.). I believe some more discussion and references to filed experiment and numerical tests could be beneficial for readers.

A1-5. The network is for research purpose without a centralized data analysis system and information is scattered in independent papers and documents, which makes SKYNET difficult to be understood by the science community. In this situation this paper intends to make an overview of key findings and issues of the SKYNET, providing better information for the community. We firstly stated this point in abstract and introduction. We also feel the original manuscript lacks some important details of the software system and data analysis protocols, so that we added more explanations in Section 2 and 5.

We eliminated 0.015 as the SSA accuracy, and instead added a statement that the difference is less than 0.03 if the improvements are introduced in the operational system, mentioning uses of AERONET knowledge. We also added discussion regarding AOT and SSA accuracies with new Tables 3, 5, and 6. We also added a new Table 2 to list information regarding the known SKYNET data archives.

4. Other revisions/corrections

The following revisions/corrections were applied other than comments by reviewers.

4-1. We added two authors, Akihiro Yamazaki and Sujung Go, because we needed their data

and discussion for producing answers to some of reviewers' comments.

4-2. We added Ministry of Ocean and Fisheries, Korea in Acknowledgments.

4-3. Accuracy of precipitable water vapor was 0.2 cm instead of typo 2 cm in the original manuscript.

4-4. Table numbering changed because of insertion of new Table 3; accordingly Table 3 became Table 4. We also added new Tables 5 and 6. Equation numbering also changed due to insertion of new Eq. (21)-(24).

4-5. We replaced Fig.8(b) from Roman result to Davos result, because, in the new corona virus lock-down in Rome, we had a difficulty to retrieve detailed data from the Italian university where the data are stored.

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