Review of paper by A. Sinyuk et al.

The AERONET Version 3 aerosol retrieval algorithm, associated uncertainties and comparisons to Version 2

The present manuscript is devoted to describing the solution of two tasks:
1) The changes and additions to the V3 aerosol retrieval algorithm over that of V2 are presented and the potential effect of each change in V3 on aerosol retrievals is analyzed. Operational almucantar retrievals of V2 versus V3 were compared for four AERONET sites (GSFC, Mezaira, Mongu,and Kanpur).

2) A new approach to estimate uncertainties in the retrieved aerosol parameters was developed. The LUT approach was tested by generating U27 for aerosol retrievals at four selected AERONET sites representing differing aerosol types.

Besides these tasks, a new sky radiance angular distribution measurements scan, called the hybrid, is introduced and discussed.

The topics in the manuscript are undoubtedly urgent.
The problem is that certain questions within each of these tasks require a more detailed description than is done in this version of the manuscript. I think it is reasonable to submit a number of considered questions either after, or in parallel with, publishing this manuscript. It is hardly appropriate to expand substantially the given version of the manuscript. In particular, the manuscript already contains very many figures and tables, complicating the perception of the material.
The second variant is to divide the text presented into two parts: description of the AERONET Version 3 and description of new approach to estimating the uncertainties in the retrieved aerosol parameters. In principle, these are two different tasks that can be described separately.

Major comments (in the order of their appearance in the text)

Line 223.
While for the almucantar (ALM) observation geometry this is a reasonable assumption (e.g. Dubovik and King, 2000b; Torres et al., 2014), for other geometries ***the sensitivity to vertical structure of aerosol and gases in atmosphere can be important****, especially at shorter wavelengths with relatively large Rayleigh scattering*.

Please provide a reference or numerical estimates

Page 9 (3.2 Effects of changes in Extraterrestrial solar flux and temperature correction)

Figure 5 discusses the temperature dependences of NSR. Seemingly, the temperatures in the range of 10-50^{o}C at the selected site are distributed non-uniformly, and points on the plots differ in statistical representativeness. Can this influence the result?

Section 4 (Hybrid scan: concept and retrieval scan).

From materials, now presented in section 4, we can gain only a general idea of the novelties associated with the new instrument type. If they are left in about the same form that we see in the manuscript, it is reasonable to consider questions, regarding the hybrid scan, in more detail and, presumably, in a separate publication. Maybe this publication does already exist now?

Reading the section raises the following questions.

How many photometers, ensuring the new scanning geometry, have been installed and already operate now?
Are they installed at all four sites, data from which are used in the present study, and how long ago?
Does the aeronet.gsfc.nasa.gov site present information on the type of instrument (or instruments, if they operate in parallel) that is used at arbitrarily chosen observation site? In any case, I cannot see such data.
Did the cloud screening procedure change after passing to new sensing geometry?

Results in subsection 4.2 are described very sparingly. Results in Figs. 17 and 18 can hardly be considered as an argument in favor of the good correspondence between results retrieved using two different scanning geometries, more so considering that the authors present no statistics that was used in these comparisons. For instance, it is unclear why the authors conclude that *at the same time the variability is increasing with increasing wavelength due to predominant contribution of fine mode aerosols to the generated statistics, and therefore much smaller AOD at the longest wavelengths which results in less sensitivity to aerosol absorption (***line 496***)*?

Can you present data for at least a few observation sites that would show how much the number of retrievals increased after the new geometry was introduced?

Line 534.
The radiometric calibration and solar spectrum irradiance uncertainties are combined in one bias because both of them affect the magnitude of sky radiances.
What is the value of uncertainty, resulting from combining the radiometric calibration and solar spectrum irradiance uncertainties?

Subsection 5.4.
In analyzing the results from retrieving aerosol characteristics, it is important for the reader to obtain information on what is the uncertainty degree of any characteristic at a specific site under certain atmospheric conditions.
The authors carried out such an analysis for four sites (GSFC, Mezaira, Kanpur, and Mongu), which correspond to four different aerosol types. It is reasonable to stress this in the text of the manuscript (put simply, starting an analysis, say, for GSFC, to prescribe aerosol type characteristic for this observation site in an explicit form). It would also be useful for the reader to see any climatologic data on characteristics for four selected sites (type of AOD distribution, relationship between fine and coarse fractions, characteristic types of the underlying surface, etc.)
Then it will be easier for the reader to choose estimates of uncertainty that correspond to the specific data that he analyzes.

Line 666.
Fig. 24 shows the uncertainties (by the U27 methodology) of the RRI at 440 nm estimated for the GSFC, Mongu, and Mezaira sites.
Can any recommendations be obtained regarding RRI at other wavelengths?

Line 679.
In contrast, the U27 estimated for SSA and observed variability of SSA retrievals are more consistent. Additionally, the upper and lower limit retrieval constraints of RRI (1.33 and 1.60, respectively) were reached at times, suggesting some potential instability in the retrievals of RRI. The percentage values of RRI retrievals reaching 1.33 and 1.6 (in parentheses) were estimated for all three sites for 440 nm AOD less than 0.2 and greater than 0.4. The estimates for smaller AOD bin show that RRI retrievals hit 1.6 boundary more often than that of 1.33: 1.6% (13.7%) for Mezaira, 3.1% (11.1%) for GSFC, and 2.2% (18.5%) for Mongu. The corresponding estimates for larger AOD demonstrate significant 685 reduction in the number of boundary hits, especially that of 1.6: 0.6% (6.8%) for Mezaira, 2.5% (0.9%) for GSFC, and 0.4%(4.3%) for Mongu.

The meaning of the sentences is difficult to understand.

Line 715
For this reason, the U27 estimates for the RRI are not reported in the AERONET database.

Is the AERONET database of the U27 estimates publicly available?

Line 816.
A climatological LUT was generated from the entire Level 2 AERONET almucantar and hybrid scan database by binning U27s in AOD (440 nm), Angstrom Exponent (AE, 440-870nm), and SSA (440, 675, 870, 1020 nm).

What is the contribution of hybrid scans to LUT?

Minor comments

Line 280.
Figure 3 illustrates the sensitivity of normalized sky radiances (NSR).…

Possibly, not all readers are familiar with the notion "*normalized sky radiances"*. Please define NSR in the text or present a reference.

Subsection 3.4
Please make the text in the section consistent with table numbering. In the text, the aerosol parameters are considered in the following order: SSA, RRI, parameters of particle size distribution. Tables are presented in a different order: SSA, parameters of particle size distribution, RRI.

Figure 3, Figure 22
Curves, corresponding to the same wavelength, are better to give in the same color.

Throughout the text.

Please explain what abbreviations (VMR, etc.) stand for, not in the figure captions, but in the text of the manuscript

This manuscript is very useful and is recommended for publication. However, the authors are hoped to consider our comments or to argue why they are unreasonable to consider.