

Dear anonymous reviewer,

Many thanks for reviewing our paper and for your useful and positive comments. We hope you find our answers and the revised version of the manuscript satisfactory.

Sincerely,

Marcin Witek

Compared with V22 aerosol retrievals that are constructed at 17.6 km spatial resolution (with 16x16 pixels), the new V23 aerosol retrievals are constructed at 4.4 km spatial resolution (with 4x4 pixels). With a reduced number of pixels used in the retrieval process, is there a reduction in signal to noise ratio? Does this reduction in signal to noise ratio affect AOD retrieval?

Re: Over oceans, DW retrievals have always been performed on a single 1.1 km pixel that is determined by the algorithm to be the darkest in the retrieval region. Therefore, the change in resolution between V22 and V23 does not affect the signal-to-noise ratio in DW retrievals. Over land, the pixel-to-pixel variability of the underlying surface is modeled with empirical orthogonal functions (EOFs), which allows to disentangle the atmospheric and surface contributions to the TOA signal. In V23 less pixels are used to construct EOFs than in V22 due to reduced resolution. This in principle can affect the accuracy of EOFs and the resulting AOD retrievals. However, our validation efforts indicate that AOD retrievals over land are actually more accurate in V23 than in V22.

Cloud screening is discussed in section 4.1.3. However, even with the use of the clear flag fraction (CFF) parameter, cloud contamination may still exist. This is because no IR channel is included in MISR observations, and this may introduce an issue for detecting very optical thin clouds (e.g. thin cirrus). The authors shall at least mention that.

Re: We added a general sentence in section 4.1.3 regarding the difficulty in detecting thin clouds with passive instruments:

“Cloud-contaminated, high-AOD retrievals in often pristine regions of the world were also apparent in the V22 aerosol product, highlighting existing deficiencies in the cloud clearing methods employed in MISR data processing (e.g., Li et al., 2009; Shi et al., 2014). **Detection of optically thin clouds (e.g., thin cirrus) is particularly challenging.** Witek et al. (2013) examined the impact...”

Page 22, line 14, the authors mentioned that AODs are reported at 550nm. What is the procedure used to convert from AOD at 558 nm (V22) to 550nm?

Re: We added clarification in section 4.1.4 regarding AOD conversion between wavelengths:

“In the V23 product, the **primary quality-screened** AOD field is named “Aerosol_Optical_Depth” and it is reported at 550 nm, to make it compatible with MODIS (Levy et al., 2013). **AOD conversion between wavelengths is facilitated thanks to a reported field “Spectral_AOD_Scaling_Coeff”, which provides coefficients of a second order polynomial fit to the spectral AODs.**”

Page 28, what is the cloud screening method used for V22 MISR AOD data for constructing Figure 7? Also, what is the method used for converting AOD from 558 nm to 550 nm?

Re: It is a default cloud screening employed in V22. There is no additional screening similar to the one described in section 4.1.3 and applied in V23. We added additional sentence clarifying AOD conversion to 550 nm in V22:

“The V22 AODs are scaled to 550 nm wavelength using the reported V22 green band (558 nm) AOD and Ångström exponent.”

Page 41, figure 15. It looks like the low bias in high AOD retrievals still exists. What are the sources for this bias and why were changes not made to correct this low bias?

Re: Yes, this initial validation against AERONET observations shows that MISR tends to underestimate AODs in high-AOD conditions. We deliberately do not elaborate on this bias, leaving its analysis to a separate study. Part of this AOD underestimate is due to aerosol spatial heterogeneity in the vicinity of AERONET stations, as documented in a previous study by Witek et al. (2019, Figure 3). In high-AOD conditions aerosols often vary considerably on spatial scales of ~25 km, which is a radius used for averaging MISR retrievals employed in this study. Witek et al. (2019) found that decreasing this averaging range improves AOD comparisons statistics between AERONET and MISR. Other reasons for this apparent low bias in high-AOD conditions will be investigated and possible solution implemented in next product release.