Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
https://doi.org/10.5194/amt-2022-60-RC1, 2022

Comment on amt-2022-60

Anonymous Referee #1

Referee comment on "Employing relaxed smoothness constraints on imaginary part of refractive index in AERONET aerosol retrieval algorithm" by Alexander Sinyuk et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-60-RC1, 2022

The paper discuss an improvement of aerosol parameters retrieval algorithm from AERONET network measurements of sun and sky radiances. The authors have focused on an optimal choice of smoothness constraints on imaginary part of the refractive index. In the previous version of the retrieval algorithm, the strength of the smoothness constraints correlated with the value of the retrieved Angstrom exponent. The authors argue that the smoothness constraints which strength depends not from the Angstrom exponent but from wavelength allow better retrieve the imaginary part of the refractive index, namely, it's wavelength variation. Aerosol single scattering albedos has been retrieved from measurements of many observational stations, using 'old' and 'new' smoothness constraints. The authors argue that the 'new' approach allows better retrieve aerosol single scattering albedo wavelength dependence, especially in the presence of brown carbon, which has strong short-wave absorption.

The following improvements are suggested.

The abstract is too long and difficult to understand.

The paper is overloaded with abbreviations. Many readers who are interested in details of AERONET retrieval algorithm will want just quickly browse the paper. In this case, the text is often too difficult to understand due to abbreviations that are not very common.

Row 77. "Absorption at 380 nm is particularly important as this is the wavelength range that satellite observations and algorithms are able to retrieve atmospheric column absorption from existing (Jethva et al, 2014) and future satellite sensors (Werdell at al., 2019)” . This statement should be clarified. Is it due to low aerosol optical depths at longer wavelengths?

Equation (3) is discussed too briefly, it is better to say a few words about what each term in it represents, rather than just defining the variables.

There are two γ variables in the equation (3), Lagrange multiplier γ_n (row 149) and Lagrange multiplier γ_k (row 146). Later in the text the authors discuss the Lagrange multiplier γ_3 (row 164). It is necessary to write explicitly which one Lagrange multiplier is considered.

The authors discuss AERONET measurements from many observational places scattered throughout the world. A table with geographical coordinates of these places would be very helpful. Please check if the name Mesaira is spelled correctly (Mesairaa?).

The authors analyze the improvement achieved with use of the ‘new’ smoothness constraints by comparing the wavelength dependence of the retrieved aerosol single scattering albedo (SSA) using the ‘old’ and ‘new’ version of the constraints. They consider the dependence of SSA on wavelength for different aerosol optical depth (AOD) bins. Fig. 1 shows SSA wavelength dependences for Rexburg and Rimrock observational places. Later, wavelength dependences of SSA are presented for AOD bins only for Rimrock (4), but not for Rexburg. Tables 1-3 present further analysis only for Rexburg, but not for Rimrock. The analysis should be done in uniform manner.

Fig. 1 shows that application of the ‘new’ version of the smoothness constraints lead to smaller SSA values retrieved at short wavelengths. The authors argue that this is due to the presence of brown carbon aerosols, which have such a dependence on the wavelength. However, the retrieved absolute values of the SSA are quite high, 0.93-0.98. Are such high values typical for brown carbons? If yes then this should be said explicitly.

It is not clear how many observations are used to produce figures 1-11.

Presence of error bars on the plots would simplify its understanding.

Tables 1-3 show absolute differences between aerosol parameters retrieved using ‘old’ and ‘new’ constraints. I suggest including relative differences also because in many cases the absolute differences are too small and seeing so many zeros in the tables is not very informative.

The analysis presented in Tables 1-3 was done for wavelengths 440,675,870,1020 nm.
Why is the 380 nm wavelength excluded from the analysis?