

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2021-269

Anonymous Referee #2

Referee comment on "Above-aircraft cirrus cloud and aerosol optical depth from hyperspectral irradiances measured by a total-diffuse radiometer" by Matthew S. Norgren et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-269-RC2>, 2021

General comments:

This manuscript deals with experimental determinations of cirrus and (tropospheric) aerosol optical depth using a prototype total-diffuse radiometer. The retrieval approach is described in detail and the described techniques are applied to measurements taken during two aircraft field campaigns in 2018 and 2019, respectively. Validation results with independent measurements are shown for both campaigns demonstrating the reliability of the retrievals. The paper is generally well-written, easy to follow and I have no major objections against the publication of this manuscript. I ask the authors to consider the following – mainly minor – comments.

Specific comments:

Line 61: "Cirrus presence is especially high in equatorial regions where their frequency of occurrence can be near 50 percent."

A reference would be good here. The cloud occurrence rate will be dependent on the spatial resolution and the sensitivity of a sensor. Does this also include sub-visual cirrus? If yes, then the occurrence rate may be higher?

Line 79: "This use of the ratio leaves the main sources of uncertainty as the instrument precision and assumptions made in the retrieval itself, resulting in RD being highly sensitive to small variations in optical depth."

I think something is missing here?

Line 115, equation (2): How strong an assumption is that? What about full RT-simulations?

Line 116: Perhaps the asymmetry parameter can be defined briefly?

Line 161: "In The" -> "The"

Line 117: "is a term encompassing non-Rayleigh extinction from trace gas molecular scattering"

I'm not sure what "trace gas molecular scattering" means. The Rayleigh scattering by trace gases is negligible. Do you mean absorption by trace gases?

Line 192: "For the aerosol-free case within the selected wavelengths region, the $\delta\sigma_{\text{ext}}$ profile (dashed blue line) .."

For the dashed blue line the Rayleigh extinction was also removed, I think. Perhaps this should be mentioned explicitly.

Lines 217 – 222: What about instrumental straylight, i.e. photons that should not end up on the detector, but get somehow scattered/reflected there? Particularly the diffuse measurements must be affected by that?

Line 251: "RD outputs have less error .."

What do you mean by "error" here? The difference between retrieved and true values or the retrieval error estimate? This should probably be stated explicitly.

Line 255: "the output of RD fall" -> "the output of RD falls" ?

Line 284: "though" -> "through"

Line 293: "Reid et al., (2021)."

Comma after "al." should be removed. Please also check the other citations.

Line 296: "decent" -> "descent"

Line 322: "DR < 0.9"

At which wavelength?

Lines 327 – 330: What about contamination of the diffuse measurements by solar photons scattered etc. by the instrument/mask etc.? There must be a contamination to a certain extent?

Line 380: "wavelenght" -> "wavelength"

Line 383: "angstrom" -> "Ångström" (or even better with \AA at the beginning)

Line 411: "DR_mea < 0.95"

At which wavelength?

Caption Fig. 4: "In red, a sample from 1 km which is within the aerosol layer"

The text in the Figure says "below aerosol". Please clarify.

Line 476: "These optical depths are mostly due to the presence of stratospheric aerosols"

Stratospheric aerosol optical depth in the visible spectral range is on the order of a few times 10^{-3} for background conditions, not more, i.e. significantly lower than 0.05.

Caption Fig. 6: "are sorted into bins with 0.25"

I think "0.25" should be "0.025".

Line 552: "However, we expect that since $\delta\tau_{\text{cirrus}}$ is a layer, and not a column optical depth, the forward scattering of light by cirrus which inhibits the SDA method to be less troublesome for our RS method because the irradiance at the top of the layer is directly characterized."

I didn't understand this sentence. Is something missing here? Please adjust or add commas to make the meaning of the statement clearer.

Line 565: "the points generally falling below"

I think "falling" should be "fall", given the first part of the sentence?

Line 574: "data is subsampled" -> "data being subsampled" ?

Line 577: "preforms" -> "performs"