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Atmospheric Measurement Techniques Discussions

Interactive comment on "Correcting for trace gas absorption when retrieving aerosol optical depth from satellite observations of reflected shortwave radiation" *by* F. Patadia et al.

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This paper outlines a revision of the Dark Target algorithm to better account for the absorption of common atmospheric gases. The radiative transfer code and spectral database have been updated since Collection 5, but the essence of the method is unchanged. A gas's optical path is modelled as a linear (or, in the case of water, quadratic) function of gas path length. Ten gases were evaluated, and the regression coefficients are reported for both the MODIS and VIIRS sensors. It concludes with a brief reminder that ignoring the difference in spectral response between two instruments can produce non-trivial errors.

Though this paper has a rather small audience, it is well within the remit of this journal and is the sort of work that is often overlooked. Other than a few minor corrections, I recommend it for publication.

A few matters that warrant consideration:

L28 Though I appreciate the simplicity of the language, aerosols aren't necessarily 'tiny'. Hinds described them as 'fine' but I find 'Aerosols are particles in the atmosphere' is usually sufficient.

L285 It is true that these gases are usually well mixed. However, a not-insignificant number of users of aerosol data study emissions from volcanoes and fires. As those emit many of the gases you are studying in significant quantities, do you have any estimate of the magnitude of errors that will result from using climatological concentrations there? A back-of-the-envelope calculation could be quite informative.

L304-9 Could you please provide some quantitative indication of the quality and uncertainty of these fits (e.g. root-mean-square deviation and the maximum error)? This would be particularly instructive for water vapour, where I would appreciate a more scientific justification for using a quadratic fit (or, *vise versa*, a justification for using linear fits with everything else).

L336-8 While I appreciate that in normal operations you can't use the MODIS water vapour product, you've presumably tried using it offline. Could you quantify approximately how much difference it makes to the final product?

L441-3 This final paragraph begs the obvious question to any algorithm paper: You've proposed something that sounds sensible, but is it actually better than what you did before? Fig. 7 implies you've processed at least a month of data with the new corrections. For that data, does the RMS difference against AERONET collocations improve (or at least not significantly degrade)?

Fig.1 The axes labels are far too small to be legible.

Figs.3-4 The axes labels aren't meaningful to someone that hasn't read the text exhaustively. Also, is the y-axis of 3(a) really the log of the log of the transmission factor?

Fig.6(a) Could this be the same size as 6(b) to facilitate comparison?

Fig.7 There might be a good reason why not, but could the fractional difference be plotted rather than (or in addition to) the absolute difference? Over the central Pacific changes appear to be 0.01, which is rather significant there.

The English quality is in the upper quartile of paper's I've reviewed. Though I found the language rather repetitive, it is not my place to nitpick style. However, I do have some grammatical recommendations:

- "the" should proceed the following words: L12 underlying, L14 Moderate, L18 High-resolution, L21 MODIS, L25 gas, L34 characterization, L40 solar, L53 accuracy, L98 context, L106 Earth's, L126 spectral reflectance, L211 coefficients, L311 gas, L326 largest, L381 HITRAN, L395 subsequent, L400 MODIS, L470 nadir.

L17 There should be a comma after 'paper'.

L23 AOD biases of up to

L24 studies are attempting have attempted to create

L35 'over broad regions' seems redundant to 'global'.

L41 from the solar radiation interacting interaction with suspended aerosol particles aerosols from the

L51 to apply in to new situations. These latter include

L55 suggested that for reducing to reduce uncertainties

L67 magnitude as to pristine AOD, and is equal

L76 (well-mixed) throughout across the globe

L77 their absorption would also would lead to

L82 gases to be too small to bother with negligible [MISR ATBD]

L105 from blue through to the shortwave

L116 'observed' seems redundant to 'as measured by the satellite'.

L123 been made for about the surface

L141 each gas were was calculated

L195 The expression for G should be typeset as math not text.

L252 This heading should be bold.

L256 database [] for calculating to calculate transmittance

L267 This heading should be bold.

L323 accordance to with absorption

L329 w should be typeset as math not text.

L347 SO_2, and other trace

L348 day-to-day should be hyphenated.

L355 different gases is different

L357 case of with a small amount

L371 ‘match’ seems to be the wrong word. I think you mean ‘be consistent with’ or ‘can be used with’.

Fig.1 are overlaid for visualizing to visualize their positioning in atmospheric ‘window’ region regions where

There are also a few thoughts I would like the authors to be aware of but which are unreasonable to expect a revision:

L86 Though aerosol retrievals don’t often discuss gas correction, sea surface temperature studies do because of their more stringent accuracy requirements, such as doi:10.1016/j.rse.2010.10.016. For aerosol in particular, §2.3.3.3 of the thesis of Haiyan Huang (http://eodg.atm.ox.ac.uk/eodg/theses/Huang.pdf and https://ora.ox.ac.uk/objects/uuid:16e444e6-5da9-43da-a122-c50c7e6a2412) presents a sensitivity study of TOA brightness temperature from AATSR to a variety of gases. I am curious if the authors have ever considered the importance of species such as F^{12} and CFCs, which Dr. Huang found to be rather important?

L257 I agree with Dr. Gordon that you should have used a more recent version of HITRAN.

L281 Many studies desire a representative set of atmospheric profiles. I appreciate that you’ve cited someone for making that decision. However, researchers have done statistically robust selections for the minimally representative set. For example, §3 of https://www.ecmwf.int/sites/default/files/elibrary/2008/11040-generation-rttov-regression-coefficients-iasi-and-airs-using-new-profile-training pdf.