Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
https://doi.org/10.5194/amt-2021-419-RC2, 2022

Comment on amt-2021-419

Bryan A. Baum (Referee)

Referee comment on "Assessing the benefits of Imaging Infrared Radiometer observations for the CALIOP version 4 cloud and aerosol discrimination algorithm" by Thibault Vaillant de Guélis et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-419-RC2, 2022

The IIR has been used in numerous studies as a complementary source for cloud/aerosol products that are simultaneous with the CALIOP products. Given the exceptional record provided by the CALIPSO platform, and the continual improvements in the cloud and aerosol products over the different Versions (currently Version 4), the current study further shows how the IIR can help to reduce some of the (small) remaining ambiguity in the V4 products. The focus is on those V4 cloud/aerosol retrievals that are derived with less confidence. The use of the IIR in this study suggests a significant improvement for ambiguous V4 cloud retrievals but somewhat less improvement for elevated levels of absorbing aerosols. Stated another way, the IIR can be used to reclassify what are currently ambiguous V4 cloud and aerosol retrievals into more appropriate categories. This is a very nice study that is worthy of publication with mostly very minor revisions listed below for the authors to consider.

A few issues came to mind as I was reading this article.

- The abstract mentions dense dust or elevated smoke layers, but smoke is not mentioned again until page 10, Section 4. The radiative transfer calculations shown in Figure 4 only refer to dust. Figures 8 and 9 refer to only dust as well. It would be interesting to see this expanded to include elevated smoke and perhaps volcanic ash. While events that involve smoke and ash are sporadic, they can have a sizable impact for the period in which they are present.
- With regards to the IIR, how stable has this sensor been over its 16-year life? Are the radiances being monitored and assessed in comparison to other imagers such as MODIS or VIIRS, and if so, are the results available? Every sensor degrades over time in space, so it would be good to know about the IIR's stability over time.
- The IIR has been used to support the CALIOP measurements in this and other studies. It might be useful to include a sentence or two to the Conclusions to suggest what sort of measurements would be useful to further reduce the ambiguities that are the focus

of this study. Perhaps polarimetric measurements might improve aerosol detection?

- Would be great to see a similar study over the poles in a future article.

Minor revisions - these are simply suggestions for your consideration.

Page 1, line 12: “are confirmed thanks to the IIR”. Suggest revising this to something like: are reclassified more appropriately through use of the IIR…

Page 2, line 28: cloud or aerosols classification —> cloud or aerosol classification

Page 2, line 51: impact of faint layers. What is meant by faint? Optically thin? Be more precise.

Page 5 (and other places): The phrase “in order to simulate” could be more simply stated as “To simulate”. The words “in order” do not add anything and it has been drilled into me by a English literature wordsmith. Just a suggestion.

Page 8, line 172: is dense enough - what does this mean? Optically thick? Be more precise.

Page 8, line 173: if the cloud is high enough - do you mean above the lower levels of the atmosphere where most of the water vapor resides? Above the boundary layer? This could be stated more clearly.

Page 8, line 174: again, what is meant by “in very dense clouds”. Optically thick?

Page 8, the sentence “Note that for liquid clouds, even optically thick and high clouds can stay in the clear-sky uncertainty region.” This is confusing to me for this reason: A mid-level water cloud composed of supercooled liquid droplets often has ice particles falling out of the base, which depletes the water content of the cloud layer. The remaining liquid droplets tend to be very small, and these small droplets tend to scatter light much more than with larger droplets, leading to high optical depths even in the IR. So the BTD signatures can be quite large. I do not understand how an optically thick and high cloud composed of liquid water droplets can be anywhere near the clear-sky uncertainty region given the lower brightness temperature of the clouds…unless you are only working with brightness temperature differences and not the actual brightness temperature, which would immediately indicate that the measurement is from a cloud and not clear sky conditions.

Page 8, line 186: IIR observations is —> IIR observations are (by the way, this sentence also includes the phrase “in order to”)

Page 10, line 250: close to dust —> close to a dust

Page 10, lines 252-253: (dense dust layers at higher altitude and/or larger optical depth are virtually impossible) - this statement (in parentheses in the manuscript) does not make sense to me as written.

Page 10, The sentence beginning online 259 needs a bit of reworking. May I suggest: …are derived for several z-tau ranges that minimize the PDF widths so that the IIR signatures are primarily dependent on layer altitude and optical thickness.

Page 12, line 317-318: …can be confirmed thanks to IIR —> can be reclassified more appropriately with the aid of IIR measurements

Page 13, line 341: The primary aerosol mentioned to this point in the article is dust. This is the first mention of elevated smoke. Volcanic aerosols are not mentioned specifically. Perhaps the manuscript could be more clear on what types of aerosol classification will be aided by the IIR. It seems to me that elevated smoke (with soot particles), volcanic ash, and mineral dust are all candidates for the IIR as they can each have significant absorption in the IR.

Page 13, line 352: since IIR —> Since the IIR

Page 15 line 399: show less good agreement —> show lower agreement

Page 15, line 403: observed by CALIOP have shown —> observed by CALIOP was shown

Page 15, line 407: However, compare to clear-sky —> However, compared to the clear-sky

Page 15, line 410: very good working —> very good skill