

The Cryosphere Discuss., referee comment RC4  
<https://doi.org/10.5194/tc-2021-397-RC4>, 2022  
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## Comment on tc-2021-397

Anonymous Referee #4

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Referee comment on "A sensor-agnostic albedo retrieval method for realistic sea ice surfaces - Model and validation" by Yingzhen Zhou et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-397-RC4>, 2022

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AccuRT/RTM looks novel but needs sharing as open source as well as documentation to be subject to rigorous peer review. For example compare this situation with the RAMI experiments (Widlowski et al., 2007) or the MYSTIC cloud simulator (Mayer et al., 2010). Similarly, MLANN looks like a significant advance but again needs sharing as an open source resource to have any impact on the community. Very limited examples are not really a proper "validation" when the uncertainties are unknown of the "truth" data-sets. The authors do not present convincing evidence that MLNN will work on a time series of MODIS (let alone other instruments) to show the evolution of sea ice albedo during the Arctic spring/summer. They ignore the work of the NOAA group on VIIRS and the NASA group at UMD on the VIIRS-SNPP and MODIS time series and the UCL group on MISR instantaneous albedo retrievals all of which have long time series datasets publicly available which this paper does not. This technique and the paper is of high interest to the community but needs less hyperbole (on line 3 the authors claim there are no reliable albedo products, this reviewer would strongly dispute this) and more quantitative intercomparison with the aforementioned datasets before it can be considered for publication. Otherwise, this paper will represent cherry-picking results without any serious self-critical analysis.

1. There is an incorrect assertion in the abstract: "there is currently no reliable, operational albedo retrieval product capable of assessing the global sea-ice albedo with sufficient spatial-temporal resolution for studies of sea-ice dynamics and for use in global climate models"
2. NOAA have had an operational spectral and shortwave albedo product multiple times per day derived from NOAA-20 VIIRS since September 2018.
3. There are a bewildering number of acronyms that are not defined in the order that they are introduced. The paper needs to include a list of acronyms that the reader can consult.
4. One example is "comprehensive SD" on line 179 which is not defined previously. What is "SD"?
5. The authors should provide evidence for the negligible differences of NIR and SW albedos for the differences given the upper wavelengths of 2.1 $\mu$ m, 2.5 $\mu$ m, and 3 $\mu$ m (lines 278-279)

6. Absolute albedo is not very helpful when the range in albedos is so large. It is better to show the coefficient of variation (stdv/mean) to see how the albedo varies in uncertainties. (Line 437)
7. The so-called validation shown here is usually referred to as stage 1 (CEOS-WGCV-LPV, see <https://lpvs.gsfc.nasa.gov/>) as there are very limited dates and there is no uncertainty specified for the aircraft measurements.
8. Why was MLANN not adapted for uses with SGLI, VIIRS, and OLCI?
9. Also, what about comparisons with the OLCI product derived using the Kokhanovsky et al. 2020 (Line 687) SNAP processor?
10. Where are the open-source repositories of AccuRT and the RTM/SciML as well as MLANN?

#### Cited references

1. Widlowski, J.-L.; Taberner, M.; Pinty, B.; Bruniquel-Pinel, V.; Disney, M.; Fernandes, R.; Gastellu-Etchegorry, J.-P.; Gobron, N.; Kuusk, A.; Lavergne, T.; Leblanc, S.; Lewis, P. E.; Martin, E.; Möttus, M.; North, P. R. J.; Qin, W.; Robustelli, M.; Rochdi, N.; Ruiloba, R.; Soler, C.; Thompson, R.; Verhoef, W.; Verstraete, M. M.; Xie, D. Third Radiation Transfer Model Intercomparison (RAMI) exercise: Documenting progress in canopy reflectance models. *Journal of Geophysical research Solid earth* 2007, 112, D09111.
2. Mayer, B.; Hoch, S. W.; Whiteman, C. D. Validating the MYSTIC three-dimensional radiative transfer model with observations from the complex topography of Arizona's Meteor Crater. *Atmos Chem Phys* 2010, 10, 8685–8696.

Annotation Summary of tc-2021-397 - annotated.pdf.

Note [page 1]: Line 3: NOAA have had an operational DAILY spectral and shortwave validated albedo product derived from VIIRS since September 2018. There is also a paper which describes the sea ice product specifically which you reference below from Peng et al. (2018) but which you ignore in your paper. Where is the evidence that this is not reliable and operational? Is your proposed product operational? This sentence should be modified.

Note [page 1]: Line 9: But neither does the MISR (Kharbouche & Muller, 2018) nor does the GLASS product both of which are produced from instantaneous measurements.

Note [page 1]: Define acronym

Note [page 1]: Line 14: This is not a very helpful measure of error if you don't provide the range and mean?

Note [page 1]: Line 23: Extent? Thickness? Concentration? Which attribute is in decline?

Note [page 2]: Spatial resolution?

Note [page 2]: What is the resolution?

Note [page 2]: Spatial resolution?

Note [page 2]: Omits MISR products from Kharbouche & Muller (2018)

Also, needs spatial and temporal resolution and time range adding as well as URLs of where the product is described and available.

Note [page 2]: Table 1 is very poor. Needs consistency in spatial resolution, needs a column for time range for which they are available. Needs an additional column for validation level (see CEOS comment later)

Strikeout [page 2]: (2018)) have been validated using ground truths from the Greenland Ice Sheet and snow-covered land, but the validation is not representative of the highly variable sea-ice surface.

Note [page 2]: L38: This is because there are no reliable long-term measurements of sea ice albedo publicly available.

Note [page 2]: Line 41: But that is true of all the so-called validation exercises including your aircraft data. This I only for a few dates, can be up to 5 hours different in time with the satellite overpass and does not have any uncertainties associated with the aircraft measurements.

Strikeout [page 3]: The CLARA-SAL product (Riihelä et al., 2013) calculates the 'black-sky albedo', the App-x and MCD43 products generate both black- and white-sky albedo (Schaaf et al., 2002), and all other albedo products directly yield 'blue-sky albedo', which is also the albedo that can be directly compared to with...

Highlight [page 4]: Section 3 is devoted to validation of the albedo-retrieval product, discussion of potential causes of uncertainty, and a sensor-to-sensor comparison of the retrieval outcomes using MODIS and SGLI radiance data.

Highlight [page 4]: (2021 (ready to submit), as well as its applicability to cloud radiative forcing (CRF) analysis and to enhancement of current regional/global climate models.

Note [page 5]: Line 118: Define acronym

Highlight [page 6]: A coupled RTM that is used in conjunction with a realistic modeling of the system based on its IOPs can address both of these challenges.

Highlight [page 8]: (i) the complicated surface and atmosphere conditions by varying the optical properties in Table 2, and...

Note [page 8]: Line 185: all the parameters need to be elaborated in a table as this is an open journal. Also, is AccuRT open source? And what about the retrieval method?

Note [page 8]: Line 195: Are these available? Where are they described?

Note [page 8]: Line 203: Reference needed

Note [page 8]: Line 208: need reference and/or URL for this unknown sensor.

Note [page 8]: Line 209: It is disappointing that this sensor was not examined as it could then be compared against the operational VIIRS product from Peng.

Note [page 9]: Line 215: What does the L stand for?

Note [page 11]: Line 281: What is this footprint? How is the difference in resolution dealt with? Aggregation?

Note [page 11]: Line 295: Where does this significant decrease come from? H<sub>2</sub>O absorption?

Highlight [page 12]: matching dates in the latitude-longitude range of night operations

(identified using the MLCM, Chen et al.

Note [page 12]: Line 311: The visible results do show the lowest value of  $r$  and slope. The authors should comment on why these produce the worst results.

Note [page 13]: Line 326: how fast did the sea ice move over the time period between the MODIS observation and the aircraft observation? It is likely that the poorer disagreement is due to the fact that the same piece of sea ice is not observed by the aircraft.

Note [page 14]: Figure 3: caption: What is the time range shown here between these 2 sets of measurements?

Note [page 16]: Line 378: This is difficult to believe as most sea ice moves at  $>10$  km/day at this time of year.

Note [page 21]: Line 437: Absolute albedo error is not very helpful when the range in albedos is so large. It is better to show coefficient of variation (stdv/mean) to see how the albedo varies in uncertainties.

Note [page 21]: Line 441: Remind the reader what MPD is and define in a list of acronyms.

Note [page 22]: Figure 10: What does EE mean? Define in the caption.

Note [page 23]: Lines 460-461: Is this upper range of wavelength for  $n_2b$  significant?

Note [page 27]: Figure 14 caption: Why is the OLCI retrieval so much coarser in spatial resolution?

Note [page 28]: Line 529: Why on earth was this done?

Note [page 29]: Line 55: this is hyperbole. Where is this demonstrated? I only see MODIS & SGLI results.

Note [page 29]: L567: Why is this important? What impact does this have?

Highlight [page 29]: Information of both the surface BRDF and the IOPs of the atmosphere have already been taken into account.

Highlight [page 29]: (2021 (ready to submit)).

Note [page 29]: Line 574: What is a whole image? A 5-minute MODIS Level-1B data granule?

Note [page 29]: Line 585: But so are MISR (which uses MODIS cloud masks) and VIIRS & MODIS (e.g. GLASS) direct estimation algorithms?

Note [page 30]: Line 588: EGU journals should only permit open access datasets with a publication DOI. In addition, all software should be open access. This is what differentiates EGU from other comparable journals. This should not be an exception.

Note [page 30]: Table A1 caption: Where does these percentages come from?

Note [page 33]: Line 597: Exact URLs should be provided.

Note [page 33]: Line 600: Grant numbers should be listed.

Please also note the supplement to this comment:

<https://tc.copernicus.org/preprints/tc-2021-397/tc-2021-397-RC4-supplement.pdf>