GENERAL COMMENT

The dataset based on upscaling could be very useful for the community, as it is a huge compilation of data from 368 sites mainly distributed in North hemisphere (mainly North of America and Europe). However, I miss a representativeness over Australia, where there are already available a large quantity of networks providing in situ albedo measurements.

Optimism about the fact of the need for upscaling techniques should be toned down, as it is not a need as community-agreed validation protocols recommend the use of in situ tower measurements, as they are the real 'truth'. The upscaling approach could be useful for heterogeneous areas, allowing increasing the representativeness of the sampling for direct validation at global scale. However, this approach introduces other sources of uncertainties, as the uncertainty of satellite high-resolution input is propagated and higher than in situ measurements. I miss this aspect in the dataset (the uncertainty should be provided). To be compliant with the concept of 'fiducial reference data', the uncertainties should be quantified and provided along with the reference dataset for conformity testing of satellite products. It is well-known that upscaling introduces additional sources of uncertainties. The next generation of satellites will reduce the spatial resolution of global coarse resolution products, allowing the use of point in situ data. Then, it should be discussed the originality of this datasets for future applications.

Based on the validation results of the method, the upscaling maps show similar uncertainty (RMSE) than existing albedo satellite products when they are compared with direct in situ measurements. Then, the upscaling method provides a useful approach to increase the number of sample for direct validation purpose but it cannot be considered as real 'truth'. This should be clearly demonstrated.

Additionally, I recommend reviewing the use of the English language along the manuscript. The presentation of the methods and results should be presented more clearly. It would be necessary to specify which datasets, quantities and resolutions (spatial and temporal) used in each step.

SPECIFIC COMMENT

Title

What do you mean by 'bias correction'? In situ measurements support validation of satellite products, providing useful data for bias quantification of satellite products. I am not sure how in situ measurement could be used to correct the bias of a satellite product.

Absract

Line 13: Same comment as before in regard to 'bias correction'. Justify the use of the 'correction term' or modify by bias quantification

Line 14: What satellite measurements are you referring? Low, medium or high (decametric) instruments.

Line 16: Justify the need for upscaling. If satellite acquisition and in situ measurement footprints are similar the upscaling introduces additional sources of uncertainties.

Introduction

Lines 55-56: The community-agreed surface albedo validation protocol (CEOS Working Group on Calibration and Validation – Land Product Validation subgroup) disagreed with this affirmation. Ground measurement can be directly used to validate satellite pixels. The current community-agreed approach is based on the evaluation of the spatial representativeness of ground measurement (Román et al., 2010, 2009).
Reference: CEOS LPV albedo protocol: https://lpvs.gsfc.nasa.gov/PDF/CEOS_ALBEDO_Protocol_20190307_v1.pdf

Lines 56-57: 'Limited by the means and methods of ground measurement, the absolute truth on the coarse pixel scale cannot be obtained.' Justify this sentence.

Lines 65-67: 'However, in situ measurements cannot be directly used as the coarse pixel scale truth given that the footprint of in situ sites is far less than the scale of a coarse pixel.' Please justify this or rephrase this sentence. In situ measurement footprint depends on the tower height. Depending of tower height and satellite spatial resolution they can be compared.

Section 2.1

Lines 115-118: 'These radiometers have been rigorously calibrated and continuously supervised to reduce systematic measurement errors (Jia et al., 2013; Wang et al., 2009; Zhou et al., 2016).' Are you confident that all radiometers from 368 sites have been rigorously calibrated and continuously supervised? This is not the case based on the references you are providing.

Lines 118-120: Justify the use of measurement at the local solar noon.

Section 2.3

The formula proposed to combine WSA and BSA used the diffuse light ratio, which is an approximation. The actual diffuse solar radiation should be used, as is the real model considering the actual environment (as you said), as considers the real atmospheric state.

Justify the use of this approximation, including the uncertainties introduced in this step. The limitations over snow targets should be also discussed.

I cannot find he formula used to calculate sky diffuse light ratio in the provided reference (Stokes and Schwartz (1994)). Please, use the right reference.

Section 2.2

Not clear what definition of satellite product is used according to illumination geometry (black-sky, white-sky)? Please provide more details about that.

Section 2.4

lines 177 – 189: This part does not correspond to ancillary data. Here you are describing the spatial heterogeneity metric (std) that should be moved to the 'methodology' section.

Section 3.1

I miss a diagram clearly showing the process of the upscaling model.

Section 4.1

The performance of the upscaling model shows that the uncertainty (RMSE) of the upscaled maps is typically between 0.03 and 0.05, which is the typical uncertainty of the surface albedo coarse resolution satellite products (e.g., MCD43A3, GLASS, GlobAlbedo, C3S SPOT/VGT, C3S PROBA-V, C3S Sentinel-3). In conclusion, the uncertainty of the upscaled maps is similar to any other product and it is questionable its utility as a reference 'ground-truth'.

Section 4.2

It is not clear which albedo quantities are you comparing: albedo single site, albedo upscaling, reference? You should focus your discussion also based on the different albedo definitions of these quantities (blue-sky, black-sky, etc).

It is not clear the spatial coverage of the study. You should clearly indicate the spatial resolution related to all datasets used in this section: albedo single site, albedo upscaling, reference.

Section 4.3

The validation of MCD43A3 V0061 using pixel scale ground 'truth' is only presented for some sites. The selection of these sites (and not others) should be justified.

What is the reason of large differences (outliers) over CA-NS2, CA-LP1, IT-Tor ?

Additionally, I miss the overall figure using the whole dataset.

Conclusions

There already exist other initiatives, like GBOV (https://gbov.acri.fr/), providing similar datasets to that presented in this manuscript, and should be mentioned.

On the other case, during the manuscript there are comments related to lack of standardized methods and operational validation systems for albedo validation. In fact, the CEOS/WGCV LPV subgroup (https://lpvs.gsfc.nasa.gov/) is coordinating these activities. An operational validation system was recently endorsed by CEOS/WGCV LPV, which is called SALVAL (Sánchez-Zapero et al., 2023) and it allows albedo products to reach operational and globally representative validation results (CEOS LPV stage 4). Access to SALVAL is available on https://calvalportal.ceos.org/salval

TECHNICAL CORRECTIONS

Line 18 – Abstract

'in situ' is not hyphenated. Please review the whole manuscript to homogenize 'in situ' term.

Line 64 – Introduction

Remove '.' before references

Line 145

'ith'?

Bibliography

Román, M.O., Schaaf, C.B., Lewis, P., Gao, F., Anderson, G.P., Privette, J.L., Strahler, A.H., Woodcock, C.E., Barnsley, M., 2010. Assessing the coupling between surface albedo derived from MODIS and the fraction of diffuse skylight over spatially-characterized landscapes. Remote Sens. Environ. 114, 738–760. https://doi.org/10.1016/j.rse.2009.11.014

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Sánchez-Zapero, J., Martínez-Sánchez, E., Camacho, F., Wang, Z., Carrer, D., Schaaf, C., García-Haro, F.J., Nickeson, J., Cosh, M., 2023. Surface ALbedo VALidation (SALVAL) Platform: Towards CEOS LPV Validation Stage — Application to Three Global Albedo Climate Data Records. Remote Sens. 2023, Vol. 15, Page 1081 15, 1081. https://doi.org/10.3390/RS15041081