Errata

Erratum to "Validation of the MCD43A3 Collection 6 and GLASS V04 Snow-Free Albedo Products Over Rugged Terrain"

Jianguang Wen, Xingwen Lin, Xiaodan Wu, Yunfei Bao, Dongqin You, Baochang Gong, Yong Tang, Shengbiao Wu, Qing Xiao, and Qinhuo Liu

In the above article [1], erroneous percentage symbols were included in the Abstract and Conclusion. These sections appear in full here with the corrected text.

***Abstract*— A comprehensive assessment of satellite-derived albedo products is undeniably essential for better use consideration and the further refinement of the retrieval algorithm. Although satellite albedo products have been extensively validated over spatially homogeneous areas, it remains a challenge to validate them over rugged terrain. Consequently, the accuracy of satellite albedo products over rugged terrain is still unknown. This study for the first time systematically evaluated two widely used satellite albedo products (i.e., MCD43A3 C6 and Global Land Surface Satellite (GLASS) V04 albedo) over mountainous areas with a mountain radiation transfer (MRT) coupled multi-scale validation strategy. Fine-scale albedo was first generated with a root-mean-square error (RMSE) smaller than 0.0317. Then, they were upscaled to the coarse pixel and as the reference data for validation. The validation results indicated that the accuracy of the two products tends to decrease with the increase of means slopes. The RMSE and relative RMSE ($RMSE_R$) of full retrieval MCD43A3 C6 black-sky albedo (BSA) and white-sky albedo (WSA) over abrupt slopes (mean slope >10°) increase to 0.0432 and 31.87% and to 0.0436 and 32.21%, respectively. The RMSE and $RMSE_R$ of high-quality GLASS V04 were 0.0452 and 33.71% of BSA and 0.0458 and 33.92% of WSA, respectively, over abrupt slopes. In particular, if the backup retrievals were included over the abrupt slopes, the RMSE and $RMSE_R$ of MCD43A3 C6 can reach 0.0600 and 36.92% for BSA and 0.0613 and 37.67% for WSA, respectively, and those of GLASS V04 can reach 0.0567 and 36.28% for BSA and 0.0540 and 35.72%, respectively.**

Manuscript received 7 November 2022; accepted 7 November 2022. Date of current version 1 December 2022. This work was supported by the National Natural Science Foundation of China under Grant 41901290, Grant 41830648, and Grant 41930111. *(Corresponding author: Xingwen Lin.)*

Jianguang Wen, Dongqin You, Baochang Gong, Yong Tang, Qing Xiao, and Qinhuo Liu are with the State Key Laboratory of Remote Sensing Science (jointly sponsored by the Aerospace Information Research Institute, Chinese Academy of Sciences and Beijing Normal University), Beijing 100101, China, and also with the University of Chinese Academy of Sciences, Beijing 100049, China (e-mail: wenjg@radi.ac.cn; youdq@radi.ac.cn; gongbc@aircas.ac.cn; tangyong@radi.ac.cn; xiaoqing@aircas.ac.cn; liuqh@aircas.ac.cn).

Xingwen Lin is with the College of Geography and Environmental Sciences, Zhejiang Normal University, Jinhua 321004, China (e-mail: linxw@zjnu.edu.cn).

Xiaodan Wu is with the College of Earth and Environmental Sciences, Lanzhou University, Lanzhou 730000, China (e-mail: wuxd@lzu.edu.cn).

Yunfei Bao is with the Beijing Institute of Space Mechanics and Electricity, Beijing 100094, China (e-mail: byf_rs@163.com).

Shengbiao Wu is with the Division of Landscape Architecture, Faculty of Architecture, The University of Hong Kong, Hong Kong (e-mail: shengwu@hku.hk).

Digital Object Identifier 10.1109/TGRS.2022.3220988

I. Conclusion

Topography causes great uncertainties in satellite albedo products when topography effects were ignored in the retrieval algorithms. Although satellite-based surface albedo products have been extensively validated over spatially homogeneous and flat surfaces, the performance of coarse-scale satellite albedo products has rarely been validated over terrain areas due to the difficulty of obtaining ground "truth" on the pixel scale [40], [41]. This blind spot will further cause large uncertainty in satellite albedo application on a global scale. This study, for the first time, conducted a comprehensive evaluation of two typical albedo products (i.e., MCD43A3 C6 and GLASS V04) over different slopes on the global scale.

The validation results indicated that: 1) both the high-quality samples and the overall samples of the MCD43A3 C6 and GLASS V04 albedo products have high confidence with reference albedos over gentle slopes with the RMSEs smaller than 0.038 and 2) both the two satellite products have great uncertainties over rugged terrain. Also, their accuracy significantly decreases as the mean slope increases. As for MCD43A3 C6, the RMSE and $RMSE_R$ were 0.0600 and 36.92% for BSA and 0.0613 and 37.67% for WSA, respectively, over abrupt slopes. Even for the full retrievals, the RMSE and $RMSE_R$ were 0.0432 and 31.87% for BSA and 0.0436 and 32.21% for WSA, respectively. As for GLASS V04, the RMSE and $RMSE_R$ were 0.0567 and 36.28% for BSA and 0.0540 and 35.72% for WSA over abrupt slopes, respectively. Even for the high-quality retrievals, the RMSE and $RMSE_R$ were 0.0452 and 33.71% for BSA and 0.0458 and 33.92% of WSA over abrupt slopes, respectively.

Although the uncertainties of these two satellite-based albedo products have been evaluated over different slopes and land cover types, it should be noted that the reference albedo was still with limited spatiotemporal coverage. More effective and globally distributed *in situ* albedos are necessary to improve the robustness of validation results in the future. Another uncertainty originates from the fine-scale albedo. The effect of such errors can be reduced in the scale-upscaling process because the errors in fine pixel scales are balanced

out when they are aggregated into a coarse resolution [41]. The fine-scale albedo and the MRT-based upscaling model have been approved to satisfy the validation requirement, and their uncertainty reduced the reliability of validation results. One beneficial try is to develop a more typic and robust fine-scale albedo algorithm. The accuracy of the coarse pixel scale reference albedo over rugged terrain should be quantitatively evaluated in the future to improve the reference albedo quality and the reliability of validation results. Despite the uncertainties of this validation approach, it still opens the way to quantitatively evaluate the coarse pixel scale albedos over mountainous areas

REFERENCES

[1] J. Wen et al., "Validation of the MCD43A3 collection 6 and GLASS V04 snow-free albedo products over rugged terrain," *IEEE Trans. Geosci. Remote Sens.*, vol. 60, pp. 1–11, 2022, doi: 10.1109/TGRS.2022.3214103.