Response to Comments by Reviewer #2

We thank the referee and appreciate the helpful comments to improve our paper. We have addressed them in the latest version of the draft and reply below. The modifications are in bold font face in the updated manuscript version.
Please note that, as suggested by the other referee, the entire analysis was done again changing the initial MODIS albedo product from MCD43C3 to MCD43D42-48. The current MODIS product we are using has a better spatial resolution and is of higher quality. All references to the MODIS product, its temporal and spatial resolutions in the paper were changed accordingly. Overall, the results did not change, and the conclusions of the paper remain the same.

Major Comments:

M1. For the seven climatology calculation steps, you need to specify/quantify how many missing pixels remain before/after each step, preferably as a percentage.

As suggested by the other anonymous reviewer, we have redone the climatology with the MCD43D42 MODIS product, which has a better spatial resolution and allows for an overall better quality climatology. As a consequence, we adapted section 2.1 to the new analysis, and we included the percentage of filled missing pixels of the climatology at each step in the item list. We also included a new figure (Fig. 1) to show the differences of missing pixels at each step of the climatology averaging over all DOYs.

M2. In light of Figure 3 and 4, it becomes evident that the employed method did not successfully generate accurate albedo representations for spectral bands not covered by the input dataset. The primary objective of this study is to construct an almost continuous albedo dataset using a limited number of input bands. While the direct comparison for the 1640 nm band exhibits strong agreement, the 810 nm band—outside the MODIS bands—shows the poorest comparison. However, it is precisely in the bands excluded from MODIS that the value of the HAMSTER product becomes apparent. Am I missing something here?

HAMSTER was trained on the 7 available MODIS bands in the VIS and NIR which carry information on the surface, thus it reproduces them exactly. It is expected that HAMSTER performs better in reconstructing albedo values for other albedo products in the wavelength bands closer to MODIS bands. The 1640 nm SEVIRI comparison shows the best performance of HAMSTER compared to SEVIRI, considering the RMSE as the metric to assess the performance. This was also expected because MODIS band 6 is centered at the same wavelength as SEVIRI channel 3. However, the referee mentions only the comparison with SEVIRI between 1640 nm and 810 nm (which is a SEVIRI band outside MODIS bands). If we take into account the other SEVIRI band we are comparing (635 nm), this is also almost centered at a MODIS band (645 nm, with bandwidth 600-680 nm, table 3), and HAMSTER basically performs the same in the validation with SEVIRI between 635 nm and 810 nm, being 810 nm very far from any MODIS band. From this, we can conclude that HAMSTER is doing well in representing albedo products outside the bands it was trained from, and the differences found are mostly intrinsic to the different albedo products from different satellites. In the paper we mention many studies assessing large discrepancies among different albedo products. We should also consider that the total reflectivity of the

planet is lower in the NIR (1640 nm), so we expect less variability here and an easier comparison among different albedo products.

In addition, the referee should not focus on Figure 3 and 4 to assess the performance of HAMSTER, because Figure 3 and 4 are meant for spatially assessing where albedo is over/underestimated in the comparison. The referee should refer to Figure 5 and 6 to look at the RMSE scores. Between 635 nm (MODIS band) and 810 nm (outside MODIS band), the RMSE goes from 0.029 to 0.032, which means that HAMSTER is successfully reconstructing albedo values outside the bands it was trained. It is true that for 1640 nm the RMSE is even better (0.019), but as we mentioned before, in the NIR there is less spread because the surface is less reflective in general. 810 nm is in the middle of the vegetation red edge ramp, so it is the most reflective region in the entire VIS/NIR range, and it makes sense the spread is larger.

M3. In Figures 5 and 6, the comparison is limited to only two specific days. While the separation into winter and summer is understandable, it raises the question of why a more extensive set of days was not utilised for potentially robust comparisons. Given the availability of numerous days, it would be beneficial to assess whether these two selected days are truly representative of broader trends.

We thank the referee for this comment, which helped us to fully address the performance of the validation of HAMSTER compared to SEVIRI and TROPOMI. We included two new figures in the manuscript (Figs. 8 and 10) where we compared each day of 2016 between HAMSTER climatology and SEVIRI (Fig. 8) and the monthly difference between HAMSTER climatology and TROPOMI (Fig. 10). TROPOMI only offers monthly products, thus we did monthly averages of HAMSTER to perform this comparison. The comparisons are done for all SEVIRI and TROPOMI channels and bands and report the RMSE. We note that there is no large trend and the two selected days (DOY 065 and DOY 209), which are studied in greater detail, are representative of the general trend.

Minor Comments:

L32: The word “the” is missing between “compared” and “Moderate”

Solved

L34: Which specific land surface products are being referred to?

The land surfaces products mentioned in Shao et al. (2021) are MODIS, GLASS (Global LAnd Surface Satellite), and CGLS (Copernicus Global Land Service). We included them in the sentence.

L42: Please define the acronym VIS upon first use.

Solved

L52: I would argue that radiative transfer simulations do not demand all wavelengths, but only the representative ones. The simulations likely does benefit from higher resolution. Could you support your statement with a reference?

We included as a reference Li and Yang (2024), which shows how retrieval of the cloud pressure thickness from the O2A band is dependent on the albedo assumption overlaying the region. Thus, to correctly perform retrievals, you need precise radiative transfer calculations across all wavelengths.

L60: Not sure what you mean by extrapolated in time, could you describe it a bit more.

We changed the sentence. We just mean that we build a climatology (10-year average with subsequent filling of missing pixels as described in section 2.1) for each DOY, since the MCD43D product provides albedo data for each DOY separately.

L70: Consider adding a sentence to differentiate your work on hyperspectral albedo maps from that of Braghiere et al., emphasising any novel aspects.

We included a short paragraph explaining Braghiere et al. (2023) approach to build an hyperspectral soil reflectance map to our dataset.

L96-100: Could you provide a clearer description or explanation for the content in lines 96-100? It was challenging to grasp.

We rewrote the paragraph, also taking into account the difference from the previous climatology (8 days of temporal resolution) with the climatology obtained from the MCD43D product (1 day of temporal resolution). Also the spatial resolution among the two products is very different, and this was adjusted in the manuscript.

L124: Could you explain the rationale behind assuming no atmosphere in this part?

We need to assume no atmosphere, otherwise we would not treat the reflection of the ocean surface anymore, but rather the reflectance of the ocean plus Earth's atmosphere, including atmospheric absorption band features.

L335-336: Please verify the parentheses in this section to ensure correctness.

Solved

L347: Could you provide additional context or highlight the substantial increase mentioned?

We had a sentence referring to the increase at around 700 nm as seen in Fig. 10.

L408: Please specify the number of principal components obtained in your analysis.

It is already written two lines below "With the PCA, we extract six principal components as in Vidot & Borbas (2014), and, with the addition of a seventh constant eigenvector, we combine them with the seven bands of MODIS data" (L411-412, old manuscript)

L419: Include the range here.

We included the range.

L432: Consider adding a statement explaining that performance deteriorates as wavelengths move farther away from the MODIS input bands (as mentioned in comment M2).

As explained for comment M2, performances do not substantially deteriorate going outside MODIS bands. Since outside the MODIS bands we are interpolating with the PCA, it is expected that performances will slightly deteriorate, and we do not think it is relevant to mention it again at this stage.