Anonymous Referee #1

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Referee's Comment 1:

Firstly, I note that the method is very similar to that used in ESA's GlobAlbedo product (see GlobAlbedo's Algorithm Theoretical Basis Document on http://www.globalbedo.org/docs/GlobAlbedo_Albedo_ATBD_V3.1.pdf, Sect 3.6.3, p.61), in itself based on (Quaife and Lewis, 2010). In essence, the authors exploint temporal correlation in the signal. I think that the most critical assumption is that the conditional distribution of albedo at time k, nalpha_{k}$ on $nalphaˆ{*}_{k+nDeltak}$ (albedo estimates at other times) is believable, but ought to be tested.

Authors' reply:

Thank you for pointing out the similarity to the method used in ESA's GlobAlbedo product. Citation of the GlobAlbedo manual should be added into the manuscript since it is published online recently. Indeed, these two approaches choose the same principle, i.e. temporal smoothness, and have similar formulation. But they are independently derived methods which have different heritages as well as technical details. Basically, the STF algorithm, as introduced in this manuscript, originates from Bayes theory, while the GlobAlbedo algorithm originates from regularisation; and the Bayes theory will export a seasonal curve of multi-year average albedo in the total absence of valid observation data, while the regularisation-based algorithm will export a straight line in such circumstance. Actually, Bayes theory has many advantages in noise reduction and prediction, resulting in the good performance of STF algorithm.

The conditional distribution of albedo time series is the critical assumption of the STF algorithm. This assumption is statistical (as the characteristic of Bayes theory) and comes from ten-years of MODIS MCD43B3 product. We found that, generally, the linear correlation decreases as temporal interval increases. And the magnitude of the temporal correlation is function of location and time. For example, in the snow falling or melting season, the correlation is weak which allows for drastic albedo change in the resulting time series. However, physical mechanism of the conditional distribution of albedo time series is beyond the scope of this paper.

Referee's Comment 2:

The use of the prior is an important and welcome addition. However, I envisage problems when the climatology is derived from e.g. snow free scenes and the observations have snow. If this is not carefully treated, we might miss the snow event.

Authors' reply:

When generating the albedo climatology, both the snow-free and the snow-covered MODIS albedo products have been used. Because our climatology database is pixel-based and season-based, the statistics in winter for high-latitude or middle-latitude pixels are derived from snow-covered MODIS albedo products. In the transition period between snow-free and snow-covered states, the statistical variance of albedo is large, putting more weights on the observations. In this way, the albedo change during the snow event can be preserved as much as possible.

Referee's Comment 3:

The abstract is a bit unclear. However, the second paragraph of the conclusions does a good job of explaining what this paper is about: a Bayesian filter that updates a prior distribution based on an albedo climatology plus a weighted combination of temporally close observations and an idea of temporal correlation in albedo. The result is a smooth and complete time series of albedo plus uncertainties.

Authors' reply:

Thank you for the precise summary. We will revise the abstract to make it clearer in the next version of manuscript. The preliminary revised abstract is as follows:

Land-surface albedo plays a critical role in the Earth's radiant energy budget studies. Satellite remote sensing provides an effective approach to acquire regional and global albedo observations. However, owing to cloud coverage, seasonal snow and sensor malfunctions, spatially-temporally continuous albedo datasets are often inaccessible. GLASS preliminary albedo datasets (GLASS02A2*x*, *x* =1, 2, 3 and 4) are newly developed global daily land-surface albedo products. Like other products, GLASS preliminary albedo datasets surfers from large areas of missing data. Beside this, sharp fluctuations exist in GLASS preliminary albedo time series due to data noise and algorithm uncertainties. Based on Bayesian theory, a statistics-based temporal filterer (STF) is proposed in this paper to fill data gaps, smooth albedo time series, and generate the final GLASS albedo product. This Bayesian filter updates GLASS preliminary albedo datasets by combining albedo climatology and weighted observations in neighboring days. The results of

STF algorithm are smooth and gapless albedo time series, with uncertainty estimations. The performance of STF method was tested on one tile (H25V05) and on three ground sites. Results show that the STF method has greatly improved the integrity and smoothness of the final GLASS albedo products. Seasonal trends in albedo are well depicted by the STF results. In some cases, however, GLASS albedo time series are found to be overly smoothed by the STF method. Compared with MODIS product, the final GLASS albedo product has higher actual temporal resolution and more competence in capturing the surface albedo variations. It is recommended that the quality flag should be always be checked before using STF results.

Referee's comment 4:

I don't really see the point of using 4 input products. Why not just group together the MOD09/MYD09 observations? Presumably all these products are very correlated (see point above)? And in most cases, the products are quite undistinguishable from MOD43!

Authors' reply:

We are sorry that we did not make this part clear. We will try to clarify our point in the revised manuscript. Although, these four GLASS preliminary products are highly correlated statistically (see Section 4.1 Consistency between GLASS02A2x and MCD43B3 products), they contain independent information (two satellites: Terra and Aqua) or have different error characteristics (two algorithms: AB1 and AB2). The GLASS02A23 and GLASS02A24 products, which are generated directly from MODIS top-of-atmosphere radiance (i.e. MOD/MYD021km product), are really indispensable because in some occasions the result based on MODIS atmosphere correction products (i.e. MOD/MYD09) may contain large error. To learn more about the albedo inversion algorithm from top-of-atmosphere radiance, please refer to another paper of our team member: Qu, Y., Q. Liu, S. L. Liang, L. Z. Wang, N. F. Liu & S. H. Liu (2012), Direct-estimation algorithm for mapping daily land-surface broadband albedo from MODIS data. IEEE Transactions on Geoscience and Remote Sensing, in review (revision).

Referee's comment 5:

There are only very limited comparisons with the official MODIS products. I guess the paper does not answer the question of why would anyone bother using the new product directly. Factors for this are: credible uncertainty, gap filled product, and similar or better performance to the MODIS algorithm over large areas.

Authors' reply:

Thank you for the comment. We will clarify the merit of the new algorithm as well as new product in the revised manuscript. As the Anonymous Referee have mentioned, the proposed STF algorithm can fill data gaps, estimate uncertainty and maintain the temporal resolution as much as possible. The accuracy of the final GLASS albedo product depends not only on the STF algorithm but also on the accuracy of preliminary products. Because the main object of this paper is to introduce the new temporal filtering algorithm and its performance in reconstructing gapless albedo distribution, the validation and accuracy analysis part is intentionally shortened. For a full validation of GLASS albedo product as well as inter-comparison to MODIS products, please see another paper of our team (Liu Q., L.Z. Wang, Y. Qu, N.F. Liu, S.H. Liu, H.R. Tang & S.L. Liang (2012), Preliminary Evaluation of the Long-term GLASS Albedo Product, International Journal of Digital Earth, under review)

Referee's comment 6:

Finally, given that snow has a very high albedo, its treament should be high up in the list of priorities.

Authors' reply:

Yes, the proper treatment of snow is the most critical part in generating a global albedo product. GLASS algorithm team has put much effort in dealing with the snow. In the STF algorithm, the special treatment of snow is implied in the statistical database, in which snow is characterized by its high expectation, large standard deviation and small temporal correlation. Besides, there is a procedure to regularize the statistical database in polar areas which is not mentioned in the previous version of manuscript, but will be briefly introduced in the revised version.

Minor revision:

Authors' reply:

We have thoroughly revised the manuscript, including the following points which have been mentioned by the anonymous referee. The revised the manuscript will be uploaded shortly.