Earth Syst. Sci. Data Discuss., referee comment RC1
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Comment on essd-2021-156

Anonymous Referee #1

Referee comment on "Fusing MODIS and AVHRR products to generate a global 1-km continuous NDVI time series covering four decades" by Xiaobin Guan et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2021-156-RC1, 2021

This paper by Guan et al. aims to create a new NDVI dataset through fusion of AVHRR GIMMS 3g and MODIS NDVI dataset. The new dataset, namely, STFNDVI has a monthly temporal resolution and 1km spatial resolution, covering the period of 1981-2000. The authors applied several procedures during this process, including denoise, normalization, spatial-temporal fusion. The algorithm is evaluated during the overlapping period and resultant dataset is compared with LAC and HRPT AVHRR NDVI data which are at higher spatial resolution. Obtaining a global high resolution long-term NDVI dataset can be critical for global change studies. This study presented a first attempt to solve this issue, but from my point of view, it is still a rather premature dataset and have limited value.

I have this opinion based on the following points:

- When do we need a high-resolution dataset? The answer seems to be clear, when low resolution dataset cannot provide enough details. This include two major aspects, one is that there is enough spatial heterogeneity at finer resolution, the other is that there is additional information that can only be obtained at this finer resolution. One good example for this second point is the change of land cover, e.g., deforestation or reforestation. Using high resolution data can provide information on when these activities happen and how much do they contribute to the changes of vegetation in addition to the nature factors. Another example is tracking vegetation phenology when multiple biome types co-exist within a pixel, and they respond differently to climate change (see Zhang et al. 2017; Chen et al., 2018). Under these conditions, the sub-pixel spatial patterns within a coarse resolution pixel also changes, but the current algorithm cannot get this information. This is critical issue since getting changes of this sub-pixel patterns is often why people would use high resolution dataset. The current algorithm assumes there is no interannual variations in this sub-pixel variation since the reference sub-pixel spatial pattern is provided by one year of MODIS data. This greatly undermines the value of this high-resolution dataset and the author did not even discuss this aspect. Using long-term high-resolution observations such as Landsat may help solve this issue.

- Data quality control. One large difference between GIMMS and MODIS is the data quality control procedure. Since GIMMS does not provide effective quality flag for snow or cloud covered pixels, there can be large differences in early or late growing season in northern high latitudes, as well as the tropical ecosystem, where the authors found large discrepancy during the comparison (Figure 4 and 14). A good practice would be to remove these observations during the per-pixel normalization period based on the MODIS quality flag, and only use the good observations to build the MODIS AVHRR relationship. The author mentioned that they use Whittaker filtering method to reduce noise, however, due to the presence of cloud, snow and aerosols, the anomalies of NDVI are often negatively biased, which cannot be effectively handled by the Whittaker filtering method.
- Continuity of the dataset. The authors claim that they generated a high spatial resolution dataset spanning over four decades, I guess that they suggest this new dataset can be used in together with MODIS NDVI. However, using two datasets together may create additional problems. For example, the trend for the first period is provided by AVHRR while the second period is from MODIS. Previous studies have demonstrated that the trend from different sensors can be quite different (e.g., Jiang et al., 2017). There may be additional risks that due to the differences in sensor performance, the NDVI calculated from both sensors may have a non-linear relationship, i.e., the probability density functions (PDF) for each pixel may be different between sensors. This cannot be corrected using the linear regression method as proposed by the authors, but requires additional procedure, e.g., PDF matching. This issue can be easily tested using BFAST or other breakpoint detection algorithms.

In conclusion, this is a good attempt to generate a high-resolution dataset based on the fusion of MODIS and AVHRR, however, due to the above-mentioned issues, I don't think this dataset meet the high standard of ESSD.

Detailed comments:

L35, visible->red

L59, decades->decadal?

L110, "limited attempts" means very few attempts, I guess the authors mean "a few attempts"

L130, MOD13A2 has a 16-day temporal resolution, I guess this should be MOD13A3?

L139, the GIMMS 3g v1 version extends to 2015 December. Did the authors use this newer version?

L175, why 1989-1993, why not longer?

L179, it is not common to use ecological communities, it usually refers to the group of people who study ecology. I suggest to use ecosystems or biome types.

L222, the authors use "prove" several times throughout the manuscript, it is a very strong word that requires rigorous test and derivation. I suggest to use "demonstrate" or "show"

L257-258, using one year of data as reference can be risking, for example if drought happens in a savanna ecosystem, the tree-grass difference is greater than normal years, which will affect the spatial patterns at sub-pixel scale.

L343: why do you need to mention "famous" here?

L370: I suggest the authors to make comparisons where land cover changes happen during the past decades, for example, "the arc of deforestation" in Amazon, Sahel region in Africa, Northern China, these are research hotspots where high resolution dataset is needed.

L385, to qualitatively analyze the difference, I suggest to add a fourth row showing the difference between the first and third.

L400, using this 3D plot does not quantitively provide the information of r since it is difficult to locate the absolute value and. The color scheme also changes for each subplot. You may consider just use 2D plot with year as x-axis, month as y-axis and use color to represent the value.

L401, Grammarly incorrect, please rewrite.

L490, is this r value calculated based on the average value of the 12 months? this should be very high since the spatial details are averaged.

Reference

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