

Interactive comment on “Improving the monitoring of deciduous broadleaf phenology using the Geostationary Operational Environmental Satellite (GOES) 16 and 17” by Kathryn I. Wheeler and Michael C. Dietze

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We want to thank the reviewer for their useful and thoughtful comments, as well as their overall positive response in feeling that our paper was interesting and a useful contribution to the community.

We appreciate that the reviewer thinks that this article may be better suited in a remote-sensing journal, but think that the biogeosciences community would be interested in a new way to monitor phenological change. We have already published the methodolog-

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ical details of our GOES algorithm in a remote sensing journal, and to make this paper more accessible to non-remote-sensors we will reduce the remote-sensing jargon. Ultimately our interest here is in the biological process of phenology and not the satellite specifics.

We thank the reviewer for catching the error in Equation 3. We will change that.

We thank the reviewer for the suggestion on how to further eliminate noise by looking at the raw red and near-infrared (NIR) values for the observations that had an NDVI value of 0.6040. We will update the manuscript to further explain that all of the NDVI values of 0.6040 only occurred in the early morning and the evening. Based on the days and sites that we looked at, the NDVI value of 0.6040 seems to occur for multiple different combinations of red and NIR values (e.g., $R=1.87e-5$, $NIR=7.57e-5$; $R=-2.80e-4$, $NIR=-1.14e-3$; $R=3.18e-4$, $NIR=1.29e-3$; $R=1.95e-5$, $NIR=7.90e-5$). It seems that when these reflectances occur they are usually in pairs that result in an NDVI value of 0.6040. When we saw them occurring elsewhere it was limited to the noisy morning and evening sections. We already filtered most of this out by removing the NDVI values that occurred before 1.5 hours after sunrise or 1.5 hours before sunset. In future work, we will consider further filtering based on the reflectance bands.

We agree that as this research scales up it will become more important to come up with better quality control methods. There are definitely options for how to do that, but implementing and testing these QC algorithms, and selecting between different approaches, is beyond the scope of this paper, especially since we wanted to maintain the focus on phenology and not on the remote sensing methods.

We thank the reviewer for pointing out the ambiguity in the supplementary figures. We think that labeling the axes would help make them clearer and plan to do that.

We thank the reviewer for pointing out that our assertion that the higher temporal frequency of GOES data would provide better real-time estimates of transition dates is not fully supported by our methods. We will change the wording for this in the manuscript

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to focus more on GOES providing real-time estimates of phenological conditions. We'll also expand the Discussion on how that real-time data does or does not translate into better estimates of transition dates and how that might be affected by different estimation methods (e.g., concluding spring has started when the index value is 10% greater than the winter baseline). We are currently working on iterative fitting and the estimation of phenological transition dates in near-real-time and will include this in future papers.

The raw data are not comparable between GOES and MODIS because GOES is geostationary and MODIS is on sun-synchronous satellites. Unlike GOES, MODIS changes viewing angles between measurements. The advantage of geostationary data is not just the higher frequency of measurements, but also the consistent viewing angle. The MODIS composite product is created not just to average to reduce noise, but to consider the multiple viewing angles of MODIS observations. To the best of our knowledge there are also no good error estimates for the daily MODIS data, which would also affect our ability to compare them. There has been a lot of calibration and validation that has gone into the MODIS products so returning to the raw MODIS data would be difficult and very time consuming – at the moment we don't think this would be worth the effort.

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