Dear reviewer,

We would like to thank you for your critical feedback on our paper. We appreciate your time and effort, and we are committed to addressing your concerns.

We agree that the manuscript is lengthy and that more detail is needed in some parts. Mainly, this concerns the introduction, which should more clearly outline the need for a new review and formulate a clear research question.

We reformulated our objective, aligned with the advice of the reviewer, into the following research question: "**What are the state-of-the-art methods for estimating vegetation productivity using remotely sensed time series data, and what are the key gaps, challenges and opportunities for further improvement?**"

This question will be included in the revised manuscript and clearly positioned in the introduction section as soon as the revision is elaborated. As indicated by the reviewer , in Section 3, we will provide a clear overview of the methodologies used to derive the productivity metrics that we reviewed for this manuscript.

Our main focus lies on the precise remote sensing-based estimation of productivity with consideration of the trend toward the increasing availability of higher spatial resolution EO data. Global change is resulting in a landscape, which is more fragmented, scattered and characterized by small patterns. One example is the upcoming trend of agroforestry to make agriculture more resilient. As a consequence, the analysis of productivity needs to integrate high spatial resolution remote sensing data and we preferred to focus more on the spatial scale than on the minimum number of time steps. One of the main keywords of our systematic literature review was "time series." We did not initially define a minimum number of consecutive observations for inclusion in the review. Unlike other papers, which define a time series as consisting of a minimum of several observations, we included studies with a minimum of two images without an upper limit. This allowed us to include studies that have traditionally been labeled under the topic of change detection analysis.

We chose to do this for two reasons. First, we believe that the minimum number of observations in a time series is arbitrary, and we wanted to take a more comprehensive approach to examining the aspect of time. Second, the number of studies using long time series consisting of tens to hundreds of high-resolution (10-30 m pixel size) images is relatively small. If we had only looked at long time series, we would have excluded many studies that observe productivity from Landsat and Sentinel-2 satellites.

The following figures show the number of published papers per number of observations in a time series. Two observations emerge from these figures: i) A relatively large number (about 37) of studies mention the term time series but are based on only 2 images; ii) at a larger

number of observations (n) there is a normal distribution going up to 1000 observations with a slowly decreasing number of papers (p) with increasing n.

Based on the suggestions of the reviewer, we have analyzed this further, and we will add this aspect (including the figure) to the description in section 5.1.

Regarding your point: "...while multiple sections discuss VIs and RTMs as proxies for productivity, my expectation was that the authors would concentrate on reviewing the methodologies to derive the productivity metrics they defined in table 1 using VIs etc…"

Please note that VIs or RTMs are needed to derive information about productivity metrics as listed in the blue box. It is therefore crucial to concentrate on these methods, which are not always proxies. VIs have been used often as proxies, but RTMs are not direct proxies; they provide traits that can act as proxies or can be further used in process models to derive productivity metrics (like VIs).

Please note that **Section 1** is the introduction section. In the introduction section, we want to give an overview of the different concepts, sensors, and methods, which are repeated but explained more in detail in the following sections, as also referred to. However, since it appears to you that we repeat the same information, we will make sure to delete redundant sentences.

Specifically, we will prioritize refining **Section 1.1** to ensure that it provides a comprehensive and accurate overview of photosynthesis, and we will review the literature to add any relevant references that we may have overlooked.

We will also strongly revise **Section 1.2** to ensure that it is organized and that information is not repeated in other sections. In **Section 1.3,** we will emphasize that we estimate productivity using remote sensing data rather than measuring it directly. We will also clarify the relationship between VIs and other variables and productivity metrics.

Furthermore, we will revise **Section 2.4** to ensure that it is more focused on productivity metrics.

Sections 3.1.3 to 4.2: We will revise these sections to clarify and state their main objectives and focus them more directly on the productivity metrics that we are discussing. We will also ensure that these sections are consistent with the overall objectives of the manuscript.

Section 5.1: We will link this section to GPP and AGB more explicitly, as we have defined these as productivity metrics. We will also discuss the relationship between VIs and GPP/AGB in more detail.

We will also revise the application section as best as possible to make it more focused.

We would like to thank the reviewer again for their thoughtful and constructive feedback. We are particularly grateful for your insights into the structure and organization of the manuscript, as well as your suggestions for how to improve the clarity and focus of our writing. We are committed to addressing your concerns to the best of our ability. Therefore, we will carefully consider all your comments and make appropriate revisions to the manuscript. We are confident that we can produce a revised manuscript that meets the reviewer's expectations and makes a significant contribution to the field.
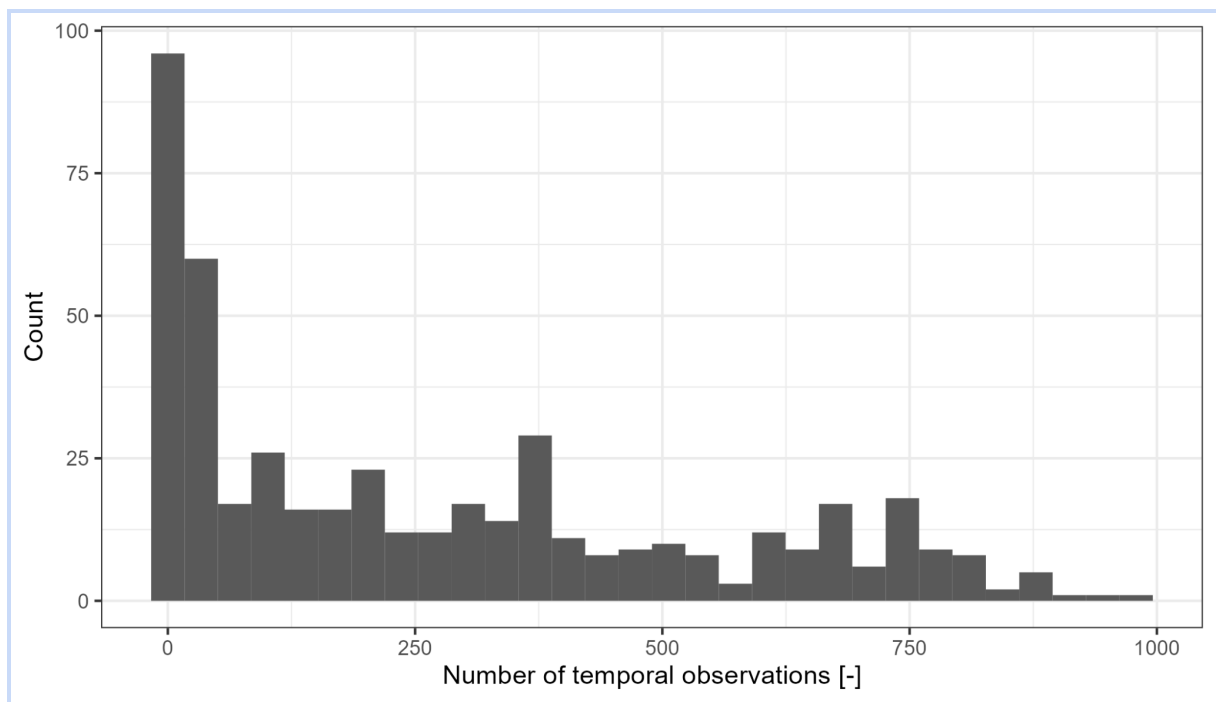
(33 studies omitted with >1000 observations)
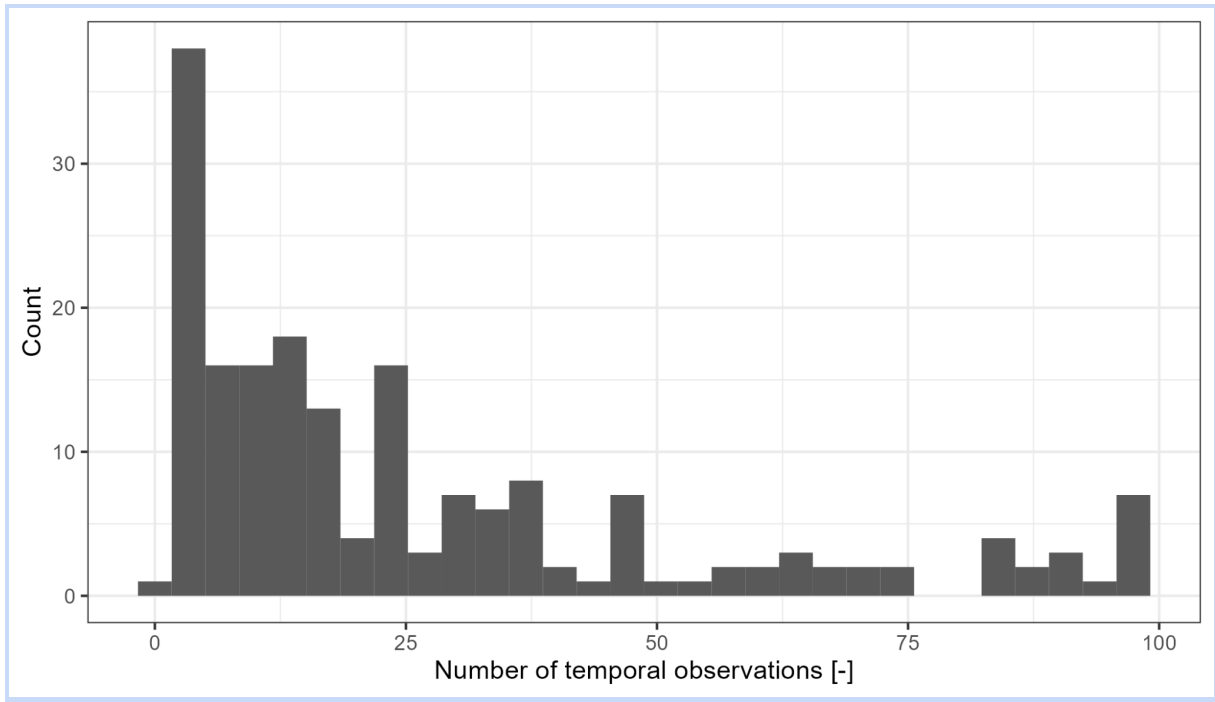
(321 studies omitted with >100 observations)

Response letter reviewer 1:

Reviewers suggestions	Our response	Changes in the manuscript
Overall, I think the authors did a good job at reviewing the state of the literature surrounding using EO for time-series analyses of productivity. While it was quite long, even for a review paper, it read well and contained a lot of interesting information. I do feel as if there could be some minor improvements made to various aspects of the paper regarding the following sections:	Thanks for your positive reply…	
The systematic literature review is a bit lengthy while adding relatively little to the overall paper. I believe it could be retained but shortened. For instance, the figures could be compressed into one, multi-panel figure. Figure 8 could be removed. And overall writing could be more efficient.		
• Some advances have been made in linking RTMs with DVMs and at least some of them should be cited. A few that I know of: o Shiklomanov et al., 2021. o Wang et al., 2021, Braghiere et al., 2023 (and other papers regarding the CLIMA Land model). o Poulter et al., 2023. Full discloser, I am a coauthor on one of these publications, but I leave it up		

to the authors to discern and cite the most relevant ones.		
• There are a number of current and future missions missing from figure 3, such as EnMAP, EMIT, PACE, and SBG (to name a few).		
• "NBP" is missing from the productivity definition box but is discussed later on. Along these lines, figure 13 doesn't quite make sense to me. Is this saying that NBP is 0.5% of GPP?		
• Figure 7 could be improved.		