The paper studied the impact of varying representation of C3/C4 fractions across models on their photosynthesis and vegetation carbon simulations. They analyzed output from 11 CMIP6 models and found large spread in C3/C4 area, GPP and Cveg across models. However, the study relied on some assumptions that largely introduced bias, especially regarding the C3/C4 crop fractions and GPP calculations. I recommend a major revision and suggest authors to reconsider how to deal with those models without these outputs provided.

Major Comments:

1. For models lacking explicit C3/C4 crop fractions, authors used cropFrac × c3PftFrac or cropFrac × c4PftFrac to obtain the values. This can propagate large biases into estimates of C3/C4 crop area. For example, in a grid with 90% C3 tree and 10% C4 crop, you'll get C3 crop = 0.09 and C4 crop = 0.01, which is totally wrong. Although the authors already acknowledged this issue, this process was problematic and largely influenced the reliability of the findings.
2. Also, attributing C3/C4 GPP using the product of total GPP with C3/C4 fractions is problematic. Although the authors noted this overestimated C3 GPP, the issue was broader and could influence all subsequent analyses, e.g., range of C4 GPP (12–27% in Fig. 5i).
3. Section 3.3 states "The increase in GPP in crops is linked to the area increase, while the GPP change in natural vegetation is decoupled from the change in area". This is an interesting point, but I did not see any evidence supporting this statement. I also suggest authors to reframe their study to discuss why models all dependent on LUH2 still disagree strongly on area and fluxes.

Minor Comments

Line 13: Change "affect" to "affects"
Line 18: What does this mean by 'the data-based estimate'?
Line 19: I did not see the value of "17%" over the Results
Line 85: Clarify how cSoil was used
Table 1: Provide the spatial resolution of each model
Line 101: It would be helpful to provide details about the preprocessing differences among models that all relied on LUH2
Line 103: Ensure consistent use of CNRM-CM6-1 or CNRM-CM6.1.
Line 110: This paper did not include any analysis about 'ecosystem carbon content'
Line 143: Why was 12.5 ‰ chosen for isotopic discrimination? Is this value spatially robust?
Line 150: Why is the isotopic analysis based on 1970–2014, while other analyses span 1850–2014?
Line 156: What does this mean by 'lack of precipitation in UKESM1'
Figure 2: Change "earth" to "Earth" and "For" to "for." Also, subfigures should be labeled (a)–(e).
Figure 3: Clarify the y-axis label
Line 177: The number (−19 to +3%) differs from the Abstract
Line 194–195: Provide full names of the MPI models. Also, use UKESM1 rather than UKESM2.
Figure 4: Provide data sources for ESA CCI, Still, and Luo.
Line 223: Should be Fig. 5c, not Fig. 6c and Line 245: Should be "Fig. 6b."
Line 285: how uncertainty in actual crop area is quantified?
Line 298–305: This could also be related to differences in the natural vegetation composition