

**Response to remarks from the preceding review file validation:**

[Comment 1] With the next revision, please transfer the image of the figure 1 to the caption.

**Response:** Many thanks for pointing out this mistake, we have transferred the image of the figure 1 to the caption. Please refer to the revised manuscript line 153.

## **Response to Reviewer #1:**

**[Comment 1]** The authors coupled new spring and autumn phenological models based on co-regulation of temperature and photoperiod into the LPJ-GUESS model, and constructed a new parameter set of different vegetation types, and forcing data is bias corrected ERA5-land daily temperature data. The results show that the LPJ-GUESS with the new phenology modules substantially improved the accuracy in capturing start and end dates of growing seasons. This research points out that the accurate simulation of vegetation phenology is of great significance to reduce the uncertainty of carbon and water cycle process, especially under the future climate change. I have read the previous reviewer's comments as well as the author's replies and revisions to the manuscript. The revised manuscript has been greatly improved and the authors have addressed previous concerns. Current version is a significant contribution and worthy of prompt publication.

**Response:** Many thanks to the reviewer for his/her recognition of improvement and importance of our revised manuscript, and also for his/her very helpful comments. We have revised the manuscript according to the reviewer's comments, as detailed in the follow-up reply and revised manuscript.

**[Comment 2]** I also have a few other minor suggestions.

1. Line 223: Please use 'extension' instead of 'improvement', for Figure 2 also uses 'extension', consistency helps improve the readability of manuscript.

**Response:** Following the reviewer's suggestion, we have replaced 'improvement' with 'extension'. Please refer to the revised manuscript line 234.

**[Comment 3]** 2. Figure 5: The legend font is a little small, please make the legend font larger.

**Response:** Following the reviewer's suggestion, we have increased the font size of the legend in Figure 5. Please refer to the revised Figure 5.

## **Response to Reviewer #2:**

**[Comment 1]** The authors have solved all of my major concerns in this revised version. After reading the new version, I have some additional minor suggestions. Please find them below:

**Response:** We thank the reviewer's the recognition of the modification of our revised manuscript. We have revised the manuscript according to the reviewer's comments, as detailed in the follow-up reply and revised manuscript.

**[Comment 2]** 1. Some key references related to LPJ-GUESS and its uncertainty analysis can be cited in the manuscript. For example, Smith et al. (2001, GEB) is a critical reference which introduced the patch-based model structure for LPJ-GUESS; Ahlstrom et al. (2015, ERL) identified vegetation productivity is the key uncertainty source in terrestrial carbon cycle within LPJ-GUESS. Those studies should be introduced, at least mentioned, in this paper.

**Response:** We thank the reviewer's helpful and constructive comments, and following the reviewer's suggestion, we have added these references. Please refer to the revised manuscript line 207 and 502-503.

**[Comment 3]** 2. There are several types of "model" in this study, e.g., Lines 89-91. It would be better to clarify their difference from or relationship to LPJ-GUESS.

**Response:** Following the reviewer's suggestion, we have changed the description of phenological model to phenological algorithm. Please refer to the revised manuscript.

**[Comment 4]** 3. The PFT scheme in LPJ-GUESS is quite different from other models. Please make them clearer, either in the figure legend of Fig. 1 or related text.

**Response:** Following the reviewer's suggestion, we have added the description of the correspondence between GLC2000 PFT and the PFT scheme in LPJ-GUESS in figure legend. Please refer to the revised manuscript line 157-161.

**[Comment 5]** 4. Please further check the format of each equation. For example, Eq. 10 and 12 use different symbols for multiplication.

**Response:** We thank the reviewer for pointing out this mistake, and we have unified the use of the multiplication symbol. Please refer to the revised Eq. 12.

**[Comment 6]** 5. Table 1 is not clear enough. A dashed line could be added to separate the two models.

**Response:** Following the reviewer's suggestion, we have added a dashed line. Please refer to the revised Table 1.

**[Comment 7]** 6. Italized those statistical symbols in the text.

**Response:** Following the reviewer's suggestion, we have italicized those statistical symbols in the manuscript.