

## Response to reviewer #3

Thank you for the comprehensive comments, and also for taking the time to truly read through our manuscript. We feel that your comments were very helpful for increasing the quality of the paper to its current level.

The reviewer's comments are in black and our responses in blue.

5 Main concerns:

*Comments 1: There is lack of validation of vertical root distribution and seasonal root length variations based on evidence of in situ observation. It is necessary to clarify the limitation of model and add some reliable proof for the root growth modeling or remaining future work for model development.*

10 **Response:** Thanks for your comment! Indeed, this study does not validate the simulation of seasonal vertical root length profile due to lacking of in situ observations. We are trying to collect some field measured maize root length density to validate the root growth simulation ability of STEMMUS-SCOPE, and some relevant results will be published in a future work. (line 451-452)

Details:

*Comments 1: L42: Oxygen for plant is not main topic of this paper. Please remove "oxygen".*

15 **Response:** Done. (line 42)

*Comments 2: L76: Please show the simple introduction of STEMMUS itself, and explain why STEMMUS is necessary to determine RWU based on detail process in STEMMUS model (compared to SPAC models as reviewer#2 mentioned). Please also remind the importance of heat transfer processes which is not uncovered through the Introduction.*

20 **Response:** Thanks for your comment! We have added a simple description of STEMMUS, more detailed information about STEMMUS can be found in the section of methodology and data. Previous SPAC simplified the water and heat transfer process and the soil layers was fixed. In STEMMUS, the soil layer can be set flexible. In addition, the heat transfer (the soil temperature) is vital for vegetation phenology development and freeze-thaw processes. (line 79, line 121 to 123)

*Comments 3: L63, L67, L69: Vegetation appearance may be replaced to remote sensing signals. It sounds ambiguous terms.*

**Response:** Done. (line 63, line 67, line 68)

25 **Comments 4:** L82: Please add “SIF” in the purpose as one of Results chapter focused on SIF, and that is the advantage of SCOPE.

**Response:** Done. (line 84)

**Comments 5:** L103: Please add “SIF” in the sentence, as same manner in the chapter of the Results. Please add clear explanation of geometry parameter on SIF at nadir or any view zenith angle or field of view angle.

30 **Response:** Done. (line 103)

**Comments 6:** L122–123: Please move the sentence to Introduction.

**Response:** We request to keep it here and we have added a relevant explanation in the Introduction section. (line 80-81)

**Comments 7:** L135: Please add version information of SCOPE which you based on for the coupling model.

**Response:** Done. (line 139)

35 **Comments 8:** L137: Please add “SIF” among calculated output on SCOPE coupling model.

**Response:** Done. (line 141)

**Comments 9:** L175: Please clearly show leaf water potential and water stress factor in here and in Table2, section 3.6 as well.

**Response:** Done. (line 179-180)

**Comments 10:** L201: Please add general description of exact values of RMSE and  $d$  as same manner in next section.

40 **Response:** Done. (line 201-204)

**Comments 11:** L252: There are mismatch of drought water stressed period as follows. DOY193-202 for ET in Yangling. L268: DOY183-202 for transpiration in Yangling. L346: DOY192-202 for WSF in Yangling.

**Response:** Done.

**Comments 12:** L270: “better simulation” is not clear description. Please correct a little more detail.

45 **Response:** Done. (line 278)

**Comments 13:** L328: Please move the following sentence to the method “Leaf water potential is a parameter to reflect plant water status.”

**Response:** Done. (line 144-145)

50 **Comments 14:** L354: Table 3 did not contain root distribution gradient information. The Author also did not clearly present the validation of root depth between model prediction and observation in maize and grassland species. Before referring previous studies, the quality of root depth representation should be shown in proper manners.

**Response:** Relevant sentence has been corrected. (line 364)

**Comments 15:** L337: Martineau et al (2017) described leaf water potential in MPa pressure unit. Please refer the original values too. And please show the proof of unit conversion.

55 **Response:** Thanks for your comment! We have added the original values in the reference and showed how does the unit converted. (line 345-346)

**Comments 16:** L388: Please check correct figure number (Figure 13a.).

**Response:** Done. (line 396)

**Comments 17:** L394: Please check correct figure number (Figure 13a.).

60 **Response:** Done. (line 403)

**Comments 18:** L395: Please explain the reason why you chose DOY199. You may show the validity that SIF-drought response was not affected by dependence on PAR variations in diurnal cycle. (e.g. sky clearness stability during daytime)

**Response:** Thanks for your comment! We have added the reason why the DOY 199 was selected. (line 401-402)

65 **Comments 19:** L418: This sentence is unclear. Is there any evidence that embolism and refilling process cannot occur in cropland and grassland? Please make clear that is related to whether land use, meteorology or plant traits.

**Response:** Thanks for your comment! The threshold which can result in embolism of maize is about -1.6 MPa (Cochard, 2002), and the maize cropland in Yangling was not reached such a low leaf water potential. For the grassland, it experienced a very severe dry season and the grass was dead or dormant. So, this study cannot validate the effect of embolism and refilling on the drought response ability of STEMMUS-SCOPE.

70 **Comments 20:** L437: “though it well predicted root depth which is the most critical factor” Actual validation of the root depth prediction was not found in the manuscript.

**Response:** It has been corrected. (line 445)

**Comments 21:** L455: As you noted in L464, the study did not validate modeled SIF against observations. It may be replaced as potential applicability.

75 **Response:** It has been revised. (line 466)

*Comments 22: L465: “an effective observation operator to simulate remote sensing signals” It is not clear what you want to say. Please revise plainer sentence.*

**Response:** Done. (line 475)

80 *Comments 23: L593: Soil water potential and leaf water potential  $\psi_{leaf}$  are noted as pressure head unit (head, m) in this study. Please describe the unit of water potential clearly, to avoid confusing to MPa pressure unit.*

**Response:** The unit of water potential has been described in detail in the manuscript. (Line 602)

## **References**

Cochard, H. (2002). Xylem embolism and drought-induced stomatal closure in maize. *Planta Berlin*.