

We sincerely thank the two reviewers for the second review. Our responses to each comment from both reviewers are given below, directly following each bullet point. Reviewer's comments appear in black font and our responses appear in blue font.

Responses to Reviewer #1

The authors did a good job in addressing my previous comments and I don't have further comments for this manuscript besides the following minor suggestion:

L103-104: please double check if the reference is Feng et al. (2020) or Feng et al. (2022).

Reply: Thanks for the catch! That seems to be a glitch in the Zotero. We managed to resolve and thus it has been corrected.

Responses to Reviewer #2

The revised study and authors made good efforts to address past concerns and specific questions, especially by adding the open loop simulations. However, some minor comments remain below. This study may be helpful for those requiring decision making in this study region of CONUS and helps contextualize the different soil moisture products available for the upper layer. The comparison between outputs based on a physics-based model and a ML-based model is helpful for understanding the drawbacks/benefits of either.

Minor comments:

1. It would be good to show the figures for justifying the NCEP Stage IV precipitation product as shared in the author's responses for Section 3.2.3 at least in the supplementary document. This is to help readers who may not check the reviewer's comments otherwise.

Reply: The figure showcasing the contrast between the NCEP Stage IV and NLDAS-2 precipitation rates are now valid in the supplementary document as the new Figure S1. Additional description of this figure is added in L203.

2. Figure 8 (and Figures S5, 10) may be further improved with the addition of the OL timeseries, to contextualize how much improvement the SMAP DA was compared to it.

Reply: The three figures have been updated with the addition of the OL timeseries, correspondingly.

3. A statement on why only GLEAMv4.1 is used to compare the drought event in 2016 against SMAP DA should be made (and not including ERA5-L, GLASS, and SMAP AM, which were analyzed in the previous sections).

Reply: A statement explains why the GLEAMv4.1 was chosen as the primary benchmark in the specific comparisons can be found in L532 – L533.

4. The RMSE for land cover types in the response (Figure 6) is recommended to also be included in the supplementary section.

Reply: Thanks for the suggestion. The figure illustrating landcover-dependent SM RMSEs now appears in the supplementary material document as Figure S9. The relevant discussions in section 4.2.4 have also been revised accordingly.