Anonymous Referee #2
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Soil moisture is very crucial in exploring the response of vegetation dynamics to the climate change in ecohydrological processes. Having professed my general enthusiasm for the topic and its importance, I have some concerns that require substantive effort, a large part should be recalculated and rewrote.
Response: Thank you for your valuable comments on our manuscript, which are very important and helped us to improve the quality of dataset and paper. **We have upgraded the dataset based on the comments of reviewers and many users' feedback in the process of applying data, and it is currently updated to version 3 and has been downloaded 1716 times (https://zenodo.org/record/4738556#.YJJcs8DiuUk). We have received good comments from many users,** and studied each comment and have made revisions. Please find our detailed responses below. Revisions to the manuscript will be highlighted in blue in the revised manuscript file. Thanks again.

Best regards,
Xiangjin Meng and co-authors

The paper should be suitable for publication following the recommend major revisions below:
1. There are several similar studies on the reference. What are new findings on this study?
Response: In addition to providing a set of soil moisture data sets with high spatiotemporal resolution for agricultural drought monitoring and climate change models, we also analyzed the spatiotemporal changes in different regions. In the past 17 years, China's soil moisture has shown cyclical fluctuations and a downward trend, but the northwest has a slightly wet trend. Global warming drives the intensification of the water cycle, which is the fundamental reason for the warming and humidification of the climate in Northwest China. For the Northwest, water vapor mainly comes from the Arabian Sea and the Indian Ocean. As the Arctic warms, water vapor from the Arctic Ocean increases. Under the action of air currents, water vapor in the three places concentrated in the northwest, and precipitation in the northwest increased rapidly, which leads to an increase in soil moisture. For more specific analysis, please refer to the manuscript.

2. Line 111-114: The authors should explain more about how to divide into these six regions (NEM, NCM, SCM, etc.) by climate and topography, and add these in Fig 1. What does the different color mean is Fig 1 (the patch not the points).
Response: We mainly divide regions based on topography (elevation), rainfall and other factors, so that we can better evaluate soil moisture changes and make corrections and assessments based on corresponding ground observation sites. Different color means different elevation information.

3. Eqs4: Why do you need to correct the surface temperature? Did these data already include the elevation effects?

Response: There are a lot of clouds in some mountainous areas in the south, and a few places have very few effective values of surface temperature. Only the bottom of the mountain has an observation station. In order to obtain a more reliable temperature at high altitudes, we can only use the valley ground observation site temperature, so the influence of elevation must be considered in the correction process.

4. Eqs8: These letters (i, j, a and b) seem to be four different pixels. Please explain clearly about how to get the new soil moisture data from the previous soil moisture and TVDI in different location.

Response: Thank you for your guidance. We have made revisions. Revisions to the manuscript will be highlighted in blue in the revised manuscript file.

5. Line 327-328: Can you explain why for this: 'the downscaled SM data underestimated the ground observations at all three temporal scales, especially the monthly scale.'

Response: Compared with thermal infrared remote sensing, passive microwave remote sensing has less influence on clouds and rainfall. Especially when there is rainfall, the accuracy error of passive microwave inversion of soil moisture is still relatively large. Therefore, when it is judged that there is rainfall and the error is relatively large, the inversion algorithm usually sets this inversion value to an invalid value (0). Some algorithms are filled by neighboring pixels. In addition, there is a gap between the data of two adjacent scenes, and some algorithms fill it with adjacent pixels. When there is rainfall, most of the soil moisture value reaches the maximum saturation value. The processing method of the inversion algorithm will lead to underestimation of soil moisture content during rainfall, which will lead to underestimation of soil moisture at all three temporal scales, especially the monthly scale. In view of this defect, we have performed optimized calculations to improve the accuracy as much as possible.

6. Lin 343: 'possibly attributable to ice and snow cover in winter' If it is true, why the RMSE in April was higher than that in November.

Response: In most areas, RMSE is relatively larger in winter. However, in some places, due to more rain and clouds in the spring, the error of the satellite inversion of soil moisture is relatively large, resulting in relatively large errors. In addition, it has something to do with the site location and measurement. Due to the low resolution of passive microwaves, there is a big difference between the representativeness of the site and the real pixels, which will also cause deviations in the validation process. We have already made more analysis and explanation in the manuscript.

7. There are five elements including station, vegetation types, R, SDV and RMSE in Fig 5. It is difficult for the reader to get information easily and it did not show the highlight (SM associated with higher vegetation is more variable) well.

Response: Thank you for your guidance, we have made revisions and gave a more detailed description.

8. Line 378-379: Would it be affected by the soil types either? The soil types could also affect the soil moisture. Please include the effect of soil types in this part.
Response: Thank you for your guidance. The type of soil (surface type) has also a certain impact on the change of soil moisture, and we have made a supplementary explanation in the manuscript.

9. Fig6: I found large interannual variability along with the declined trend in each panel. Please explain the variability in the main text. Is it caused by low quality of the data or climate change?
Response: There may be many reasons, but the most important reason is global warming. The overall increase in temperature leads to an increase in evaporation, so that the overall soil moisture has a slight downward trend. The change trend of soil moisture is fluctuating, and the performance is different in different places. After considering the impact of rainfall, we re-corrected and re-analyzed the data in the manuscript.

10. Please mark the 'Changbai Mountains', 'Liaodong Peninsula', 'Sichuan Basin', etc. in relevant figures.
Response: Thank you. We have made revisions.

11. Fig8: why did the soil moisture increase in Northeast China in autumn?
Response: Global warming drives the intensification of the water cycle, which is the fundamental reason for the warming and humidification of the climate in Northwest China. For the Northwest, water vapor mainly comes from the Arabian Sea and the Indian Ocean. As the Arctic warms, water vapor from the Arctic Ocean increases. Under the action of air currents, water vapor in the three places concentrated in the northwest, and precipitation in the northwest increased rapidly, which leads to an increase in soil moisture.

12. The authors actually did 'results and discussion' in 'results' session. The 'Discussion and conclusions' part did not show much discussion. Please modify the session name.
Response: Thank you for your guidance. We have made revisions.