

Dear authors,

Your manuscript has now been reviewed by one of the reviewers who also reviewed the manuscript previously. As you can see, the reviewer is happy with the revised version but has a number of minor issues that will need to be addressed. As a result, I am happy to conditionally accept your manuscript for final publication in HESS, provided your response to the remaining issues is sufficient. In order to make the process as efficient as possible, the manuscript will not be returned to the referee and I will do the evaluation myself. I am looking forward to receiving your revised version.

Best regards

Ryan Teuling

Response: Thank you for your timely letter concerning our manuscript (No. HESS-2024-105) on the first day of 2025. We tried our best to improve the manuscript and made some changes in the manuscript. These changes will not influence the content and framework of the paper. We appreciate the Editor and Reviewer's warm work earnestly and hope that the correction will be approved. Revised portions are marked in red on the paper. The main corrections in the paper and the responses to the reviewer's comments are as follows:

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Response to Reviewer #1:

Reviewer #1: Thanks to the authors for patiently addressing my comments and suggestions and providing substantial additional analyses. I am satisfied with the modifications to the manuscript. I still have a few comments, but those are minor and I concur with closing the review cycle. – Hsin.

Response: Thank you very much for your invaluable comments and suggestions. In the new version, we mainly integrate the two paragraphs of the conclusion, increase the importance and future potential of the research results, and modify some details in the full paper.

1. The conclusion needs improvement. The second paragraph in the conclusion **largely repeats the description of results**. You have sentences like “... **is essential for** the vegetation state and corresponding land-atmosphere coupling” and “**offering valuable insights** into the potential water limitation on ecosystems under comparable SM circumstances” in the abstract. Therefore, your conclusion should **echo these statements** and **provide some prospects** for future relevant studies.

Response: We changed the conclusion as follows:

“Our main accomplishment is observing and identifying water and energy limit shifts using multi-source satellite-based water and carbon fluxes over China. These shifts show which areas are more likely to be affected by climate change. To do so, we first examined the consistency of ET and GPP derived from the site- and satellite-based grid observations and the consistency of CSM derived from the EF-SM, covariance, and correlation-difference methods. CSM detected by the covariance between VPD and GPP and CSM using the correlation-difference metric using VPD, ET, and SM matched well with CSM using the EF-SM method at the site scale, suggesting that these methods could detect large-scale CSM. According to satellite-based CSM from four ET products, four GPP products, and the latest SM dataset, surface water- and energy-limited regimes varied among land cover types, soil textures, and water resource subregions; soil textures of clay and land cover types of grassland had a large range of SM within water-limited regimes. Based on the spatial pattern of CSM, we further attributed the dominant

factor of Δcorr and discovered that VPD was the most important predictor across 24% of Pearl River Basin and 19% of Tarim Basin. However, unlike the declining VPD in Pearl River Basin, the increasing VPD aggravated the water stress in Tarim Basin, especially for the more fragile grassland in these areas. As environmental change and extreme disturbances affect CSM, future research directions will aim at the impact of hydraulic projects such as inter-basin water transfers on CSM, the impact of extreme disturbances such as tropical cyclones and wildfires on CSM, and possible changes in CSM.

This study used multi-source satellite-based water and carbon fluxes and different methods to detect CSM, and more efforts were put into the evaluation and validation of CSM. 18 years of datasets used for CSM were quite typical of the long-term climatology of continental wetness. Since CSM, an emerging property, is generated by multiple processes occurring on the land surface, in the atmosphere, and at the interface between them, uncertainties of ET and GPP from the algorithm, uncertainties of SM from ground sampling, and enhanced land-atmosphere coupling due to external forcing all contribute to CSM uncertainties. We emphasize that SM behavior below and above CSM determines ET and GPP and that water-limited regimes of the SM range depend on CSM. Water and carbon fluxes are vulnerable to the sensitivity of Δcorr to hydrological, meteorological, and ecological predictors. Accordingly, the water and carbon algorithm should consider water-energy limit shifts to improve the simulation accuracy. Thus, applying our new understanding of Δcorr and CSM under changing land-atmosphere conditions will provide a more complete perspective of the evolution of regional terrestrial ecosystems over extended periods.”

2. I suggest using $\Delta\text{CorrVPD}$ instead of CorrVPD to emphasize that it represents a difference. This would also be consistent with the notation in Denissen et al., 2020.

Response: In the revised version, we used Δcorr same with Denissen et al., 2020, instead of CorrVPD .

3. Line 26: “higher CSM than SM, making them in water-limited regimes.” What does SM refer to? Should it be mean SM?

Response: Yes, we changed it to “CSM for grassland and clay was higher than average SM, making them in water-limited regimes”.

4. Line 40: “relationship between SM and leaf conductance follows a linear trend.” I think “trend” here is not the best wording, as it has a specific meaning in climate studies. Also, please indicate whether the relationship is positive or negative.

Response: We changed it to “SM and leaf conductance follow a positive linear relationship”.

5. Line 174: “CMS” should be “CSM.”?

Response: We changed it to “CSM”.