

Item-by-item responses to all review comments

NOTE: To facilitate the evaluation of our responses, original comments are listed first in their originals (in black), followed by **our itemized responses (in red)**. An annotated version of revised manuscripts is attached.

Community's Comments

The manuscript examines groundwater storage decline in China's Three-North Shelterbelt Forest Region using GRACE/GLDAS, in-situ wells, land-cover data, and structural equation modeling. It reports a regional mean GWS decline of about -5.47 mm yr^{-1} , with stronger depletion in forest gain areas, and argues that vegetation restoration, especially conifer pure stands dominated by spruce, has become a major anthropogenic driver of groundwater loss. This is a very good and well-designed study with strong relevance to groundwater sustainability and forest restoration.

Response: First of all, we would like to thank you for your constructive comments to improve our manuscript. We really appreciate your precious time and great efforts on reviewing the manuscript. We have carefully addressed all the comments, which have greatly improved the quality of this manuscript. Please find below our detailed responses to the comments point by point.

Specific comments:

1. The abbreviation GWSA should be used consistently throughout the manuscript. In several places, the text alternates between GWS and GWSA, which may confuse readers.

Response: We thank the reviewer for pointing out this inconsistency in terminology. Based on your suggestion, we have thoroughly checked the entire manuscript, figures, tables, and supplementary materials. We have unified the terminology by using GWSA (Groundwater Storage Anomaly) consistently throughout the text whenever referring to groundwater storage anomalies, eliminating any alternating or ambiguous uses of GWS.

Please see the revised manuscript for these updated terms across all relevant sections.

2. Several figures, particularly Figures 6–10, contain multiple panels and extensive information. Increasing the font size of labels and legends would improve readability.

Response: We thank the reviewer for this practical suggestion to improve the visual presentation of our figures, we have thoroughly revised Figures 6-10 by increasing the font size of axis labels, legend text, sub-panel labels, and annotations. We also optimized the layout and spacing to enhance clarity and overall readability.

Please see the revised Figures 6-10 in the updated manuscript.

3. The manuscript contains several long sentences, especially in the Discussion section. A careful language edit would improve readability and the overall flow of the manuscript.

Response: Based on the comments, we have thoroughly revised the manuscript, with a particular focus on the Discussion section. Long, complex sentences have been restructured, split into shorter, clearer statements, and refined for better logical transition and flow. Please see the revised manuscript for these language and readability improvements across all sections.

4. The reference list should be carefully checked for formatting consistency,

particularly regarding journal titles, capitalization, and DOI presentation.

Response: Based on the comments, we have thoroughly audited and updated the entire reference list to ensure strict formatting consistency. Please see the revised References section in the updated manuscript for these corrections.

5. The authors are strongly recommended to cite recent work on assimilating remotely sensed vegetation information into integrated hydrological modeling, particularly “Assimilation of Sentinel-based Leaf Area Index for Modeling Surface-Ground Water Interactions in Irrigation Districts” (Zafarmomen et al., 2024, Water Resources Research). This study demonstrates how high-resolution satellite-derived vegetation information can improve the representation of vegetation–water interactions and would strengthen the discussion of remotely sensed vegetation products in groundwater studies.

Response: Based on the comments, we have read and incorporated this important study (Zafarmomen et al., 2024) into Section 4 (Discussion). Please see Lines 518-519: *“In addition, assimilating high-resolution leaf area index data into coupled surface water – groundwater models can further refine the simulation of vegetation – water interactions (Zafarmomen et al., 2024).”*

6. It would be helpful to include a brief table summarizing the main datasets (source, spatial resolution, temporal resolution, and study period) to improve the readability of the methodology.

Response: We have added a summary of the main datasets in Table S1 of the Supplementary Materials to improve the clarity of the methodology.