

Manuscript ID: egusphere-2025-4600

Manuscript title: Retrieving root-zone soil moisture from land surface modelling and GRACE/-FO and validating its dynamics with in-situ data over West Africa

Response to the Editor-in-Chief

We thank the Editor-in-Chief for the careful assessment of our revised responses and for the constructive feedback regarding the presentation quality of the manuscript. We have carefully addressed all these remarks in the revised version of the manuscript and have made substantial efforts to improve the writing, its organization, readability, and overall presentation quality.

1. Abbreviation and Acronym Consistency

1.1. The manuscript suffers from highly inconsistent abbreviation practices, which significantly impacts readability. Please adhere strictly to the standard rule of defining an acronym at its first use and exclusively using the acronym thereafter.

For example, Soil Moisture (SM) and Surface Soil Moisture (SSM): The term "soil moisture" is introduced multiple times early in the text (e.g., Lines 73, 75, 81) without an abbreviation, but the "SM" abbreviation is introduced later. Subsequently, "SM" is redundantly redefined throughout the manuscript (e.g., Figure 1 caption, Lines 286, 325, 367, 394, 403, 557, 655, 656, 662). Similarly, Surface Soil Moisture (SSM) is defined in Line 62 but repeatedly redefined (e.g., Lines 447, 459, 475, 517). Please define these terms once at their first appearance. If you feel "SM" is not a necessary abbreviation, please spell out "soil moisture" consistently throughout.

Response: We sincerely thank the Editor for this important observation. We agree that inconsistent abbreviation usage can negatively affect the readability and overall quality of the manuscript. We have carefully revised the manuscript to ensure strict compliance with the standard abbreviation convention. In the revised version (Lines 17, 18, 23), each abbreviation is now introduced only once at its first occurrence, with the full term followed by the abbreviation in parentheses. Specifically, soil moisture (SM), surface soil moisture (SSM), and root-zone soil moisture (RZSM) are now defined at their first appearance and the abbreviations are used consistently throughout the remaining manuscript. All redundant definitions of SM, SSM, and the RZSM in the main text, figure captions, and tables have been removed.

Furthermore, we performed a comprehensive review of all abbreviations used in the manuscript to ensure that each acronym follows the same rule: full terminology at first mention and abbreviation only thereafter. This revision has improved consistency, reduced repetition, and enhanced the readability of the manuscript.

1.2. TWSA: "Total Water Storage Anomaly" is defined in Line 105 but is redundantly redefined very closely at Line 150 and Line 219.

Response:

We agree that repeating the definition of an acronym after its first introduction may reduce readability and create unnecessary redundancy.

We have revised the manuscript accordingly. The term *Total Water Storage Anomalies (TWSA)* is now defined only at its first occurrence (Line 107), and all subsequent occurrences throughout the

manuscript have been revised to use only the abbreviation **TWSA**. The redundant definitions previously appearing at Lines 150 and 219 have been removed.

1.3. ESA CCI: In Line 287, the "European Space Agency's Climate Change Initiative" is properly defined. However, in Line 304, the full phrase is unnecessarily spelled out again for "ESA CCI-LC". Please Utilize the already established "ESA CCI" abbreviation and simply introduce "Land Cover (LC)" WFDE5 (Line 195): While the acronym "WATCH" is explained in the parentheses, it is unclear what the "FDE5" portion of WFDE5 represents.

Response:

For ESA CCI, we have revised the manuscript to retain the previously defined abbreviation European Space Agency Climate Change Initiative (ESA CCI) and avoid repeating the full term when introducing ESA CCI-LC. The term is now introduced as ESA CCI Land Cover (ESA CCI-LC) by defining only the new component Land Cover (LC), while maintaining consistency with the previously established ESA CCI abbreviation.

For WFDE5, we agree that the explanation of the acronym was incomplete. We have revised the text to clarify that WFDE5 refers to the WATCH (WATER and global CHange) Forcing Data methodology applied to ERA5 reanalysis data, with the acronym components properly explained at its first occurrence.

2. Methodological Clarity and Terminology

Analytical Solution to Richards' Equation: In the abstract and text, you mention a "novel application of an analytical solution to Richards' equation" to project surface moisture to deeper layers. The current explanation of the formula and the specific steps taken to achieve this are difficult to follow. Please expand this a bit to explicitly detail how this mathematical translation was executed so that readers can fully grasp the methodology.

Response:

We thank the Editor to point out this. This issue was also raised by **Reviewer #2**, and we had previously addressed it by providing additional details in Section 3.1 (Lines 358–362) and by adding a statement at the end of Section 5 (Lines 681–685) in the previous revised manuscript version. However, we agree that the description could be further improved to enhance the clarity of the mathematical translation from surface soil moisture (SSM) to deeper soil layers. Therefore, in the revised manuscript, we have further expanded this section by providing a more detailed and explicit description of the implementation procedure (section 3.1, Lines 343 - 349), including the input variables, underlying assumptions, and the step-by-step computational workflow used to derive the soil moisture vertical profile and estimate root-zone soil moisture (RZSM).

Word Choice (Line 253): The phrase "moisture transport" is used here. Typically, "transport" is a term reserved for solutes (e.g., solute transport). Please consider changing this to "water flow" or "soil water movement" for more precise hydrological terminology.

Response:

Line 246 : Accordingly, we have revised the terminology throughout the manuscript and replaced "moisture transport" with the more appropriate term "**soil water movement**" to accurately describe the physical movement of water within the soil system. This change improves the hydrological accuracy and clarity of the manuscript.

Research Questions (Lines 138-146): The core research questions are presented as a bulleted list. This formatting is uncommon in formal scientific manuscripts. Action: Please integrate these bullet points into a standard paragraph if possible.

Response:

We agree that presenting the research questions in a continuous paragraph is more consistent with the formal style generally adopted in scientific manuscript. Accordingly, we have revised this section by removing the bullet-point format and integrating the research questions into a coherent paragraph (section 1, Lines 135 - 140). This modification improves the flow of the introduction and enhances consistency with the overall manuscript style.

3. Figure Formatting

Figure Readability (Figures 3 and 4): The axis labels and tick marks in Figures 3 and 4 are blurry, and the font size is too small to be legible. Please increase the font size of within these figures so that it closely matches the font size of the main manuscript text.

Response :

Thanks. We agree that the font size of the axis labels and tick marks in Figures 3 and 4 was too small and could affect their readability. In the revised manuscript, we have increased the font size of all axis labels, tick marks, and legends in Figures 3 and 4 to better match the font size used in the main text. Additionally, the figures have been regenerated and exported at higher resolution to improve clarity and reduce blurriness. These modifications enhance the overall readability and presentation quality of the figures.

4. Grammar, Punctuation, and Flow

Line 107: There is an extraneous right parenthesis that needs to be deleted.

Line 110: The sentence "This study will incorporate this approach" feels abrupt and disrupts the logical flow of the paragraph. Please integrate this thought more smoothly into the surrounding text, or remove it entirely.

Line 408: The phrase "addressed in the first subsection" is ambiguous. Please explicitly state which subsection is being referred to; it is not clear at all.

Line 619: The word "figure" should be capitalized as "Figure".

Line 640: There is a punctuation error (a comma and/or period issue) after "5 cm." Although, I raised the issue in my previous comment "There is a typo (an extra dot) after "5cm"." and you replied that this has been corrected "In the revised manuscript, the typo on line 603 (extra dot after "5 cm") has been corrected." But it is still there in the revision version.

Please correct the punctuation here.

Line 669: The use of em-dashes ("— whether in in-situ records or satellite-derived products —") is a bit too informal for this academic context, which might come from AI writing. Please replace the dashes with commas or parentheses.

Line 683: The phrase "would actually mean taking steps" uses the word "mean" somewhat awkwardly. Please replace "mean" with a more formal academic term, such as "require," "involve," or "necessitate."

Response:

We sincerely thank the Editor for these helpful comments regarding grammar, punctuation, and clarity of expression. We have carefully revised the manuscript accordingly:

- **Line 104:** The extraneous right parenthesis has been removed.
- **Lines 108-109:** The sentence “This study will incorporate this approach” has been revised to improve readability and logical continuity within the paragraph. It has been integrated into the surrounding text, and the passage has been restructured to better link the advantages of GRACE data with the description of the modelled data approach.
- **Line 403:** The phrase “addressed in the first subsection” has been revised to explicitly identify the relevant subsection. The section number and title have now been provided to improve clarity and allow readers to easily locate the corresponding discussion.
- **Line 607:** The word “figure” has been corrected to “Figure” in accordance with the journal’s formatting requirements.
- **Line 627:** We sincerely apologize for overlooking this issue in the previous revision. We have carefully rechecked the manuscript and have now removed the incorrect punctuation after “5 cm” in Line 640.
- **Lines 655-656:** Thanks for this valuable suggestion. The sentence has been revised by removing the em-dashes to improve the formality and readability of the text. The phrase “— whether in in-situ records or satellite-derived products —” has been revised to “, whether in in-situ records or satellite-derived products”.
- **Line 670:** We agree that the word “mean” is less appropriate in this context. The phrase “would actually mean taking steps” has been revised by replacing “mean” with “require” as suggested to improve the formality and precision of the statement.