Review by Divyeshkumar Rana – 31/05/2025

Technical Note: GRACE-compatible filtering of water storage data sets via spatial autocorrelation analysis

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This paper is accepted to subject a minor revision:

Rating at 1 to 4 scale, 1 means excellent and 4 means poor score:

---------- Scientific significance ---------- SCORE: 2 (Good)

---------- Scientific quality---------- SCORE: 2 (Good)

---------- Presentation quality---------- SCORE: 2 (Good)

---------- Overall Rating ---------- SCORE: 2 (Good)

1.1. Recommendation

Minor Revision

1.2. Overview

This technical note explores methods to make Water Storage Compartments (WSCs) data compatible with Terrestrial Water Storage Anomaly (TWSA) data derived from GRACE satellite missions, specifically for isolating groundwater storage. Because GRACE data inherently have spatial smoothing and noise, other WSC datasets must be filtered similarly for accurate comparisons and subtractions. The study found that anisotropic decorrelation filters, like DDK, introduce artefacts in WSC data, suggesting that an isotropic Gaussian filter is more suitable. By analysing spatial autocorrelation and minimising differences between WSC and TWSA autocorrelation functions, an optimal Gaussian filter width of 250 km was identified for a combined WSC dataset to align with GRACE-based TWSA data characteristics.

This technical note is well written, and the overall quality of the manuscript is excellent. The research question is clearly defined and addressed in a scientifically sound manner. However, to enhance the scientific rigour of the work, I have a few specific comments regarding certain aspects of the study:

1.3 Minor comments

Abstract (line 20): Please include the RMSD results corresponding to the optimal filter width, as this will help emphasise the most significant findings for the reader.

Abstract: The time period of the data is not mentioned in the abstract. Please include it to provide readers with an immediate contextual understanding of the study.

Line 155: I would have appreciated more information regarding the choice of bilinear interpolation. Kindly consider including a specific reference and a clear justification for its use, particularly in relation to the data characteristics and the goals of the analysis.

Line 194: The manuscript mentions the time period as 2002 to 2023 in one instance, while the data preprocessing section refers to 2002 to 2020. Please ensure consistency throughout the manuscript regarding the time period to avoid confusion and maintain clarity.

Line 195: I would have liked to have more information on the spatial autocorrelation method employed in the study. It is not clearly described in the text, nor is a reference provided. Please consider elaborating on the approach used—such as whether it is based on Global Moran's I or another technique—and include an appropriate citation to support the methodology.

Line 196: I would have liked to see equation numbers included throughout the manuscript, as currently the equations are only referred to in the text without numbering. Including equation numbers would improve clarity and allow for more precise referencing within the manuscript.

Line 242: For the sake of consistency, I would suggest using "RMSD" in Equation 4, as it aligns with the terminology used throughout the manuscript. This will help maintain uniformity and avoid potential confusion for the reader.

Line 250: I would have liked to see the Fig. 4 flowchart improved through a clearer colour scheme and more concise text to enhance readability and understanding.

Line 330: I would have liked to see the projection system specified for the global maps presented in Figure 8. Including this information would enhance the reproducibility and clarity of the spatial analysis.

Line 390: I would have liked to see proper basemap credits included in Figure 11. Acknowledging the source of the basemap is important for transparency and adherence to data usage guidelines.

I would recommend a thorough grammatical review of the manuscript, with particular attention to sentence structure and overall presentation. Enhancing linguistic clarity and

coherence will significantly improve the readability and professional quality of the work. A few examples of:

(i) have been suggested change to “has been suggested” (line 56)

(ii) to change to “with” etc.. (line 70)

I would suggest including an abbreviation table at the end of the manuscript, as numerous technical terms and abbreviations are used throughout. This will enhance clarity and assist readers in understanding the content more easily.

In conclusion, I recommend that the study be accepted, subject to the minor corrections outlined above, to enhance its scientific rigour and clarity.