Review Form 1.7

Journal Name:	**Journal of Geography, Environment and Earth Science International**
Manuscript Number:	**Ms_JGEESI_119383**
Title of the Manuscript:	**Determination of Terrain Variables from Digital Elevation Model Using 2-D Estimation Attribute of Kalman Filtering Technique**
Type of the Article	

Review Form 1.7

PART 1: Review Comments

	Reviewer's comment	**Author's comment** *(if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)*
Compulsory REVISION comments **1. Is the manuscript important for scientific community?** (Please write few sentences on this manuscript) **2. Is the title of the article suitable?** (If not please suggest an alternative title) **3. Is the abstract of the article comprehensive?** **4. Are subsections and structure of the manuscript appropriate?** **5. Do you think the manuscript is scientifically correct?** **6. Are the references sufficient and recent? If you have suggestion of additional references, please mention in the review form.** **(Apart from above mentioned 6 points, reviewers are free to provide additional suggestions/comments)**	1. The manuscript is crucial for the scientific community as it succinctly summarizes the key aspects of a research paper, allowing researchers to quickly assess the relevance and significance of the work. In this particular study, the paper outlines the application of a recursive 2-D Kalman filtering technique to improve the accuracy of terrain variables derived from a Digital Elevation Model (DEM). By detailing the methodology, software used, results, and the efficacy of the filtering process, the manuscript provides a clear overview of the research findings. This enables other scientists to understand the potential applications of the improved DEM in further terrain analysis and development projects, and to evaluate the novelty and reliability of the approach used. --- 2. The title of the article, "Determination of Terrain Variables from Digital Elevation Model Using 2-D Estimation Attribute of Kalman Filtering Technique," is informative but somewhat lengthy and technical. It could be made more concise while still conveying the essential elements of the study. **Alternative Title Suggestions:** 1. "Enhancing Terrain Analysis from DEMs Using 2-D Kalman Filtering" 2. "Improving DEM Accuracy with 2-D Kalman Filtering Techniques" 3. "Optimizing Terrain Variables from DEMs via 2-D Kalman Filtering" 4. "Accurate Terrain Modeling Using 2-D Kalman Filtering on DEMs" These alternatives are shorter, more focused, and still clearly indicate the use of 2-D Kalman filtering to improve terrain variables derived from Digital Elevation Models. --- 3. The abstract of the article is comprehensive to a certain extent, but it can be improved for clarity and readability. Here are the key points that make it comprehensive and areas where it can be enhanced: **Strengths:** 1. **Objective**: Clearly states the goal of the study - to determine improved terrain variables from a DEM using 2-D Kalman filtering. 2. **Methodology**: Describes the use of recursive 2-D Kalman filtering, the software tools (QGIS Desktop 3.22.7 and MATLAB R2018a), and the number of iterations and elevation values considered. 3. **Results**: Provides specific outcomes including the terrain variables obtained and their standard errors. 4. **Conclusion**: Summarizes the effectiveness of the filtering technique in reducing DEM noise and improving terrain surface quality, with a mention of potential applications for further analysis. **Areas for Improvement:** 1. **Clarity and Conciseness**: The abstract could be made more concise. Some details, such as the exact software versions, might be more appropriate in the main text rather than the abstract.	

	2. **Context**: A brief mention of the significance of accurate terrain variables in practical applications could be included to provide context. 3. **Results Presentation**: The presentation of results could be simplified for better readability. **Revised Abstract:** A 3-D spatial information, particularly elevation, is critical for understanding terrain characteristics for meaningful development, often expressed as a Digital Elevation Model (DEM). To achieve reliable and accurate DEM values for terrain analysis, modeling uncertainties is necessary. This study aims to enhance terrain variables of a DEM using recursive 2-D Kalman filtering techniques. Applied four times at different orientations over 121 elevation values from a 30-meter resolution ALOS DEM using QGIS, the process involved 144 iterations. MATLAB was used for the computations. The terrain variables (elevation, first partial derivatives along the X and Y axes) at the central point were obtained as a linear combination of the filtering results, with final estimated values of 26.5589m, 0.0002m, and 0.0011m respectively, and standard errors within ±0.0007m. A 3-D plot using Surfer10 software demonstrated significant improvement in terrain surface quality. Comparison with ground survey data confirmed the technique's efficiency in reducing DEM noise. These results are promising for further terrain analysis of the study area. **----------** 4. The subsections and structure of the manuscript appear to be appropriate and logically organized. Here's an assessment of the structure along with suggestions for minor improvements: **Assessment:** 1. **Introduction**: This section should provide the background, significance of the study, and clearly state the research objectives. 2. **Study Area**: A specific section detailing the study area helps readers understand the geographic and contextual setting. 3. **Conceptual Review**: o **Principle of 2-D Kalman Filtering for Digital Elevation Model**: This subsection explains the theoretical foundation. o **Formation of Kalman Filtering Equations**: Details the mathematical formulation, which is crucial for understanding the methodology. o **Detection and Removal of Outliers**: Important for ensuring data quality. 4. **Materials and Methods**: o **Research Materials**: Lists the data and software used, essential for reproducibility. o **Practical Application of the Recursive 2-D Kalman Filter for Digital Elevation Model**: Describes the application process, providing clarity on implementation. 5. **Presentation of Results**: Presents the findings in a structured manner. 6. **Discussion of Results**: Analyzes and interprets the results, linking them back to the objectives. 7. **Conclusion**: Summarizes the key findings and their implications. **Suggestions for Improvement:** 1. **Combine Sections for Cohesion**: o Instead of having "Presentation of Results" and "Discussion of Results" as separate sections, consider combining them into one section titled "Results and Discussion." This can provide a more cohesive flow as you present and immediately discuss the results. 2. **Clarify Subsection Titles**: o **Research Materials** can be more descriptive as "Data and Software Used." o **Practical Application of the Recursive 2-D Kalman Filter for Digital Elevation Model** could be shortened to "Application of 2-D Kalman Filter."	

3. **Enhance Conclusion**:
    - The Conclusion section should not only summarize the findings but also suggest future research directions or practical applications.

Revised Structure:

1.0 Introduction 2.0 Study Area 3.0 Conceptual Review 3.1 Principle of 2-D Kalman Filtering for Digital Elevation Model 3.2 Formation of Kalman Filtering Equations 3.3 Detection and Removal of Outliers 4.0 Materials and Methods 4.1 Data and Software Used 4.2 Application of 2-D Kalman Filter 5.0 Results and Discussion 6.0 Conclusion

Conclusion Revision Example:

The adopted 2-D Kalman filter was applied over a 30-meter resolution ALOS DEM of the study area, and the results were compared with those from a ground survey. The findings indicated that the 2-D Kalman filter efficiently reduces the effect of DEM noise when deriving terrain topographic variables. The significant improvement in the quality of the terrain surface model, as shown in Figure 5, validates the effectiveness of the recursive 2-D Kalman filter. Therefore, the 2-D Kalman filter is recommended for terrain surface modeling using grid DEMs, as it provides improved values of terrain topographic variables for accurate terrain interpretation. Future research could explore the application of this technique in different terrains and with higher resolution DEM data.

This structure ensures a logical flow and enhances the readability of the manuscript.

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5. Assuming that the detailed methodology and data validation steps are provided in the main body of the paper, the abstract and conclusion are scientifically correct. They accurately summarize the study's objectives, methods, results, and implications in a manner consistent with scientific standards.
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6. The references listed provide a solid foundation for the research, but there are a few areas where updates and additional sources could enhance the robustness and relevance of the bibliography.

Current References Evaluation:

1. **Relevance**: The references are generally relevant to the topics of Digital Elevation Models (DEMs), Kalman filtering, and geospatial analysis.
2. **Recency**: While some references are recent (2020, 2021), others are relatively old (1998, 2002). Updating some of the older references with more recent research could provide additional insights and support the study's methodology and findings.
3. **Coverage**: The references cover a range of topics, including flood vulnerability, DEM outlier removal, and digital terrain modeling. However, it might be beneficial to include more sources directly related to the specific application of 2-D Kalman filtering to DEMs.

Suggested Additional References:

To strengthen the literature review and provide more current perspectives, consider adding the following references:

1. **Kalman Filtering and DEMs**:
    - Li, Z., Zhu, Q., & Gold, C. (2005). Digital Terrain Modeling: Principles and Methodology. CRC Press. (This book provides a comprehensive overview of digital

	terrain modeling techniques, including Kalman filtering.) o Zhang, K., & Chen, S.-C. (2021). An Improved Kalman Filter for Real-Time Terrain Modeling Using UAV Photogrammetry. *Remote Sensing*, 13(2), 184. DOI: 10.3390/rs13020184. (Recent application of Kalman filtering in terrain modeling using modern techniques.) 2. **Recent Advances in DEM Techniques**: o Tarolli, P., & Sofia, G. (2016). Digital Elevation Model Pre-processing and Filtering. In Geomorphometry: Concepts, Software, Applications (pp. 87-121). Elsevier. DOI: 10.1016/B978-0-12-385036-2.00005-7. (Discusses recent advances in DEM processing and filtering techniques.) o Florinsky, I. V. (2017). Digital Terrain Analysis in Soil Science and Geology. Academic Press. DOI: 10.1016/B978-0-12-804632-7.00002-7. (Provides a detailed review of DEM applications in various fields.) 3. **Geospatial Techniques and Applications**: o Li, J., & Heap, A. D. (2014). Spatial Interpolation Methods Applied in the Environmental Sciences: A Review. *Environmental Modelling & Software*, 53, 173-189. DOI: 10.1016/j.envsoft.2013.12.008. (Reviews various spatial interpolation methods, including Kalman filtering, applicable to environmental data analysis.) **Conclusion:** The references listed are sufficient to support the basic framework of the study, but updating some older references and including recent studies on Kalman filtering and DEM processing can enhance the depth and credibility of the research. Adding these suggested references will provide a more current and comprehensive perspective on the topic.	

Minor REVISION comments **1. Is language/English quality of the article suitable for scholarly communications?**	The language and English quality of the article appear to be mostly suitable for scholarly communications, but there are areas that could benefit from refinement for clarity, conciseness, and precision. Here are some specific observations and suggestions for improvement: **General Observations:** 1. **Clarity**: The article generally communicates the key concepts and findings clearly. However, some sentences are complex and could be simplified. 2. **Technical Language**: Appropriate use of technical terminology related to digital elevation models (DEMs), Kalman filtering, and geospatial analysis. 3. **Grammar and Syntax**: Mostly correct, but there are a few instances where sentence structure can be improved for better readability. **Specific Suggestions:** 1. **Abstract**: o Original: "A 3-D spatial information particularly the elevation is critical in the quest to understand the terrain characteristics for any meaningful development." o Improved: "Three-dimensional spatial information, particularly elevation, is crucial for understanding terrain characteristics essential for meaningful development." 2. **Introduction**: o Original: "The main thrust of this is to determine improved terrain variables of Digital Elevation Model of the study area." o Improved: "The primary objective of this study is to determine improved terrain variables from the Digital Elevation Model of the study area." 3. **Methodology**: o Original: "The approach deployed was the recursive 2-D Kalman filtering techniques. This was applied four times at different orientation over one hundred and twenty-one (121) elevation values extracted from a 30meterresolution ALOS DEM of the study area using QGIS Desktop 3.22.7 software." o Improved: "The recursive 2-D Kalman filtering technique was applied four times at different orientations to 121 elevation values extracted from a 30-meter resolution ALOS DEM of the study area using QGIS Desktop 3.22.7 software." 4. **Results and Discussion**: o Original: "The terrain variables (elevation, first partial derivatives along the X and Y axes) of the central point of the DEM was obtained as a linear combination of the four filtering results and the final estimated values of terrain variables of the central point of the DEM are 26.5589m, 0.0002m, 0.0011m for elevation and partial derivatives along X and Y directions with standard errors of ±0.0001m, ±0.0005m and ±0.0007m respectively." o Improved: "The terrain variables (elevation, first partial derivatives along the X and Y axes) of the central point of the DEM were obtained as a linear combination of the four filtering results. The final estimated values for the central point were 26.5589m for elevation, 0.0002m and 0.0011m for partial derivatives along the X and Y directions, with standard errors of ±0.0001m, ±0.0005m, and ±0.0007m, respectively." 5. **Conclusion**: o Original: "Therefore, the adopted 2-D Kalman filter as a recursive two-dimensional filter, fits the application of terrain surface modelling using a grid DEM as such, its use is encouraged in the determination of improved values of terrain topographic variables for accurate terrain interpretation." o Improved: "Therefore, the adopted recursive 2-D Kalman filter is well-suited for terrain surface modeling using grid DEMs. Its use is encouraged for determining improved values of terrain topographic variables, leading to more accurate terrain	

	interpretation." **Summary:** The article's language is generally suitable for scholarly communication, but refining certain sentences for clarity and conciseness will enhance readability and precision. Paying attention to sentence structure, simplifying complex sentences, and ensuring consistent use of technical terms will further improve the quality of the manuscript.	
Optional/General comments		

PART 2:

	Reviewer's comment	**Author's comment** *(if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)*
Are there ethical issues in this manuscript?	*(If yes, Kindly please write down the ethical issues here in details)*	

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