



**FLOOD RISK MODELLING BASED ON MACHINE LEARNING
USING GOOGLE EARTH ENGINE IN HULU SUNGAI UTARA
REGENCY**

SKRIPSI

**Untuk Memenuhi Persyaratan
dalam Menyelesaikan Strata-1 Fisika**

Oleh:

KRISNA ADITYA

NIM. 2111014310004

**PROGRAM STUDI S-1 FISIKA
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
UNIVERSITAS LAMBUNG MANGKURAT
BANJARBARU**

MEI 2025



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Dengan ini saya menyatakan bahwa dalam jurnal ini tidak terdapat karya yang pernah diajukan untuk memperoleh gelar kesarjanaan di suatu Perguruan Tinggi, dan sepanjang pengetahuan saya juga tidak terdapat karya atau pendapat yang pernah ditulis atau diterbitkan oleh orang lain, kecuali yang secara tertulis diacu dalam naskah ini dan disebutkan dalam Daftar Pustaka.

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NIM. 2111014310004

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SKRIPSI

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GOOGLE EARTH ENGINE IN HULU SUNGAI UTARA REGENCY**

Oleh:

Krisna Aditya

NIM. 2111014310004

Telah dipertahankan di depan Koordinator Program Studi, Pada tanggal:

Pembimbing



Dr. Ichsan Ridwan, S.Si., M.Kom.

NIP. 19740707 200212 1 003

Banjarbaru, 5 Mei 2025

Ketua Program Studi Fisika



Dr. Nufina, S.Si., M.Sc.

NIP. 19760414 200312 2 001



KEMENTERIAN PENDIDIKAN TINGGI, SAINS, DAN TEKNOLOGI
UNIVERSITAS LAMBUNG MANGKURAT
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PROGRAM STUDI FISIKA

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TANDA TERIMA PENYERAHAN JURNAL

Saya yang bertanda tangan di bawah ini :

Nama : Krisna Aditya
NIM : 2111014310004
Program Studi : S-1 Fisika
Fakultas : Matematika dan Ilmu Pengetahuan Alam


Dengan ini telah menyerahkan **jurnal ilmiah** dengan data sebagai berikut :

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Tanggal Penyerahan :


Demikian surat tanda terima ini dibuat untuk digunakan sebagaimana mestinya.

Banjarbaru, 02 Mei 2025.

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Maya Saffri, S.Si, M.Si
NIP.199704292029062003

Yang Menyerahkan Jurnal,


Krisna Aditya
NIM. 2111014310004



KEMENTERIAN PENDIDIKAN TINGGI, SAINS DAN TEKNOLOGI
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**BERITA ACARA PENGESAHAN REKOGNISI SKRIPSI
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PROGRAM STUDI FISIKA FMIPA-ULM**

Pada hari ini empat, tanggal 02 Mei 2025, telah dilaksanakan pengesahan rekognisi skripsi bagi mahasiswa berikut:

Nama : Krisna Aditya
NIM : 2111014310004
Judul Artikel : Flood Risk Modelling Based on Machine Learning
Using Google Earth Engine in Hulu Sungai Utara Regency
Jurnal : Q3
Status Publikasi : Accepted

Mahasiswa tersebut telah memenuhi seluruh persyaratan akademik dalam skema rekognisi skripsi melalui publikasi artikel ilmiah dan dinyatakan lulus rekognisi skripsi. Dengan demikian, mahasiswa berhak memperoleh nilai skripsi sesuai ketentuan yang berlaku di Program Studi Fisika FMIPA ULM.

Berita acara ini disahkan oleh dosen pembimbing dan panelis (jika ada), sebagaimana tercantum di bawah ini :

No.	Nama Pembimbing	Tanda Tangan
1.	Dr. Ichsan Ridwan S.Si., M.Kom.	
	Nama Panelis (Jika Ada)	Tanda Tangan
1.		

Berdasarkan ketentuan yang telah ditetapkan dalam panduan akademik Program Studi Fisika FMIPA ULM, mahasiswa ini diberikan nilai sebesar 100 (A.).

Demikian berita acara ini dibuat sebagai bukti sah bahwa mahasiswa telah menyelesaikan rekognisi skripsi dan berhak mendapatkan nilai skripsi sesuai ketentuan yang berlaku.

Dosen Pembimbing,

Dr. Ichsan Ridwan, S.Si., M.Kom.
NIP. 19740707 200212 1 003

Banjarbaru, 02 Mei 2025
Mengetahui,
Ketua Program Studi,

Dr. Nurlina, S.Si., M.Sc.
NIP. 19760414 200312 2 001

LoA

Nature Environment and Pollution Technology

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1. SJR H-Index (2023) = 17
2. Scopus CiteScore (2023) = 1.2
3. Scopus SJR (2022) = 0.204
4. Index Copernicus (2022) = 128.35
5. NAAS Rating (2024) = 5.33

Final Acceptance Letter

Paper No. D-1756

To,

Krisna Aditya, Ichsana Ridwan and Nurlina
Geophysics, Lambung Mangkurat University,
Indonesia

Dear Author(s),

We are happy to inform you that your paper entitled “**Flood Risk Modelling Based on Machine Learning Using Google Earth Engine in Hulu Sungai Utara Regency**” has been accepted for publication in the scientific journal *Nature Environment and Pollution Technology*. The paper is likely to come in Vol. 24, No. 4 (December), Year 2025. If you do not get your paper for proof correction by 15 days prior to the month of publication, please write to us.

Yours sincerely,



P. K. Goel
Chief Editor

Bukti Pembayaran

Nature Environment and Pollution Technology

(AN INTERNATIONAL OPEN ACCESS JOURNAL ON DIVERSE ASPECTS OF ENVIRONMENT SINCE 1994)

ISSN 0972-6268(PRINT); ISSN 2395-3454(ONLINE)

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No. 704

Date: 27/02/2025

1. SJR H-Index (2023) = 17
2. Scopus CiteScore (2023) = 1.2
3. Scopus SJR (2022) = 0.204
4. Index Copernicus (2022) = 128.35
5. NAAS Rating (2024) = 5.33

Invoice-cum-Initial Acceptance Letter

Paper No. D-1756

Krisna Aditya, Ichsan Ridwan and Nurlina
Geophysics, Lambung Mangkurat University,
Indonesia

Dear Sir/Madam,

We are happy to inform you that your paper entitled “**Flood Risk Modelling Based on Machine Learning Using Google Earth Engine in Hulu Sungai Utara Regency**” has been accepted for publication in the journal **Nature, Environment and Pollution Technology** (p-ISSN 0972-6268; e-ISSN 2395-3454). You are kindly requested to remit the processing charges of **US\$ 425 (+ actual bank commission of your bank)** at the earliest so as to enable us for further processing of the paper. The final acceptance letter with Vol. and Issue No. shall be sent after receipt of the publication charges. The paper will also be pre-published with DOI number on our website shortly after receipt of the processing charges.

The remittance may be made by depositing/transferring the amount in our following bank account.

Thanking you,

Yours sincerely,



(T. P. Goel)
Business Manager

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Form Review



Ichsan Ridwan <ichsanridwan@ulm.ac.id>

Revision Request for Your Submission

1 message

NEPT Journal <operations@neptjournal.com>
To: Ichsan Ridwan <ichsanridwan@ulm.ac.id>

Sun, Jan 26, 2025 at 11:04 PM

Dear Ichsan Ridwan,

Your submission, *Flood Risk Modelling Based on Machine Learning Using Google Earth Engine in Hulu Sungai Utara Regency (D-1756)*, has been reviewed, and we encourage you to submit revisions addressing the reviewers' comments. An editor will review these revisions, and if they adequately address the concerns, your submission may be accepted for publication.

The reviewers' comments are included at the bottom of this email. Please respond to each point in the reviewers' comments and identify what changes you have made. If you find any of the reviewer's comments to be unjustified or inappropriate, please explain your perspective.

When you have completed your revisions, please upload revised documents along with your response to the reviewers' comments through your submission dashboard. If you have been logged out, you can log in again with the username ichsanridwan. If you have any questions, please contact me from your submission dashboard.

Kindly follow this checklist for preparing your revisions:

1. **Ensure all references are relevant** to the content of your manuscript.
2. **Highlight any revisions** in the manuscript, so editors and reviewers can easily identify changes.
3. **Provide a cover letter** detailing your responses to the reviewers' comments, with a point-by-point explanation of manuscript revisions.
4. **Critically analyze recommended references.** If you find any recommended references unnecessary, you are not obligated to include them. However, you should explain your rationale in your response.
5. **Address comments where possible;** if certain comments are unaddressable, provide a clear explanation in your appeal.

Please note that our journal does not require authors to cite every reference suggested by reviewers. If you believe some references are unnecessary, we encourage you to provide explanations in your response to the reviewers' comments.

If your manuscript requires improvement to the language you may consider to use Author Services: <https://technosciencepub.in/author-services/>

Please complete your revisions and upload the revised file within **10 days**.

Kind regards,

Apurva Goel

Executive Editor | Nature Environment and Pollution Technology

e: operations@neptjournal.com | w: www.neptjournal.com

The following comments were received from reviewers.

Reviewer 1:

Recommendation: Revisions Required

article review results:

1. while the abstract gives a reasonably coherent snapshot of the study and its findings, it would benefit from more methodological detail—particularly regarding the machine learning approach, data sources, and validation—to be considered fully complete.
2. Research question or problem: Implicitly exists, marked by a description of the problem and research objectives. Although not in the form of an explicit question, the substance is quite clear.
3. Topic relevance: Highly relevant considering the crucial flood problem and the need for mitigation. Contribution of new insights: The use of GEE, as well as the integration of geospatial and hydrological data, shows a new method for mapping and analyzing flood risk more comprehensively, thus adding insight for disaster research and practitioners.
4. Research Design: It has been presented quite well because it describes the data, variables, and analysis flow.

5. **Sample and Sampling:** In remote sensing research, the concept of "sample" is different from conventional surveys; this study uses the entire Hulu Sungai Utara area as coverage. There is no explanation of the ground truth sampling technique, but this is commonly found if the research is purely spatial mapping without field surveys. Therefore, the sample size is considered to cover the entire area (full coverage), which in the context of geospatial modeling can be considered adequate.
6. **Instrumentation:** Instruments (satellite data, DEM, GEE platform, NDVI/NDWI index, TPI) are explained according to research needs. The explanation of scoring and weighting variables is also clear, although details about validation, satellite data periods, and technical correction procedures could be added. Overall, the Materials and Methods section has described the design and process of flood modeling quite comprehensively for geospatial studies.
7. **Results Analysis:** 1. Add discussion of potential errors or limitations in processing the data using Google Earth Engine. Include comparisons to other studies, if available, to provide greater context. 2. Expand discussion of specific impacts of the results on local policy.
8. **Tables and Figures:** 1. Ensure that each table and figure is accompanied by sufficient description in the main text to guide readers through the results. 2. On maps, add scale and north orientation to increase informativeness.
9. **Results Analysis:** 1. Add discussion of potential errors or limitations in processing the data using Google Earth Engine. Include comparisons to other studies, if available, to provide greater context. 2. Expand discussion of specific impacts of the results on local policy.
10. The references used have a fairly diverse range of publication years, ranging from 2019 to 2024, indicating that most of the references are quite up-to-date and relevant to the topic discussed.
11. The article uses scientific language that is in accordance with academic standards. Sentences are fairly well structured, avoiding the use of overly complex phrases.

Reviewer 2:

Recommendation: Revisions Required

This study has potential for publication after addressing the technical and editorial issues outlined below

1. **Model Selection Justification:** The manuscript employs specific variables (e.g., NDVI, NDWI, TPI) for flood modeling, but lacks a clear rationale for choosing these indices over others. Explain why these variables were prioritized and whether alternative indices or machine learning models were considered.

2. **Data Imputation:** The manuscript does not clarify whether missing data (if any) were encountered and how they were handled. Describe any preprocessing steps, such as outlier removal or interpolation for incomplete data.

3. Validation of Results:

- The authors present the flood risk classification but do not include statistical measures to validate model accuracy (e.g., ROC-AUC, precision, recall). Including these metrics would strengthen the study.
- The use of GEE scripts for analysis is commendable, but the lack of details about model reproducibility and parameter tuning (e.g., thresholds for susceptibility scoring) is a limitation.


4. Discussion and Context:

- The discussion focuses on the outcomes of the analysis but does not sufficiently compare the results with previous studies. Include references to similar studies conducted in other regions or with different methods to contextualize your findings.
- While the study highlights the role of GEE in flood modeling, it lacks critical discussion on the limitations of GEE or potential sources of bias in satellite data (e.g., temporal resolution or cloud cover interference).

5. **Abstract:** The abstract provides a broad overview but omits key details about the methodology (e.g., machine learning approach, validation steps) and specific findings. Highlight the novelty of the research and the advantages of using GEE.

6. **Conclusion:** The conclusion does not provide actionable recommendations or emphasize future research directions. Suggest next steps for improving flood risk models or integrating community engagement into flood mitigation strategies.

7. **References:** Ensure uniform formatting of references as per the journal's guidelines.

 **D-1756.docx**
1936K

Reviewer 1	Comment	responses
1	while the abstract gives a reasonably coherent snapshot of the study and its findings, it would benefit from more methodological detail—particularly regarding the machine learning approach, data sources, and validation—to be considered fully complete.	has been completed as per the reviewer's suggestion
2	Research question or problem: Implicitly exists, marked by a description of the problem and research objectives. Although not in the form of an explicit question, the substance is quite clear..	is appropriate
3	Topic relevance: Highly relevant considering the crucial flood problem and the need for mitigation. Contribution of new insights: The use of GEE, as well as the integration of geospatial and hydrological data, shows a new method for mapping and analyzing flood risk more comprehensively, thus adding insight for disaster research and practitioners.	is appropriate
4	Research Design: It has been presented quite well because it describes the data, variables, and analysis flow.	is appropriate
5	Sample and Sampling: In remote sensing research, the concept of "sample" is different from conventional surveys; this study uses the entire Hulu Sungai Utara area as coverage. There is no explanation of the ground truth sampling technique, but this is commonly found if the research is purely spatial mapping without field surveys. Therefore, the sample size is considered to cover the entire area (full coverage), which in the context of geospatial modeling can be considered adequate.	has been customised
6	Instrumentation: Instruments (satellite data, DEM, GEE platform, NDVI/NDWI index, TPI) are explained according to research needs. The explanation of scoring and weighting variables is also clear, although details about validation, satellite data periods, and	has been revised according to the reviewer's suggestions

	technical correction procedures could be added. Overall, the Materials and Methods section has described the design and process of flood modeling quite comprehensively for geospatial studies.	
7	Results Analysis: 1. Add discussion of potential errors or limitations in processing the data using Google Earth Engine. Include comparisons to other studies, if available, to provide greater context. 2. Expand discussion of specific impacts of the results on local policy.	<p>Limitations: We have discuss potential errors in GEE processing, such as resolution constraints and cloud interference, and compare our results with similar studies for context.</p> <p>Policy Impact: We have expanded on how our findings support local land-use planning, early warning systems, and flood mitigation strategies to enhance community resilience.</p>
8	Tables and Figures: 1. Ensure that each table and figure is accompanied by sufficient description in the main text to guide readers through the results. 2. On maps, add scale and north orientation to increase informativeness	<p>Descriptions for Tables and Figures: We ensure that each table and figure is clearly referenced and explained in the main text to guide readers through the results more effectively.</p> <p>Map Enhancements: We have been added a scale and north orientation to the maps to improve their clarity and usability. These additions will enhance the interpretability of spatial data.</p>
9	Results Analysis: 1. Add discussion of potential errors or limitations in processing the data using Google Earth Engine. Include comparisons to other studies, if available, to provide greater context. 2. Expand discussion of specific impacts of the results on local policy.	<p>Limitations: We have discuss potential errors in GEE processing, such as resolution constraints and cloud interference, and compare our results with similar studies for context.</p> <p>Policy Impact: We have expanded on how our findings support local land-use planning, early warning systems, and flood mitigation strategies to enhance community resilience.</p>
10	The references used have a fairly diverse range of publication years, ranging from 2019 to 2024, indicating that most of the references are quite up-to-date and relevant to the topic discussed.	is appropriate

11	The article uses scientific language that is in accordance with academic standards. Sentences are fairly well structured, avoiding the use of overly complex phrases	is appropriate
Reviewer 2	Comment	responses
1	Model Selection Justification: The manuscript employs specific variables (e.g., NDVI, NDWI, TPI) for flood modeling, but lacks a clear rationale for choosing these indices over others. Explain why these variables were prioritized and whether alternative indices or machine learning models were considered..	<p>NDVI, NDWI, and TPI were selected due to their proven relevance in flood modeling. NDVI indicates vegetation cover, influencing water retention and runoff. NDWI enhances water body detection, crucial for identifying flood-prone areas. TPI assesses terrain position, helping identify low-lying flood-susceptible zones.</p> <p>These indices were prioritized for their effectiveness, computational efficiency in Google Earth Engine, and data availability. Alternative indices and machine learning models were considered, and future studies may explore additional variables for improved accuracy. We have clarified this in the revised manuscript.</p>
2	Data Imputation: The manuscript does not clarify whether missing data (if any) were encountered and how they were handled. Describe any preprocessing steps, such as outlier removal or interpolation for incomplete data.	<p>In this study, missing data were minimal due to the use of well-established satellite datasets from sources such as Landsat 8, NASA SRTM, and JRC Global Surface Water Mapping, which undergo rigorous preprocessing. However, to ensure data integrity, we applied preprocessing steps, including filtering cloud-covered pixels in Landsat imagery and using median composites to reduce noise. Additionally, elevation and hydrological data were cross-validated with multiple sources to minimize inconsistencies.</p> <p>We have clarified these preprocessing steps in the revised manuscript for better transparency.</p>
3	Validation of Results: The authors present the flood risk classification but do not include statistical measures to validate model accuracy (e.g., ROC-AUC, precision, recall). Including these metrics would strengthen the	We acknowledge the importance of including statistical validation metrics to assess model accuracy. While our study primarily focuses on geospatial flood risk classification, we recognize that

	<p>study. The use of GEE scripts for analysis is commendable, but the lack of details about model reproducibility and parameter tuning (e.g., thresholds for susceptibility scoring) is a limitation.</p>	<p>incorporating measures such as ROC-AUC, precision, and recall would strengthen the evaluation. In future work, we plan to integrate these validation techniques to enhance model reliability.</p> <p>Regarding reproducibility, we utilized Google Earth Engine (GEE) scripts with predefined parameter thresholds based on established studies. The susceptibility scoring thresholds were determined through a combination of literature review and empirical analysis of the study area. We have clarified these details in the revised manuscript to improve transparency and reproducibility.</p>
4	<p>Discussion and Context: The discussion focuses on the outcomes of the analysis but does not sufficiently compare the results with previous studies. Include references to similar studies conducted in other regions or with different methods to contextualize your findings. While the study highlights the role of GEE in flood modeling, it lacks critical discussion on the limitations of GEE or potential sources of bias in satellite data (e.g., temporal resolution or cloud cover interference).</p>	<p>We acknowledge the need for a stronger comparison with previous studies. In the revised manuscript, we will incorporate references to similar research conducted in different regions and using alternative methodologies to better contextualize our findings. This will help highlight the strengths and limitations of our approach relative to existing work.</p> <p>Additionally, we recognize that while Google Earth Engine (GEE) provides efficient data processing, it has limitations, such as dependency on satellite data quality, temporal resolution constraints, and potential biases due to cloud cover interference. We have been expand our discussion to address these limitations and their possible impact on flood risk assessment results.</p>
5	<p>Abstract: The abstract provides a broad overview but omits key details about the methodology (e.g., machine learning approach, validation steps) and specific findings. Highlight the novelty of the research and the advantages of using GEE</p>	<p>We acknowledge the need to provide more methodological details in the abstract. In the revised version, we have included a brief mention of the machine learning approach used, validation steps taken, and key statistical findings to enhance clarity.</p>

		<p>Additionally, we have highlighted the novelty of our research, particularly the integration of Google Earth Engine (GEE) for large-scale flood risk assessment. We will emphasize the advantages of GEE, such as real-time data processing, access to extensive satellite datasets, and computational efficiency, which make it a valuable tool for flood modeling.</p>
6	<p>Conclusion: The conclusion does not provide actionable recommendations or emphasize future research directions. Suggest next steps for improving flood risk models or integrating community engagement into flood mitigation strategies.</p>	<p>We acknowledge the need to strengthen the conclusion by providing actionable recommendations and outlining future research directions. In the revised manuscript, we have suggested improvements for flood risk models, such as incorporating additional hydrological variables, higher-resolution satellite data, and advanced machine learning techniques for better accuracy. Additionally, we will emphasize the importance of integrating community engagement in flood mitigation strategies, including participatory mapping, real-time flood monitoring systems, and collaboration with local stakeholders. These enhancements will help improve flood preparedness and resilience in vulnerable regions.</p>
7	<p>References: Ensure uniform formatting of references as per the journal's guidelines</p>	<p>The format is uniformed</p>