

REVIEWER'S REPORT

Manuscript No.: IJAR- 58593

Title: **Analyse fréquentielle des précipitations extrêmes dans la commune de Bonou (vallée de l'Ouémé, Bénin).**

Recommendation:

Accept as it is

Accept after minor revision.....

Accept after major revision

Do not accept (*Reasons below*)

Rating	Excel.	Good	Fair	Poor
Originality		✓		
Techn. Quality		✓		
Clarity			✓	
Significance			✓	

Reviewer Name: **ANAPANA GOPAL**

Reviewer's Comment for Publication.

General Comments

This manuscript investigates the frequency analysis of extreme daily rainfall in Bonou Commune, Benin, using Annual Maximum (AM) rainfall series from 1995–2025. Three probability distributions (GEV, Gumbel, and Log-Normal) are compared, and return period rainfall thresholds are proposed for operational flood warning and anticipatory cash-transfer mechanisms.

The topic is timely and relevant to hydrology, climate risk management, disaster preparedness, and flood early warning systems. The manuscript is generally well organized, includes useful figures and graphical presentations, and attempts to translate statistical findings into practical applications.

However, several methodological and scientific issues need clarification before publication. In particular, the statistical methodology, validation procedures, uncertainty analysis, literature comparison, and discussion require considerable strengthening.

Minor Comments

1. Novelty should be better justified

The manuscript claims that this is the first commune-scale rainfall threshold analysis for Bonou. However, the Introduction does not sufficiently distinguish this work from previous frequency analyses conducted in Benin and West Africa.

The authors should clearly explain:

- What gap exists in previous studies?
- Why is commune-level calibration scientifically important?
- How does this work differ from previous studies on the Ouémé basin?

The novelty statement should be strengthened.

2. Sample size limitations require deeper discussion

The analysis uses only **31 annual observations** (1995–2025).

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Although Annual Maximum Series (AMS) analysis is common, a sample size of 31 years is relatively small for estimating T20 return periods.

The manuscript should discuss:

- confidence intervals,
- estimation uncertainty,
- reliability of higher return periods,
- limitations associated with short climatic records.

3. Model selection needs stronger statistical justification

The authors select the best distribution solely based on the Kolmogorov–Smirnov (KS) test.

However, hydrological frequency studies generally employ multiple goodness-of-fit criteria such as:

- Anderson-Darling test
- Akaike Information Criterion (AIC)
- Bayesian Information Criterion (BIC)
- Root Mean Square Error (RMSE)
- Probability plots
- Quantile-Quantile (Q-Q) plots

Reliance on only one statistical test weakens model selection.

4. Parameter uncertainty is not evaluated

Maximum Likelihood Estimation (MLE) is used to estimate GEV parameters, but no uncertainty estimates are provided.

The manuscript should report:

- standard errors,
- confidence intervals,
- bootstrap uncertainty,
- sensitivity analysis.

Without uncertainty estimates, operational thresholds may appear overly precise.

5. Validation of operational thresholds is insufficient

The manuscript proposes operational thresholds (T2, T5, T10) for flood alerts and cash-transfer activation.

However, these thresholds are **not validated** against actual historical flood events.

The authors should compare:

- major flood years,
- recorded inundation events,
- disaster reports,
- emergency response records.

Such validation would substantially strengthen practical applicability.

6. Composite risk score is subjective

The proposed score

$$\text{Score} = P(\geq 30 \text{ mm}) \times 0.6 + P(\geq 50 \text{ mm}) \times 0.4$$

appears arbitrary.

The manuscript should explain:

- why 0.6 and 0.4 were selected,

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- whether sensitivity analysis was performed,
- whether expert consultation informed the weighting.

Otherwise, the composite index lacks scientific justification.

7. Discussion needs stronger international comparison

The Discussion cites only a limited number of regional studies.

It would benefit from comparison with frequency analyses from:

- West Africa
- Tropical Africa
- Southeast Asia
- South America

This would place the findings within a broader hydrological context.

8. Practical implications require expansion

The manuscript briefly discusses:

- flood warning
- anticipatory cash transfer

Additional discussion should include:

- urban planning
- agricultural management
- reservoir operation
- climate adaptation
- disaster preparedness
- SDG implementation

Specific Comments

Title

The title accurately reflects the study.

Abstract

The abstract is generally well written.

However, it should include:

- confidence intervals,
- principal statistical findings,
- practical significance.

Introduction

The Introduction provides sufficient background.

However:

- several paragraphs are excessively descriptive;
- the research gap should be stated more explicitly;
- objectives should be presented as numbered hypotheses or research questions.

Study Area

The study area is clearly described.

Figure 1 effectively illustrates the geographical location.

Data and Methods

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The methodology is generally appropriate.

Nevertheless, additional details should be provided regarding:

- data quality control,
- missing observations,
- software versions,
- parameter estimation,
- convergence diagnostics.

Statistical Analysis

The use of:

- GEV
- Gumbel
- Log-Normal

is appropriate.

However,

the manuscript should explain why other commonly used distributions (e.g., Generalized Pareto, Pearson Type III, Gamma) were excluded.

Figures

The manuscript contains high-quality figures.

Figures 2–8 are informative and improve readability.

Nevertheless,

font size should be increased in several figures to improve readability.

Tables

Tables are clear.

However,

adding confidence intervals would improve interpretation.

Results

The Results are logically organized.

Avoid repeating numerical values already presented in tables.

Instead, focus on interpretation.

Discussion

The Discussion is scientifically sound but should be expanded.

Greater emphasis should be placed on:

- climate variability,
- hydrological processes,
- flood generation mechanisms,
- comparison with previous frequency analyses.

Conclusion

The Conclusion summarizes the study appropriately.

However,

it should also include:

- study limitations,
- recommendations for future work,

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- applicability to climate adaptation planning.

Language and Presentation

Overall English and French writing quality is good.

Minor revisions are recommended for:

- punctuation consistency,
- spacing,
- capitalization,
- figure captions,
- reference formatting.

Professional language editing would further improve readability.

Strengths

- Relevant and timely research topic.
- Clear study objectives.
- Appropriate application of extreme value statistics.
- Comprehensive graphical presentation.
- Practical implications for flood early warning.
- Well-structured manuscript.
- Good integration of statistical analysis and disaster risk management.

Weaknesses

- Limited validation of proposed thresholds.
- Short data record for estimating long return periods.
- Lack of uncertainty analysis.
- Model selection based on only one goodness-of-fit test.
- Composite risk score requires stronger justification.
- Discussion could be broadened with more international comparisons.

Final Recommendation

This manuscript presents a valuable contribution to localized flood risk assessment in Benin by developing rainfall-frequency thresholds with potential applications in early warning systems and anticipatory disaster response. The study is relevant and methodologically sound in its overall approach, but important issues remain regarding statistical validation, uncertainty quantification, model selection, and discussion of practical implications. Addressing these concerns through a **Minor revision** would substantially improve the scientific robustness and impact of the manuscript.

Recommendation: Minor Revision.