Response to Reviewer 3 Comments

The manuscript addresses the topic related to drought trend analysis and forecasting, and it appears that the authors have invested considerable effort in applying a combination of statistical and machine learning techniques. However, the manuscript suffers from several critical issues that need to be addressed before it can be considered for publication. The methodology section lacks clarity, the figures are not adequately formatted for readability, and the introduction is poorly structured. I recommend major revisions to improve the overall clarity. Here are some potentially helpful suggestions:

Introduction:

The first paragraph could benefit from improved focus and clearer logic. While it introduces the general impacts of drought, the core message is somewhat diluted. The second paragraph seems only loosely connected to the main theme of the study. I suggest the authors focus more specifically on summarizing the strengths and limitations of various drought prediction methods, rather than listing a large number of references without clear synthesis. Additionally, the third and fourth paragraphs appear closely related and might be more effective if combined.

We would like to thank the reviewer for this comment. Done, we have revised the introduction and addressed the reviewers' comments.

Method:

The authors spend a significant amount of time explaining the algorithms or working principles of SG, CEEMDAN, ARIMA, and LSTM models, which are well-known techniques. What I would like to see is how these models are integrated together—whether they form a framework or are coupled in some way. I would also like to know how the parameters for these models were set.

Reply: *We would like to thank the reviewer for this comment. This was included and explained under the methodology section.*

Results

1. The figure. 6 is not properly aligned and appear to be more suited for a report format. And I consider this figure is not the results of this paper.

Reply: *We acknowledge the reviewer's concern that Figure 6 seems better suited for a report format and does not directly present results. However, this figure is essential for the study as it provides a preliminary visualization of daily and monthly rainfall across all meteorological stations. Inspecting the raw and aggregated rainfall data is critical before computing the SPI and conducting trend analysis to understand temporal patterns, seasonal cycles, and extreme*

variability. The figure ensures transparency by showing the underlying dataset used for subsequent analysis and highlights the need for data quality checks before applying SPI calculation and forecasting models.

2. Lines 490 – Lines 520: It appears that in-situ data from 1980–2014 was used for training, and 2015–2023 for testing. This setup raises concerns about potential overfitting. To further demonstrate the model's generalizability, I suggest the authors consider adding a transfer prediction experiment.

Reply: *We would like to thank the reviewer for this comment. We did consider overfitting when using Bayesian optimization in the models by using cross-validation instead of a single train–test split during optimization and include an early stopping rule for iterative models. This model was fitted on 6 different stations on the data with the same length assuming that was enough for the model's generalizability.*

3. Given that parameter selection can significantly affect model performance, a more detailed explanation of the tuning procedures for each model would strengthen the methodological transparency.

Reply: *We would like to thank the reviewer for this comment. This was included and explained under the results section.*