Response to Comments of Anonymous Referee #2

The authors thank the anonymous referee #2 for the valuable comments and suggestions. Responses to the issues raised by the Reviewer #2 are provided below in red color:

This study conducted fractal scaling analysis of groundwater level fluctuations in confined aquifer wells by means of Detrended fluctuation analysis (DFA), Multifractal detrended fluctuation analysis (MF-DFA), and Multiscale Multifractal Analysis (MMA), and by investigating the relationship between the stability index and the Hurst exponent. In my opinion, this study provides important knowledge on groundwater level fluctuations with sufficient novelty, and this paper was mostly written well. However, some parts, especially Introduction, need to be improved before publication.

The authors thank the Reviewer #2 for the positive comments.

1. P.2 L.8-18: The relationship between this paragraph and this study is not clear. Please add some more explanations or descriptions.

More explanations will be added as suggested.

2. P.2 L.25: (MF-DFA(Kantelhardt et al., 2002) -> (MF-DFA, Kantelhardt et al., 2002)

The correction will be made.

3. P.3 L.20-21: Please add a reference for the sentence: “stability index and the Hurst exponent are related under certain conditions.”

A reference (Taqqu et al., 1997) will be added as suggested.

4. P3. L.13-21: I strongly recommend the authors to explicitly explain the differences between existing related studies and this study in order to emphasize the novelty of this study. In addition, please briefly describe the purpose of each analysis here, and explain why the authors used long-term groundwater level data in this study.

This paragraph will be modified to emphasize the differences between this study and existing related studies. A brief description of the purpose of each analysis (DFA, MF-DFA and MMA) will be added. The reason for the selection of long-term groundwater level data will be further explained.

5. Equation (1): Please define t.

t denotes time. The definition will be added in the revised manuscript.

6. P.4 L.1-3: I recommend the authors to explain in this section why it is important to detect evolving nonstationarities in this study.

As the reviewer recommended, explanation of the importance of detecting evolving nonstationarities will be added to the revised manuscript.

7. 3 Data Analysis: How were the two wells selected? Why were only two wells used in this study?

The reasons why the authors only focus on the two specific wells are: firstly, the groundwater level monitoring records of these two wells are long (70 and 80 years for Well1 and Well2 respectively). Long-term records can provide adequate data for fitting the probability density function. In addition, a larger sample of data can make the estimated Hurst exponent more stable (Weron, 2002). Secondly, we do agree with the reviewer that other long periods of groundwater datasets exist. For example, the dataset of groundwater monitoring in Texas, which was mentioned in the manuscript, includes more than 250 wells. Other long records can also be found in this dataset. However, comparing to the two wells selected in the study, these long records have large percentage of missing data, which make them difficult to be used. Thirdly, the authors found these two wells (Well1 and Well2) are very representative, i.e., one of them falls in the Brownian motion domain and the scaling pattern fluctuates in the investigated time intervals, while the other one illustrates the heavy-tailed characteristics and shows persistent scaling pattern. Focusing on the analysis of Well1 and Well2 can provide a more detailed picture of the groundwater level fluctuations. Therefore, Well1 and Well2 are chosen in specific to be analyzed in the manuscript. The manuscript will be revised to add the reasons illustrated above.

8. Figures 10 and 11: What are the red dot lines in the normal probability plots?

The red lines in Figures 10 and 11 denote the theoretical normal probability. The data probability curve would lie on the straight line if the data are Gaussian distributed. The authors will add such information in the revised manuscript.

9. Conclusions: Please add the summary of the investigation on the relationship between the stability index and the Hurst exponent.

The summary of the investigation on the relationship between the stability index and the Hurst exponent will be added in the revised manuscript.

Reference

Taqqu, M. S., Willinger, W., and Sherman, R.: Proof of a fundamental result in self-similar traffic modeling, ACM SIGCOMM Computer Communication Review, 27, 5-23, 1997.

Weron, R.: Estimating long-range dependence: finite sample properties and confidence intervals, Physica A: Statistical Mechanics and its Applications, 312, 285-299, 2002.