

List of changes in the revised paper:

This document explains the changes made in the revised manuscript while dealing with the comments raised by the reviewers. Editor's and reviewer's comments are marked in **black** colour while author's response is shown in **Red** text.

Editor's comment:

Comment 1: please shorten the title, it is really too long. There is no need to mention all methods.

Answer:

Thanks for your valuable comment. It was shortened as follows:

Spatial Prediction of Groundwater Spring Potential Mapping Based on Adaptive Neuro-Fuzzy Inference System and Metaheuristic Optimization

Comment 2: In your replies, please provide answers to all comments (most will be the same as you have already given in Interactive Discussion), explain what do you change in the manuscript, and clearly indicate (e.g. in color) what have you changed in the new version of the manuscript.

Answer:

All changes were highlighted in green.

Comment 3: give serious attention to improving English.

Answer:

An English language was corrected seriously, which for the last time was corrected using Prof. Bjørn Kristofersen at University of South-Eastern Norway.

Comment 4: Please consider shortening the paper. It is really very long. Consider removing text-book material (provide references instead)

Answer:

Thanks for your suggestion and valuable comment. The paper shortened as far as we could, from 14,800 words to 10,900 words, and proper citation has been added for more details.

Comment 5: Clearly describe what you have done, and your results - make your message shorter. It is often useful to make Appendices and to put additional material there.

Answer:

Thanks for your valuable comment. The results section has been corrected as follows:

Groundwater is the most important natural resource in the world and about 25 percent of all fresh water is estimated as groundwater. Thus, the groundwater potential mapping has been considered as one of the most effective methods for the management of groundwater resources for better exploitation. The main result of the present study can be summarized as:

- 1- The results showed that although all models had very good reasonable results, but, the ANFIS-DE had the highest prediction power (0.875) followed by ANFIS-IWO and ANFIS-FA (0.873), ANFIS-PSO (0.865) and ANFIS-BA (0.839).
- 2- According to the results of the SWARA method, most springs existed in an altitude of 1703-2068 m, flat curvature, east aspect, TWI of 6.6-7.9, TRI of 0-8.7, SPI of 583969-1330153, Inceptisols soil, slope of 0-5.5 degree, 0-200 m distance from river, 500-1000 m distance from fault, rainfall between 500-600 mm, in a garden, in a Pliocene-Quaternary lithological age and OMq lithology unit at the case study.
- 3- Based on the information gain ratio, the most important factors on the groundwater occurrence are land-use/land-cover, lithology, rainfall and TWI, but the least important factors are plan curvature, distance to fault and SPI.
- 4- Based on the ANFIS-DE model, totally 39.33% of the case study have a high and very high groundwater potential placed at north of the case study.

Dear Editor: Thank you so much for your positive and valuable comments.

Reviewer 1:

Comment 1: I think title of the mentioned research is very long; please authors try to decrease it.

Answer:

Thanks for you valuable comment. Authors agree with you, the title have been shorted as follows:

Spatial Prediction of Groundwater Spring Potential Mapping Based on Adaptive Neuro-Fuzzy Inference System and Metaheuristic Optimization

Comment 2: In abstract, your means from curvature is which one? Plan or profile?

Answer:

Our mean is plan curvature which was corrected from throughout the paper.

Comment 3: In abstract, what is your means from soil order?

Answer:

To identify, understand, and manage soils, soil scientists have developed a soil classification or taxonomy system. The most general level of classification in the United States system is the soil order, of which there are 12 (such as Alfisols, Aridisols, and etc.). Each order is based on one or two dominant physical, chemical, or biological properties that differentiate it clearly from the other orders.

Comment 4: Results of models are very similar together. Please edit results of lines 33-35.

Answer:

Thanks for this valuable comment. The sentences have been corrected as:

The result showed that all models have high performance; however, the ANFIS-DE model has the highest prediction capability (AUC = 0.875), followed by the ANFIS-IWO model, the ANFIS-FA model (0.873), the ANFIS-PSO model (0.865), and the ANFIS-BA model (0.839).

Comment 5: Please add a reference in lines 118-119 for rainfall descriptions.

Answer:

The proper references have been added as ‘Iran Meteorological Organization’

Comment 6: Quality of Fig. 2 isn't proper. Please draw it again.

Answer:

This Figure was draw and corrected again and added to the paper.

Comment 7: Please add source of groundwater spring inventory map

Answer:

The proper source have been added: a total of 2463 springs were selected from documentary source (Iranian Water Resources Management) and considered for modeling.

Comment 8: Please explain about classification of different layers or at least add some citations for the mentioned classifications.

Answer:

Some references have been added to then sentences as:

The process of converting continuous variables into categorical classes were carried out based on our frequency analysis of springs location (Khosravi et al, 2018) in order to define the class intervals

Comment 9: Fig. 3 (j) and 3 (m) what are codes?

Answer:

Thanks for your punctuality, it was corrected and considered at the paper. The new figures for them were draw.

Comment 10: According to Table 2, I think it isn't a land use map, it is land cover. Please change its name or present land use/land cover

Answer:

Thanks for your punctuality; it was corrected to land-use/land-cover throughout the paper.

Dear Reviewer 1: Thank you so much for your positive and valuable comments.

Reviewer 2:

Comment 1: There are many grammatical mistakes appeared in the article. I strongly request that this manuscript should be totally edited by professional English editors for improving the English writing.

Answer:

We have carefully checked and revised English in the manuscript.

Comment 2: In Figure 2, thirteen groundwater conditioning factors were served as input of hybrid models. The sensitivity analysis should be performed to investigate that which conditioning factor is most important factor to affect the output.

Answer:

Thanks for your valuable suggestion. It was performed using one of the most widely used methods namely Information Gain Ratio (IGR) as follows:

4.2. Determination of the most important parameters

The most common method of information gain ratio (IGR) was applied to identification of the most important conditioning factors. Result shows that all thirteen conditioning factors are effective on groundwater occurrences as the land-use/landcover factor has the most important impact on groundwater (IGR=0.502) followed by lithology (IGR=0.465), rainfall (IGR=0.421), TWI (IGR=0.400), soil (IGR=0.370), TRI (IGR=0.337), slope degree (IGR=0.317), altitude (IGR=0.287), distance to river (IGR=0.139), aspect (IGR=0.066), plan curvature (IGR=0.0548), distance to fault (IGR=0.0482) and SPI (IGR=0.0323).

Comment 3: How many non-spring stations in the study area? Why are the numbers of non-spring stations should same with spring stations?

Answer:

In the present study the same number of 2463 springs and non-springs location have been considered which stated in the paper. Number of non-springs location can be different from spring location (higher or less than), but it is better be the same, as the result of the models depends on it and also with testing dataset (30% of both of spring and non-springs location) the prediction ability of the model is evaluated, thus, for example, if there is a lot of non-spring location in compare to spring location, and may be this

location located on the non-spring potential area, thus accuracy of the model would be increased in inaccuracy method. But for achieve the better and more accurate result it is better that has a same number.

Comment 4: In line 171, “In the current study, 14 conditioning factors.” should be “13 conditioning factors.”

Answer:

Thanks for your punctuality, it was corrected.

Comment 5: I am wondering that Figures 4, 5, and 6 are necessary, because these figures are taken from other literature.

Answer:

Thanks for your valuable comment, the authors agree with you and removed these three Figures from the paper.

Comment 6: In equation (1), what is “I”? The term “I” should be “i=1”.

Answer:

“I” is the index of each expert. We must write SWARA method completely in method. But, we added number of expert for determining the priority for each criterion.

Comment 7: Pages 12, 13, and 14, the authors spend many spaces to describe the algorithm of ANFIS model. Actually, we can find the same description in many references. I am also wondering that the description of ANFIS model is necessary. Should it move to Appendix.

Answer:

Thanks for this valuable comment. The extra explanation has been removed and proper reference added for more details for ANFIS model.

Comment 8: In “Discussion” Section, lines 708-719, why are these sentences put here? These sentences seem to repeat again.

Answer:

Thanks for your punctuality and valuable comment; it was removed from the paper as they are repeated.

Comment 9: Can the authors describe that how much time you spend to run for each hybrid ANFIS model in MATLAB environment?

Answer:

Yes, we have proved a figure that show the processing time for each model in the revised manuscript (Fig.1).

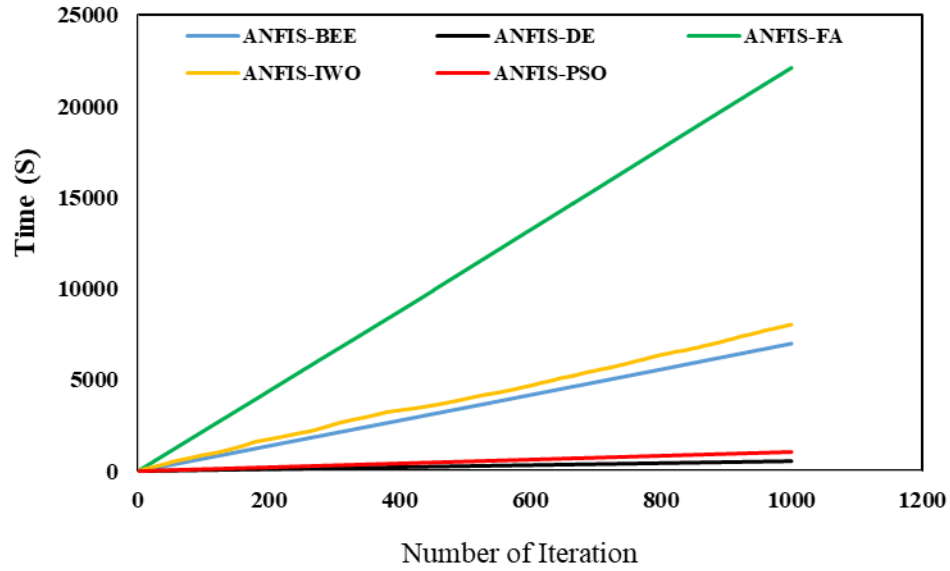


Fig. 1. Processing time used for training the models

Comment 10. The important factors to be adjusted for each hybrid ANFIS model should be listed with a Table.

Answer:

Processing in Matlab shown in Figure 2. FIS is structure and many variants. Consequently, show all optimize parameters for each hybrid models are very difficult and get many space in paper if presented in table format. So, our suggestion is replacement of table of optimize parameters using figure 1 for describe processing. This Figure was added to the paper as well.

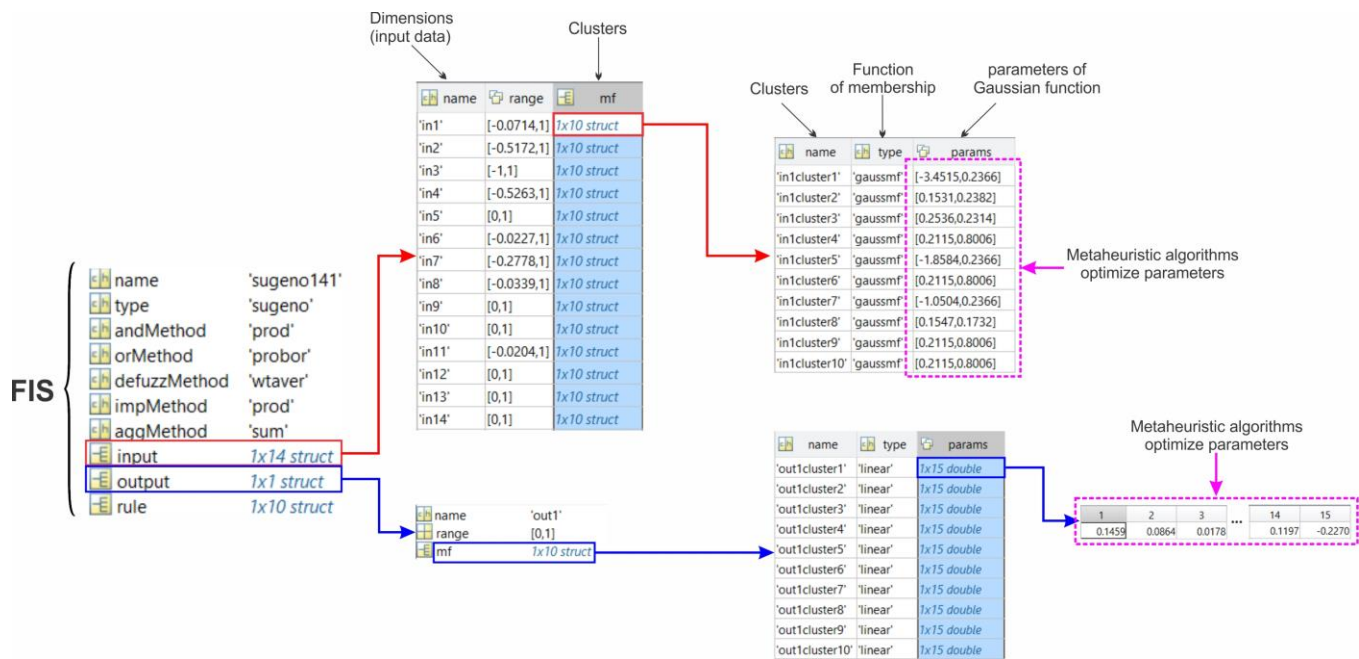


Fig.2. processing of ANFIS hybrid model

Dear Reviewer 2: Thank you so much for your positive and valuable comments.

Dear Editor and reviewers:

Thank you so much for your viewpoints and comments in regarding our manuscript. I hope the emendations caused to consent the respected reviewers and editor-in-chief and made my paper well qualified for publication.