

## ***Interactive comment on “A coupled Bayesian and fault tree methodology to assess future groundwater conditions in light of climate change” by J. J. Huang et al.***

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Received and published: 26 October 2014

We wish to express our sincere thanks to you for the constructive comments, suggestions and valuable time spent on reviewing our manuscript. Accordingly, many modifications were made to clarify many items in the paper. Further explanations corresponding to your comments are listed as follows.

### General Comment

In my opinion the paper does not contribute with new scientific knowledge. The authors present an application to a case study where the results are scarce. The main result is

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the estimated groundwater table drop, and it is not clear how this number was calculated. The estimated groundwater table drop rate considering climate change is very similar to the “actual” rate, which according to the authors is due to the intensive exploitation. From the discussion is not clear what the real impacts of the climate change are. No conclusions are given regarding the methodology neither the application. I recommend mayor revisions, which should be focused on clarifying the research question, improving the results and discussion, and giving insightful conclusions.

A: 1. With the regards of contribution with new scientific knowledge, we have addressed it by adding a new paragraph in the introduction section. Please see the last paragraph of Introduction. 2. Re how the number was calculated; a detailed explanation can be seen in Section 3. 3. One paragraph was added into the conclusion section to explain the novelty of the methodology and the effective and efficiency of the methodology in this application

### Comment 1

In the abstract it is mentioned: “To assist planning to protect against desertification, a fault tree methodology, in conjunction with fuzzy logic and Bayesian data mining, are applied to Minqin Oasis, a highly vulnerable regime in northern China.” And neither in the results nor in the conclusions it is mentioned how the used methodology assists on planning to protect against desertification.

A: In the last paragraph of section 5.2, it is recommended that “It is necessary to plan water consumption of Minqin scientifically and effectively, through management measures.”

Comment 2 In the introduction it is mentioned: “Investigation of climate change impacts on lowered water tables will provide a clearer picture of the potential for ecosystem failure and provide insights into selection of optimal measures for improving the environment.” And nothing is mentioned in the conclusions about it. How much will affect to the ecosystem a drop on the groundwater level of 0.6 m/yr-1? There is nothing said

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about optimal measures for improving the ecosystem. Ĩij A: In this study, we specify the amount of water consumption for each water sector. Please see Table 5. For ecological water consumption, its impact on total water consumption is 0.13 and the impact of total water consumption on groundwater drop is 0.36. The answer is given other way around instead in this study because the focus of this study is to quantify all the causative effects on groundwater drop rather than the effects of groundwater drop on ecosystem. The studies on ecosystems had been done by other researchers as listed in the literature review section.

#### Comment 3

In the introduction is missing a review of the state of art of the use of the fault tree method in subsurface hydrology. It is also missing a clear research question that the paper tries to answer. I think a better explanation of the method is needed.

A: 1. Following your suggestion, two additional references have been added in Section 2.1. Please see the first paragraph of Section 2.1 2. Following your suggestion, a paragraph has been added at the end of Introduction section to further explain the motivation of the research

#### Comment 4

In section 2.3 it is mentioned that the natural vegetation needs 500 mm for a healthy growth, but the paper focus on the depth to the groundwater table. How deep can the groundwater level be in order to still have healthy vegetation?

A: As explained in addressing the question of Comment 2, this is not the focus of this study. We believe that this has been done by many other researchers and the answer may be able to find in other literature.

#### Comment 5

Then the other points. What is the spatial resolution of the climate scenarios used? How many cells did you considered in your case study? What is the spatial variation of

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the variables considered?

A: The resolution of the CGCM3.1 used in this study is 3.75x3.75 degrees. The Minqin Oasis is a relatively very small area in the context of climate change. The spatial variation is therefore not considered in this study.

#### Comment 6

In section 3.2 there are several paragraphs that were already mentioned before.

A: The duplicated statement in section 3.2 has been removed as suggested.

#### Comment 7

In line 20 of page 9376, It is mentioned: "Risk factors for the decline of water table levels in the three scenarios could be transformed to the rate of descent in water table levels" This is most important result and it is not explained how it was calculated.

A: 1. It is done by find the corresponding number in the cumulative frequency curve. 2. To clarify, changes have been made for the sentence as following: "Risk factors for the decline of water table levels in the three scenarios could be transformed to the rate of descent in water table levels by looking up the value at the cumulative frequency curve for the decline of the water table, as shown in Table 6."

#### Comment 8

There is nothing mentioned about the recharge process. Through all the paper it is mentioned several times that the climate change will have negative effects on the groundwater table. However, in line 10 (page 9376) it is mentioned that the risk factors are lower than the year 2004. It is also mentioned that 2004 was a dry year, why did the authors chose this year? It is also mentioned that the groundwater withdrawal is the responsible of the groundwater table drop. Therefore, what is the real impact of the climate change?

A: 1. Re recharge process, this study uses fault tree model to model the causative

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factors for groundwater decline instead of using process based model to model the physical process. Therefore, the recharge process is not the focus of this study. 2. Re the risk factors are lower than the year 2004, It has been explained in section 4.3.3. 3. The year of 2004 was chosen as the baseline year by Chinese government due to the Shiyang River watershed strategic plan was started since this year.

Comment 9

As already mentioned, I think the conclusions need a significant improvement. What are the advantages of using this methodology? Can the authors give some recommendations that can be extrapolated to other case studies? Can something be said about the climate change scenarios? How much will affect to the ecosystem the estimated groundwater table drop? In several parts of the text is mentioned that is important to have a healthy natural vegetation, how can this be achieved? What is the real impact of the climate change?

A: 1. To address above questions, one paragraph has been added at the end of the conclusion section. Re climate change scenarios and the real impact of the climate change, please see section 5.1 and 5.2 2. Re the effects to the ecosystem the estimated groundwater table drop and how a healthy natural vegetation being achieved: as explained in previously, it is not the focus of this study. In this study, the reason that we mentioned the importance of the above, is to bring up the motivation and the importance of this research, however, they are not the focus of this study.

Comment 10

Technical corrections Line 11-13 on page 9362 – The sentence is not clear. Which implications?

A: The abstract has been rewritten to make things more clear.

Comment 12

Line 5 on page 9363 - What does 'bgs' stands for?

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A: 'bgs' stands for "Below ground surface"

Comment 13

Line 11 on page 9364 - Include a reference to the statement.

ĩČij References have been added as suggested.

Comment 14

Line 17 on page 9365 – Include a reference to the statement.

A: The reference has been included to the statement as suggested

Comment 15

Line 28 page 9367 / line 1 page 938 – I believe that the number 8 should a superscript..

A: These have been corrected as suggested

Comment 16

Figure 1 – It should focus on the area of the case study

A: Figure 1 have been revised as suggested

Comment 17

Figures 6, 7, 8 and 11 can the three scenarios be shown in one figure?

A: It would be very massy to show the three scenarios in one figure, so there should be no change for the three figures.

At the end, we would like to take the opportunity to thank you again for your valuable effort in making the paper clearer and better.

Please also note the supplement to this comment:

<http://www.hydrol-earth-syst-sci-discuss.net/11/C4608/2014/hessd-11-C4608-2014->

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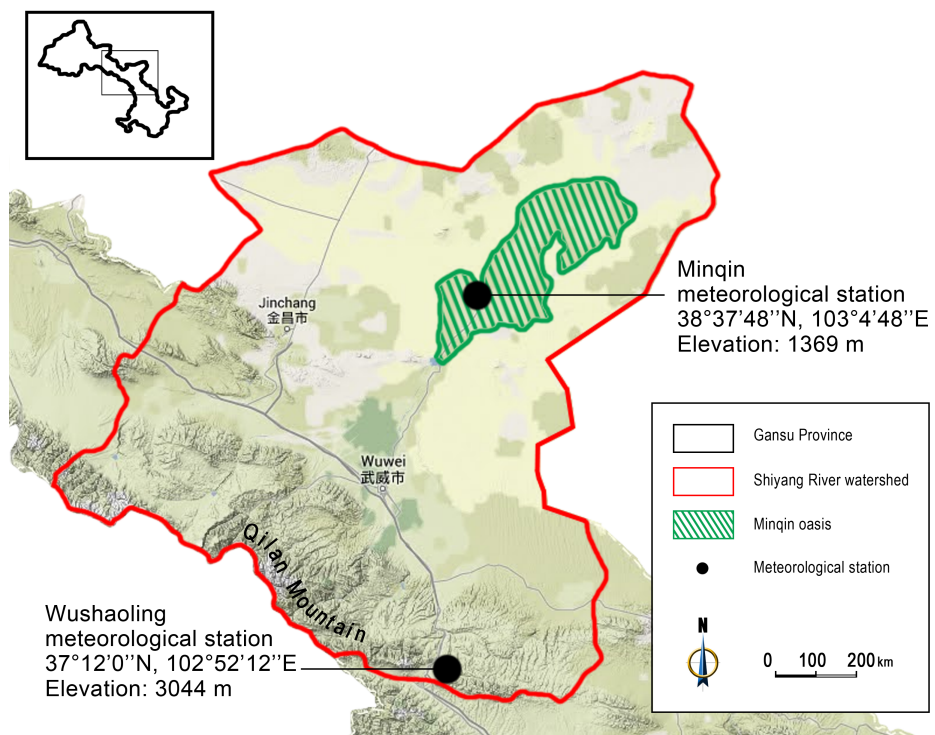


Fig. 1.

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