Response to Reviewer #2's comments:

1. Line 305 – 320

In the equation 10 and 13, for calculating maximum allowable storage capacity, there is a precipitation component associated with the water source. I'm uncertain about the methodology used to quantify this. Is a rainfall runoff model employed for this purpose?

Thanks for your question. Well, the principle of equitation 10 and 13 is based on hydrologic budget and conservation of mass. In the equitation, the precipitation component associated with the water source could be obtained by observed data of each sub-catchment extracting of the water source or rainfall runoff model as you said. The methodology depends on the data available in the study area. In our application of the model, this precipitation component associated with the water sources were calculated by Tyson polygon method based on the measured data of seven rainfall stations (Shi Caotou, Suxi, Yiwu, Fotang, Baifeng, Fengkeng, Changfu) in the basin in normal (1984.1–1985.1), dry (2008.1–2009.1), and extremely dry (1971.1–1972.1) scenarios, relatively. Limited by the space constraints, this section does not elaborate. Thanks for your question reminding us the importance to clarify the issue. So, the related supplementary statement has been added in line 771-776: "In our application of the model, this precipitation component associated with the water sources were calculated by Tyson polygon method (Liu et al., 2014) based on the measured data of seven rainfall stations (Shi Caotou, Suxi, Yiwu, Fotang, Baifeng, Fengkeng, Changfu) in the basin in normal (1984.1–1985.1), dry (2008.1–2009.1), and extremely dry (1971.1–1972.1) scenarios, severally."

2. Line 601– 679

The introduction of study area doesn't clearly indicate whether the reservoir serves an *energy-related purpose. If it does serve an energy-related purpose, it's unclear whether the impact on energy production has been considered in an analysis.*

Thanks for your question. The energy-related purpose is quite important part for reservoir operation which has generating function. However, the seven main reservoirs do not have generation function in Yiwu City. Because the main power generation mode of Yiwu city is photovoltaic power generation and others (Yiwu City government service portal), and the reservoirs do not need to undertake generating function limited by relatively low elevation difference in this area. So, the impact on energy production has not been considered in an analysis. But your consideration is really enlightening, thus we will focus on the reservoirs serves energy-related purpose in other study area and further enrich the model in the future study.

3. Line 609– 612

The three indices introduced here require further elaboration to help readers interpret the case study results. For instance, it would be beneficial to explain the range of values for these indices and what high values, such as H and others, signify. Additionally, insights into what lower values indicate would be valuable.

Thanks for your valuable comment! The introduction of the three core indices is a little rough in the previous manuscript. We deeply agree with your comment and suggestion. So, the range of values for these indices and what high values as well as what lower values indicate have been classified in line 631-639: "SSI is ranged form 0~N, and higher SSI indicates higher connectivity of the objects in the system which means they are easier to promote each other, and lower SSI indicates lower connectivity which means the promotion is hard to realize and obstacles to each other may occur. H is ranged from 0~N*log(1/N), lower H indicates better overall equilibrium and higher H indicates worse overall equilibrium from objective perspective. TSI is greater than 0. When a water resource system's TSI value is higher, the degree of synergy is higher; conversely, when a water resource system's degree of synergy is lower, the TSI value is lower. In our application, based on actual evaluation, the criteria as divided. When TSI≥5, the degree of sunergy is considered satisfactory. Additionally, 5>TSI≥3 is moderate synergy degree and 3>TSI is low degree."

4. Line 775– 775

To provide a more comprehensive overview of the optimization process, it would be beneficial to include information about the computational setup and the time required for the analysis. For instance, it would be helpful to know how long it took to generate Pareto sets across 500 runs of the PTSOA model and whether high-performance computing was utilized.

Thanks for your valuable comment! It is quite beneficial to include information about the computational setup and the time required for the analysis. There are 1000 iterations of each run in most cases. If The feasible solutions could not be found in some cases, the number of iteration would be increased. Based on the log recording, this important information had been added in line 819-823 of the revised manuscript: "If The feasible solutions could not be found in some cases, the number of iteration would be increased. It took approximately mean 17 h of CPU time on a computer with 32 GB memory and intel corei7@3.4 GHz of CPU. Therefore, in this study, each iteration for a single trial solution takes 0.12 s of CPU time on the computer with the named specifications."

5. Line 808-809 and 889 - 891

The labels on Figure 5 and Figure 9 are nearly impossible to read, even when I zoom in to view the names of the classes. Please consider using different label colors and adjusting the background to ensure the labels are easily discernible. Additionally, please explain the Figure labels (F1, F2, F3) in the caption.

Thanks for your comment! The Figure 5 and Figure 9 have been repainted by using different label colors and enlarging the sub-figures. Hope they are easier to read now.

Additionlly, the labels in Figure 1, Figure 2 and Figure 3 have been explained in the caption in line 208-212, line 235-238, line 709-712 as follows: “In Fig. 1, the grey boxes indicatethe three different allocation dimensions, the green boxes indicates the three different decision levels coupled with spatial scales, the bright yellow boxes indicates every key nodes in the whole allocation process and the buff boxes indicates nested time scale.” “In Fig. 2, there are three layers in the framework and each layer has two parts: multi-objective optimal water resources allocation and collaborative water resources allocation for objectives. In the multi-objective optimal water resources allocation sub-layers contain key nodes in the allocation process and relevant objectives and constraints. In the collaborative water resources allocation for objectives sub-layers contain optimization algorithm and decision selection method.” “In Fig. 3, the white labels indicate five sub-regions in the city, the black labels near the reservoirs are their name, the black labels named O1~O6 indicates the name of the water distribution outlets and the labels near the lifting pump station are their names.”

6.Line 798 - 800

Could you please clarify how the selected decision alternatives achieve a water supply reliability greater than 95% under the three different conditions? It would be helpful to understand the approach used to derive this information from these three panel plots.

Thanks for your question. It is necessary to clarify how the selected decision alternatives achieve a water supply reliability greater than 95% under the three different conditions. There are 6×3 decision alternatives selected in the six clusters of the optimal first-layer results. To help to understand the approach used to derive this information from these three panel plots, the clarification is added in line 358-361 of the revised manuscript as follows: “The water shortage varies in the range of -1.2×106~0.8×105 m^3, -0.5×105~2.0×106 m^3, 0~3.5×106 m^3 in normal, dry and extremely dry scenarios respectively. The average water demand is around 1.8×108 m^3, and water shortage of the selected decision alternatives are all less 9×106 m^3.” Thanks to your suggestion, this part seems clearer.

8. Line 1006- 1008

The performance of the PTSOA model is compared with some known MOEAs. Yet there *are other algorithms that perform better than the ones that have been tested. For example, Borg MOEA has accomplished superior performance levels across a wide number of challenging multi-objective problems by meeting or exceeding the performance of other state-of-the-art MOEAs. It would be interesting to test the Borg algorithm as well to see if it can produce different results. It would also be valuable to compare the computational time of these MOEAs with the time required for your model.*

Thanks for your comment! Borg Multi-objective Evolutionary Algorithm (MOEA), an efficient and robust many-objective optimization tool. It is characterized by its use of auto-adaptive multi-operator search and other adaptive features, allowing the algorithm to tailor itself to local search conditions encountered during optimization. Using a rigorous diagnostic framework, the Borg MOEA is distinguished against a broad sample of state-of-the-art MOEAs. The Borg MOEA meets or exceeds the efficiency, reliability, and search quality of other MOEAs on the majority of many problems (David M. Hadka,2013). Large-scale parallelization of the Borg MOEA for many objective optimization of complex environmental systems. The multimaster Borg MOEA (Hadka and Reed, submitted manuscript, 2014) combines two parallelization paradigms: (1) master-worker distributed function evaluations and (2) multiple cooperating search populations (also termed the island model [Cantu-Paz, 2000]). Effective parallelization of the multimaster Borg MOEA maximizes this parameter for a given amount of wall-clock time. So, multimaster Borg MOEA seems quite suitable for many-objective optimization of the complex system.

Based on your helpful comment, the Borg MOEA has been tested and compared with other algorithms. In the TSI dimension, it is performance is slightly worse as shown in Table 4 of the revised version. In this study, our main focus is to find the most collaborative solution through optimization. Thus, PTSOA has accomplished superior performance level in this respect. However, we are surprised to find that the Borg MOEA algorithm could save around one-fifth of the computing time of the model. So, in the future, we may be interested in figure out how to coupling the Borg MOEA algorithm with our PTSOA model in a more efficient and synergetic way. The replenishment about the Borg MOEA has been added in line 1128-1137 as follows:

“Borg MOEA, an efficient and robust many-objective optimization tool. It is characterized by its use of auto-adaptive multi-operator search and other adaptive features (Reed et al., 2013). The TSI of Borg MOEA is lower than PTSOA. Therefore, in the TSI dimension, it is performance is slightly worse than PTSOA model. However, it is noticed that the Borg MOEA algorithm could save around one-fifth of the computing time of the model (around 7h). In the future, it would be interesting to figure out how to coupling the Borg MOEA algorithm with our PTSOA model in a more efficient and synergetic way. In this study, our main focus is to find the most synergetic solution through optimization. Thus, PTSOA has accomplished superior performance level in this respect.”

9. A general issue:

Each figure and table in the paper must have a caption that provides enough information that a reader can understand the data presented without referring to the text.

Thanks for your comment! This comment is really valuable to improve this paper. Most figures and tables have been completed by a caption providing enough information. The captions are modified as follows:

“Fig. 5. Sets of Pareto solutions after 500 model simulations with the hierarchical optimal algorithm under (a) normal, (b) dry and (c) extremely dry scenarios. (F1: total water supply shortage, 104m3; F2: total water supply benefit, 104 Chinese Yuan; F3: the total amount of reserved water in reservoirs, 104m3. The red arrow indicates the direction of optimization. K1-n， K2-n and K3-n represents the nth class of solutions in the normal, dry and extremely dry scenario separately, n=1~6.)”

“Fig. 6. Comparison of TSI (total synergy index), SSI (total connectivity) and H (overall equilibrium) values among various Pareto solutions in different classes for the (K1) normal, (K2) dry, and (K3) extremely dry scenarios. (K1-n， K2-n and K3-n represents the nth class of solutions in the normal, dry and extremely dry scenario separately, n=1~6.)”

“Fig. 7. Water supply from each reservoir to connected water works in each month in the normal scenario 104 m3

(K1-n represents the nth class of solutions in the normal scenario, n=1~6.)"

"Fig. 8. Pareto fronts of the second layer in the PTSOA model after 500 simulations with the hierarchical optimal algorithm in the normal, dry and extremely dry scenarios. (F1 represents the total amount of water retained in water works ,$10^4 m^3$; F2 represents the amount of unconventional water supplied,10^4 m^3. The direction of optimization is from the top-right corner to the bottom-left corner. K1-n represents the nth class of solutions in the normal scenario, K2-n represents the nth class of solutions in the dry scenario, and K3-n represents the nth class of solutions in the extremely dry scenario, n=1~6.)"

"Fig. 9. Illustration of parallel-reference Pareto sets from the third layer in the PTSPOA model attained across all runs for the (S1) normal, (S2) dry, and (S3) extremely dry scenarios (S1-1 represents the normal scenario with the minimum total amount of water retained in water works, S1-2 represents the normal scenario with the maximum unconventional water supply and S1-3 represents the normal scenario with the maximum synergy degree in the second layer)"

"Fig.10. Comprehensive benefit in five sub-regions after the regional collaborative allocation of water resources (S1 represents normal scenario, S2 represents dry scenario, and S3 represents extremely dry scenarios; S1-1 represents the normal scenario with the minimum total amount of water retained in water works, S1-2 represents the normal scenario with the maximum unconventional water supply and S1-3 represents the normal scenario with the maximum synergy degree in the second layer)"

10.Line 251, ...

Each section that describes the three layers of the process shares the same subsection name; I would recommend renaming them to avoid any confusion.

Thanks for your comment! The names of the sub-sections have been corrected in the revised version. For example: 2.1.1Objective functions of the first layer; 2.1.2 Constraints of the first layer; 2.2.1 Objective functions of the second layer; 2.2.2 Constraints of the second layer; 2.3.1 Objective function of the third layer; 2.3.2 Constraints of the third layer.

11. Line 228: space after "interactions"

Thanks for your comment! The whole paper has been checked and the missing spaces have been added like the space after “interactions”.