Dear reviewer,

Thank you for your comments on our manuscript. Indeed, we found your comments very helpful.

The following summarize our revisions in response to your criticisms.

We hope you find these revisions acceptable.

Thank you for your kind consideration of our manuscript.

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The following is a point-to-point response to your comments.

**Question1:**

The paper shows an optimization algorithm for the management of a set of stormwater pumping stations, applied to a case study consisting in 9 pumping stations in Beijing. In my opinion, the paper has a potential because the topic is of interest for the scientific community, but it needs major revisions concerning several issues described below:

General. In my opinion, the paper has a big flaw which should at least be discussed. Pump-related optimization problems are usually based on the concept that a pump faces time-variant hydraulic conditions, that must be managed (i.e. a stormwater event) without posing risks for the infrastructures, but at the same time the pump is constrained to work in a limited range of hydraulic conditions (water head and discharge) that should be as close as possible to its Best Efficiency Point (see for example Fecarotta et al. 2018 https://doi.org/10.3390/resources7040073). However, pump efficiency, which is the keyword of every pump-related optimization problem, is not even mentioned in this paper, but only the number of on-offs is considered as the parameter influencing the life of pumps. This is not true because even if the number of on-offs is small, if the pump works with h-Q values far from its BEP its life will be short just as well. Of course, considering efficiency-related issues among the constraints complicates the solution of the problem, but at least efficiency should be checked for the solutions proposed by the Authors.

Answer: Thank you for your suggestion. I very agree that the pump efficiency is very important and should be discussed in the paper. In the reviewer’s question 4, the same question about pump efficiency is also raised. So, we answered the question 1 and question 4 together in the answer part of question 4. For more details, please see the answer of question 4.
Question 2:

Introduction. There is a wide literature concerning the optimization of pumps for stormwater management, however this literature is not adequately described in favour of a brief review of papers related to the topic of pump operation on flood control. This makes it difficult to understand what is the novelty or the strength of the proposed optimization methodology, and, in more general, how the proposed method is placed within the wide framework of optimization problems. More in general, a wider review of international literature is required.

Answer: Thank you for your suggestion. We very agree with that the section “Introduction” needs a wider review of international literature. We added ten more references related to the topic of pump operation on flood control in the “Introduction”, and also added the description about these references. Please see lines from 50 to 68 in the revised paper.

Question 3:

Methodology. It is not clear whether the proposed system is made up of a parallel (line 104) or a series (line 117). The function to be minimized is only presented in a conceptual fashion, while it should be made explicit by adding i.e. information about the involved pumps (for example, is pump speed constant or variable?) and all the relevant information required by the algorithm to run. Optimization solving by PSO is basically given for granted and not adequately described: for example, Figure 2 cites “acquiring personal best position and global best position” which is not described nor named in the text.

Answer: Thank you for your suggestion. It should be noted that pumps in a drainage pumping station are typically single-frequency and work in parallel”. It means the pumps work in parallel in a pumping station, doesn’t mean the pumping stations work in parallel. In line 117(line 136 in revised paper), it is described like that “Several pumping stations usually constitute a system in series”. It means pumping stations work in series in a system. So, the proposed system is constituted with several pumping stations which work in series, and in each pumping station, the pumps work in parallel.

As reviewer’s suggestion that more information should be added to the function, we revised the function, and added description about it. Please see Function (1) and lines from 160 to 166 in revised paper. In this function, the total number of pump start-up/shutoff times \((N_{total})\) is the sum of the numbers of start-up/shutoff times of pumps \((N_1, N_2, ..., N_n)\). The \(N_1, N_2, ..., N_n\) can be calculated by the “\(F(h_1, h_2, ..., h_n, q_1, q_2, ..., q_n, A, H)\)”. The “\(F(h_1, h_2, ..., h_n, q_1, q_2, ..., q_n, A, H)\)” usually means that using the hydrodynamic model to simulate the operation of pumping station, and obtaining the \(N_1, N_2, ..., N_n\) from the model results. The \(h_1, h_2, ..., h_n\) are the start-up depth of each pump. \(q_1, q_2, ..., q_n\) are the pumping flow of each pump. \(A\) is the area of the storage. \(H\) is the height of the storage. It should be noted that, for a pumping station which has been built, the \(q_1, q_2, ..., q_n, A, H\) and \(H\) have already been determined. So, the “\(q_1, q_2, ..., q_n, A, H\)” are inputted into the model at first, and then set the “\(h_1, h_2, ..., h_n\)” in the model and run the model for simulation. Finally, the “\(N_1, N_2, ..., N_n\)” can be obtained from the model results, and the \(N_{total}\) can be calculated according to the sum of “\(N_1, N_2, ..., N_n\)”.

In addition, the pump speed (pump flow in the model) can be inputted into the model, which including constant flow or variable flow. So, for the” “\(q_1, q_2, ..., q_n\)” in “\(F(h_1, h_2, ..., h_n, q_1, q_2, ..., q_n, A, H)\)”, both constant flow and variable flow can support the simulation of the model.

The PSO is a mature algorithm, and it has been widely used. So, in this paper, we did not introduce
the theory of PSO, and straightly explained the steps of optimization calculation (the optimization steps in section “2.3 Solution to the Optimization Model of Start-up Depths of Pumps”) by combining the PSO and SWMM. In the step 4, it is described that “The optimal historical position of each particle and the optimal global position of the swarm are obtained.”. The “optimal historical position” is also called “personal best position”, and “optimal global position” is also called “global best position”. In order to make the description to be consistent, the “personal best position” and “global best position” are revised to “optimal historical position” and “optimal global position” in Figure 2. Please see Figure 2 in revised paper.

Question 4:
Results and discussion. Results are merely presented but not effectively described. The Authors should discuss in detail why the only used the number of on/offs as target function without considering pump efficiency, which is often the most important parameter in this kind of problems. At least the Authors should check if, even though efficiency is not included in the optimization, the solutions provided by the algorithm are sustainable for the pumps.

Answer: Thank you for your suggestion. Pump efficiency is very important during pump operating. I very agree with that.

The optimization method of this paper is mainly about using hydrodynamic model to simulate the flow process of rainwater in the whole drainage pipe network system, which includes: 1) rainfall falls down to the ground and forms runoff of rainwater; 2) The runoff rainwater flows into the upstream drainage pipe system of the pumping station; 3) The water in the upstream drainage pipe system flows into the storage tank; 4) The pumps pump the water from storage tank into the downstream drainage pipe network system. The model (SWMM was selected in this paper) mainly simulates the above four processes.

In the model, the input data is needed to build the model. The input data of the drainage pipes, which includes the spatial topology, the diameter, the length and the elevation of each pipe, needs to be input into the model. The input data of the pumping station, which includes the area, height, and elevation of the storage, the pumping flow of each pump, and the rule of start-up/shutoff of each pump (the start-up and shutoff of each pump is controlled by the water level in the storage tank), also needs to be input into the model.

For the drainage system which has been built and put into use, the input data of pipe network, storage tank is constant, and the model can be constructed base on these data. The pumping flow of each pump is also need to inputted into the constructed model, and the input pumping flow can be either constant or variable. When all the input data has been finished, we can set the start-up depth of each pump and run the model to obtain the number of start-up/shutoff times of pumps from the model results (this process is “F (h₁, h₂, ..., hₙ, q₁, q₂, ..., qₙ, A, H)” in Formula (1) of the revised paper). The purpose of above description is mainly to explain that, the model used in this paper obtains the number of pump start-up/shutoff times through simulating the rainwater flow process in the whole drainage system, and the model was combined with PSO to optimize the pump start-up depths in order to minimize the number of pump start-up/shutoff times.

The optimization method of this paper did not consider the pump efficiency. The Best Efficiency Point is usually related to pump rotational speed, power, grid frequency, and so on. So, the optimization of pump efficiency often concerns more about the optimization of the performance properties of the pump itself to minimize the pump energy cost. For example, the article (Fecarotta
et al. 2018 https://doi.org/10.3390/resources7040073), mentioned by the reviewer, is to optimize the pump efficiency with variations in the pump rotational speed.

This paper optimized the number of pump start-up/shutoff times through simulating the rainwater flow process in the whole drainage system, and did not include the calculation of or performance properties (such as rotational speed, power, and so on) of pumps. Only one thing related to the performance properties is the input data of pumping flow in the model.

Therefore, the optimization method in this paper and the optimization method mentioned by experts are optimizations of two different aspects, as follows:

**Method 1:**
In this paper, the number of pump start-up/shutoff times is optimized through the simulation of rainwater flow process in drainage system (includes pipes, storage tanks and pumps). In the model, the input data related to the performance of pumps is only the pumping flow of each pump (the pumping flow inputted into the model could be constant or variable).

**Method 2:**
The method mentioned by the reviewer is optimized pump rotational speed (performance properties) to improve the pump efficiency, so as to save energy.

So, in the Method 1 (the optimization method in this paper), the pumping flow is just taken as an input data of the model. Whether the inputted pumping flow is the most efficient one is not considered in Method 1.

From above description, the two methods (Method 1 and Method 2) are independent of each other. Method 1 focuses on minimizing the number of pump start-up/shutoff times through simulating the rainwater flow process in the whole drainage system (including pipes, pumps, storage tanks). Method 2 focuses on the optimization of pump efficiency through optimizing the performance properties of pumps.

If the number of pump start-up/shutoff times and the pump efficiency all need to be considered in the optimization, the Method 1 and Method 2 could be combined to solve it like that: using Method 2 to optimize the pump efficiency, and the pumping flow in the optimization results of Method 2 could be inputted to the Method 1 to optimize the number of pump start-up/shutoff.

We think the combination of Method 1 and Method 2 needs further study, not in this paper. As the reviewer’s suggestion, the pump efficiency (energy saving) of the method in this paper should be discussed at least. We summarized above description and added it into the revised paper. Please see the lines from 306 to 314 and lines from 348 to 354.

Although the method of this paper does not consider the optimization of pump efficiency, we discussed the reduction of pump operating time in section “4.3. Comparison of pump operating time”. If the pump operating time is reduced, the pump will save energy to a certain extent. The optimization results show that the pump operating time can be reduced through minimizing the number of pump start-up/shutoff times. So, the method in this paper can save energy to a certain extent. But the method in this paper cannot obtain the best pump efficiency, and it needs the further study.