Dear Editor:

Thank you for your letter and for the comments concerning our manuscript entitled " Integration of 2D Hydraulic Model and High-Resolution LiDAR-derived DEM for Floodplain Flow Modeling". Those comments are all valuable and helpful for revising and improving our paper, as well as the important guiding significance to our researches. We have studied comments carefully and have made correction which we hope meet with approval. Revised portion are marked in red in the paper. The main corrections in the paper and the responds to the .comments are as follows:

1. **Comments:** The manuscript is devoted to the 2-D floodplain flow modeling, that is the problem whose solution is strongly depended, first of all, on progress in two fields: technologies (from computer capabilities to technologies of measurement and data processing) and numerical methods. Both fields are explosively advanced during the last years and recent opportunities for the above problem solution are much wider than those even 10 years ago. Nevertheless, the most recent publication cited in the manuscript is (Gichamo et al., 2012) and more than half of the references were published in 1990s and early 2000s. I fully agree with the last comment of the 1st Referee and suggest the authors renewing the reference list. Particularly, I suggest reviewing(not just mentioning) publications, where high-resolution LiDAR data were used directly for 2-D simulation, and clarifying weaknesses of this method by the example of more recent publications than (Marks et al., 2000). In my opinion, reasonable choice of mesh type (Cartesian grids, constrained and unconstrained triangular grids, constrained quadrilateral grids, mixed meshes, etc.), which is adapted to specifics of floodplain surface (e.g. takes into account linear objects, as 2st Referee pointed out), allows one to integrate high-resolution DEM into 2-D model and maximizes computational efficiency (see, for instance, Alexeevskiy et al., 2014; Kim et al., 2014Li et al., 2014)

   Responses:

We really appreciate the comments on the review in our paper and the recommendation of relative papers. We refer to relative researches in recent years, analysis the progress in high-resolution DEM applied in flood simulation, and summarize these research approaches. The section Introduction has been rewritten. Major changes are as follows:

Line 34-49: analyze the advantages of applying 2D hydraulic models in flood simulation. Especially with the development of surveying and mapping technology such as LiDAR, the access of high-resolution DEM has become easier and easier. Solutions to the previous problems that lack of terrain data and precision issue have been found, and applying high-resolution DEM in 2D hydraulic models has become a trend. It is pointed out by our paper that high-resolution DEM has been tried to apply in flood simulation by many researchers.

Line 50-60: explain that in current researches on 2D hydraulic models, though processing capacity of computers is promoted and applying high resolution DEM has become a reality, the processing efficiency of computers still has a giant impact on models. If a comparatively coarse computational mesh is generated based on DEM, micro-topography information will be lost to some extent and the precision of models will be reduced.

Line 61-84: analyze that in early researches, in order to simulate the influence of artificial ground features on water flow, a comparatively large roughness coefficient was usually set on the model mesh. However, this approach often led to a low accuracy. On raster-based models, above-mentioned problem can be solved based on sub-grid and porosity parameterization methods. However, while presenting surface features, the flexibility of computation grid of these raster models is not as good as that of unstructured grid. Finite element or finite volume approaches on the basis of unstructured grid are more widely used currently.

Line 85-100: summarize a fact of researches on flood simulation in recent years that the resolution of model mesh has achieved 2 meters. Under such high-resolution computational mesh, the influence of buildings on water flow and the flow among buildings can be well simulated. 4 approaches to deal with buildings in hydraulic models are also summarized.

Line 101-113: though the problems of applying high-resolution DEM have been solved to some extent, the impact of computers' processing capacity have not been eliminated yet. Under a 1-meter resolution computational mesh, the extent of study area is usually greatly limited.

Line 114-131: some other strategies like parallel technology or computer cluster are also employed in calculating hydraulic models. However, these methods are not satisfactory and hard to promote and apply. Some of them have limited improvements on computing efficiency, while some others have high requirements on software/hardware configuration due to complexity of their programs.

While revising our paper, we add 37 references, most of which are newly published relative papers. In consideration of the length of our paper and the relativity of references, we also delete some previous references.

2. **Comments:** Inverse distance weighted (IDW) interpolation is used for calculating flood water level in DEM grid cells and is one of the key-point of the method proposed by the authors for solving high-resolution DEM associated problem. The IDW interpolation is very easy to use but, I agree with the 2nd Reviewer, this method can lead to poor results of interpolation of high resolution topography into nodes of computational mesh. Weaknesses of the IDW interpolation are well-established and result from the fact that this method doesn't satisfy the major requirements for deterministic methods of interpolation on arbitrary sets of points; such requirements as linearity, monotony, uniqueness (Sukumar et al., 2001). This disadvantage results in the following, just for example, consequences: a patterns are smoothed between the data points; the interpolated pattern can have

a discontinuity in slope at the data points; interpolation results depend on size of search window and poor window choice can produces artifacts when use with high-resolution data (e.g. Kravchenko, Bullock, 1999; Hartkamp et al., 1999; Blöschl, Grayson, 2000; Yasterbi et al., 2009). I recommend the authors discussing interpolation methods and showing advantages of the IDW interpolation for the problem under consideration.

Responses:

We really appreciate the comments on IDW used in our paper. According to the editor and reviewer, we used IDW to interpolate high resolution topography into nodes of computational mesh. Instead, we used calculating results of 2D model as known water level points, and performed interpolation on each DEM grid cells. We apologize for our ambiguity in replying the 2nd reviewer.

At present, there are plenty relatively mature methods for generating 2D hydraulic models' unstructured computational mesh from DEM. The 2nd reviewer does a large quantity of relative researches, and some hydraulic model computation software also provide function of generating computational mesh (such as Surface-water Modeling System, SMS). Generating computational mesh is not what our paper focused on.

After computing a 2D hydraulic model, water levels are on computational mesh nodes. No matter how the resolution of computational mesh changes, the mesh can be considered as a discrete expression. To calculate every points' water level in the study area, interpolation based on known water level points need to be performed. It is common in 1D hydraulic models that DEM is subtracted from floodwater level generated from interpolation to obtain the inundation extent and depth. Thus, we refer to this idea, use IDW to perform interpolation on water level.

When interpolating, the connectivity of DEM grid cells need to be considered, because some of the inundated grid cells are not inundated actually. Common methods for verifying connectivity can hardly be applied on high-resolution DEM. Thus, we presented the run-length encoding method to solve the connectivity issue, which enables regular computers to process large quantity of data, and is one of the innovations of our paper.

Comparing to DEM, floodwater level surface is relatively flat. In addition, comparing to that in 1D hydraulic models, the known discrete water level points (the nodes of computational mesh) in 2D models are evenly distributed， IDW could have a better performance on such water level surface. Holding the same statement with Moore, the primary advantage of this method "is the ability to use a lower resolution mesh to achieve results that are comparable to using a higher resolution mesh". This method "provides the balance between accuracy of results and simulation time"(Moore, 2011).

technical corrections:

1. P. 2018, L. 6: the terms S** differ from the corresponding terms in Eq. 2. Please correct.

Response: We are very grateful to you for pointing out this mistake. It has been corrected in the revised version (please see line 240-241).

2. Z_{cell} and $Z_{waterlevel}$ terms are specified after Eq. 4 and repeated after Eq. 5.

Response: Thanks for your comment. We have deleted the specification of Z_{cell} and $Z_{waterlevel}$ terms after Eq. 5 (please see line 287-288).

3. P. 2024 L. 13: "220 000 Rows"; Fig.3 caption "22 000 rows" What is correct?

Response: We are very grateful to you for pointing out this mistake. The correct one is "22 000 rows". It has been corrected (please see line 361).

4. It is not necessary to repeat three times the IDW equation (Eqs. 6-8)

Response: Thanks for your comment. We have deleted Eqs. 6 and 8, and kept Eq. 7 (please see line 338).

Special thanks to you for your good comments.

Reference:

Moore, M.R. Development of a high-resolution 1D/2D coupled flood simulation of Charles City, Iowa. MS (Master of Science) thesis, University of Iowa, 2011. (http://ir.uiowa.edu/cgi/viewcontent.cgi?article=2417&context=etd)