Letter to the Editor:

Dear Dr. Wickert,

We would like to thank you for your support during the review process and would like to extend our sincere gratitude to the reviewers for their time and efforts in reviewing our manuscript titled ***"Development of an under-ice river discharge forecasting system in Delft-Flood Early Warning System (Delft-FEWS) for the Chaudière River based on a coupled hydrological-hydrodynamic modelling approach***" and sharing their insightful comments leading to the improvement in the quality of our work.

We have now addressed and incorporated all the comments from the two reviewers and revised our manuscript. Below, we provide a detailed point-by-point response to each of the comments from each reviewer highlighting the changes made in the revised manuscript as well as some other editorial changes deemed necessary by us.

Reviewer 1:

The reviewer suggested only technical corrections which are detailed below:

Correction 1: line 385: extra space before a period ending the sentence.

Response: The extra space has been removed in the revised draft. The change is reflected in line 468, page 20 of the Marked-Up manuscript.

Correction 2: line 515: should 2023 be 2022? Line 517 references 100 days, which does not add up with 2023.

Response: The year was 2022. This has been corrected in the revised draft. The change is reflected in line 606, page 24 of the Marked-Up manuscript.

Correction 3: line 630: replace 'till date' with 'to date'

Response: The correction has been done from 'till date' to 'to date.' The change is reflected in line 806, page 34 of the Marked-Up manuscript.

Correction 4: line 633: should 'stale' be 'stable'?

Response: The word 'stale' has been replaced with 'stable' in the revised draft. The change is reflected in line 809, page 34 of the Marked-Up manuscript.

Reviewer 2:

The reviewer had raised major and minor concerns. All the concerns have been responded during the open discussion round and necessary amends have been made in the revised draft. The detailed point-by-point response to the reviewer has already been submitted. Below we provide a point-by-point account of the changes made in the revised manuscript.

Major comments:

Comment 1: I have several concerns about your model evaluation. In your forecasts for the evaluation, the measurement is always available on day 1. Why did you choose to do so? What is the difference if you start the forecast earlier (so that the measurement is available on day 2, 3, …)? Does this help to evaluate the model forecast for different days? Could you perform this analysis?

Response: A new analysis was performed incorporating the suggestions of the reviewer. The details of this analysis along with new results are reflected from lines 580 – 586, page 24; lines 679 – 754, pages 29-31. The new analysis in summarized in Figure 13 presented in line 792 page 33 and the old Figure 13 has been removed (line 791, page 33).

Comment 2: Unfortunately, the discussion of your work is very limited. What are the implications and limitations of your work? How is your model performing better than models not accounting for ice conditions? Could you discuss the uncertainty in your data and model estimates as well as your system evaluation? How do you estimate the uncertainty of your corrected observed discharge data (corrected with the backwater coefficient)? How does your study compare to others, what are differences and similarities?

Response: The discussion of the work has been improved. The changes are reflected in lines 757 -789, pages 31-32, and lines 820 – 832, page 34.

Comment 3: You discussed one event in detail, including three figures, and provided both the results of the hydrological and hydraulic modelling. Why have you chosen this period? Is it representative of frequently occurring conditions?

Response: The comment has been responded during the open discussion round and no specific change to the manuscript was deemed necessary in its response.

Minor Comments:

Comment 1: How can the presented methodology be transferred to another study site? Which conditions and data are required? What may cause problems?

Response: The comment has been responded in the open discussion round. The changes related to the comment in the manuscript can be found in lines 780 – 784, page 32.

Comment 2: This study strongly relies on Montero et al., 2023. Please clarify the difference between your study and the previous one as well as your advances compared to that study.

Response: The comment has been replied in the open discussion round and the changes required in the manuscript are reflected in line 122-123, 125, 127-130 and 131 on page 4.

Comment 3: L21: system or systems?

Response: The correct word is "system." The change is reflected in line 21, page 1.

Comment 4: L29: Is the hydrological module better including the ice component than without it?

Response: The comment has been responded, and no change was required in the manuscript.

Comment 5: L36: introduce

Response: The grammatical error "introduces" is corrected to "introduce" and the change is reflected in line 39, page 2.

Comment 6: L50-58: How are measurements of under-ice discharge made in other countries across the world?

Response: A brief description of practices observed in other countries has been included in the revised manuscript. The changes are reflected in lines 62 – 69, page 2.

Comment 7: L61: What is the HBV model? Can you describe it quickly?

Response: Details on the HBV model have been included in the revised manuscript. The changes are reflected in lines 71 – 78, page 2-3.

Comment 8: L83: Please provide a reference for HEC-RAS.

Response: Reference added. The change is reflected in line 100, page 3.

Comment 9: Table 1: Please provide a reference for your data.

Response: Reference added. The change is reflected in line 140, page 4.

Comment 10: Figure 1: Please clarify your figure (increase font size, no upside down labels, make clear that the Lower Chaudière is not included into the analysis, use different shapes and easily visible colors for the different measurement stations). You may consider labelling the subcatchments right next to them for simplified identification. Please add also a clearer map of the location of the study area in North America, including readable city names.

Response: The figure has been replaced by a new figure that incorporates the recommended changes. The change is reflected in lines 179 to 185, page 6-7.

Comment 11: L155: The correct name is Environment and Climate Change Canada.

Response: The name has been corrected. The change is reflected in line 168, page 5.

Comment 12: L156: Please provide the reference of these data sets, not of the secondary literature.

Response: Reference added. The change is reflected in line 170, page 5.

Comment 13: L157: Please provide the reference.

Response: References added. The change is reflected in line 171, page 5.

Comment 14: L170-186: Please clarify this paragraph, the determination of the backwater factor is not clearly described and easily understandable but has a major impact on the corrected data. How do you make sure that the applied correction is correct and representative of the in-situ conditions?

Response: The paragraph has been reworked. The changes are reflected in lines 210-211, 213-215 and 218-222 on page 8.

Comment 15: Figure 2: Please increase the font size of the axis labels and label the subplots as a) and b) instead of using figure titles.

Response: The figure has been reworked. The change is reflected in lines 239-241, page 9-10.

Comment 16: L194-202: Please provide references.

Response: References added. Changes can be found in lines 244, 246, 247, 248, page 10.

Comment 17: L206-215: Please provide references for the used softwares and models. What is precisely the novel contribution of your study in this methodology and which part of this approach has been used in former studies?

Response: The references have been added. Changes can be found in lines 258, 261, and 263, page 10. The novel contribution to the methodology by the study has been explained through lines 266-271, page 10.

Comment 18: L218: Are only the resulting precipitation values used or also other data?

Response: The comment has been responded and changes reflected in lines 276-277, 279, 282-283, page 11.

Comment 19: Figure 3: Is REPS0 the unperturbed control member? Why is it framed? Please write the numbers of the control members elsewhere in each subfigure instead of within the catchment. The color scheme of the legend seems to be different to the one used in the figures.

Response: The comment has been addressed. Changes in the manuscript are reflected through line 286-288, page 11.

Comment 20: L240-242: Please clarify. Are all data (open water and ice) used at a 3h resolution for the modelling? If yes, how have you increase the resolution during ice conditions, where only daily data is available?

Response: The comment has been responded in the open discussion round. The changes in the manuscript are reflected in lines 303 - 312, page 12.

Comment 21: Figure 4: Please increase the font size of the axis labels and label the subplots as a) and b) instead of using figure titles. The data are hardly visible, so that the measurements and the model are hardly distinguishable. This hinders the evaluation of the model's performance. Please improve the readability of the results.

Response: The figure has been reworked. Changes reflected in line 353-358, page 14- 15. The hydrographs for the three sub-catchments have also been provided as supplementals to improve readability.

Comment 22: Figure 5: Please increase the font size of the axis labels.

Response: Figure has been reworked. Changes reflected in line 360, page 16.

Comment 23: L262-265: What do you think is the reason for the lower KGEm in the validation case in the Upper Chaudière?

Response: The comment has been responded in the open discussion round. Changes in the manuscript are reflected in lines 337 – 339, page 13.

Comment 24: L267-270: Please explain why you are using the unsteady model.

Response: Explanation added. Changes reflected in lines 343 – 347, page 13.

Comment 25: L483-484: To which water stage does this elevation correspond? How many days per year or measurements are not possible at this site? What is its influence? Can measurements be performed in winter during the ice conditions?

Response: The comment has been responded. No changes made to the manuscript.

Comment 26: L494: How are the RMSE and Pbias calculated for the average ensemble values for each event? Are they calculated for every ensemble and then averaged to obtain the results in Figure 13?

Response: The comment has been responded during the open discussion round. Changes in the manuscript are reflected through line 577 – 581, page 23 - 24.

Comment 27: L500, 508: Please reorder figures or their reference, here Figs. 11 and 12 are referenced before Fig. 10.

Response: The refencing of the figures in the text has been improved. Changes reflected in line 591, page 24.

Comment 28: L502-504: How was the discharge measured? How is the averaged discharge for the entire day determined?

Response: The comment has been responded. during the open discussion round. No changes done in the manuscript.

Comment 29: L524: You mentioned that ice thickness and the under ice roughness are important. Have you performed any measurements of the under ice roughness? If no measurements are available, how is this value chosen in the model?

Response: The comment has been responded during the open discussion round. No changes done in the manuscript.

Comment 30: L504: How was the ice thickness measured? At one cross-section only or several ones?

Response: The comment has been responded during the open discussion round. No changes done in the manuscript.

Comment 31: Figure 10: Please label the subfigures with according the journal guidelines, instead of using figure titles. Please provide the reference for the used data.

Response: The figure has been reworked, and changes are reflected in lines 619-624, page 25 - 26.

Comment 32: Figure 11: Please clarify this figure. Especially in the right part (after Feb 25th), the different lines and percentiles are difficult to distinguish, you may want to use different line styles and filling styles.

Response: The figure has been reworked, and changes are reflected in lines 641-646, page 27.

Comment 33: L531-545: Please consider splitting this paragraph. What is the uncertainty in the corrected observed data?

Response: The paragraph has been split into two paragraphs. The changes are reflected in lines 626 – 635, page 26. The comment on corrected observed discharge has been responded to during the open discussion round.

Comment 34: Figure 12: Please also rework this figure.

Response: The figure has been reworked, and changes are reflected through lines 668 - 673, pages 28-29.

Comment 35: Figure 13: Please use different colors in the top and bottom plots to represent different locations. What represents the grey shaded areas precisely? Is this performance evaluation for this specific February 2022 event only or averaged values for all events? Please clarify.

Response: The figure has been reworked, and changes are reflected in lines 790-795, page 33.

Comment 36: L654-655: Are those your future steps or do you generally recommend this to others?

Response: The comment has been responded to during the open discussion round. Changes reflected through lines 843 – 845, page 35.

Additional Changes to the manuscript:

Some additional changes have also been made to the manuscript to improve the results and address oversights in the previous draft. Those are detailed below:

Change 1: Changes in abstract have been made to reflect the new analysis. These changes are reflected in lines 30, 32-34, page 1.

Change 2: In line 557 **Table 3 Summary of the Events used to evaluate the system.** The discharges reported on 14-02-2023 and 28-02-2023 were reported incorrectly. The correct values of discharges have now been replaced in the text. This error did not impact results since the mistake was made in the manuscript and not the dataset.

Change 3: In line 557 **Table 3 Summary of the Events used to evaluate the system.** The event of 23-02-2022 has been removed from the events evaluated. This is because this event had extremely large uncertainty and impacted the performance evaluation of the system. The reason for this uncertainty will be investigated in the future work. Since the current dataset is much small, an outlier event impacts the averages significantly. Therefore, it was decided to not include this event in the overall evaluation of the system.

Change 4: The section **2.2 Data** has been moved from lines 187 – 205 on page 7 -8 to lines 162 – 178, pages 5 – 6. This has been done to improve the flow of text and figures in the manuscript and avoid unnecessary page space wastage.

We are hopeful that these changes to the manuscript will be up to your satisfaction. We are thankful to your cooperation.

Best regards,

Kh Rahat Usman and co-authors.