Challenges in modelling ice floods on the Ningxia-Inner Mongolia reach of the Yellow River, China

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We would like to thank the Reviewer 2 for taking time in reading and suggesting modification to the paper.

Answers to specific comments of the reviewer follow:

Introduction:

The paper presents results of river ice regime research of Yellow River Ning-Meng reach. The authors chose for this study method of one dimensional modeling, this choice looks adequate to data availability. The paper has logical structure, contains good review of ice floods modeling, case study description. Authors described in details model set-up and model sensitivity and uncertainty analysis. Calibration of model YRIDM was carried out for winter season 2008/2009 and showed reasonable water level, discharge, water temperature, and ice cover thickness simulated results.

Authors' answer: We would like to thank the reviewer for evaluating the article as well-founded from the point of view of the objective and clarity of the presentation. We do address all the comments raised by the reviewer bellow.

General Comments:

There are some changes and remarks I suggest to take into account by the authors:

Comment 1: *Authors studied ice processes during cold season from November till April, and obtained and analysed results of water level, discharge, water temperature, and ice cover thickness modeling from freezing to break up of Ning-Meng reach. It seems, that name of the paper is better to change partly: change "modeling ice flood" on something like "modeling ice processes" or "modeling river flow and ice regime". Though ice floods took place in the studied area, and this research is important for further ice floods study, but the most part of this article devoted to ice processes and river flow modelling throughout all period with ice on the river, ice flooding is not described in details.*

Authors' answer: Thank you very much for this useful suggestion. The reviewer is indeed right and the authors proposes the change in title as "Challenges in modelling river flow and ice regime on the Ningxia-Inner Mongolia reach of the Yellow River, China"

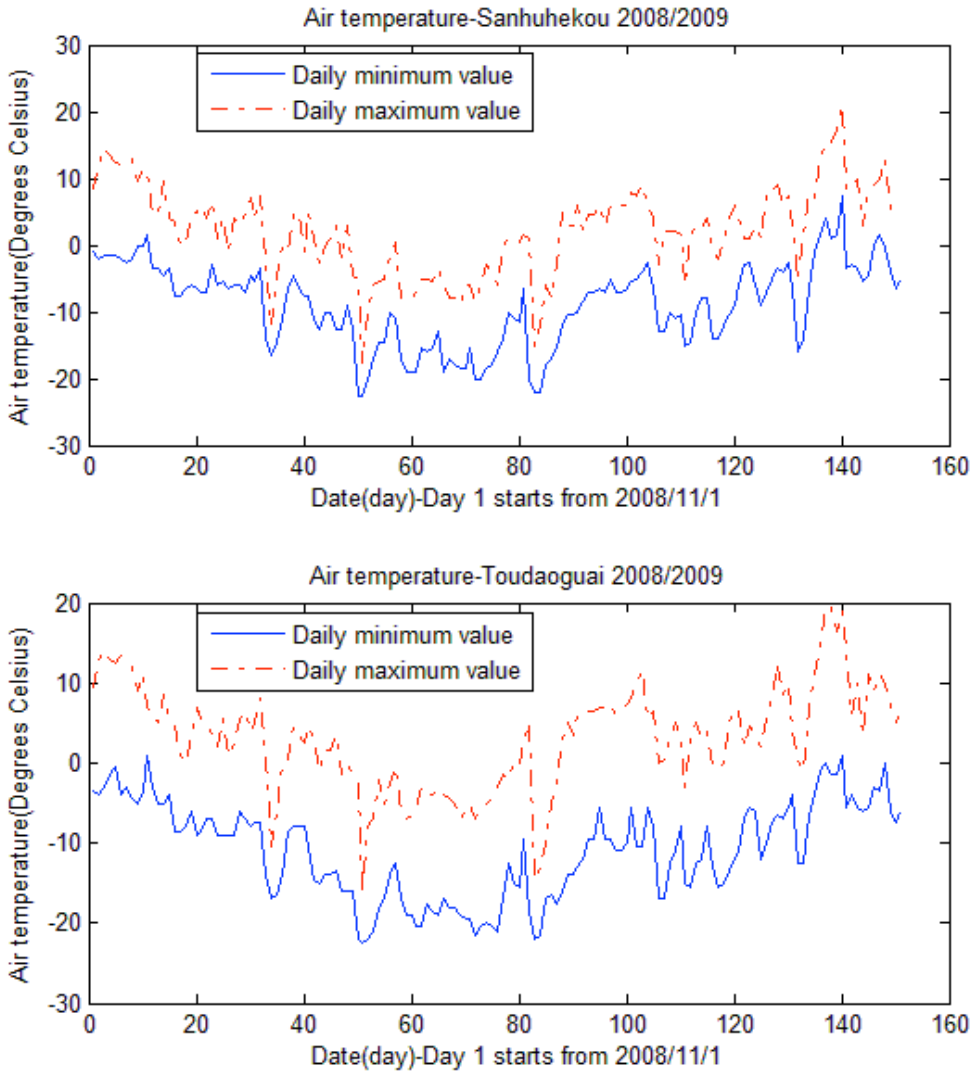
Comment 2: *Paper doesn't contain results of model verification, "the model verification cannot be conducted because the model cannot work when the water level exceeds the height of embankments". After detailed sensitivity and uncertainty analysis, which is showed, that some parameters are sensitive to water levels and ice cover thickness, it is very important to check the model behaviour on the data, which were not used for calibration. Is it possible to simulate part of the season 2007/2008 (till dike breach, which probably take place in spring time) or choose other season without such high flood for model verification?*

Authors' answer: Thank you reviewer for pointing out this. We are trying to solve this issue, however lack of data is our main issue.

Comment 3: *Model doesn't show good correspondence between observed and simulated ice thickness in the beginning and especially in the end of ice cover period (fig. 6 and 10).*

Because ice cover thickness in the spring is important characteristic for planning preventive measures against ice floods, some explanation of such results of modelling is necessary. It would be useful to add on one of the graph (with water temperature or with ice thickness) data about air temperature.

Authors' answer: Thank you reviewer for this important addition. We will add the requested data. We printed the air temperature here, but we will make it together with the ice thickness graph.



It can be seen from the results of the simulation that as from day 1 to day 60, the trend of simulated result is consistent with the observed one, but not good in terms of values, because the simulated ice cover thickness is affected by the initial condition.

As of day 125 till the end of simulation period the result are not good because the model could not simulate ice jam breakup during the breakup period. According to the observed data water level decreases suddenly, which indicates that the ice jam at the downstream of Sanhuhekou station collapses, however the model could not be used to simulate such a phenomena.

Comment 4: *It is not clear, calibrated bed roughness for different cross sections (N1, N2: : :N4,table 3) is varied in big range, are these values reflected different type of channel bed,or it is only calibration effect? For such case it is also very important to verify the model.*

Authors' answer:

The calibrated bed roughness for different cross sections is varied for a large range of values, i.e from 0.004 to 0.017. These values are provided by YRCC and reflects the four different types of channel bed of the modelled river reach.

The Ningxia river reach, which is 397 km long, starts at Nanchangtan and ends at Mahuanggou, in Shizuishan city. From Nanchangtan to Zaoyuan, on a 135 km, there is an uncommon freezing state of the river reach, because the bed slope is steep and water velocity is high. This state makes the river reach to be frozen up just during very cold winters. On the reach from Zaoyuan to Mahuanggou, on 262 km, on the other hand, there is a common freezing state of the river reach because the slope is gentle and water velocity is small.

The Inner Mongolia reach is located on the north of Yellow River basin and has a total length of 830 km. The reach is wide with gentle slopes, meandering twists and turns. Although it is located in the middle and lower Yellow River, its slope is close to that of the Yellow River Estuary.

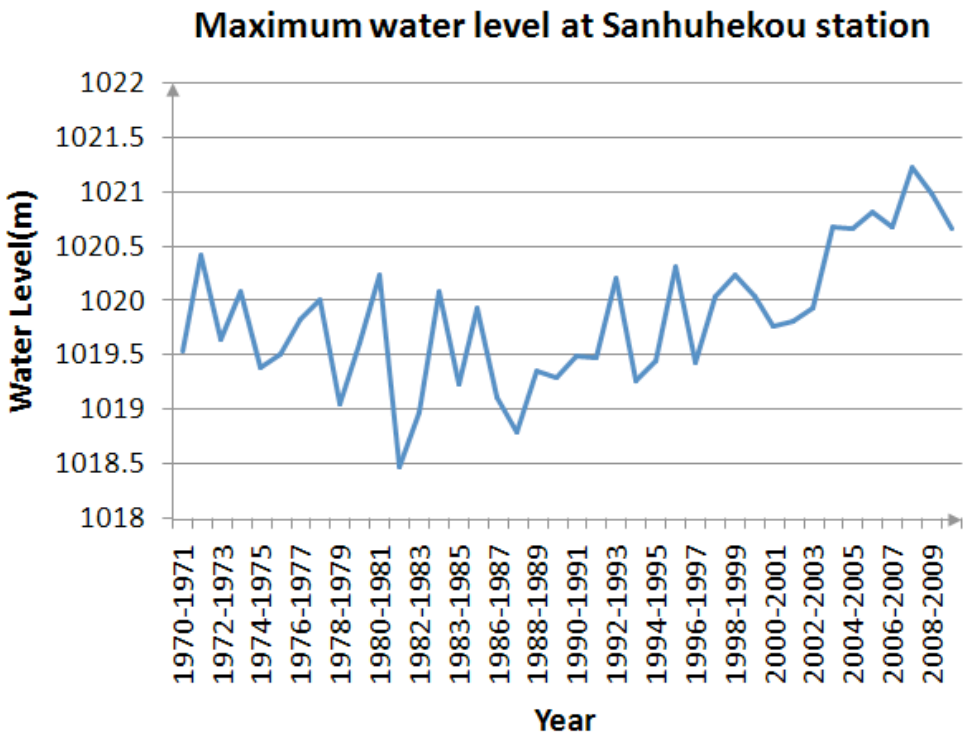
A summary of the slopes, width and roughness of these four types of considered reaches is given in the table bellow, which will be included in the final paper version

Table: Channel characteristics of Ning-Meng reach

Autonomous Region	Section	Channel Type	Channel Length (km)	Average Channel Width (m)	Main Channel Width (m)	Channel Slope (‰)	Roughness
Ningxia	Nanchangtan-Zaoyuan	valley type	135	200-300		0.8-1.0	0.005-0.014
	Zaoyuan-Mahuanggou	transition type	262	500-1000		0.1-0.2	0.005-0.014
Inner Mongolia	Mahuanggou-Wuda bridge	valley type	69.0	400	400	0.56	0.011-0.020
	Wuda bridge-Sanshenggong	transition type	106.6	1800	600	0.15	0.011-0.020
	Sanshenggong-Sanhuhekou	wandering type	205.6	3500	750	0.17	0.009-0.018
	Sanhuhekou-Zhaojunfen	transition type	126.2	4000	710	0.12	0.009-0.018
	Zhaojunfen-Lamawan	bend type	214.1	3000 -2000	600	0.10	0.002-0.010
	Lamawan-Yushuwan	valley type	118.5				0.002-0.010
Total	Nanchangtan-Yushuwan		1237				

Comment 5: *It would be nice to add in the part about past floods (p. 12302) information about observed range, maximum and mean characteristics of water levels, discharges Ning-Meng reach.*

Authors' answer: Please see bellow the chart with water levels, as per request. We will incorporate the graph in the new version of the manuscript.



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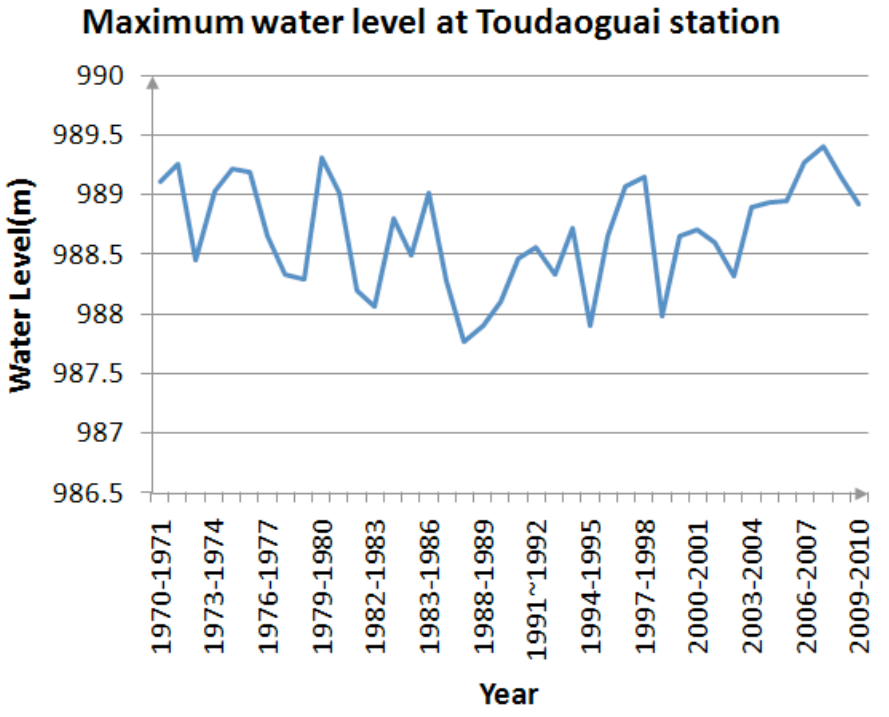

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3 Though two reservoirs were put in operation in 1960 and 1968, Qingtongxia and Liujiaxia
4 Reservoir respectively, ice flood disasters still occurred in 1993, 1996, 2003, and 2008 (Gao
5 et al., 2012). During the winter season 2007/2008, the water storage in the Inner Mongolia
6 reach reached the largest value, 1,835 million m^3, 730 million m^3 more than during the

normal flooding condition (1,105 million m^3). As a result, the water level at Sanhuhekou hydrological station reached a recorded level of 1,021.2 m, 0.41 m higher than any recorded level at the station, which led to dike-break at two sites, causing serious economic losses. During the breakup period in the winter 2005/2006, the water level at Sanhuhekou station reached 1,020.81 m, for a maximum discharge of 772 m^3/s.

Comment 6: Technical Corrections

6.1. *p.12310, line 12-13 -"ice cover thickness is 0,5786 m". I think, it is better to round off this value -"ice cover thickness is 0,58 m", and say, that simulated and observed ice cover thickness have the same values, because it is not possible to measure this characteristic in the field or calculate such precisely.*

Authors' answer: Thank you for pointing to us this, indeed it is a mistake of typing. We will correct accordingly.

6.2. *The same for axis X marks on the fig. 11, fig. 12 - it is better to round of the values of ice cover thickness.*

Authors' answer: Correction will be done accordingly.

6.3. *p.12310, line 9-10. "number of cases designed for the uncertainty analysis is 400, which is not sufficient". Which quantity would be sufficient?*

Authors' answer: Thank you for the comment, the phrase is unclear, we will rephrase it as : " Number of cases designed for the uncertainty analysis is 400, which is not always sufficient enough to show the characteristics of a model uncertainty. A higher number of runs will give a better overview of the uncertainty" .

6.4. *Table 1-3. Necessary to check, bed roughness in tables 1, 2 has range 0,019-0,045 and in table 3 has values out of this range - 0,004 - 0,017*

Authors' answer: Correction will be done accordingly.

Thank you for pointing to us this, it is a typing mistake. Values should be 0.004-0.045. We will correct accordingly.

All our responses to the questions raised by the referee will be included in the revised version of the manuscript.