Response to Comments of Referee #2:

Hou et al. offer a new high-resolution gridded water industrial water withdrawal dataset for China, covering the period 1965 through 2020. The dataset relies on industry data not previously adopted in national water withdrawal datasets for China, and thus offer a promising contribution for water resources studies.

Response: We would like to sincerely express our gratitude to you for your careful reading and constructive comments. According to the comments, we have tried our best to improve the manuscript, and an item-by-item response follows.

The method is unclear, with some very questionable assumptions, including:

1. **use of a constant water efficiency estimate from 2008 to extrapolate water withdrawal through time, not giving ample consideration to possible changes in industrial water use efficiencies and production per unit of water for each industry type since the 1960s.**

Response: Thank you for the comments.

We used constant water use efficiency and the resulting spatial-seasonal patterns of IWW in 2008 to downscale IWW in other years from 1965 to 2020, serving as a time-invariant pattern for downscaling. First, we made this choice mainly because of the data constraint since no data were available to calculate subsector water use efficiency for years other than 2008. This practice is not ideal but justifiable given the data limit and the practices adopted in other studies. Developing long-time series gridded data of IWW based on either a time-invariant pattern (e.g., H08, WaterGAP3, and PCR-GLOBAL) or patterns with decadal updates (e.g., Huang et al., 2018; Dong et al., 2022) for downscaling can be found in previous studies (Table R1). Second, industrial water use efficiency generally improved over time with the development of technology. This means that the temporal improvement in water use efficiency is likely to apply for all enterprises (Chen et al., 2019), while the spatial differences in water use efficiency of a given year are still determined by the spatial distribution of economic conditions which remain relatively stable over the years. The influence of long-term factors could be reflected through the changes in total IWW from statistical IWW data. For the above reasons, we chose the approach to develop the long-term gridded IWW data.

The dataset developed based on the time-invariant pattern of 2008 should be reasonably well for the recent ~20 years but may contain larger biases for earlier years. We added this important point to the manuscript to make the users aware of this issue so that they can choose the period of the data for their specific needs and accuracy considerations. In the revised manuscript, we added a more detailed discussion on using a time-invariant spatial pattern for long years IWW downscaling.

Table R1. Spatial pattern used for long-term data extension in previous studies

Spatial pattern	Long-term data	Used for	Reference
NASA Back Marble night-time light	1980-2016	Model (VIC-5)	Droppers et al., 2020

intensity map 2012-2016			
Distribution of urban population in 2009	1950-2010	Model (WaterGAP3)	Flörke et al., 2013
Global population distribution map and national boundary information in 2005	1970-2010	Model (H08)	Hanasaki et al., 2008
Global IWW map in 2000	1960-2001	Model (PCR-GLOBWB)	Wada et al., 2011a, b
Linear Interpolation based on GDP dataset in 1990, 2000 and 2010, same as 1990 before 1990	1971-2010	Model (CLHMS, the Coupled Land Surface-Hydrologic Model System)	Dong et al., 2022
Global population density maps with decadal updates (1980, 1990, 1995, 2000, 2005)	1970-2010	Water Dataset	Huang et al., 2018

2. **lack of units (e.g., unit of industrial output value?)**

Response: Thank you for the comments. We apologize for the confusion regarding the units of data variables. We have added the unit of industrial output value and revised the correctness of the units.

3. **unclear descriptions of existing water data used (the term "statistical data" is used throughout... does this mean "observed", "surveyed", "modeled" ...?);**

Response: Thank you for the comments. The statistical data for different variables could be collected through different methods.

We have supplemented the data types and sources as follows:

(a) 2.1.1 Surveyed data for industrial output value and water withdrawal

(b) The industrial enterprise dataset used in this study was from the Database of Chinese Industrial Enterprises in Mainland China from 1998 to 2013 (https://www.lib.pku.edu.cn/portal/cn/news/0000001637, last access: 18 May 2022), which is a surveyed dataset.

(c) 2.1.3 Surveyed data for monthly industrial product output

The monthly industrial product output data were from the China Industry Product Output Database (http://olap.epsnet.com.cn/auth/platform.html?sid=9C98BFB19A412FF66F744C2DA364ED5E_ipv473399501&cubeId=52, last access: 26 September 2021), which is also the surveyed data.

(d) 2.1.4 Statistical data and literature data for water withdrawal to extend long-term water withdrawal data

Provincial surveyed statistical data on IWW in China from the National Water Resources

Bulletin (http://www.mwr.gov.cn/sj/tjgb/szygb/, last access: 3 May 2022) from 2003 to 2020 were used.

4. **repeating seasonal pattern that fails to consider the important factors raised in the introduction, including weather and climate conditions changing though time.**

Response: Thank you for the comments. This is a good point.

The seasonal patterns derived from monthly industrial product output include signals of variations in climate and weather. For example, industrial product output for certain sectors could be affected by seasonal climate conditions and extreme weather events (e.g., production shutdowns or restrictions due to heat, thunderstorms, torrential rains, and other weather conditions). However, we acknowledge that climate change could affect the seasonality of industrial production and water consumption. For example, it is expected that a hotter summer increases cooling demands while a warmer winter reduces heating demands and thus affects IWW for energy production to some extent. However, we expect these seasonal changes would be slow and gradual, and their influence on IWW would be much smaller than the IWW increase driven by economic development. The seasonal and long-term climate change effects will be included in the yearly statistical IWW data. We added this supplement in the method section.

5. **Method must be described more clearly with all necessary details for a reader to reproduce the approach.**

Response: Thank you for the comments. We checked and revised the method section to clarify the key processes. Additionally, we will make the code and data open-access so that the readers can dig into more technical details and use them to reproduce our methods and results.

6. **The authors provide a limitations section that raises some of these problems. However, the assumptions lead to a dataset that fails to deliver on the stated goals of the manuscript--"a dataset with higher accuracy at fine scale." I would suggest either finding a way to extrapolate the more accurately, or reducing the ambition, so that the dataset not present water withdrawal from decades ago that is surely not credible given the assumptions used.**

Response: Thank you for the comments.

Our motivation for this work is that we realized that the currently available gridded datasets of IWW in China are those from global data which typically have poor performance at fine scales due to their methodology and data sources. Our data improve upon existing data in China mainly through two aspects: using spatial proxies that are directly relevant to IWW and localized statistical data sources for downscaling. Therefore, this study aims to develop a gridded long-term IWW dataset specifically for China with significant improvement upon other datasets at the local level to provide more accurate estimations of IWW. Following this suggestion, we revised the sentence in the abstract section:

"The CIWW dataset presented significant improvement upon previous studies in characterizing the spatial and seasonal patterns of IWW dynamics in China, ensuring consistency with statistical records at local scale."

To further validate the performance of the CIWW dataset, we added the spatial pattern comparison with the modeled data to the original comparison (Figure R1). Compared with the dataset from Huang data (Huang et al., 2018) and models data (ISIMIP2b Input Data-IWW-from 1901 to 2005, the average of three models (H08, PCR-GLOBWB, Water GAP)), our datasets is more consistent with prefecture literature data (Zhou et al., 2020), showing a much higher R2 (0.76, 0.47, and 0.56) and RMSE (Root Mean Square Error) (0.33 vs. 0.15 vs. 0.14 $10^9 m^3$) than Huang2018 data and model data. It means that the dataset improved industrial water withdrawal in China a lot.

Also, there are still uncertainties and limitations of the CIWW dataset. The dataset can be improved with better data sources in the future, especially early data. In the revision, we updated Figure R1 to Figure 2 and comparison results in section 2.3.

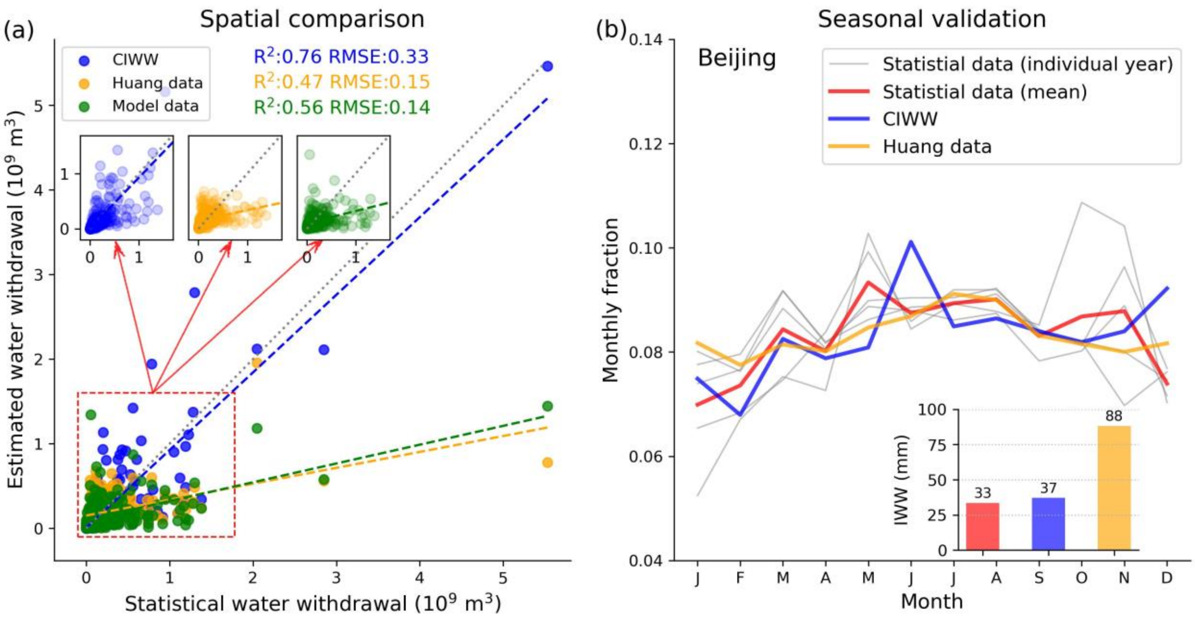

Figure R1 (Figure 2). Validation of CIWW data against statistical data for spatial distribution and seasonal variation. (a) The relationship between the mean IWW of 1971-2005 from literature data (Zhou et al., 2020) and CIWW, Huang2018 data (Huang et al., 2018) and model data (ISIMIP2b Input Data-IWW, average of three models (H08, PCR-GLOBWB, Water GAP) from 1901 to 2005) for 329 cities in China. The grey dotted line indicates the 1:1 line, and the colored dashed lines indicate the fitted lines. (b) The comparison of the 5-year mean (2006-2010) monthly variation in IWW from surveyed data (red, Long et al., 2020), CIWW (blue), and Huang2018 data (green) in Beijing. The solid grey line shows IWW for individual years from 2006 to 2010. The inset shows the annual mean total IWW from 2006 to 2010. For this comparison, CIWW was processed to the same spatial resolution of Huang2018 data at 0.5°.

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