RC1: Comment on hess-2024-72

The manuscript systematically elaborates on the knowledge system of key river. Among them, the key processes and algorithms has its further selection principles or unique applicability, and there is a detailed introduction. This is very important in the evaluation of knowledge system services and is more conducive to comparison between different studies. However, after overall review, there are still many doubts regarding the following:

Overall Comment:

(1) Formula Standardization

There are descriptive words in formulas 1, 2, and 3 in the manuscript. Please explain the variables and their meanings in a more explicit way (e.g. "where, x is ... " in Eq.3), and use a more explicit variable calculation form to present the "median" (Eq.3).

Thank you for your comments. We will refine and add further explanations for Eq.1-3 as follows:

For any discipline-issue network i:

$$DM_i = \frac{2C_d}{n(n-1)} \quad \text{(Eq.1)}$$

where DM_i is the Degree of Multidisciplinarity value of a discipline-issue network i, C_d is the total number of existing connections between any issue and discipline d in the network, and n is the total number of d in the network.

For any issue network i:

$$DI_i = \frac{\sum_n C_m}{n} \quad \text{(Eq.2)}$$

where DI_i is the Degree of Issue-connectivity of an issue network i, C_m is the number of adjacent connections to any specific issue m, and n is the total number of m in the network.

The Sen's slopes (Sen, 1968) were then used to measure the magnitudes of the trends as Eq.3:

$$d_{Sen} = \tilde{d}\left(\frac{x_j - x_i}{j-i}\right) \text{ for } 1 \le i < j \le n \quad \text{(Eq.3)}$$

where $\tilde{d}$ is the median value separating the higher 50% from the lower 50% of the indicator value x in the time series, i and j are adjacent time points, and n is the total number of time points.

(2) Structural Issues

Can the representation of the framework in Section 2 be considered as a preface to the Methods section? Among them, the density of the discipline-issue network and the calculation method for the degree centrality of the issue network are all in the Section 3. It becomes clearer whether they can be merged.

Thank you for your comments. We will integrate Section 2 into the Method section as a new Section 2.1, and consolidate the descriptions of the framework and relevant calculations about the discipline-issue network and the issue network in the new Section 2.1.

(3) Comprehensive Knowledge Structure

The selection of 72 river basins is mostly typical of river systems in various continents, and is also significantly influenced by human activities. And the information must also be relatively detailed, which is a necessary foundation for this research method. However, can the representativeness of social and policy analysis be highlighted based on existing analysis results? ("Abstract: ...Evaluating these structural characteristics against 6 impact indicators on society and policy, over 90% of rivers were found to had knowledge structures that strongly linked to societal impacts whereas only 57% were to the policy...") After all, the title mentions global river basins, but currently the intuitive feeling is to search for conclusions in large rivers influenced by humans, which always feels somewhat inappropriate. Please take above concern into consideration.

Additionally, why are there missing rivers in the North Asian region, such as the Ob River and Yenisei River basins? Will the North Asian rivers, which are relatively low in human activity, affect the relevant conclusions on policy and social impact in the abstract?

Thank you for your comments. The 72 river basins were selected based on those receiving the highest numbers of publications in the WoS database. We chose peer-reviewed publications in the WoS as our data source as it provides consistent, systematic documentation of scientific knowledge development across a broad range of disciplines for a long timeframe. At least one river basin in each of the continents was included for the spatial representativeness of this study.

However, we agree that there is a potential bias towards large river basins with societal and natural significance to be studied, and some rivers may not be included due to comparatively fewer publications in the WoS. For example, the Lake Baikal catchment was studied, which was a major part of the Yenisei River. We will clarify this in the method section and recognize it as a limitation in the discussion section.

In addition, we will change our title as "Impacts of science on society and policy in main river basins in the world" to better reflect the scope of the study.

(4) Support for key conclusions in the manuscript

The following sentence is an explanation of the key conclusions in the abstract ("Abstract: ...over 90% of rivers were found to had knowledge structures that strongly linked to societal impacts whereas only 57% were to the policy"). However, is the R2 the smallest among the 41 basins greater than 0.3, or is the mean of the 41 basins greater than 0.3? The R2 value is indeed a bit low, and the correlation explanation is weak; But it is possible that in such studies, more than 0.3 has already met the interpretive requirements. The manuscript can supplement the general situation of R2 in similar studies and compare the level of 0.3. To enhance the reliability of the conclusions of this article.

" The structural characteristics of the knowledge systems had been strongly linked to the society indicators with over 90% river basins had acceptable regression model fits, but much weaker with the policy indicators as only 41 river basins had two or more linear models that validated the relationships between their knowledge systems and the policy (adjusted R2 > 0.3, statistical significance p < 0.05). "

Thank you for your comments. The R^2 values in this study were estimated in each regression model for each river basin, and any models with R^2 values smaller than 0.3 were grouped into the 'unclear knowledge-society' or 'unclear knowledge-policy' pattern.

The threshold of 0.3 was selected based on studies in conventional statistical regressions (Ratner, 2009; Royston, 2007), which identified 0.3 to have "weak" explanation power between the knowledge indicators and society/policy indicators. Similar thresholds between 0.2 and 0.3 have also been found by correlations between knowledge, attitudes, and practices regarding environmental problems (Afroz & Ilham, 2020; Alias, 2019). In general, a recent meta-analysis (Hernanda et al., 2023) indicated an acceptable range for correlation levels to be 0.26 to 0.48 across 23 studies published from 1999 to 2022. We will provide this additional justification in the method section.

(5) Section of "Data and code availability"

(Only representing personal opinions) Compared to conclusive summaries, collecting and organizing information and making accurate judgments in the process will be more important. Can the manuscript be supplemented with information about the data or list of statistically analyzed in the article, in order to facilitate further research development or review during the evaluation process.

Thank you for your comments. We have provided an Appendix document, and will add additional explanations for each section detailing the data information and statistical analysis conducted to support the results in the manuscript. R codes used to generate the results were also commented and deposited in the public repository Github (https://github.com/SLWU423/Code-for-global-river-basin-science-policy-society-impact) for reproduction of the results and further research development.

General Comment:

(1) Image clarity

The text resolution in Figure 2-c is not sufficient to see clearly, and there is overlap with the 0-axis. Is the threshold for "low DM" or "high DI" in the manuscript Line 230~235) divided by the 25th and 75th percentiles in box boundaries?

The resolution in the all figures is not clear, especially in the form of coordinate axis subfigures.

Thank you for your comments. We refrained from introducing additional subjective bias to define a specific threshold value for DM and DI, and considered the comparative values of DM and DI among the 72 river basins. Therefore, the low and high DM and DI were determined by their z-scores:

For any river basin k, and any knowledge, societal, and policy indicator x:

$$\mathrm{x}_{\mathrm{k}}' = \frac{\mathrm{x}_{\mathrm{k}} - \overline{x_k}}{\sigma_k}$$

where x_{k}' is the z-score of any knowledge, societal and policy indicator of x_{k} , $\overline{x_k}$ is the mean value, and σ_k is the standard deviation.

Therefore, we determined the division between ‘low’ and ‘high’ scores by the zero value of z-score. A z-score above zero means that the DM or DI value is above the average value for all rivers, and therefore having a ‘high’ DM or DI. Similarly, a z-score value below zero will be considered having a ‘low’ DM or DI. This will be clarified in the framework in the new Section 2.1 and in the Result Section 3.1 in the revised manuscript.

We will also increase the resolutions and fonts for all figures for improved clarity in the revised manuscript.

(2) Optimization processing of Appendix

The table in the Appendix only requires quantity, and the proportion of 0.00% is the result of omitted accuracy. The number of columns can be changed to reduce pages (Table A1, Table A2).

Thank you for your comments. We will remove the proportion values and reformat all tables in Appendix A.

References:

Afroz, N., & Ilham, Z. (2020). Assessment of Knowledge, Attitude and Practice of University Students towards Sustainable Development Goals (SDGs). *The Journal of Indonesia Sustainable Development Planning*, *1*(1), 31-44. https://doi.org/10.46456/jisdep.v1i1.12

Alias, N. A. (2019). Correlation between knowledge, attitude, and behavior towards river pollution. *International Journal of Modern Trends in Social Sciences*, *2*(9), 31-38.

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Sen, P. K. (1968). Estimates of the Regression Coefficient Based on Kendall's Tau. *Journal of the American Statistical Association*, *63*(324), 1379-1389. https://doi.org/10.1080/01621459.1968.10480934