Dear Editor,

Thank you for the opportunity to address the one issue remaining from the reviewers' comments. As described below, previously we had not included a description to the earlier version as this was focussed on sediment tracing, not water source tracing, and we did not want to confuse the main message of our paper. However, we suggested that we could add some text if needed and this we have now done, as requested. We are very pleased that both reviewers have assessed the paper as having either good or excellent scientific significance and quality.

Below we provide the discussion background and a detailed response.

[Reviewer comments in black/ italic; responses in blue]

Referee #1 (Report #2)

Accepted as is. Excellent scientific significance and quality; good scientific reproducibility and presentation quality. No additional comments.

We are very grateful to the reviewer for their assessment of our paper.

Referee #2 (Report #1)

Accepted subject to minor revisions. Good scientific significance, quality and reproducibility, and good presentation quality.

Comment:

Thank you for effort making the changes as per the different suggestions you had received. However, during my review, I raised a concern regarding the novelty of the proposed CL model with tracing mechanism and inquired about the distinctiveness and innovations incorporated in the current work compared to existing ones. I found your response ("that is fundamentally different application - and science/coding issue") somewhat equivocal and not entirely satisfactory. Apart from this concern, I would like to acknowledge that all other queries have been adequately addressed, and I am satisfied with the overall quality of the work.

We are very grateful to the reviewer for their assessment of our paper and glad to hear that, with one exception, we have addressed all issues raised in the previous review. We thank the reviewer for highlighting their concern regarding a previous version of the model (CAESAR) which incorporated a form of sediment tracing that is not within the current version (CAESAR-Lisflood). We have sought to clarify the differences and have included a brief description, as below. The relevant comments from the original review and the response are included here for context.

Review comment (from 16 Oct 2022):

> *The wiki section of caesar-lisflood says "In the file tab - there are no additional boxes, but the tracer boxes have been removed. Tracer was rarely used yet added quite some complexity to the code, so for now has been removed." It looks like perhaps some earlier version of the model has already some sort of tracing mechanism with the caesar-lisflood model. If yes, how the current mechanism is different from the earlier one and why is it not even mentioned once in the manuscript?*
>
> *https://sourceforge.net/p/caesar-lisflood/wiki/Moving%20From%20CAESAR%20to%20CAESARlisflood/*

Response (from 9 Feb 2023; underline added to show quoted text):

> Here the reviewer has looked at the main CAESAR-Lisflood repository rather than the Zenodo site flagged in the paper that contains the updated water tracing code. As in our response to reviewer 1 above - we have modified and clarified the supplemental material containing the code and examples.
>
> To answer the reviewers question, an earlier version of CAESAR had a sediment tracing component for looking at the movement of contaminated sediment (see https://doi.org/10.1130/0091-7613(2003)031<0451:MLCIRS>2.0.CO;2) that is fundamentally different application - and science/coding issue.
>
> We have not addressed this directly in the text - as again we don't want to confuse the main message of the paper (and the reviewer found outside of the paper supplemental material). However, if the editors wish this to be addressed we can add a sentence outlining/clarifying previous tracing functions.

The review comment refers to the CAESAR-Lisflood webpage which provides user advice for moving from the earlier CAESAR model (focussed on sediment transport, steady state flow assumed, designed for simulation long term landscape evolution) to the current CAESAR-Lisflood (combined sediment transport and unsteady flow model). The key differences in the approaches are described in detail by Coulthard et al. (2013). The focus in the current paper is on tracing of water sources using the hydrodynamic model, independently of sediment routing. This would not have been possible with the CAESAR model due to its steady state flow formulation, as Coulthard et al. 2013 acknowledge. However, for completeness, we acknowledge that a reference to the earlier approach for sediment tracing would be useful.

On L44 of the manuscript, we have included a new paragraph to describe the previous work from Coulthard and Macklin (2003), and highlighted the difference with the approach here:

> In earlier work with CAESAR, Coulthard and Macklin (2003) demonstrated how sediment eroded from mining waste deposits could be traced downstream. The model worked by including different types of sediments which were used to represent contaminated and uncontaminated sediments as separate arrays for each sediment diameter included; during erosion and deposition of different sediment sizes, equal proportions of contaminated and uncontaminated sediment were transported. This enabled the prediction of patterns and levels of floodplain contamination, over a period of ~400 years. However, the approach was limited to sediment tracing only and did not account for different sources of water, which may carry contaminants with it. As noted by Coulthard et al. (2013), the inclusion of an unsteady flow formula within CAESAR-Lisflood has enabled the possibility, for example, to simulate water balances and solute fluxes using the model code. Here, we present the formulation of a simple methodology to enable this functionality by accounting for the source of water within model cells throughout the simulation.
>
> We use only the hydraulic and hydrological functionality of CAESAR-Lisflood to demonstrate the tracing method and visualisation of water sources, independently of sediment routing. We have used CAESAR-Lisflood for this purpose… etc.

We hope that this sufficiently clarifies the differences between the two approaches.

References:

Coulthard, T. J., & Macklin, M. G. (2003). Modeling long-term contamination in river systems from historical metal mining. *Geology*, *31*(5), 451-454.

Coulthard, T. J., Neal, J. C., Bates, P. D., Ramirez, J., de Almeida, G. A., & Hancock, G. R. (2013). Integrating the LISFLOOD-FP 2D hydrodynamic model with the CAESAR model: implications for modelling landscape evolution. *Earth Surface Processes and Landforms*, *38*(15), 1897-1906.