Comment on gmd-2021-340
Anonymous Referee #1

The paper presents an algorithm that allows water source tracing and visualisation of water sources for flood inundation. The algorithm and concepts are outlined and described clearly in the paper, and each step of the process is easily understood through the text. The uses and implications of the algorithm that involve contaminant tracing or how inundation water quality is affected by different sources is also briefly discussed but could have been further emphasised in the paper. Having three case studies of varying sizes, flood mechanics and origins, and timescales was good since it showed the algorithm's flexibility. Overall, the paper is well-written and the algorithm contributes further to the field of floodplain inundation modelling. I would recommend it for publication with minor revisions through adding some additional information to the introduction and discussion, and improving the presentation of some of the results.

Introduction

The LISFLOOD-FP model is briefly described in the introduction (purpose, use, representation of floodplain). The CAESAR model is also mentioned (P2, L33) but it does not get a similar description. It would be good to see a few lines describing the CAESAR model so the reader knows its purpose within the CAESAR-Lisflood model.

It would be good to see a brief review of previous work around tracing flood water sources in flood models in simpler schemes like LISFLOOD-FP. P1 L21-22 says that this ability is presently missing from reduced-complexity models, so have there been other papers that have tried to represent water source tracing in floodplain inundation models?

Methods

P4 L88-89: “Thus, fractions from sources where water is added to the cell are adjusted upwards, while fractions for non-source volumes are adjusted downwards.”

- Why? What would be the physical basis behind this?
What are some of the advantages and limitations when four flow directions are considered? Would using the D8 or D-infinity representations of flow direction meaningfully affect the final results?

**Results**

For the final layout of the paper, can the maps and graphs for each case study be placed closer to the text of the case study? The UK results are fine, but the NZ and Brazil results are placed further and further from their respective sections. It would be better for the reader if the supporting maps and graphs were closer to the text.

The inundation maps (Fig 5, P13; Fig 7, P16; Fig 9, P19) show a very good overview of where the water sources for the inundation are coming from and how they are mixing. Would it possible to have a scale or legend item showing their respective depths? The text specifies that the darker colours represent deeper depths, but a darkness-depth scale/legend item for the individual colours would be useful.

P14 L220-224: This section outlines the implications of knowing where water that is likely to contain pollutants is being deposited, and its effects on environment and human health. This discussion can be further expanded as this is a very important issue for water resource management. The abstract could also be updated to include one sentence or so about how the algorithm contributes to the mitigation/assessment of water quality issues.

Similar to the New Zealand application, does the Brazil application also have similar water quality issues? Do the Solimões and Purus rivers have similar or differing water quality and how would it affect downstream processes? Have there been water quality issues associated with flooding in the New Zealand and Brazil case studies?

Although the processing time for the case studies is not comparable because of their differing timescales, it would be nice to have a summary table/overview of the three case studies taking about modelling domain size, grid size and number of cells, timescale, time taken to run the simulation, etc.

**Discussion**

As mentioned previously, it would be good to see discussion about the advantages of considering four flow directions, and if there would be significant changes if the D8 or D-infinity flow directions are incorporated into the model.

It would be good to have more discussions about the implications for water quality/contaminant issues on the environment health and human health, and how the algorithm can contribute to the mitigation of water quality issues. It helps underscore the contribution of the algorithm to modelling and to water resource management.

**Testing the model**

Please see the supplementary PDF for my notes about testing the model. I encountered some problems with running the Planar Test Case and the supplementary PDF shows the screenshots I encountered.
Please also note the supplement to this comment: