The submitted manuscript presents a framework to study sediment dynamics under a particular experiment condition using existing particle tracking software (TracTrac) and an in-house post-processing algorithm. The manuscript is centered on technicality (parameter settings in TracTrac and the post-processing algorithm), not the meaning of their finding in the context of Earth surface dynamics. The current presentation style seems to me better suited for other technical journals (e.g., *Experiments in Fluids*), not *Earth Surface Dynamics*. The manuscript often reads as a software manual rather than a scientific paper. Also, the application of their proposed method is validated under limited conditions and interesting sediment dynamic results are only from green particles. The submitted manuscript requires major revision prior to publication. During the revision, I strongly recommend the authors focus on presenting how their results contribute to a better understanding of sediment dynamics and their geomorphological impact on rivers. I also recommend quantifying and reporting scalability and generalizability of the proposed method. Below are my specific comments.

Major comment

1. The parts that readers of *Earth Surface Dynamics* would be most interested in start from L399 on page 18. Before that, the manuscript focuses on parameter selection, associated validation, and descriptions of the particle detection algorithm. I strongly suggest shortening those parts before L399 (putting some content in the supplementary information document or making it concise).
2. The most interesting findings of the paper (Figure 10 & Figure 11) come only from the green particles, as the particle motion detection algorithm most reliably works for the color. However, the results from the green particles are not scientifically intriguing or sufficient to be presented in a scientific journal. I suggest the authors expand their analysis to other colors (orange and pink). It would be particularly interesting to know how the particle dynamics of the orange and pink colors differ from the green ones and whether there are particle interaction mechanisms that have not been reported in the literature. You can provide uncertainties associated with the errors in your tracking algorithm for orange and pink particles.
3. As the authors acknowledge in the discussion section, my biggest concern about the proposed algorithm in the submitted manuscript is its generalizability and scalability. If users need to conduct fine-tuning of the proposed detection algorithm each time under different flow conditions and particle composition, the adoption of this new technique will be discouraged. Are there any publicly available field or laboratory datasets where you can apply your algorithm and demonstrate its generalizability and scalability?

Minor comment

- Please avoid using “novel” throughout the manuscript. The originality of your technique should be able to stand out without this term.
- **Abstract**
    - Grammatic errors or typo

        - L12: flume experiments -> a flume experiment
        - L17: were forming -> were formed

- **Introduction**
    - L83: it is not clear why the blob detection algorithm is better than existing algorithms and was selected for the study.
    - Related to the comment above, please consider providing a table that summarizes existing tracking algorithms and their limitations. This would allow the advantage of the blob detection algorithm to stand out and provide justification of its usage.
    - L95: the camera above the water surface is prone to distortion induced by light reflection (or deflection) on undulating water surface, also by light source. This part is less relevant to introduction. Please relocate it to the experimental setup and elaborate in depth.
    - Grammatic errors or typo
        - L56: easir -> easier
- **Methods**
    - L106: A 2-year return period discharge often represents bankfull discharge. Also, the slope of 1.5% seems significant. Are there any reasons to select this condition?
    - L104: 106: Please provide other important key experiment parameters: cross section averaged velocity, water depth, Shield number, Froude number, Reynolds number.
    - Please provide details on how sediment is fed. Was it recirculated? Or just continuously fed upstream?
    - L114-117: Please elaborate on sediment composition setup in the experiment. The experiment allows coarse sediment to cover a bare bed mimicking clay till. Such co-existence of two sediment classes seems unique and requires justification.
    - L122-123: Have you conducted any testing on the installation height of the camera and light?
    - L146: Was it visually observed? Froude number can indirectly indicate the magnitude of the undulation of the water surface.
    - L164: Figure2 -> Figure3.
    - L166: Figure2a -> Figure3a.
    - L168: Figure2c -> Figure3c.
    - L175-245: I'm unsure how many readers would be interested in reading all these details about somewhat subjective selection of parameter selections. I wonder whether it would be worth shortening these subsections and moving the information to the supplementary information document.
- **Results**
    - L270: Please define the blob scale and the peak neighbors when they are introduced.

- Figure 6 & Figure 7: Please ensure you have the correct figures and captions. Figure 6 says it is blob scale, but the caption says peak neighbors. Vice-and-versa for Figure 7. In both captions, also define n is the number of identified particles.
- L299-300: Is there any way to quantify this tracer percentage fraction-induced error and determine it in advance?
- L296-336: Please rework this paragraph. From my understanding, the relative frequency is the ratio of the estimated mass of each particle class to the actual mass based on size distribution. Please define it in simpler language, as it is a bit difficult to follow. Also, start the paragraph by explaining why this parameter is important. In addition, provide reasons for overrepresentation of the green particle, as it is not obvious to me.
- L338: shown in Figure ** -> Figure 2a
- Figure8: change the label name from hour min to min to be consistent with the text.
- L343-344: rework sentence “To verify, the cases where particles were detected automatically but not manually were reviewed”
- L339-363: please relocate this content to the validation section, including Figure 8. Also quantify and provide errors associated with manual and automatic detection. Or place this content in the supplementary information document.
- L373-398: please relocate this content to the validation section, including Figure 9. Or please place this content in the supplementary information document.
- L399-424: please rework this paragraph. My interpretation of Figure 10 is simple. The green particles laterally migrate from the far side to the near side over time, demonstrating formation of alternating bars. The text is overcomplicated.
- L399-424: The description of particle movements for one sediment class is not scientifically interesting. Please consider adding more analysis on how the particle movements differ among each sediment class and whether there are any interesting interactions between sediment classes. This would be more suitable for a scientific journal, rather than simply demonstrating how your algorithm works.
- L403: Figure 11 -> Figure 10.
- Figure 10: please avoid the green color legend for the time to prevent comfusion.
- Figure 10: please use the same coordinate you introduced in Figure 1 (x & y distance) instead of pixels.
- Figure 11: please add explanations why the narrow corridor (50min) becomes wider (70min & 90min) and narrower (110min).
- Figure 11: please replace the time format from hour min to min for the sake of consistency.

- **Discussion**
  - Please introduce subsections for your discussion points.
  - L465: different than -> different from

- L474: based on your introduction paragraphs, it does not seem your work is the first to use UV lights and fluorescent paint for particle tracking. Please modify the language.
- L460 – 478: This is a summary of your work, not relevant for the discussion section. Please relocate it to conclusion.
- L480: bedform -> alternate bar
- L505-506: Please provide quantitative values for particle densities, bed cover scenario, and discontinuous data.
- L509: what is “partial sediment transport”?
- L515: current videos -> our videos

- **Reference**
  - Please provide doi or link for each reference for easier access.
  - References are also not easily distinguishable between lines.