

Dear Editor,

Please find enclosed the files corresponding to the revised version of the manuscript titled *SERGHEI v2.1: a Lagrangian Model for Passive Particle Transport using a 2D Shallow Water Model in SERGHEI* (ref: egusphere-2025-722). The manuscript has been modified and improved according to the reviewers' suggestions. The specific ways in which their comments have been addressed are listed below.

Best regards,

The Authors

Reviewer 1

The authors exhaustively answered previous comments, improving the paper clarity. Unfortunately, Figure 14 is not visible in the present version, and there are some formatting typo (e.g., line 384). Please, check and correct such issues.

ANS: The authors thank the reviewer for the positive comments. We apologize for the formatting issues in the marked revised version. These issues (see images below) were caused by the difftex process, which introduced formatting typos. Importantly, these typos do not appear in the unmarked revised version, where Figure 14 and the rest of the manuscript are correctly displayed.

380 **4.4 Example application: surface runoff in the Arnís catchment**

The implemented Lagrangian model may have applications in ecohydrology, such as seed, pollutant, or nutrient transport. Consequently, a case involving a precipitation event over the Arnís catchment (see Figure 14a) was simulated to show the potential application of this model. This catchment is located in the Borau valley (Northern Spanish Pyrenees). In the last decades, this region has been an area of exhaustive study of different hydrological processes (Lana-Renueth et al., 2007; García-Ruiz et al., 2007; Lana-Renueth et al., 2007; García-Ruiz et al., 2005). Physical processes such as rainfall, infiltration, runoff generation, and gully formation have been simulated in detail using various methods (López-Barrera et al., 2011; Fernández-Pato et al., 2016; Vallés et al., 2024). The primary objective of simulating this case was to assess its potential utility in environmental applications. Information derived from conservative tracers and field experiments measuring isotopes in water has been widely used in hydrology to characterize hydrological pathways and connectivity, with ideas such as transit or residence times, and travel time distributions (Benettin et al., 2022). Here, we show a minimal example of how analogous ideas can

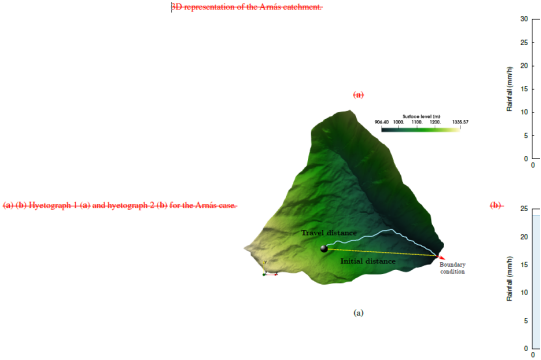


Figure 14. States for 3D representation of the particles trajectories at Arnís catchment, including the middle-travel distance and the initial distance (a), and hyetographs of precipitation event 1 (a) (b) and event 2 (c) for the end-of-Arnís case.

Reviewer 2

I have read with care the new version of the paper and the point-by-point response to my earlier comments. In general, the authors have satisfactory responses for them and have made the necessary changes in the text. However, I still have a suggestion related to my previous comments 8 and 9. In those comments, I remarked that “test cases” in Sections 4.2 and 4.3 were not really used to analyze the accuracy of the numerical schemes and the algorithm implementation, which is stated as a primary objective. The author’s response was that, in particular, for the case in section 4.3, it was not a “formal verification benchmark”. Hence, I would suggest that the authors rephrase the sentences in lines 5-8 and 71-76. It would seem to me that the primary objective of this paper is to introduce the capabilities of this new Lagrangian particle model and that, as part of that, you analyze the accuracy and computational efficiency of the numerical schemes and algorithm.

ANS: The authors thank the reviewer for the positive comments and for the suggestion. Following the recommendation, the text in lines 5-8:

The primary objective of this work is to analyze the accuracy and computational efficiency of the numerical schemes and the algorithm implementation for particle transport.

has been revised to:

The primary objective of this work is to present the capabilities of the new Lagrangian particle model, while also providing an analysis of the accuracy and computational efficiency of the numerical schemes and their implementation for particle transport.

Similarly, the text in lines 71-76:

The primary objective is to analyze the accuracy and computational efficiency of the numerical scheme and the algorithm implementation for particle transport.

has been modified to:

The primary objective is to present the capabilities of the new Lagrangian particle model, together with an accompanying analysis of the accuracy and computational efficiency of the numerical scheme and its implementation for particle transport.

These modifications clarify that the main goal of the paper is to introduce the new Lagrangian particle model, while also providing an analysis of the numerical schemes and algorithm implementation, in line with the reviewer’s suggestion.

In addition, I have a couple of minor comments:

Line 196. Change “articles” to “particles”.

ANS: The authors thank the reviewer for the observation. The typo has been corrected.

Line 247. It reads “The turbulence term can displace the particle vertically upward relative...”. I was confused there because the particles are always on the “surface”, so there should be no vertical motion caused by the turbulence. Could you clarify/correct?

ANS: The authors thank the reviewer for the observation and apologize for the misunderstanding. As noted, the particles are always on the water surface. The paragraph has been rephrased for clarity:

The dispersion term can relocate the particle horizontally across the surface, and if this displacement places it in a dry cell with a higher elevation than its previous location, the particle undergoes an unphysical "jump" in its trajectory. This arises because dispersion terms depend on friction velocity without properly accounting for flow direction constraints.