Thank you to both reviewers for detailed and constructive comments. The reviews identify a need to clarify the research question and intent, carefully distinguish transport capacity from actual transport, revisit the reasons for spatial presentation of the results, and improve the presentation of equation and methods.

This combined response addresses the issues raised in each review, and proposes two additional analyses and a focused reframing of the research question and contribution.

Research question and scope

We seek to understand how spatially-resolved substrate data changes the calculation of sand-transport competence and deficits on a braided riverbed, which varies both in morphology and composition across a wide area. The specific advance is the use of spatially-varying substrate data at scale, which required both detailed 2D hydraulics to resolve at the local scale, and a way to aggregate the result to the larger scale without the additional step of sediment routing. Instead, we focus on finding areas of competence and deficit, and compare it to the simpler setup where we do not have spatial bed data.

The spatial distribution matters because an assessment based only on the main channel(s) or spatially-averaged hydraulics can obscure the fate of low-capacity side channels, backwaters, and marginal environments that are considered critical, sentinel habitats. High transport potential in one area does not demonstrate the behaviour, under potentially subtle flow changes, of these marginal areas.

The fixed-bed framework is deliberate, holding the surveyed morphology constant alongside the snapshot of substrate. The experiments are therefore numerical, varying the degree to which we use the spatial data and replace unknown parts of the riverbed. We can only demonstrate the change in potential transport capacity, not evolve the bed. We agree with Reviewer 2 that bed response is inferred from changes in competence rather than demonstrated by the model and will state this explicitly. Comparisons between flow regimes use the same surveyed terrain and are not predictions of the bed that would develop under each regime. At the scale of the full study reach, we treat the gravel framework (slope and braiding characteristics), as statistically likely to continue in its diversity rather than assuming that individual channel forms remain unchanged, which motivates the large spatial scale of the surveys.

We will also define the sand-sized sediment focus earlier and consistently. The analysis focused on the observed sand fraction on the bed and in suspended samples; similarly in response to Reviewer 1, further details on the suspended sediment data collected by others will be presented or refererenced if published in time. The study's motivating focus on sand was based on the concerns over accumulation in side channels and marginal environments, but also with the ability of the facies mapping to distinguish sand-rich surfaces (compared to the subtle textural difference of gravel sizes). Gravel transport is relevant, but not the principal question of this paper.

Spatial interpretation and circularity of analysis

Reviewer 1 asks whether the maps add any information beyond accumulated shear stress forced by morphology; Reviewer 2 identifies that the 'best' model is circular in its presentation, using observed sand facies both to force the transport equations, and comparing result to the same map. We agree that the additional analysis suggested by Reviewer 2 would better demonstrate independence of the model to the bed map. We propose to retain a reduced set of

maps, because the different morphologies of potential deposition are one of the key exploratory reasons for the model (bar tops, backwaters, dry braided channels, at different discharges, can all be depositional).

The first additional analysis will use selected uniform sand fraction scenarios from the existing sensitivity tests, and compare their predicted deficit pattern with observed sand occurrence. The comparison will use the common inundation footprint, excluding areas with no mapping, and report concordance with a confusion matrix together with an aggregated by flow enrichment ratio. This will show, statistically and spatially, whether observed sand is more prevalent in areas predicted by the model without using the map of observed local sand fraction as an input. A concise large scale summary will go in the main paper, supported by a local-scale explanatory comparison in the supplement.

The second analysis will briefly address, with two additional sensitivity tests, Reviewer 2's concern that the sediment supply uncertainty has received less attention than bed-related parameters. We will test sand fractions of the incoming load at 30% and 50%, above and below the presented 40% ratio, not repeat the entire experiment, and carry the sensitivity through to the reach-scale comparisons to determine whether the 'moderate flow bands' we identify as critical remain consistent, and whether the spatial concordance patterns change.

Hydraulic model evaluation and presentation

We will make the hydraulic calibration and evaluation more explicit, by providing a table first showing the model's roughness calibration, as well as a high-flow inundation comparison with a PlaneScope image of the next flow event after the survey. The comparisons between the flow library approach and an unsteady simulation will be retained and clarified that these test the approximation central to the efficiency of the method, which is a secondary model-to-model step after the primary model calibration to observations.

Local supply, limiting assumptions, and data aggregation

We will respond here and clarify in the final manuscript to review comments regarding the aggregation of local transport deficits into a reach-scale comparison. We accept that using three points are not representative of the diversity of different zones, but the aggregation method was an attempt to recognise this diversity rather than average it out, and it does not rely on river width or evolving sand supply. With a constant sand concentration in kg m^{-3}, the local mass flux per unit width is $Cs\ u\ h$, in kg s^{-1} m^{-1}. No width is assumed, but locally defined by the grid discretisation and flow library. At the three demonstration locations, the prescribed concentration is the same for a given whole-river (upstream) discharge, and the local supply flux differs because $u\ h$ differs. We will clarify that the locations are just demonstrations, not meant to represent all such morphologies.

The integration at reach scale requires this standardisation of concentration because we do not take the logical step of sediment routing and concentration evolution at scale. Within each 1 km reach polygon, unit-width sediment fluxes are integrated over representative cell widths and normalised by the ratio of the similarly summed water flux to the known river discharge. The suspended sediment equation's contribution is capped at the prescribed local supply, before aggregation. This prevents the high suspended transport potential in large energetic channels

from being overcounted as capacity available to offset deficits elsewhere. It is the deficits that we are attempting to sum, and is a diagnostic assumption stemming from the lack of concentration advection. Bedload capacity remains an additional potential transport term. The net reach-scale balance can then coexist with local capacity deficits. We will distinguish the framing more specifically as a deficit-aggregator. We will also revise the maps and transport histograms with correct units and avoid interpreting the results as potential bed-elevation changes.

Equations, presentation and interpretation

We will distinguish corrections to printed equations and notation from assumptions requiring physical justification. Presently identified corrections to the text include the logarithm notation, the sign of the exponent in the Grams-Wilcock inversion, and the density term in the WC equation. The grain-related roughness assumption and the bedload behaviour at shallow inundation will be checked and sensitivity-tested.

The revised maps and figures will correct figure labels and units, define 'moderate flow' consistently, and distinguish percentage points from percentage change. Figure 2's stacked areas will be retained with more explicit definitions of components and annual load per unit discharge units. Some of the repetitive sensitivity plots in the discussion section will be replaced with the analyses mentioned above, covering concordance. We will also explore additional explanatory processes for longitudinal patterns, such as local sediment sources, abrasion, and vegetation trapping, but will retain our focus on longitudinal, reach-scale changes in transport deficits under different assumptions. We will also bring in relevant recent literature. In particular, Trevisson and Eff revisit the cobble-sand hiding and erosion balance with protrusion where we relied on inversion of the Grams and Wilcock papers.

Comments on sediment routing and subsequent work

The present study focuses on transport competence, and its deficits, on an observed bed. Sediment routing, storage, and remobilisation are beyond its scope. Omitting them isolates the effects of substrate knowledge as convolved with hydraulic forcing. Our ongoing development of a width-resolving sediment routing framework, introduced in Rogers and Brasington (2026), is the attempt to move past this limiting assumption. We mention the progression briefly to clarify the goal of the present study, which was to address 2D spatial questions about competence under different flow regimes.

References

Trevisson, M, and Eiff, O.. "Near-bed hydrodynamics controlling fine-sediment erosion over immobile coarse-grained beds." *Journal of Fluid Mechanics* 1045 (2026): A37.

Rogers, J.M. and Brasington, J. (2026). Adapting CASCADE for braided rivers: A 1.5D sediment transport approach with variable substrate and width. *EGU General Assembly 2026*, EGU26-15789. doi:10.5194/egusphere-egu26-15789. Conference abstract.