Review of the manuscript "Sediment transport capacity in a large braided river: integrating substrate mapping with flow scenarios" by J. M. Rogers, J. Brasington & J. Hoyle submitted for publication in EGUsphere.

Major comments

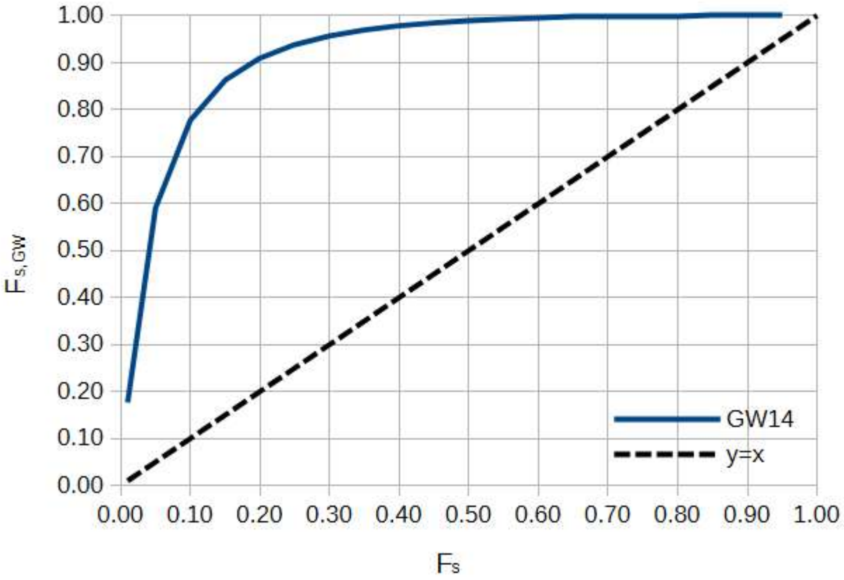
- The present paper introduces a hybrid methodology using spatially-distributed models of bed substrate based on remote-sensing observation and hydraulic modelling to study the sand fraction dynamics in a large braided river. A huge work has been done but it needs to be more synthetic. The paper is quite long with some figures not so useful. Also, since the objectives of the paper are not very clear, it is somehow difficult to follow.
- The authors need to better define what they call "fine sediments". As far as I understood, they exclude (ignore) silt and clay fractions and focus on the sand fraction.
- The calibration and validation of the hydraulic model is not clear. First, the authors should better describe data used (date of the event, discharge when aDcp measurements were taken, etc.) as well as the 23 discharges modelled. More details on the calibration of α is needed, at least in the supplementary materials.
- One of the major problems with this approach is that it assumes a fixed river channel and steady flows, whereas braided rivers are highly dynamics, fine deposits closely linked to the flow times-serie and morphology. Furthermore, morphodynamics and GSD are closely related. This point is addressed in section 5.4 but it is actually rather difficult to assess the validity of the present results given these limitations. Eventually, I think you could skip the discussion on potential sand erosion or deposition (Fig. 8ac, Fig. 12ac). Given all the assumptions made (and particularly the assumption of a constant sand supply in space and time for a given discharge), they only correspond to a spatial distribution of the bed shear stress (high in channels → erosion, low over bars → deposition), and so don't have so much interest compared to the complex phenomena observed. I suggest that the authors focus this study on the overall (spatial) assessment of sediment transport in a complex river system (multiple channels, variable GSD).
- A significant effort is needed to present the model's equations more clearly in order to clarify all the assumptions (many typos). In a similar way, the methodology is not always presented clearly; some improvements are required. I suggested numerous small corrections (minor comments) but stopped checking sections 4 and 5.

Minor comments

- L20: It seems a little bit awkward to discuss hiding and exposure formulations without discussing sediment transport capacity formulations
- L32: no comma after "hydraulics"; more recent references would be useful (after 2018)
- L35: Define "fine sediments"; as far as I understand, you mean the "sand fraction" and exclude silt and clay
- L40: Note that recent advances in GSD mapping remain limited to surface GSD, which can be different from subsurface GSD (Deng et al., 2024)
- L65: Again, any references after 2018?
- L67: "sediment transport"
- L69: D_{50} (variables in italic, math mode)
- L80: What do you call "quasi-2D models"?
- L81: "key local processes"
- L85: "sediment transport capacity"
- L100: This paragraph should be introduced earlier, including a clear definition of fine sediment
- L120: "increasing fine sediment deposits/quantities" (?)
- L148: Geomorphic sections are not presented in Fig. 1
- L156: "25 km"; Please locate the Klondyke gauging statino on the map Fig. 1

- Fig. 1: Use proper arrow fors “Ab.” and “Br.”; In the figure caption: “(Water abstraction -Ab.- and bridges -Br.-)”
- L165: Be consistent with notation: m^3/s or m^3s^{-1} ?
- L168: Mean value is sufficient (skip the median value)
- L171: Three times median flow
- L179: Ok but you should be clearer about the data collected (location of the sampling on the side of the river?, surface sampling? etc.), the sample GSD, and overall uncertainties of these data
- L180: Turbidity is very sensitive to grain size. What about uncertainties here (Navratil et al., 2011)?
- L182: Discharge of the larger flood ?
- L184: This sand fraction percentage could be much lower for relatively low flows (below 100 m^3/s approximately) even if it should be negligible in term of average sand load.
- Fig. 2a: If it is an example of flow time series, the date should be provided
- Fig. 2b: It would be more readable to present the flow duration curve as a probability of exceedance (in the log scale); Are these curves based on daily averaged discharges or hourly averaged discharge?
- Fig. 2c: Unreadable. Do you consider a fit of turbidity to the data, i.e. $C_T = 0.6T$ (T : turbidity). Are you considering total suspended sediment concentration for the samples ? What do “sand@40%” and “With RDR” curves corresponding to?
- Fig. 2d: Unreadable; use lines rather than filled plots; Since the flow duration curve reaches 2000 m^3/s, this plot should go till 2000 m^3/s as well. The plots do not correspond to sand load but to yearly averaged sand fluxes for a specific flow occurrence.
- L186: Sentence unclear; define exactly what you mean by sediment load (it actually corresponds to a year-averaged flux for a specific occurrence and thus combine sediment capacity and flow occurrence); by negative, do you mean abstractions? And by positive, do you mean flushing of the RDR? The low quality of Fig. 2d makes impossible to evaluate the possible offset. If I can understand you assume the same sand concentration for the abstractions, how did you evaluate the sand load flushed from the RDR sand trap?
- L189: The effective discharge is approximately 150 m^3/s.
- L192: Having in mind uncertainties, two significant figures are largely enough, i.e. 1.6 Mt/yr. But what do you obtain based on your own method?
- L193: D_{50} (variables in italic, math mode)
- L195: My feeling is that you should take thes efigures with care. It appears quite suurprising to have bedload of the same order of magnitude than suspended load for such a fine fraction…
- L203: ortho-imagery
- L211: 25 km (use unbreakable space)
- Fig. 3c: Legend for the bed facies and land cover should be simplified; it is unreadable (what is the mean of the numbering 1 to 31?)
- Fig. 3d: legend for the grain size could be improved (not easy to read)
- Fig. 4a: I don’t understand what you mean by “synthetic GSDs? Water KM 50
- L229: D_{50} , D_{84} ; sentence incomplete (?)
- L231: km 36
- Fig. 5: $k_s = \alpha D_{84}$: roughness height (not defined); in the same way, F_i and F_s are not defined. Sand fluxes $Q_{b,sand}$, $Q_{b,i}$ and $Q_{s,sand}$ are not defined …
- L276: Clearly define the friction coefficient: as far as I understood, C_{2D} correspond to a Chezy coefficient (with a dimension). Following your notation, it should be in bold… Any variable including a parameter with spatial variability has obviously a spatial variability as well.
- L277: $\boldsymbol{k_s} = \alpha \boldsymbol{D_{84}}$ is the roughness height. Provide the values of κ and g .
- L282: 3.2.2.

- L285: What range of discharges? Please provide somewhere the 23 discharges chosen.
- L286: $n=23$
- L294: 3.2.3. Since it corresponds to an application of the Wilcock and Crowe (2003) and van Rijn (2007a) formulas, I think this paragraph could be largely reduced and the details put in appendix or supplementary materials
- L308: $q_{b,WC}$
- L309: “where F_s is the local sand fraction, s the ratio of sediment to water density, […]”
- L316: “e” should not be in italic (function)
- L319: in Equations 2 and 5
- L326: “using a reference concentration, c_a, written as follows:” skip the discussion of the shape factor actually introduced later.
- L328: typo (bracket)
- L329 “ where D_i “, no capital as it is the same sentence
- L330: D_*
- L332: $q_{s,WC}$. “min” should not be in italic (function). $SSC_{Gorge}=S^2 C_{Gorge}$ is not a proper variable. F should be detailed somewhere, Van Rijn (2007) suggested some formulas.
- L333 “where u is the local depth averaged velocity”v
- L344: (McCarron, 2019)
- L345: To be consistent with previous notations (Eq. 4), you should use b_{McC} instead of γ_{McC} . Also, be consistent with subscript: s for sand, g for gravel. Also, define b_s (γ_{sand}) and b_g (γ_{gravel})
- L347: The negative sign appears not consistent with Eq. 6
- L348: ξ not defined; Eq. 11 appears useless if you precise in the text that a maximum value was imposed. Is the same hiding function used for the application of the WC bedload formula? If not, you need to explain why.
- L357: “where τ' ”
- L360: Not consistent with Eq. 1
- L362: D_s
- L363: reference for this equation
- L366: “where ν is the kinematic viscosity” (s already defined)
- L368: This is not correct for a mixture of sand of gravel. The grain-related roughness is generally estimated such as $k_{s,grains}=2D_{90}$ (Yalin, 1977), where D_{90} is the particle size value from the bed GSD where 90% of particles have a diameter less than or equal to this value. That is actually the equation you used to calibrate the model (with the parameter $\alpha\approx 2$ as a first approximation based on Yalin, 1977). As a consequence, the imposed value appears largely underestimated.
- L380: “where”
- L381: There is an error, it should be $\boldsymbol{z_s}=0.25\left[1-\ln\left(\boldsymbol{F_s}^{-1/5}-1\right)\right]$; I have’t read in details the paper by Grams & Wilcock (2015) but the application of Eqs. 18 and 19 leads to a huge difference between $F_{s,GW}$ and F_s (see figure below). Is it realistic? How do you explain it?



- L385: 3.2.4.
- L391: $\boldsymbol{q_w} = \boldsymbol{u} \cdot \boldsymbol{b} \cdot b'$; don't use the star symbol (*) for multiplication. Use the capital $\boldsymbol{Q_w} = \sum \boldsymbol{q_w}$ for the total discharge
- L392: "where b' is the [...]" (u and h are already defined)
- L295: Don't use the variable Q as it does not correspond to a discharge but a dimensionless correction factor; I suggest α_{cor} .
- L396: "where Q_{known} "
- L399: Eq. 22 should be written: $Q_{i,reach} = \frac{\sum q_i \cdot b'}{\alpha_{cor}}$ where the subscript i stands for b (bedload) or s (suspended load). I don't understand the meaning of "KM" or "G"
- L400: and any longitudinal position (?)
- L419: $Fit = F \cdot i \cdot t$ is not a proper variable
- L421: $Skill = S \cdot k \cdot i \cdot l^2$ is not a proper variable. Typo in Eq. 23 (O_i instead of O)
- L426: "bed shear stress"
- L430: Remind what the variable α means, i.e. $\alpha = k_s / D_{84}$. These small values are indeed very surprising. How different are the results if you use more conventional α -values, i.e. $\alpha \approx 2$? This calibration and validation of the numerical model should be provided in the supplementary material.
- L433: D_{84}
- L442: what survey day? what discharge?
- L446: A bit subjective. How do you define "reasonable"...
- Table 1: I don't see any calibration here, i.e. values of all these parameters for different values of α .
- L459: What events? There is a need to clarify data used for calibration and validation; $Q_w =$
- L460: "5.0 to 3.5 hours, respectively". What did you model the system for the same discharges as observed? The comparison is obviously slightly biased.
- Fig. 6 (caption): Don't add comment ("The worst mismatch […]") here but put it in the text. Fig. e, f, g, h not described. Actually, they appears useless and could be skipped.
- Fig. 6b: The title needs clarifications. The position of the legend box introduces confusion (make it smaller and move it within the graph). Anyway, we don't care about all the dry pixels. What is important from my point of view is the wet pixels properly modelled, the dry pixels modelled wet, and the wet pixels modelled dry. These 3 figures could be made dimensionless using the total number of wet pixels.
- Fig.6c does not appear consistent with Fig. 6b. It don't see its interest
- L466: What do you mean by "accumulation of [bed] shear stress". If there is no comment on

this Fig. 6c, it means you can skip it.

- L468: τ -interpolated and τ -event ratio being not really defined, it is not possible to understand how good the agreement is…
- L474: It would be more logical to choose spatial-averaged values for each of the characteristic zones (thalweg, side channel, dry channel), not a specific point. How can you assess it is representative of the whole zone? The “dry channel” zone has no real meaning as it is dry for low discharge only. And looking at Fig. 7b, it is underwater for similar discharges as the side channel ($Q_w = 250\,m^3/s$)…
- L479: Be clearer, there are four lines on Fig. 2d; it does not correspond to a sediment transport capacity but a yearly-average flux for each flow occurrence.
- L481: F_s
- L483: define "equal mobility"
- L485: I’m a bit lost. How can you compare global estimation of the sand supply to local estimation of the bedload capacity. How did you calculate q_s in kg/s/m for the sand supply based on Fig. 2?; what river width did you use? How possibility do you find a different sand supply for the three different zones?
- L489: I t seems to be a numerical issue due to low water depths, nothing to do with a realistic bedload burst.
- Fig. 7abc: Please explain how the GSD were estimated. The sand fraction is not represented
- Fig. 7def: Add variables on the Y-axis (not only units)
- Fig. 7ghi: For greater consistency, add a symbol for the “WC Gravel” curve and don’t use a thick line.
- Fig. 7jkl: Add variables on the Y-axis (not only units) corresponding to a yearly-averaged sediment flux; problems with Matlab plots (“w” half erased). Use a line for all plots, not only for “WC gravel”. Please remind how you evaluated the sand supply.
- L499: I don’t understand this sentence
- L501: (Eq. 8)
- L508: I don’t understand this sentence
- L511: If I understand correctly, these plots correspond somehow to a difference between the estimated sand concentration (sand supply, C_{SS}) and the modelled sand concentration (capacity, C_{VR}). There is deposition if $C_{SS} > C_{VR}$, and erosion if $C_{SS} < C_{VR}$. However, the limitation with the supply-limited concentration in Eq. 8 makes things very unclear. How can you have $C_{SS} < C_{VR}$ in that case?
- Fig. 8: Be homogeneous for the size of the figures. Also be clearer for the legend: “Sand load, Gorge”=”Sand Supply”, “Sand bedload”=”WC Sand”,“Gravel bedload”=”WC Gravel”, “Suspended”=”VR Sand”. Use a line for all plots, not only for “WC gravel”. What is “model scenario 257”? How is the potential sand deposition calculated? As discussed above, I guess it just corresponds to a difference between the estimated upstream concentration (Sand Suply) and modelled concentration (VR Sand). Eventually, I’m a bit dubious about the interest of this plots (Figs. 8a and c). Indeed, as you assumed a spatially and temporally constant sand supply, and as bed shear stresses are obviously higher in the channels, it resuls in erosion in channels and deposition over bars… What about the unit for Fig. 8b and d? I don’t understand; it should be in t/yr.
- L527: variables in italic
- L536: This sentence should be move to the initial description of the model (section 3)
- Tab. 2: Please first explain the reference calculation corresponding the the previous results. Why did you test the max hinding limit only? What about testing different values of the b -coefficient. There is lots of literature about it (McCarron et al., 2019)
- Fig. 9 is interesting but I expected this plot earlier for the reference calculation. In term of methodology, does it mean total load throughout the river cross-section was made every km such as in Fig. 8? The total yearly averaged load corresponds here to the sum of each occurrence (discharge modelled), isn’t it? The sensitivity analysis is interesting indeed, but it

shows a huge uncertainty in the results. And somehow, you could obtain the results you want playing with the parameters…

- L569 and following: variables in italic
- L570: Avoid math language (2x) in the text
- Fig. 10: Use thick plain line for suspended load and thin dashed lines for bedload. There are two many lines (not necessary and unreadable as it is) in Fig. 8d. Bedload lines are missing in Fig. 8e and f. Don’t use a shaded area for the incoming sand load but a line (grey thick dashed line for example)
- L620: It i not that clear that the classification-based GSDs presented in section 3.1 is novel.
- L623: So, try to explain why it is useful.
- L649: 0.2% to 0.6%
- L650: 0.6% to 0.4%
- L660: Pebble count method is not very accurate to evaluate the sand content (Deng et al., 2024)
- L673: Is it that surprising? The incoming sand load was evaluated based on suspended load data. And for such grain size ($D_s \approx 250\,\mu\text{m}$), sand suspended load usually prevails.
- L678: “intense […] modelling”
- L695: Ok but is this physical? If $b=1$, $\xi = D_i / D_{50}$, and $\tau_{ri}/D_i = \tau_{r50}/D_{50}$. It just means that we assumed a constant reference Shields number, which appears physical. Adding a limit for ξ is then not necessarily correct.
- L710: Would it be possible to provide some uncertainties on these estimates?
- L740: If we consider sand deposition dynamics, a first limitation of this work would be from my point of view the simulation of steady flows only. It would have been interesting to model a single flood assuming a fixed bed for the hydrodynamics but considering potential erosion or deposit of the sand fraction. The results on the spatial distribution of erosion/deposition is very limited.
- L753: I don’t understand the point on “the limiters we implement on equilibrium suspended concentration”
- L761: Again, be careful about the generalities on fine sediments. If the sand fraction can bed capacity limited, it is generally considered that the silt and clay fractions have a nearly infinite transport capacity and so, can only be supply limited.
- L775: The Klondyke gauging station at the gorge is apparently a perfect place to evaluate the total amount of fine sediment entering the system. I guess you should focus on this site to better evaluate the quantity and quality of the SSM. It would be very useful to obtain a more robust sand rating curve at this station even if this requires hard experimental work (Marggraf et al., 2024).
- L776: One important issue would be here the calibration and validation of the numerical model. Anyway, a step before using a full 3D model would be an unsteady 2DH model. One possibility could be to apply it for fine sediments only assuming a fixed bathymetry (for the gravels). A second step would be the application of a total load modelling with bed evolution. But as fa as I know, such model has not been validated yet.
- L834: The title must not be in capital letters
- L856: Ensure consistency and do not capitalise the first letter of each word in the title
- L892: doi?
- L905: doi?
- L920: Typo, erase “López, Raúl Barragán, Javier” and add the title instead “Equivalent roughness of gravel-bed rivers”
- L991: journal?
- L999: J. Geophys. Res. Earth Surf.,
- L1007: The title must not be in capital letters

Additional references

- Deng. J., Camenen, B., Legout, C. & Nord, G. (2024). *Estimation of fine sediment stocks in alpine rivers including the sand fraction*. Sedimentology, 71(1): 152-172
- McCarron, C. J., Van Landeghem, K. J. J., Baas, J. H., Amoudry, L. O. & Malarkey, J. (2019). *The hiding-exposure effect revisited: A method to calculate the mobility of bimodal sediment mixtures*. Marine Geology, 410: 22-31
- Marggraf, J., Le Coz, J., Camenen, B., Lauters, F., Dramais, G., Pierrefeu, G. & Topping, D. J. (2025). Improving hydroacoustic methods for monitoring suspended-sand flux and grain size in sediment-laden rivers. Earth Surface Processes & Landforms, 50(1, e6056): 1-23
- Navratil, O., Esteves, M., Legout, C., Gratiot, N., Némery, J., Willmore, S. & Grangeon, T. (2011). *Global uncertainty analysis of suspended sediment monitoring using turbidimeter in a small mountainous river catchment.* Journal of Hydrology, 398: 246-259
- Yalin, M. (1977). *Mechanics of Sediment Transport*, 2nd edition, Pergamon Press, Oxford