Responses to Review Comments

In the following, review comments are in ***blue italic*** font, while responses are in **black normal** font.

Reviewer #1 (David Nworie)

Dear Editor,

I have reviewed the paper by Huang et al titled "Confinement width controls the morphology and braiding intensity of submarine braided channels: Insights from physical experiments." It is well written and has great figures. I recommend publication after minor revisions. A few comments are below for the authors to consider addressing, in no particular order:

Reply: We thank the reviewer's positive feedback and comments. Our responses to each question are listed below.

(1) Title can be rephrased as "Confinement width controls the morphology and braiding intensity of submarine braided channels: Insights from physical experiments and reduced complexity models".

Reply: We changed the title to "Confinement width and inflow-to-sediment discharge ratio control the morphology and braiding intensity of submarine braided channels: Insights from physical experiments and reduced-complexity models".

(2) Line 86: Please include the concentration of sediments/particle (in percentage) in the dyed and saturated inflows for easy comparison with other experiments.

Reply: In our experiments, we used "saturated brine" to simulate turbidity currents and we did not add fine grains for suspended load. The dry sediment added upstream is used to simulate "bed load." The saturated brine used in our experiments implies that the suspended load is always suspended in the flow layer and will bypass the basin without settling. These saline underflows can effectively transport bed load, change the morphology and form submarine braided channels. As requested, we can convert the inflow density (ρ_{in}= 1200 kg/m^3) to sediment concentration by the following formula (Morris and Fan, 1997):

$$C = (\rho_{in} - \rho_w)/(1 - \rho_w/\rho_s) \qquad (1)$$

Therefore, the converted sediment concentration of the fluid is C = 321.2 g/L. For reference, when the inflow density is ρ_{in} = 1025 kg/m^3, the corresponding sediment concentration of the fluid is C = 40 g/L. Above this threshold, it is the typical condition for forming hyperpycnal flows in the ocean.

(3) Describe the nature of the flows in the experiments in the result section. Where the flows turbulent or tractional or both? Relate this to your statement in line 365 "absence of suspended load" and 87.

Reply: We use the essential dimensionless parameters to describe the characteristics of flow and sediment, including: Reynolds number (Re), densimetric Froude number (Fr_d), reduced bed shear stress (τ_b), Shields parameter (θ), boundary Reynolds number (Re_p), dimensionless stream power (ω^*) and dimensionless sediment-stream power (ω^{**}) (see Table 2 and Line 321 to Line 324). The dimensionless numbers are defined as follows:

Reynolds number $$Re = \frac{hu}{\nu} = \frac{Q}{\nu} \quad (2)$$

Densimetric Froude number $$Fr_d = \frac{u}{\sqrt{g'h}} \quad (3)$$

Reduced bed shear stress $$\tau_b = (\rho_{in} - \rho_a)ghS \quad (4)$$

Shields parameter $$\theta = \frac{\tau_b}{(\rho_s - \rho_{in})gd_s} = \frac{(\rho_{in} - \rho_a)ghS}{(\rho_s - \rho_{in})gd_s} = \frac{hS}{R'd_s} \quad (5)$$

Boundary Reynolds number $$Re_p = \frac{u_* d_s}{\nu} \quad (6)$$

Dimensionless stream power $$\omega^* = \frac{(\rho_{in} - \rho_a)QS}{\rho_{in} w_s d_s^2} \quad (7)$$

Dimensionless sediment-stream power $$\omega^{**} = \left(\frac{B}{h}\right)\left(\frac{Q_s}{Q_{in}}\right)S^{0.2} \quad (8)$$

where h is the flow depth of the saline underflow, estimated from the experiments ($h \approx 0.002$ m); $u = Q_{in}/(hB)$ is the cross-sectional averaged flow velocity; B is confinement width; ν is water kinematic viscosity ($\nu = 10^{-6}$ m^{2}s^{-1}of water 20° C); $g' = g(\rho_{in} - \rho_a)/\rho_{in}$ is the reduced gravity; ρ_{in} is the density of inflow ($\rho_{in} = 1200$ kg/m^3); ρ_a is the density of ambient water ($\rho_a = 1000$ kg/m^3); S is bed slope; ρ_s is the density of plastic sand ($\rho_s = 1500$ kg/m^3); d_s is sediment grain size ($d_s = 0.34$ mm); $R' = (\rho_s - \rho_{in})/(\rho_{in} - \rho_a)$; $u_* = \sqrt{\tau_b/(\rho_{in} - \rho_a)}$ is shear velocity; $w_s = \frac{Rgd_s{}^2}{C_1\nu + (0.75C_2Rgd_s{}^3)^{0.5}}$ is sediment settling velocity reported by *Ferguson and Church* [2004]; $R = (\rho_s/\rho_{in} - 1)$ is submerged relative density of sediment ($R = 0.25$ in this study); $C_1 = 18$ and $C_2 = 1$ are two constants for typical natural sands.

Based on our calculations, the flow condition of the submarine braided channels is laminar (Re<200), subcritical flow (Fr<1), and the Shields parameter is around 0.4, which is much higher than the critical threshold (0.04~0.06). Conventionally, Re_p<5 implies the regime of smooth bed with small local flow velocity around the particle; Re_p>70 is the regime of rough bed with large local velocity. Our conditions ($Re_p \cong 16$) are in-between. We also add new Fig. 14 and Fig. 15 in the revised manuscript for better comparison between submarine braided channels and fluvial rivers. Above descriptions are all integrated in Table 2.

(4) In the discussion, relate the influence of flow concentration to support mechanisms for transport and deposition and how does that relate to the braiding intensity.

Reply: In this study, we use a fixed inflow density ($\rho_{in} = 1200$ kg/m^3), which corresponds to a fixed sediment concentration of the fluid ($C = 321.2$ g/L). Therefore, in this study we cannot demonstrate the influence of different inflow densities on submarine braided channels. However, according to Lai et al. (2017), active braiding intensity (BI_A) is proportional to the dimensionless stream power (ω^*). Therefore, higher inflow density would result in higher active braiding intensity. Our current study indicates this trend still holds for both submarine braided channels and fluvial braided rivers with lateral confinements (see Fig. 16c).

(5) The figures are clear and nice but some of the captions are short and say little about what is shown in the figures. Normally the Figures + Captions should be self-explanatory. I suggest the captions be expanded.

Reply: We rewrote most of the figure captions to include more information.

References cited in our reply:

Foreman, B. Z., Lai, S. Y. J., Komatsu, Y., and Paola, C.: Braiding of submarine channels controlled by aspect ratio similar to rivers, Nat. Geosci., 8, 700-703, https://doi.org/10.1038/ngeo2505, 2015.

Lai, S. Y. J., Hung, S. S. C., Foreman, B. Z., Limaye, A. B., Grimaud, J. L., and Paola, C.: Stream power controls the braiding intensity of submarine channels similarly to rivers, Geophys. Res. Lett., 44, 5062-5070, https://doi.org/10.1002/2017GL072964, 2017.

García, M.: Discussion of “The Legend of AF Shields”, J. Hydraul. Eng., 126, 718-720, 2000.

Morris, G. and Fan, J.: Reservoir sedimentation handbook, McGraw-Hill, New York, 1997.

Parker, G.: On the cause and characteristic scales of meandering and braiding in rivers, J. Fluid Mech., 76, 457-480, https://doi.org/10.1017/S0022112076000748, 1976.