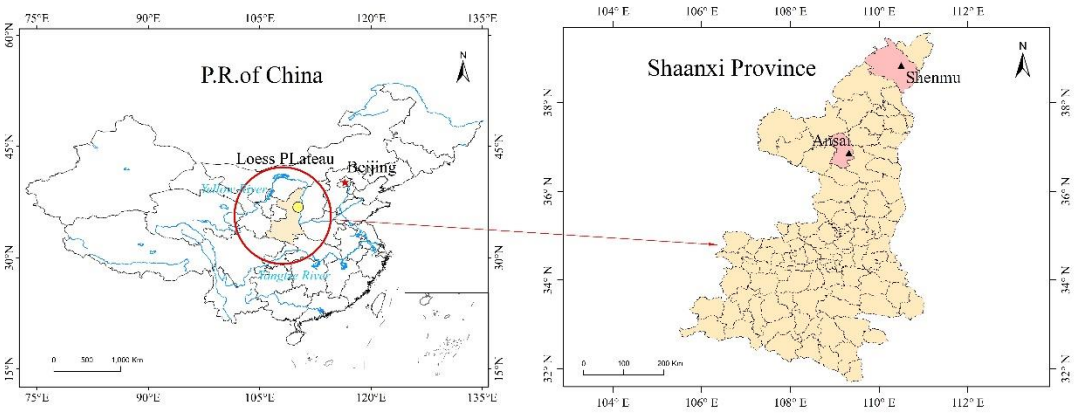


Fig 1. Location of this test area

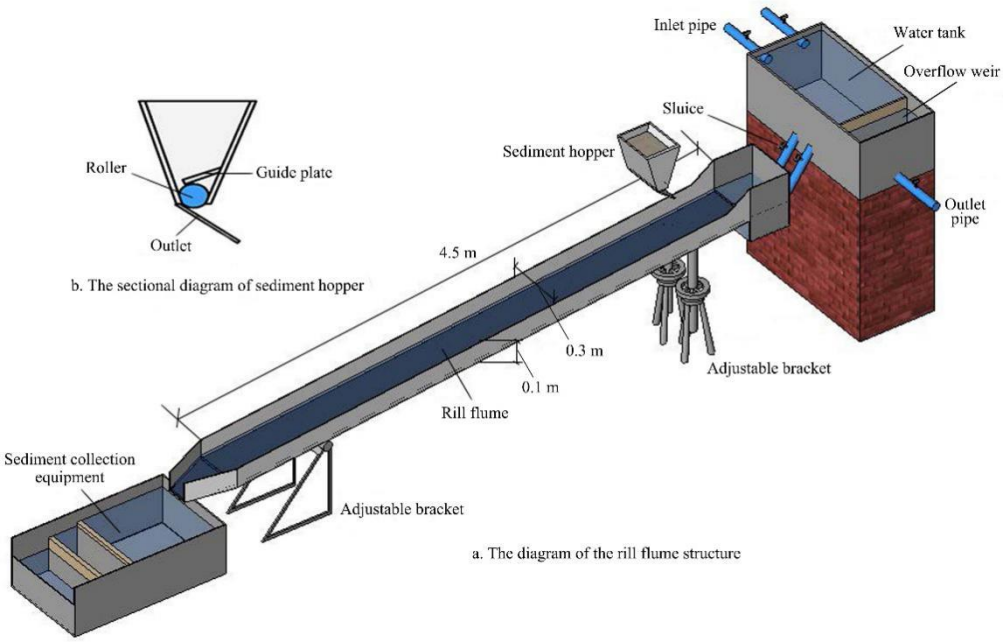


Fig 2. Schematic of the experimental set-up

(a) Water depth measurement

(b) Flow velocity measurement

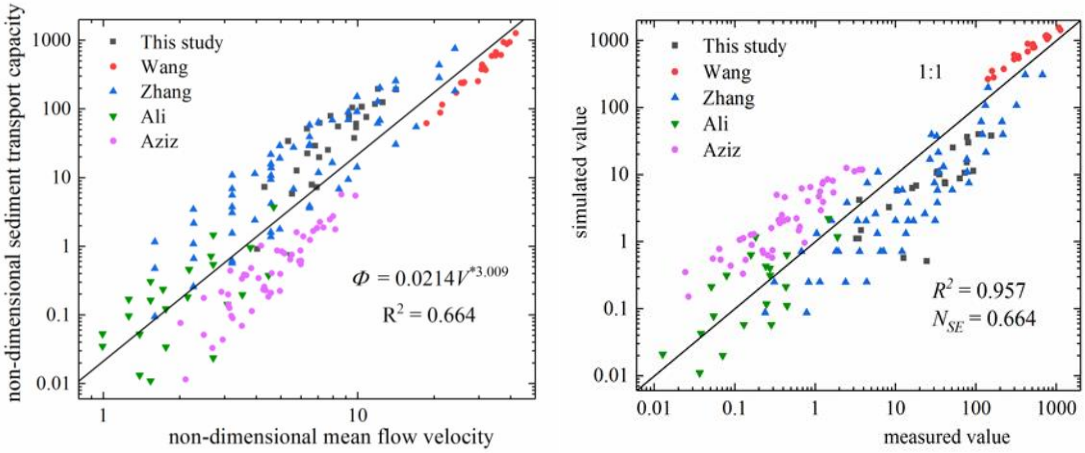
Fig. 3 The measuring method

(a). Wave-current coupling in sediment-laden flow

(b). Wave crest and trough in wave-current coupling

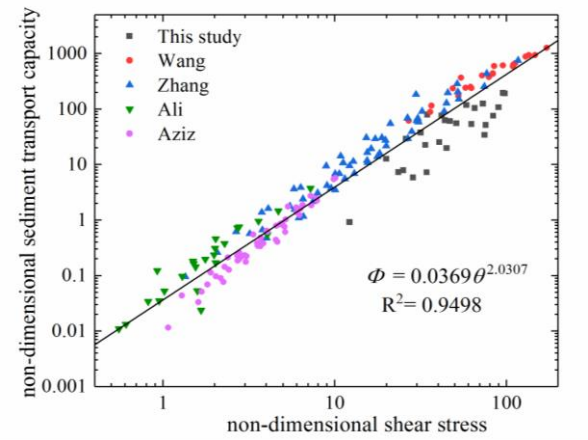
(c). Regular sediment transport in sediment-laden flow

Fig.4 The sediment transport phenomenon in sediment-laden flow

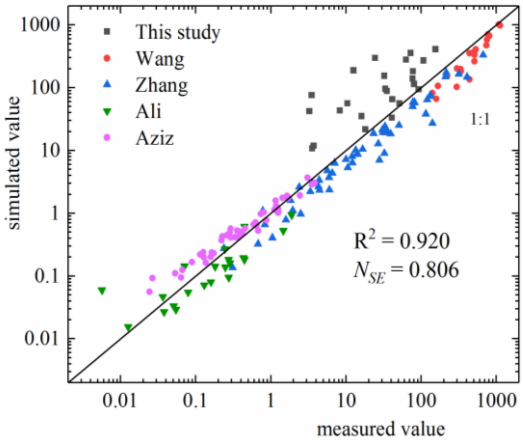


(a).The relationship between Φ and V^* (b). The comparision of simulated and measured values in formula (16)

Fig 5. Relationships between Φ and V^* and the fitting precision of formula (16)

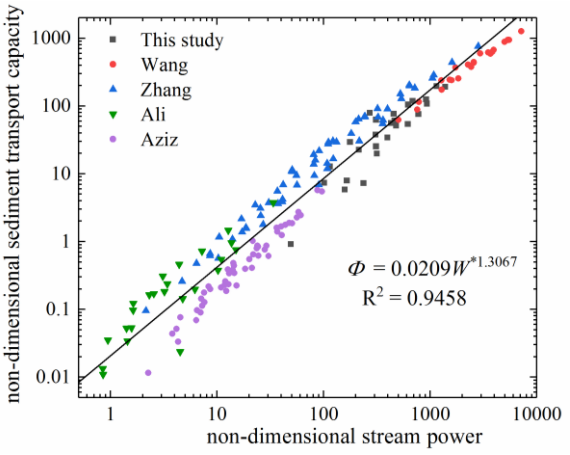


(a).The relationship between Φ and θ

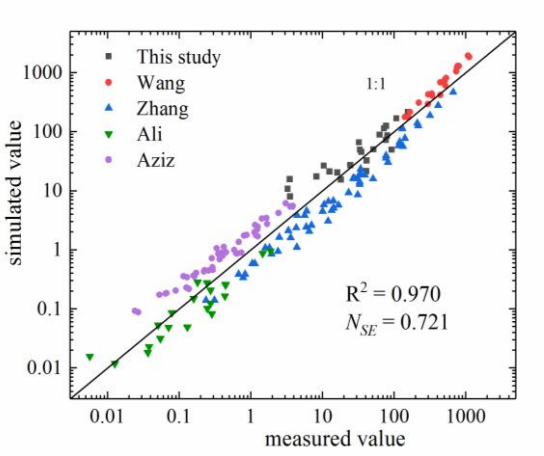


(b). The comparision of simulated and measured values in formula (17)

Fig 6. Relationships between Φ and θ and the fitting precision of formula (17)

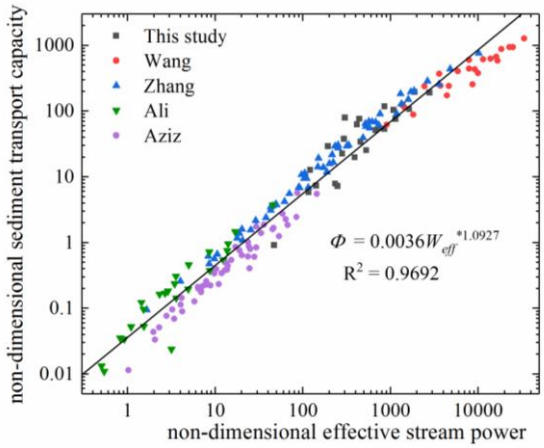


(a). The relationship between Φ and W^*

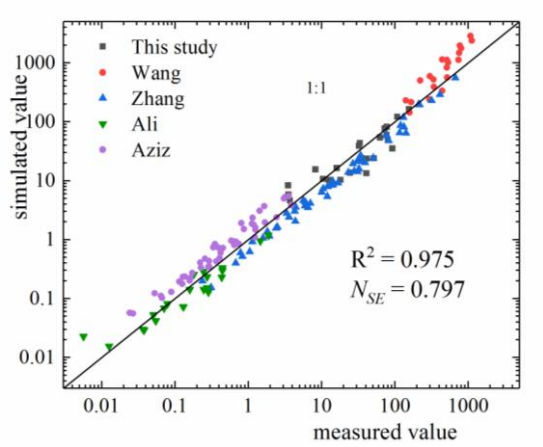


(b). The comparision of simulated and measured values in formula (18)

Fig 7. Relationships between Φ and W^* and the fitting precision of formula (18)



(a).The function relationship betwee Φ and W_{eff}^{*}



(b). The comparision of simulated and measured values in formula (19)

Fig 8. Relationships between Φ and W_{eff*} and the fitting precision of formula (19)

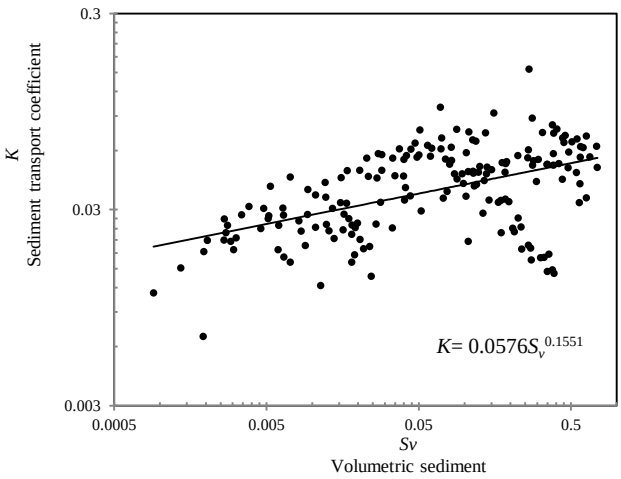


Fig.9 Relationships between K and S_v

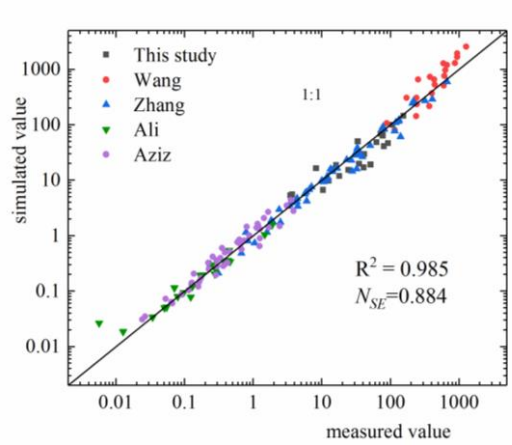
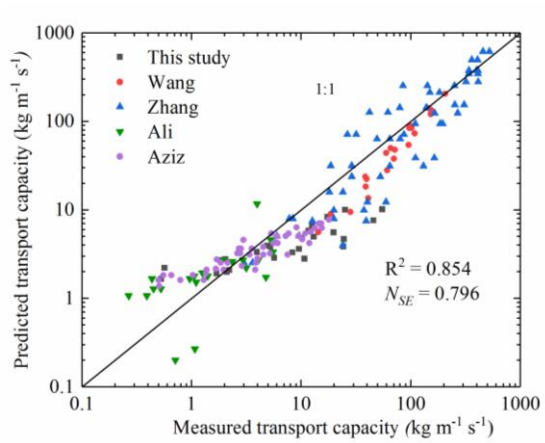
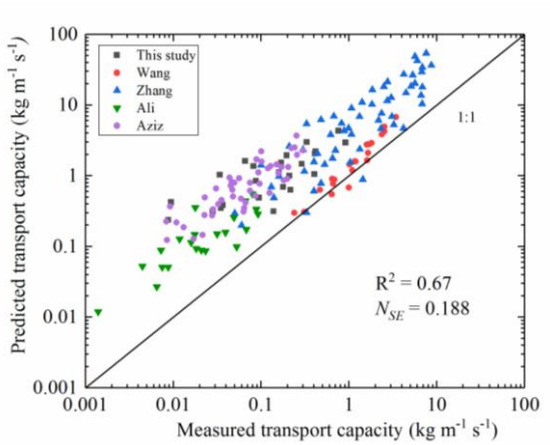


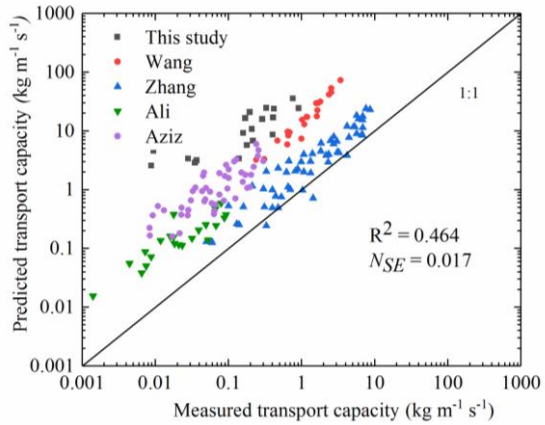
Fig. 10. Comparison between simulated and measured value of formula (29)



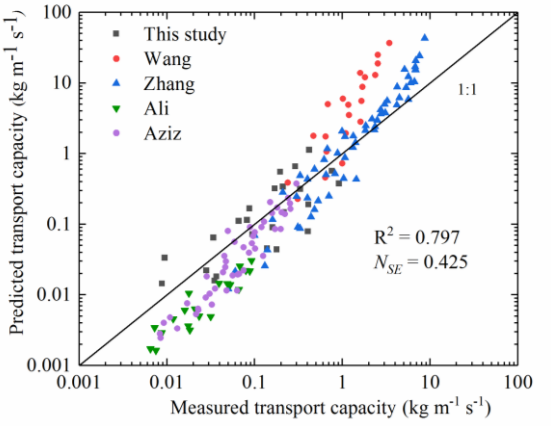
(a).The comparision between simulated values and measured values in ANSWERS model



(b). The comparision between simulated values and measured values in improved WEPP model



(c) The comparision between simulated values and measured values in Zhang's model



(d). The comparision between simulated values and measured values in Ali's model

Fig 11. Comparison between simulated and measured value of four models

Table 1. Particle size distribution of different soil materials

Particle size/mm	Coarse sand >0.25	Fine sand 0.25~0.05	Coarse silt 0.05~0.01	Medium silt 0.01~0.005	Fine silt 0.005~0.001	Clay particles <0.001
d_{50}=0.095mm	0.30%	64.9%	22.0%	2.8%	3.2%	5.8%
d_{50}=0.04mm	0%	36.58%	48%	3.84%	4.73%	6.85%

Table 2 The experimental data (Shenmu sand loess, median particle size =0.095mm)

Median particle size/mm	Slope/%	Unit discharge/m^2 s^{-1}	Water depth/m	Sediment transport capacity/kg m^{-1} s^{-1}	Flow velocity/m s^{-1}
0.095	10.5	0.00014	0.00186	0.0090	0.158
		0.00028	0.00249	0.0350	0.226
		0.00042	0.00304	0.1250	0.226
		0.00056	0.00351	0.1790	0.266
		0.00069	0.00397	0.2870	0.267
		0.00083	0.00433	0.4050	0.277
		0.00111	0.00527	0.7800	0.307
	15.6	0.00014	0.00176	0.0368	0.160
		0.00028	0.00257	0.0778	0.259
		0.00042	0.00300	0.1600	0.259
		0.00056	0.00346	0.2220	0.249
		0.00069	0.00407	0.4100	0.273
		0.00083	0.00450	0.6160	0.278
		0.00111	0.00487	0.9170	0.315
	20.8	0.00014	0.00181	0.0720	0.169
		0.00028	0.00249	0.0820	0.208
		0.00042	0.00313	0.2490	0.300
		0.00056	0.00368	0.3310	0.313
		0.00069	0.00393	0.5470	0.329
		0.00083	0.00443	0.7630	0.347
		0.00111	0.00502	1.0270	0.374

Table 3 The experimental data (Huangmian soil, median particle size =0.004mm)

Median particle size/mm	Slope/%	Unit discharge/m^2 s^{-1}	Water depth/m	Sediment transport capacity/kg m^{-1} s^{-1}	Flow velocity/m s^{-1}
0.04	7.0	0.00039	0.00312	0.0157	0.141
		0.00058	0.00413	0.0282	0.163
		0.00075	0.00322	0.1015	0.247
		0.00095	0.00421	0.1391	0.267
		0.00112	0.00419	0.2052	0.276
	10.5	0.00019	0.00225	0.0088	0.094
		0.00039	0.00231	0.0195	0.176
		0.00058	0.00294	0.0948	0.197
		0.00075	0.00286	0.1634	0.251
		0.00095	0.00313	0.2171	0.283
		0.00112	0.00425	0.3167	0.298
	14.1	0.00019	0.00216	0.0095	0.094
		0.00039	0.00211	0.0532	0.180
		0.00058	0.00336	0.0875	0.200
		0.00075	0.00322	0.1447	0.251
		0.00095	0.00311	0.2102	0.301
		0.00112	0.00396	0.3366	0.319
	17.6	0.00019	0.00314	0.0340	0.076
		0.00039	0.00325	0.0916	0.136
		0.00058	0.00335	0.1700	0.187
		0.00075	0.00312	0.2039	0.235
		0.00095	0.00323	0.2909	0.310
		0.00112	0.00422	0.5242	0.306
	21.3	0.00019	0.00314	0.0660	0.073
		0.00039	0.00243	0.1381	0.161
		0.00058	0.00322	0.1958	0.200
		0.00075	0.00321	0.2889	0.264
		0.00095	0.00334	0.4203	0.305
		0.00112	0.00312	0.5137	0.360

Table 4. Non-dimensional formulas of flow intensity parameters

Flow intensity parameters	Formulas of flow intensity parameters	Non-dimensional formulas of flow intensity parameters
Mean velocity	V	$V^* = V / \left[\sqrt{(\gamma_S / \gamma - 1) g d_{50}} \right]$
Flow stress force	$\tau = \rho g h S$	$\theta = \gamma h J / \left[(\gamma_S - \gamma) d_{50} \right]$
Unit stream power	$P = VS$	$P^* = VS / \omega$
Stream power	$W = \tau V$	$W^* = \theta V^*$
Effective stream power	$W_{eff} = W^{1.5} / h^{0.67}$	$W_{eff}{}^* = W^{*1.5} / (h / d_{50})^{0.67}$
Sediment transport capacity	$T_c = M / (Tb)$	$\Phi = T_c / \left[\gamma_S \sqrt{(\gamma_S / \gamma - 1) g d_{50}^3} \right]$

Notes：γ_s is particle density of sediment particles, γ_s was 2650（kg/m^3）in this study. γ is water particle density. ω is the settling velocity of sediment particles；J is the energy slope. d_{50} is the median particle size of sediment particles. V^* is the dimensionless mean velocity. θ is the dimensionless shear stress. W^* is the dimensionless stream power. P^* is the dimensionless unit stream power. $W_{eff}{}^*$ is the dimensionless effective stream power. Φ is the dimensionless sediment tranport capacity.

Table 5. The range of different hydraulic parameters

comparable objects	Median particle size/mm	Slope/%	Unit discharge/m^2 s^{-1}	Mean flow velocity/m s^{-1}	Water depth/mm	Sediment transport capacity/kg m^{-1} s^{-1}
This study	0.095	10.5~20.8	0.00014~0.00111	0.158~0.374	1.86~5.02	0.009~1.027
	0.04	7~20.8	0.00019~0.00112	0.527~1.11	1.42~4.13	0.0088~0.5243
Wang et al. (2016)	0.04	10.5~38.4	0.00082~0.00319	0.474~1.063	1.08~3.65	0.1673~3.4281
Zhang et al (2011)	0.1~1.16	8.7~42.3	0.00066~0.00526	0.218~0.952	1.98~8.43	0.07~8.66
Ali et al. (2012)	0.23~1.02	5.2~17.6	0.00007~0.00207	0.163~0.473	0.75~5.65	0.0008~0.1337
Aziz and Scott (1989)	0.29~1.02	3~10	0.00165~0.00473	0.27~0.706	3.51~11.58	0.0089~0.353