

1 Supplementary Data

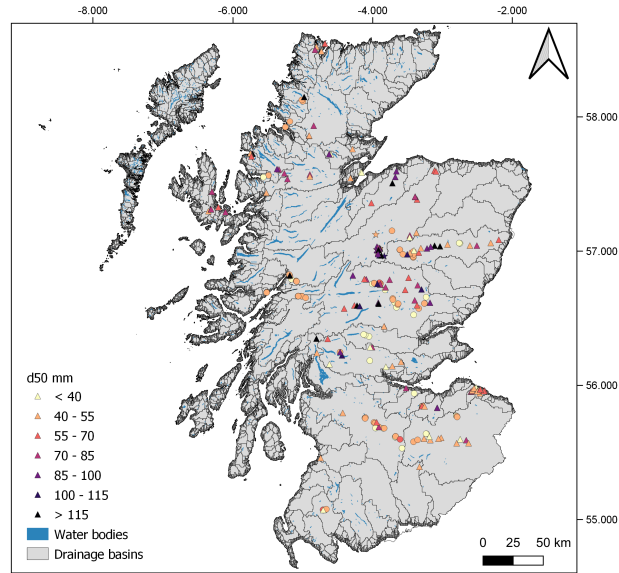
This Supplementary Data section includes figures and tables presenting information on d50 grain sizes, manually measured grain sizes, bedrock erodibility, and the PebbleCounts algorithm.

Sample number	Sample name	Latitude	Longitude
1	Mei	56.53787	-3.38905
2	Dalguise	56.59245	-3.62323
3	Garryfalls	56.76528	-3.95298
4	Tummel_lower	56.65848	-3.67399
5	Garry_Bridge	56.7221	-3.7792
6	DallCottage_Trib	56.79954	-4.03774
7	Drum	56.82606	-4.21938
8	SoldiersLeep	56.74118	-3.77322
9	Trib_Soldiers_Leep	56.741178	-3.77314

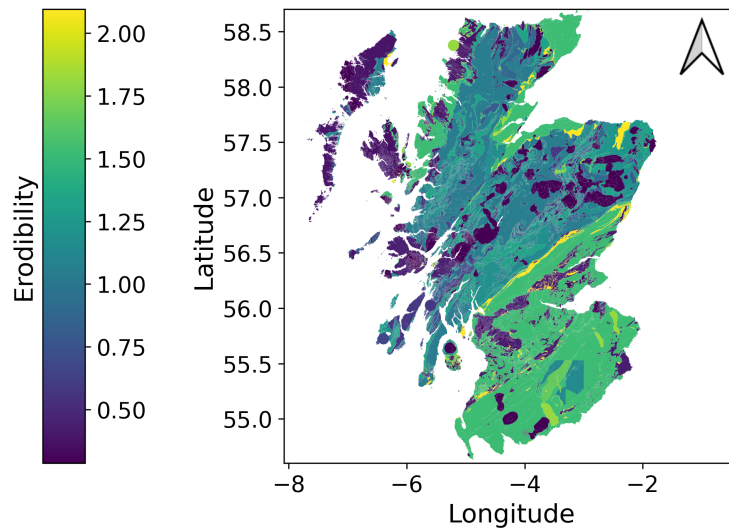
**Table S1.** Details of samples used to compare PebbleCountsAuto to the manually measured control dataset. Sample numbers correspond to the sample numbers in Figure 2 in the main text.

Change in height (cm)	Camera resolution (mm/pixel)	Pebble size (mm)	Pebble size % difference relative to original resolution
0	0.54	108.47	
5	0.56	111.97	3
10	0.58	115.47	6
15	0.60	119.28	10

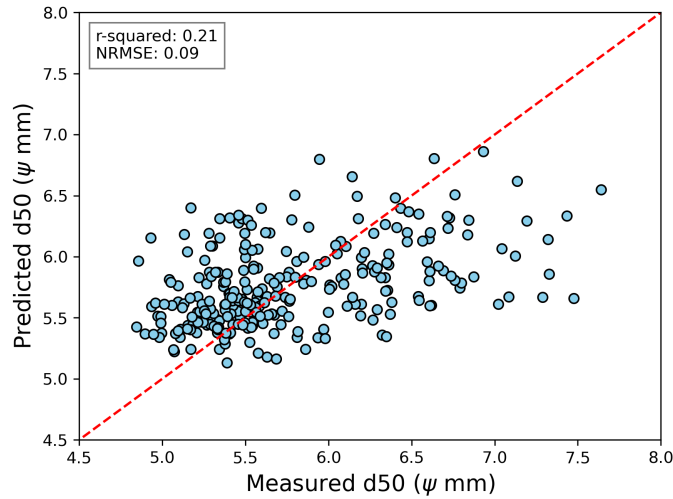
**Table S2.** Sensitivity of PebbleCounts-derived grain size measurements to variations in camera height. The camera resolution and final pebble size (mm) were calculated using a standard consumer-grade mobile phone camera (e.g., sensor height = 4.55 mm, sensor width = 6.17 mm, focal length = 4.3 mm, image height = 3024 pixels, image width = 4032 pixels) and a pebble pixel size of 200 pixels. The percentage differences represent the differences in the pebble size relative to that calculated from a resolution of 0.54 mm/pixel (ie., 108.47 mm for a 200 pixel pebble), which is the average camera resolution used in this study.



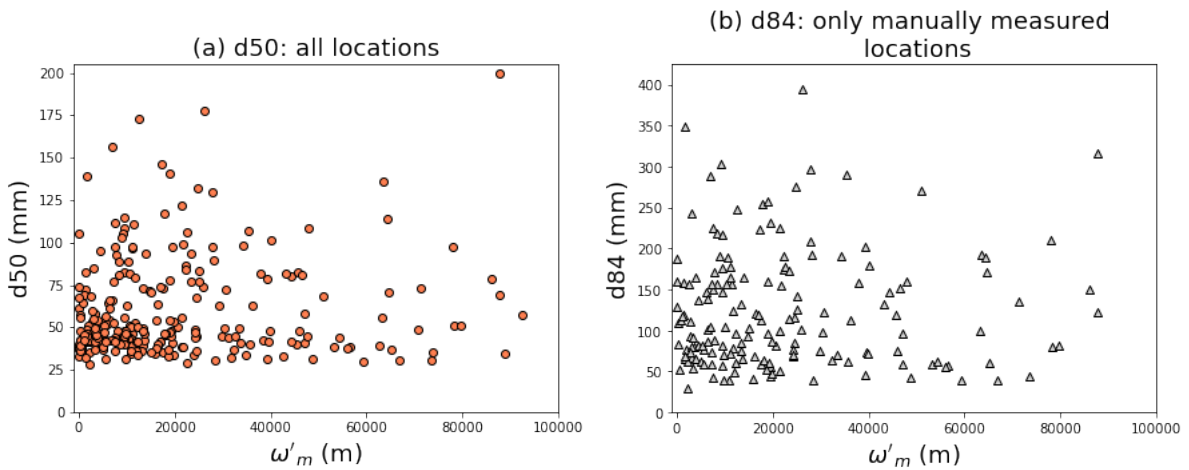
**Figure S1.** Map of Scotland (focused on the mainland) showing 279 locations coloured according to d50 (mm). Circles represent samples processed with PebbleCountsAuto, triangles show manually clicked sites, and stars represent samples measured using Wolman Point Counts. Water bodies (<10 hectares) are shown in dark blue and drainage basin outlines (15 arc-second resolution) in black (sourced from the HydroLAKES and HydroBASINS databases, (Lehner and Grill, 2013; Messenger et al., 2016))



**Figure S2.** Map of Scotland (focused on the mainland) showing bedrock erodibility which was calculated using the method outlined by Clubb et al. (2023).



**Figure S3.** Results from the Random Forest Regressor analysis for the d50. Figure shows the model’s predictive ability which is poor. The dashed red line represents the 1:1 relationship.



**Figure S4.** (a) d50 as a function of  $\omega'_m$ , for all surveyed locations. (b) d84 as a function of  $\omega'_m$  for only the sites that have been manually measured (i.e., photos that have been manually clicked and sites that were surveyed using Wolman Point Counts). Both plots display null correlations.

## 5 References

- Clubb, F. J., Mudd, S. M., Schildgen, T. F., van der Beek, P. A., Devrani, R., and Sinclair, H. D.: Himalayan valley-floor widths controlled by tectonically driven exhumation, *Nature Geoscience*, 16, 739–746, <https://doi.org/10.1038/s41561-023-01238-8>, 2023.
- Lehner, B. and Grill, G.: Global river hydrography and network routing: Baseline data and new approaches to study the world’s large river systems, *Hydrological Processes*, 27, 2171–2186, <https://doi.org/10.1002/hyp.9740>, 2013.
- 10 Messenger, M. L., Lehner, B., Grill, G., Nedeva, I., and Schmitt, O.: Estimating the volume and age of water stored in global lakes using a geo-statistical approach, *Nature Communications*, 7, 1–11, <https://doi.org/10.1038/ncomms13603>, 2016.