Supplementary materials

1. Model input parameters

The sensitivity analysis was performed in different simulation sets, in each one a single parameter was varied while others kept the fixed value in the defined variation range. The setting of defined variation range of the rheological parameters was estimated based on previous studies [18,41,44,45]. This simulation was aimed at predicting potential landslide mass. A sensitivity analysis was made to assess the variability of the results based on the actual deposit thickness. So only the changes that these values have on the deposit depth, sliding velocity and impacting area were examined. Table 1 in the main text displays the ranges of input parameters.1 The following section is to compare the simulation results in different rheological parameters. The quantitative indicators include deposit characteristics, sliding velocity and predicted landslide area.

2. Sensitivity analysis

2.1 Chèzy coefficient

Figure.1s, 2s, 3s and 4s are the simulation results in different Chèzy coefficients (the fluid rate is 10m/s). And Figure.5s shows the simulation results in different fluid rates (the Chèzy coefficient is

200 m/s^2). Figure.1s depicts the collapse body thickness in different Chèzy coefficients, which shows that the depositing characteristics including morphological characteristics and thickness distribution are basically consistent. Figure.2s is the cross section (A-A′) of depositing thickness in the accumulation area, showing the deposit thickness of the accumulation area decreases gradually from the center to both sides. Figure.3s is the predicted landsliding area in different Chèzy coefficients, which shows that the impacting area of unstable rock mass under different parameters is basically similar, But the higher the Chèzy coefficient is, the larger the impacting area on the opposite bank of Zagunao river is. Figure.4s is the variation of max sliding velocity, showing the sliding velocity increased with the rise of Chèzy coefficients. Overall, the Chèzy coefficients influenced the sliding velocity unstable rock mass, but predicted landslide boundaries and depositing characteristics of the landslide is similar (Figure.5s).

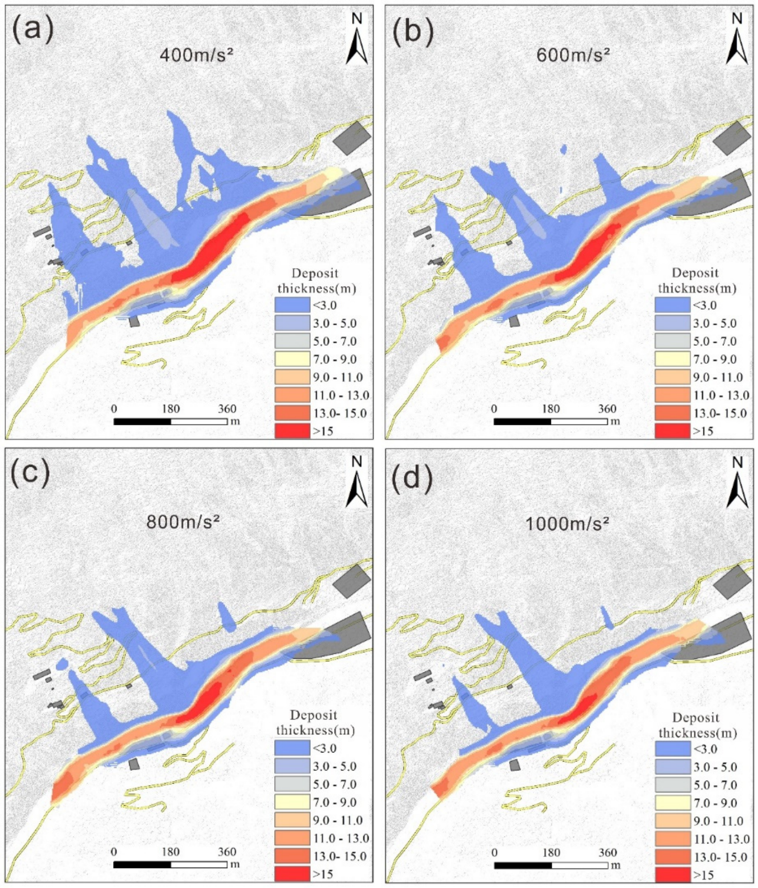

Figure. S1 Distribution of collapse body thickness in different Chèzy coefficients. (a) 400m /s^2; (b) 600m /s^2; (c) 800 m/s^2; (d) 1000 m/s^2

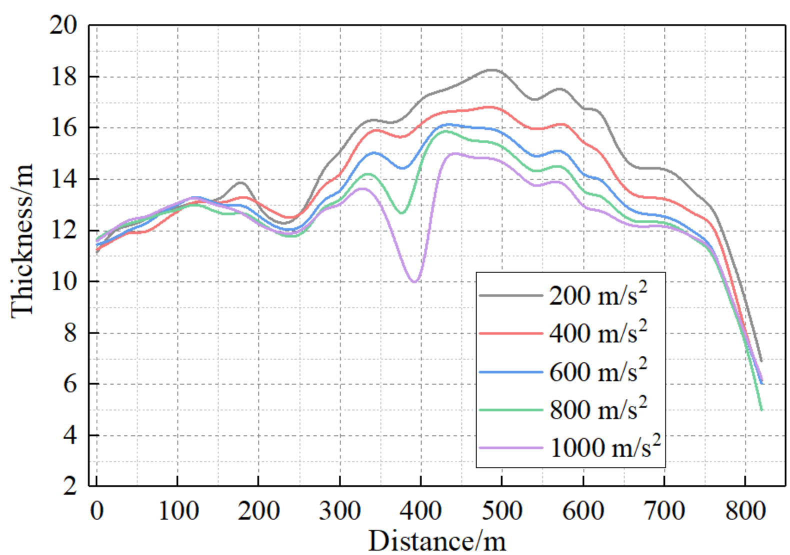

Figure. S2 Deposit thickness along longitudinal profile A-A′ in different Chèzy coefficients (a) 400 m/s^2; (b) 600 m/s^2; (c) 800 m/s^2; (d) 1000 m/s^2

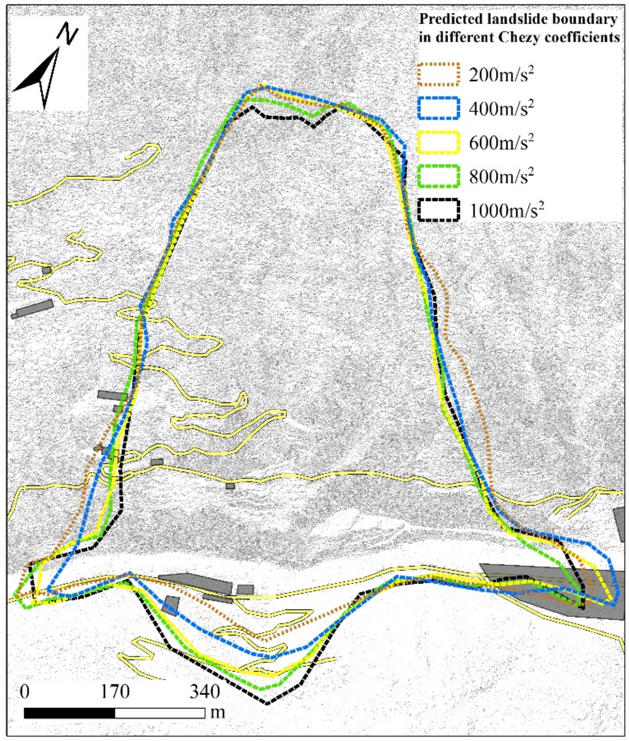

Figure. S3 Predicted landslide boundaries in different Chèzy coefficients (a) 400 m/s²; (b) 600 m/s²; (c) 800 m/s²; (d) 1000 m/s²

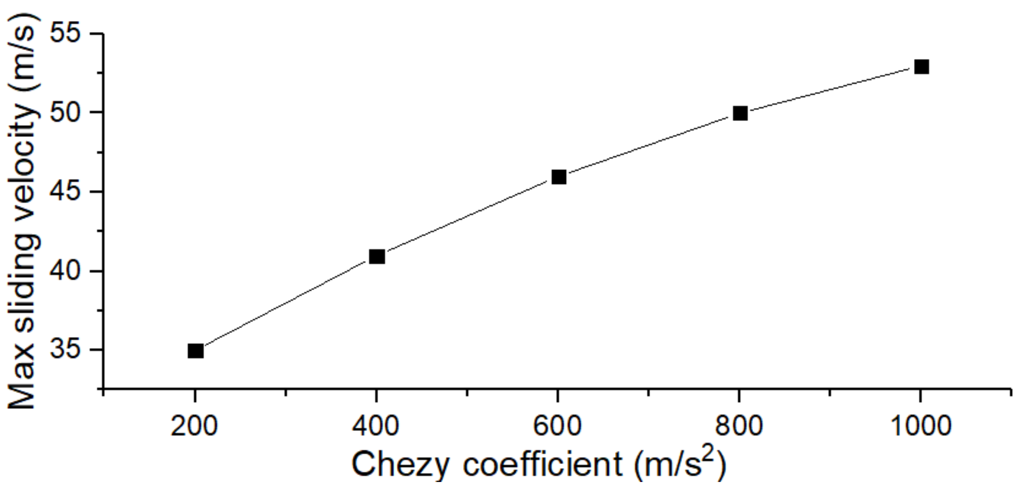

Figure. S4 Max sliding velocity in different Chèzy coefficients (a) 400 m/s²; (b) 600 m/s²; (c) 800 m/s²; (d) 1000 m/s²

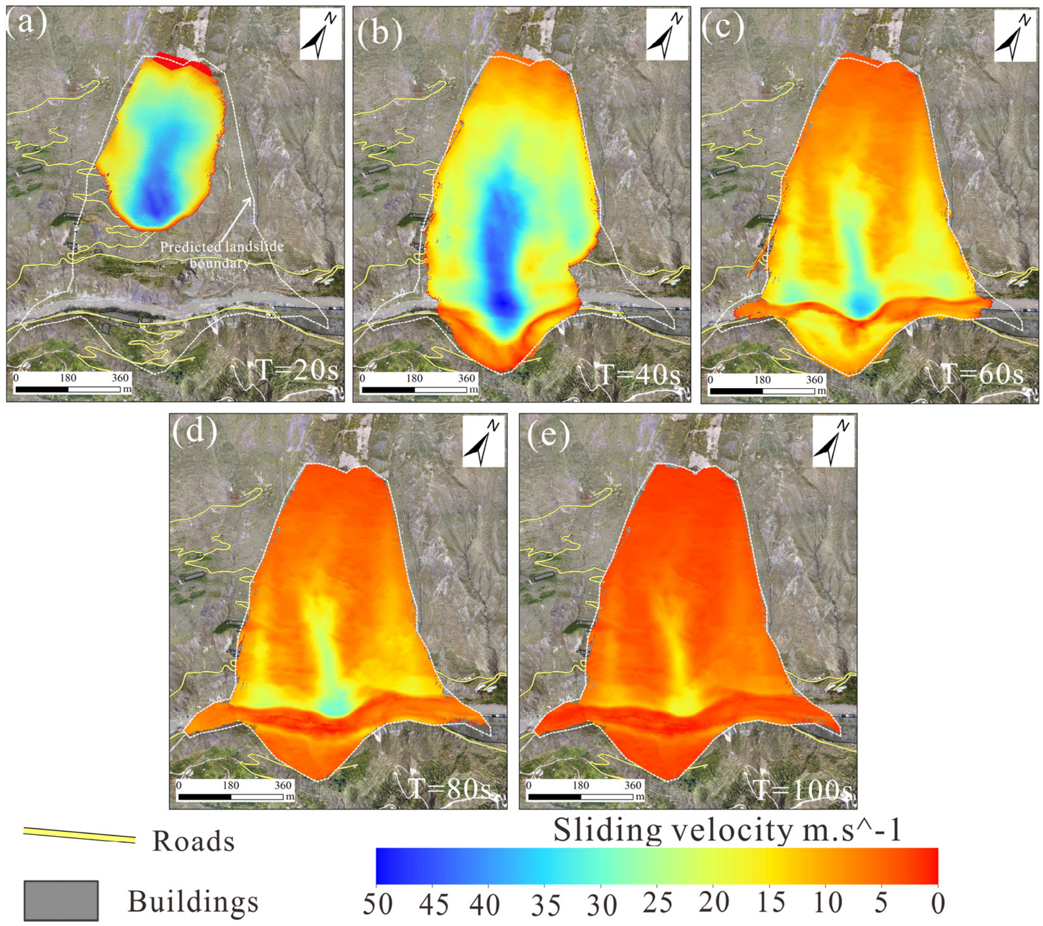

Figure. S5 Simulated sliding velocity of the unstable rock mass with Chèzy coefficient and fluid rate being 800 m/s and 10m/s (a) t = 10s, (b) t = 30s, (c) t = 40s, (d) t = 60 s, (e) t = 80 s and (f) t = 100 s.

2.2 Fluid rate

In addition, we also compared the simulation results under different fluid rates (the Chèzy coefficient is 200m/s^2). Figure. 6s show the maximum velocity and deposit thickness under different fluid rates, respectively. The results show that with the increase of fluid rate, the maximum velocity gradually increases from 33.7m/s to 36.0m/s, while the maximum thickness of the accumulation area slightly decreases. Overall, this parameter has modest effect on the accumulation distribution and movement characteristics when the value of fluid rate is within a reasonable range.

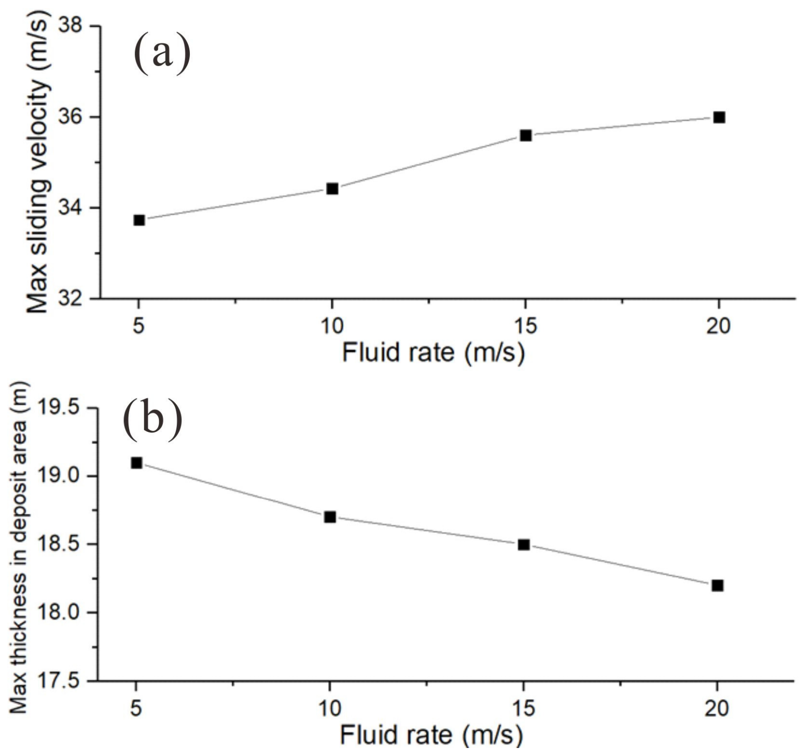

Figure.S6 Maximum sliding velocity (a) and maximum thickness (b) versus fluid rates.