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## The Topography Meter: a measurement system applicable for gravity-erosion experiments using a novel 3D surface measuring technique

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Gravity erosion is one of the most remarkable natural hazards in mountainous regions, especially on the Loess Plateau of China. Nevertheless, the measurement of failure mass is very difficult because gravity erosion usually occurs randomly and it combines with hydraulic erosion. Here we present a novel testing technique that could quantitatively measure time-variable gravity erosion on the steep loess slopes. A structured light 3D surface measuring apparatus, the Topography Meter, was designed and manufactured in our laboratory. Dynamic variation of the steep slope relief was monitored under rainfall simulation and the slope deforming process was recorded by a computer video technology. With the help of laser marking, plane figures were vectorially transformed into 3D graphs, thus the shape of target surface was accurately computed. By comparing the slope geometries in the moments before and after the erosion incident on the snapshot images at a particular time, we could obtain the volume of gravity erosion and many other erosion data, including the volume of slide mass, the amount of soil loss eroded by overland flow, etc. A series of calibration tests were conducted and the results showed that the accuracy of this technique was high and sufficient for exploring the mechanism of slope erosion. More than 120 rainfall simulation events were subsequently tested with the apparatus, further confirming its feasibility and reliability.