Magnitude-frequency distribution of mega-collapses in Japan

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A number of researches have already investigated magnitude-frequency relationship of slope deformation, such as slope failures and landslides. On the other hand, the relation between magnitude and frequency of the mega-collapse (i.e. sector collapse) mainly occurred on the volcanic edifice have not been necessarily discussed enough. And also, it is unclear whether the occurrence pattern of the mega-collapses can be related to that of the smaller events. This study, to make the effort to tackle the above challenges, investigates the magnitude-frequency distribution of slope failures in Japan, including the largest events, and discusses its geomorphological significance. The study stands mainly upon the existing datasets by Yoshida (2010) for the mega-collapses on the volcanoes, and by Machida et al. (1987) for the events relatively smaller but more abundant in number. Based on these, the magnitude-frequency distribution of slope failures in volumetric scale equal to and more than 10^7 m^3 could be investigated as, logN(x)=a-bx, where N(x) is cumulative number of events larger than and equal to x, x is the magnitude expressed by logV, V is the volume of a slope failure, and a and b are constants. Constant b ranges from 0.7 to 0.8, which indicates that the smaller events are exactly susceptible to have occurred frequently. In addition, based on the reanalyzed data once had been shown by Ohmori and Hirano (1988), originally collected by Construction Ministry of Japan during 1975-1983, similar constant b value is obtained for the events with a volumetric scale equal to and more than 10^{5-6} m^3. From the above, this study is successful in offering a new understanding of the magnitude-frequency distribution of mega-collapses in Japan. Considering recent records for the past millennium or bit more in Japan, the obtained magnitude-frequency relationship shows substantially the situation during several tens thousands years. This speculation enables us to predict event probability along with the recurrence intervals for any event with a certain magnitude. For example, mega-collapses with a volume of 10^9 m^3 should occur repeatedly at least every 1000 to 2000 years in anywhere in Japan, from a probabilistic viewpoint. Such above investigation indicates that mega-collapses are never "rare" events in the geomorphological time-scale.

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