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Spatial Distribution and Casual Factors of Landslide Dams Triggered by the 2008 Wenchuan Earthquake

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Landslide dams induced by earthquakes always pose serious threats to people and property due to possible upstream flooding as the impounded lake water level rises and possible downstream flooding due to dam-break floods. In this study an inventory was made of 828 landslide dams, triggered by the 2008 Wenchuan earthquake in China, using visual interpretation of a series of pre- and post earthquake satellite images and subsequent field checks. Of the 828 landslide dams, 501 completely blocked the rivers, while the others only caused partially damming. The inventory was used to analyze the spatial pattern, size-frequency distribution and the causal factors of the landslides and resulting dams. The spatial distribution of landslide dams was compared with the total landslide distribution, revealing a similar pattern. It shows that landslide dams occur most frequent in the southeast directed steep watershed in the hanging wall of the Yingxiu-Beichuan Thrust Fault, and in the northeastern part of the strike-slip fault near Qingchuan. Both landslide and landslide dam densities are higher on the hanging wall of the Yingxi-Beichuan fault than on the footwall. Size-frequency distributions were made of both datasets, as well as of the dammed lakes. They all show a “rollover” for small scale features and a distinct power law decay for medium and large scale ones. The relation between landslide dams and a series of seismic, topographic, geological, and hydrological factors was analyzed. The results show that landslide dam density decreased sharply with the increase of the distance to fault. Slopes steeper than 40o with elevation ranging from 700 m to 1700 are more susceptible to generating damming landslides. Pre-sinian schist and Cambrian sandstone and siltstone are the most vulnerable lithologic units for landslide dam formation. Hydrological parameters such as distance to streams and stream order also play important roles in controlling landslide dam occurrence. Landslide dams were classified into four types according to their main composition, which were related to the typology, initiation mechanism and dynamic processes of the corresponding damming landslides. This classification is proposed as an indicator to empirically assess the stability of landslide dams. Multi-temporal images were used to estimate the survival rate of landslide dams. 27 dams were found still existing now. A correlation was made between the landslide initiation and accumulation areas, and between runout distance, initiation area and total drop height. The results revealed clear positive power-law relationships of above parameters.