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GIS-based analysis of 1933 Diexi Landslides and dam breach on the Min River, Sichuan, China

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Due to complex tectonic and geomorphologic factors, the Tibetan Plateau and its surrounding areas, are particularly prone to landslides. Rivers have deeply cut into bedrock, forming narrow valleys that are especially prone to landslide damming. Numerous landslide damming and subsequent dam breaching events are recorded from the region in historical documents and the geosciece literature; these include events at the Dadu River (1786), Diexi (1933), Tanggudong (1967), Yigong (2000), and Tangjiashan (2008). We report the results of a GIS-based analysis of earthquake-generated landslide dams at Diexi. The Diexi Earthquake (M=7.5) occurred on August 25, 1933 and induced a series of giant landslides along the Min River, some of which blocked the river and formed three large landslide lakes. The landslide dam located furthest downstream breached on October 9, 1933, 45 days after the earthquake. The outburst flood resulted in huge damage to the downstream area killing 2,423 people, one of the most serious landslide-related disasters in China during the 20^{th} Century. In the present work, GIS analysis is applied to the Diexi Landslides, based on a review of historical documents and previous studies, data collected during field work, and remote sensing and SRTM-3 digital terrain data. We attempted to determine the precise locations of the 1933 landslides and measured dam height, cross-section area, and volume of the damming landslides. Due to the lack of topographic data before the 1933 earthquake, data of the landslide lakes, including maximum water elevation and total impounded volume can only be estimated. Using credible water levels and inferred submerged topography we calculate an outburst volume for the 1933 event. Moreover, cross-sections are made for both the damming area and the Min River downstream in order to make a general assessment of the damage due to the subsequent flood. Maximum flood discharge is estimated by regression equations. The two remaining lakes on the Min River have experienced a slight water level decrease after over 80 years of outlet erosion. Despite this, these two lakes are considered to be safe.