Rethinking Probabilistic Seismic Hazard in Eastern Taiwan after the 2018 Hualien, Taiwan, Earthquake Sequence

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This study re-assesses probabilistic seismic hazard for eastern Taiwan after the 2018 Hualien sequence based on an innovative approach, combining both the Brownian Passage Time (BPT) model and the Coulomb stress change. The 2018 Hualien sequence starts from one M_w4.9 earthquake and a subsequent event with M_w6.1 on February 4th. Due to far away from populated area, no damage was reported. On February 6th, another larger earthquake with M_w6.3 took place close to Hualien City, with more than 100,000 populations, and resulted in damage and fatality. Thus, subsequent seismic activity becomes of crucial concern to rapid hazard re-evaluation and responses to victim relocation and sheltering.

Understanding seismic behaviour relies on interdisciplinary collaboration between seismologists and geologists. The earthquake catalogue shows a sequence of M7-class earthquakes along the Milun and Longitudinal Valley Faults in 1951. Paleo-seismic and geomorphological evidences by the Taiwan Earthquake Model suggest earthquake recurrence periods along the Milun and Longitudinal Valley Faults are 67 and 189 years, respectively. Based on the time elapsed since the last fault-rupture and recurrence intervals mentioned above, the BPT models forecast the rupture probabilities on the Milun and Longitudinal Valley Faults in the coming 50 years are 80 % and 21 %, respectively. In addition to long-term rate model, short-term rate change was evaluated based on the static Coulomb stress interaction between seismogenic sources. The model shows four of the neighbouring seismogenic structures are significantly closer to failure after this sequence, suggesting a higher seismic hazard level. Combining all of the information mentioned above, probabilistic seismic hazard in various time snapshots could be assessed. After the February 4th earthquakes, stress triggering elevated seismic hazard near the epicentres, inferring occurrence of the M_w6.3 event two days later. After February 6th, earthquake probability further increases, suggesting occurrence of aftershock sequence or potential of next larger earthquake in the vicinity. Note that this model forecasts the seismicity rates on the Northern and Southern Ilan Structures are 59 % and 45 %, respectively, higher than the background.

Keywords: PSHA, Brownian Passage Time, Coulomb stress change, Taiwan

