Systematic Detection and Relocation of Microseismicity Before the 2008 Mw 7.9 Wenchuan Earthquake

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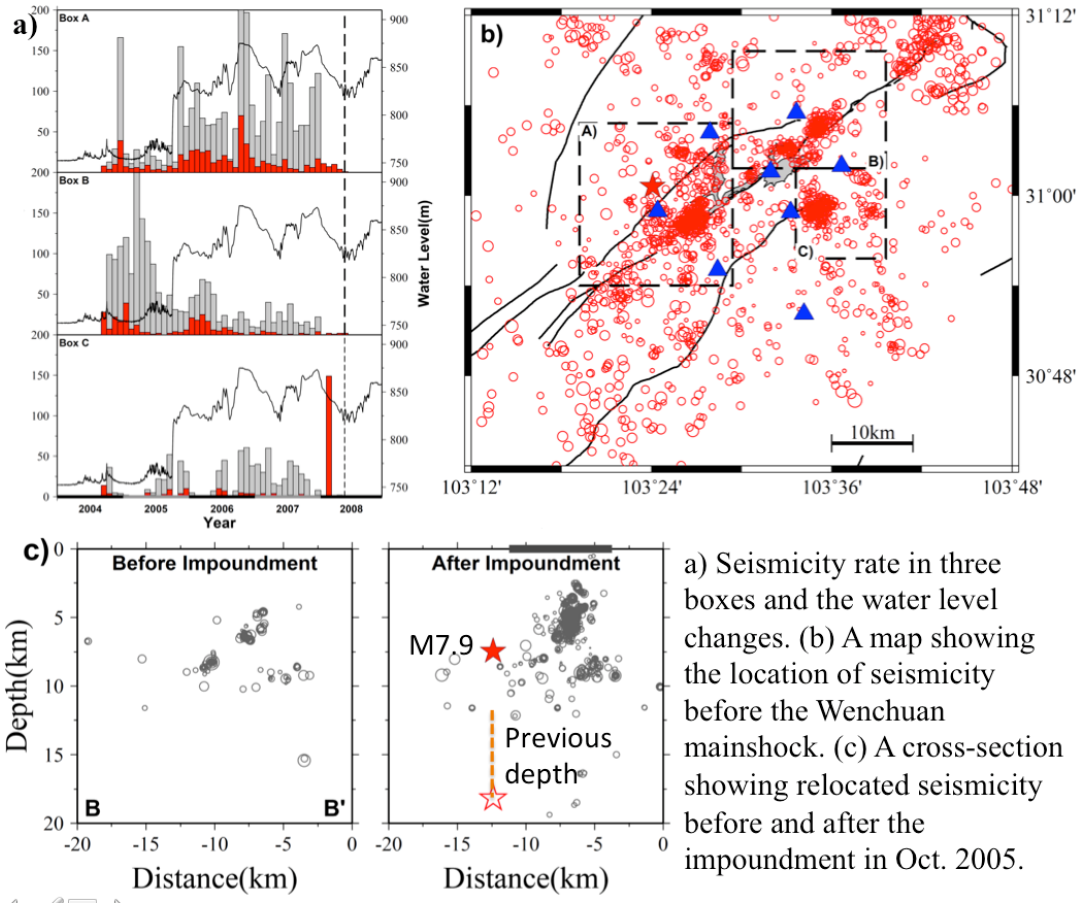
It is still not clear whether the 2008 M7.9 Wenchuan earthquake was triggered by the impoundment of the nearby Zipingpu reservoir in Fall 2005. We conduct a detailed analysis of the microseismicity in the last four years around the Wenchuan epicenter. Staring with ~2,630 catalog events recorded by the Zipingpu reservoir network within 20 km between September 2004 and May 2008, we first manually pick the phase arrivals and obtain their absolute locations using the Hypoinverse program. These events are then utilized as matched filters to scan through continuous recordings to identify missing similar events. We end up with ~7,700 new events. Together with existing catalog events, differential travel times between linked events are precisely measured using waveform cross correlations. Next we use them in the double-difference relocation algorithm to better constrain relative locations for ~7,100 events. Our results show three major clusters around the water reservoir area, and virtually no seismicity right beneath the reservoir. The cluster to the southwest shows dipping features consistent with the inferred rupture plane during the 2008 Wenchuan earthquake. In addition, the seismicity rate shows a clear increase following the first impoundment in October 2005, and the subsequent rate changes are consistent with the annual water level changes. On the other hand, the northeastern cluster is active prior to the water impoundment, and the events closer to the reservoir become much less following the water impoundment. Finally, the third cluster beneath the city of Dujiangyan became activated in February 2008, and they likely occurred on the inferred detachment fault extending further into the Chengdu plain (Ruan et al., 2018). Our next step is to compare the seismicity rate changes with Coulomb stress changes from the Zipingpu reservoir. Updated results will be presented at the meeting.



a) Seismicity rate in three boxes and the water level changes. (b) A map showing the location of seismicity before the Wenchuan mainshock. (c) A cross-section showing relocated seismicity before and after the impoundment in Oct. 2005.