Detecting and locating aftershocks for the 2020 M_W 6.5 Stanley, Idaho earthquake using convolutional neural networks

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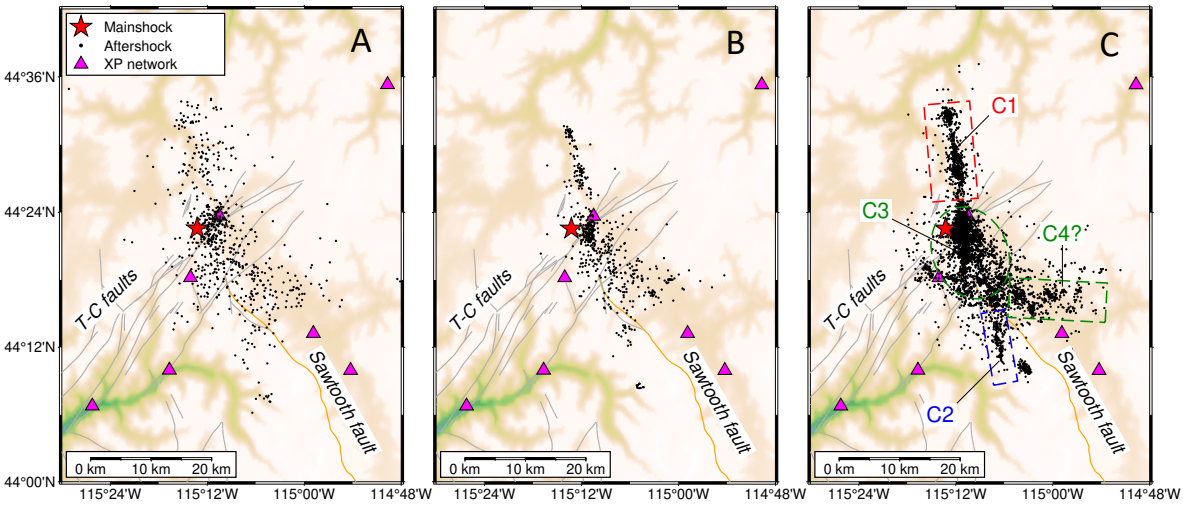
Our study is to build an aftershock catalog with a low magnitude of completeness for the 2020 M_W 6.5 Stanley, Idaho earthquake. This is challenging because of low signal to noise ratio for recorded seismograms. Therefore, we apply convolutional neural networks (CNNs) and use a 2-D time-frequency feature maps as inputs to address this problem. Another trained CNN is used to automatically pick P-wave arrival times, which are then used in both nonlinear and double-difference earthquake location algorithms. Our new one-month-long catalog has 4,644 events and a completeness magnitude $M_c = 1.9$, which has over 7 times more events and 0.9 lower M_c than the current USGS-NEIC catalog. The distribution and expansion of these aftershocks improve the resolution of two NNW trending faults with different dip angles, providing further support for a central step-over region that changed the earthquake rupture trajectory and induced sustained seismicity.



Panels A and B show 662 aftershocks in the USGS-NEIC catalog before and after the double-difference relocation, respectively. Panel C presents 4,644 detected events using the CNNs. Three well-defined aftershocks clusters are labeled as C1, C2 and C3.