Alaska landslide research benchmark dataset

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We assemble a benchmark set of landslides spanning southern Alaska for which proximal seismic records and accurate volume estimates are available. This dataset serves as the foundation for developing a portable, real-time landslide assessment approach, particularly when supported by a robust seismic network. Our goal is to establish the foundation for this system, tune critical parameters, and showcase efficacy using this benchmark dataset.

We have compiled this benchmark dataset from known historical landslides found in the Exotic Seismic Events Catalog (ESEC, Allstadt et al., 2017; Collins et al., 2022). The ESEC is a compilation of known mass movements recorded on existing seismic networks. This catalog documents basic information on these events like location, size (area, volume, mass), photos, maps, references, etc.

We selected events that are (1) in Alaska, (2) have a volume estimate, (3) have at least four stations within 2 degrees of the source location, (4) are not lahars, explosions, or ice avalanches, (5) occur near the coast, and (6) happened after 2010. Using these criteria, we added six events spanning roughly 1000 km of coastline:

The ***Taan Fiord*** (also referred to as Icy Bay) landslide and tsunami happened on 18 October 2015 at 05:18 (all times in UTC unless otherwise noted) (Gualtieri & Ekström, 2018; Haeussler et al., 2018; Higman et al., 2018). This event is located in an arm of Icy Bay within Wrangell-St. Elias National Park and Preserve in Alaska. The landslide is one of North America's largest, and the resulting tsunami runup of 193 m is the fourth-highest recorded globally. The Global CMT project detected the event (Ekström & Stark, 2013). There are multiple size estimates for this landslide: mass is estimated to be ~150 million metric tons from surface-wave seismic inversion (Gualtieri & Ekström, 2018), and volume is estimated to be 76 Mm^3 calculated from a variety of imagery sources (e.g., InSAR, airborne LiDAR, structure from motion) (Haeussler et al., 2018; Higman et al., 2018).

A local pilot found the ***Lamplugh Glacier*** rock avalanche, which occurred on 26 June 2016 at 16:21 at the Glacier Bay National Park, Alaska (Bessette-Kirton, 2017; Bessette-Kirton et al., 2018; Dufresne et al., 2019; Petley, 2016). This event is one of the largest landslides recorded in the park's history. The event volume is estimated to be 69 Mm^3, calculated from DEM differencing.

The ***Red Glacier*** rock and ice avalanche occurred on 22 May 2016 at 07:57 at the east flank of the Iliamna Volcano on Red Glacier, Alaska (Toney et al., 2021). This significant event was recorded at numerous seismic and infrasound stations across Alaska. The Alaska Volcano Observatory first detected this event, and a local pilot confirmed the location. The volume estimate from the satellite-imagery-based calculations is 13 Mm^3.

On 16 February 2014 at 14:24, a near-vertical wall on the flank of Mount La Perouse, located at the Glacier Bay National Park and Reserve, collapsed (Nielsen, 2014; Petley, 2014). Ekström & Stark's (2013) surface-wave event detection algorithm detected the ***Mount La Perouse*** rock and ice avalanche. The mass of the landslide is estimated at 68 million tons. The ESEC volume estimate is 14 Mm^3.

The ***Taku River*** rock avalanche occurred on 24 December 2020 at 19:50 ~75 km northeast of Juneau, Alaska (Miller, 2020; Petley, 2020). A helicopter pilot discovered the event while flying over the Taku River. The photographs suggest that a substantial mass was detached from a near-vertical slope and was in freefall for a significant distance. The ESEC estimates the volume of the event as 0.6 Mm^3.

The ***Cowee Creek*** rockfall, on 30 December 2016 at 18:27, happened ~45 km northwest of Juneau, Alaska, and was first detected as an M3.4 seismic event (Gullufsen, 2018; Petley, 2018). Later, a team of U.S. National Forest Service scientists discovered the rockfall while studying this region. They noted that this event remapped a part of Cowee Creek by causing an "alpine tsunami." The rockfall collapsed into the lake below. Because the lake was nearly full, it displaced a 10-meter tall wave of water down Cowee Creek. The ESEC estimates the volume of the event to be 0.54 M m^3.

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