Detecting and measuring catastrophic landslides using seismology

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Massive, rapidly accelerating landslides generate surface waves detectable on seismometers many 100s of kilometers distant. Time-series single-force inversion of the long-period phases allows approximate reconstruction of the progressive unloading and reloading of the solid earth below the sliding mass. We thus obtain the dynamics of bulk landslide motion and its location. The bulk 3d momentum vector approximates the mass-scaled evolving velocity; by assuming constant mass for the main phase of acceleration and deceleration we can infer a mass-scaled runout trajectory; calibration against satellite imaging of mass-center displacement leads to an estimate of landslide mass. We have developed and applied this methodology to the global detection of >10Mt landslides on a near-real-time basis for several years, and the inventory of such events leads us to make several important conclusions: (1) several such massive landslides go unreported each year; (2) the majority of unreported events take place in SE Alaska and the Himalayas-Karakoram; (3) only supraglacial landslides exhibit long-runout; (4) supraglacial landsliding is a significant and underestimated player in the erosion of glaciated landscapes; (5) on rare occasions, a teleseismically detectable landslide triggers a tsunami, and the precise timing, location and dynamics gleaned from single-force inversion provides an exciting new constraint on tsunami physics.

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