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Terrestrial overview of a landslide-tsunami-flood cascade at Elliot Creek, British Columbia

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On 28 November 2020, some 18 Mm³ of quartz diorite detached from a steep rock face at the head of Elliot Creek in the southern Coast Mountains of British Columbia. The rock mass fragmented as it descended 1000 m and flowed across a debris-covered glacier. The rock avalanche was recorded on local and distant seismometers, with long-period amplitudes equivalent to a M 4.9 earthquake. Local seismic stations detected several earthquakes of magnitude <2.4 over the minutes and hours preceding the slide, though no causative relationship is yet suggested. Pre-slide optical and radar remote sensing data indicated some slope deformation leading up to failure. More than half of the rock debris entered a 0.6 km² lake, where it generated a 115 m displacement wave that overtopped the moraine at the far end of the lake. We estimate that some 13.5 Mm³ of water left the lake from the combined impact of the landslide as well as erosion of the dam. The water that left the lake was channelized along Elliot Creek, scouring the valley more than 40 m in some places over a distance of 10 km before depositing debris on a 2 km² fan in the Southgate River valley. Debris temporarily dammed the river, and turbid water continued down the Southgate River to Bute Inlet, where it produced a 70 km turbidity current and altered turbidity and water chemistry in the inlet for weeks. The landslide

followed a century of rapid glacier retreat and thinning that exposed a growing lake basin. The outburst flood extended the damage of the landslide far beyond the limit of the landslide, destroying forest and impacting salmon spawning and rearing habitat. We expect more cascading impacts from landslides in the glacierized mountains of British Columbia as glaciers continue to retreat, exposing water bodies below steep slopes while simultaneously removing buttressing support.