Historic, post-eruptive debris flows of remobilised volcanic ash are rare in Iceland, being restricted to explosive eruptions. A slurry of volcanic ash from the southern slopes of the ice-capped Eyjafjallajökull volcano on 19 May 2010 is the first lahar observed in Iceland since the 1947 Hekla eruption. This study focuses on the volume of sediment transported, the size and hydrological behaviour of watersheds, and the resulting erosion. Our analysis is based on: (i) direct measurements of the 19 May lahar; (ii) direct measurements of ash fallout; (iii) aerial and ground-based imagery; (iv) topographic data from an airborne LIDAR survey; (v) airborne synthetic-aperture radar; and (vi) flow modelling using LAHARZ. The volume of the lahar in the Svaðbælisá channel was estimated at 200,000 m³. This flow originated from crown and flank failures, similar to slab avalanches, with water-saturated, fine-grained ash as the slip surface. Several ash-laden floods occurred in Svaðbælisá and neighbouring channels during the summer of 2010. None, however, were as saturated as the 19 May lahar. Large quantities of volcanic ash mantle the lower slopes of the ice-cap. Ash in the ablation zone is expected to be transferred down-slope in the next few years. Fieldwork during the summer of 2010 has resulted in a map showing the volume of ash above and below the ablation zone of the main catchments. Ongoing removal of large quantities of ash from the course of Svaðbælisá has prevented damage to the main highway to the south of the volcano.