

A national glacier inventory and variations in glacier extent in Iceland from the Little Ice Age maximum to 2019

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Abstract — A national glacier outline inventory for several different times since the end of the Little Ice Age (LIA) in Iceland has been created with input from several research groups and institutions, and submitted to the GLIMS (Global Land Ice Measurements from Space, nsidc.org/glims) database, where it is openly available. The glacier outlines have been revised and updated for consistency and the most representative outline chosen. The maximum glacier extent during the LIA was not reached simultaneously in Iceland, but many glaciers started retreating from their outermost LIA moraines around 1890. The total area of glaciers in Iceland in 2019 was approximately 10,400 km², and has decreased by more than 2200 km² since the end of the 19th century (corresponding to an 18% loss in area) and by approximately 750 km² since ~2000. The larger ice caps have lost 10–30% of their maximum LIA area, whereas intermediate-size glaciers have been reduced by up to 80%. During the first two decades of the 21st century, the decrease rate has on average been approximately 40 km² a⁻¹. During this period, some tens of small glaciers have disappeared entirely. Temporal glacier inventories are important for climate change studies, for calibration of glacier models, for studies of glacier surges and glacier dynamics, and they are essential for better understanding of the state of glaciers. Although surges, volcanic eruptions and jökulhlaups influence the position of some glacier termini, glacier variations have been rather synchronous in Iceland, largely following climatic variations since the end of the 19th century.

INTRODUCTION

Most glaciers in the world have retreated from their advanced positions of the Little Ice Age (LIA, ~1450–1900 in Iceland), which they reached at different times (e.g. Grove, 2004). There is a robust trend of shrinkage and volume loss of glaciers in all glacierized regions of the Earth (Paul and Bolch, 2019; Zemp *et al.*, 2019). The LIA outer boundary is often marked by terminal and lateral moraines as well as trimlines, which have been used to reconstruct the maximum LIA extent of glaciers (e.g. Paul and

Bolch, 2019). Reconstructions of glacier extents from a variety of sources such as historical documents, pictorial sources, delineation and dating of moraines and lacustrine records have revealed a detailed timeline of glacier variations during the LIA for many glaciers in the Alps (e.g. Zemp *et al.*, 2008), South America (e.g. Masiokas *et al.*, 2009; Zalazar *et al.*, 2020), Norway (e.g. Nesje *et al.*, 2008; Nussbaumer *et al.*, 2011) and Iceland (e.g. Þórarinnsson, 1943; Björns-son and Pálsson, 2004; Bradwell *et al.*, 2006; Sigurðsson, 2010; Aðalgeirsdóttir *et al.*, 2011; Pálsson