

Mass and volume changes of Langjökull ice cap, Iceland, ~1890 to 2009, deduced from old maps, satellite images and in situ mass balance measurements

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Abstract – We describe the mass balance of Langjökull ice cap, Iceland, ($\sim 920 \text{ km}^2$, $\sim 190 \text{ km}^3$) during several time intervals of different climate conditions that span the 20th century until present. The elevation range of Langjökull is 460–1440 m a.s.l. with a zero mass balance equilibrium line altitude (ELA) of 1000 m (southern outlets). The mass balance of the ice cap has been observed in situ every year since 1996–1997 and also assessed from estimation of glacier volume changes by comparing series of elevation maps from: 1937, 1945–1946, 1986, 1997 and 2004. The glacier margin of the Little Ice Age maximum (LIA; ~ 1890) was estimated from the location of end moraines. The difference between the 1997–2004 annual specific net balance estimated by volume change and in situ measurements is negligible ($\sim 5 \text{ cm}_{we}$). During the two warm periods 1936–1946 and 1997–2009 the mean mass balance was similar; -1.6 and $-1.3 \text{ m}_{we} \text{ yr}^{-1}$, respectively. The colder climate during 1946–1986 and cooler yet in 1986–1997 resulted in specific mass balance close to zero; -0.3 and $-0.2 \text{ m}_{we} \text{ yr}^{-1}$, respectively.