Monacobreen is a 40 km long surge-type tidewater glacier in northern Spitsbergen. During 1991-1997 Monacobreen surged and advanced by about 2 km, but the front did not reach the maximum Little Ice Age (LIA) stand. Since 1997 the glacier front is retreating at a fast rate (~ 125 m/a). The questions addressed in this study are: (1) Can the late Holocene behaviour of Monacobreen be understood in terms of climatic forcing ?, and (2) What will be the likely evolution of this glacier for different scenarios of future climate change ?

Monacobreen is modelled with a Minimal Glacier Model, including a parameterization of the calving process as well as the effect of surges. The model is driven by an Equilibrium Line Altitude (ELA) history derived from lake sediments of a nearby glacier catchment, in combination with meteorological data from 1899 onwards. The simulated glacier length is in good agreement with the observations: the maximum LIA stand, the front position at the end of the surge, and the 2.5 km retreat after the surge (1997-2016) are well reproduced (the mean difference between observed and simulated glacier length being 6% when scaled with the total retreat during 1900-2016). The effect of surging is limited. Directly after a surge the initiated mass-balance pertubation due to a lower mean surface elevation is about -0.13 m w.e. a^{-1}, which only has a small effect on the long-term evolution of the glacier. The simulation suggests that the major growth of Monacobreen after the Holocene Climatic Optimum started around 1500 BCE. Monacobreen became a tidewater glacier around 500 BCE, and reached a size comparable to the present state around 500 CE. For the mid-B2 scenario (IPCC, 2013), which corresponds to a ~ 2 m a^{-1} rise of the ELA, the model predicts a volume loss of 20 to 30 % by the year 2100 (relative to the 2017 volume). For a ~ 4 m a^{-1} rise in the ELA this is 30 to 40 %. However, much of the response to 21st century warming will still come after 2100.