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Modelling the response of Vatnajökull´s southeastern outlet glaciers to climate change

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Icelandic glaciers are sensitive to climate change and provide important climatic information through variations in mass balance and extent. The small non-surging outlet glaciers of southeast Vatnajökull are located in the warmest and wettest area of Iceland. The documentary record of glacier variations and detailed information about glacier geometry is unique for studying the response of glaciers to climate change.

Data on the extent, bedrock and surface topography of outlet glaciers of southeast Vatnajökull, (from Öræfajökull and Breiðabunga) along with meteorological data, is used to study the connection of glacier variations and climate change and tune a coupled glacier mass balance and flow model. Our finite element flow model is based on shallow-ice approximation and Weertman-type sliding. A degree-day-mass balance model uses records from meterological stations located away from the glacier, and is calibrated to annual mass balance observations at 23 stakes on southern Vatnajökull since 1996.

Preliminary results indicate that the mass balance model may underestimate the mass balance in the accumulation areas of the studied glacier outlets. This is supported by calculated precipitation from the mesoscale atmospheric model WRF 2.2 in 9 km resolution for the period 1958-2007.

The model calculations were tuned with ice geometries of the year 2000 and using the average 1981-2000 reference climate, a period of which mass balance was generally zero for glaciers in Iceland. The models were initiated with runs simulating glacier changes from 1880 until present day. Local temperature data is available since 1884 and local precipitation data since 1932. The glacier extent is known from the Little Ice Age maximum (1870-1890) from detailed mapping in the field and satellite images.