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Long-term dynamics of a tidewater outlet glacier in West Greenland and its relation to external forcing

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Dynamic changes of ocean-terminating outlet glaciers such as terminus retreat and flow acceleration are responsible for about half of the current mass loss of the Greenland ice sheet. Although these changes seem related to the general warming in recent decades, the detailed link between external forcing from the atmosphere and/or ocean and glacier response is not well understood. Further, existing observations of tidewater outlet glacier change also show strong temporal fluctuations and are mostly limited to the last two decades of satellite observations. It is therefore difficult to derive and interpret long-term trends in outlet glacier change which is relevant in the context of century scale predictions.

Here we present and analyse a detailed long-term record of flow and geometry evolution of Eqi Sermia, a ocean terminating outlet glacier in West Greenland. This record starts in 1912 and has, due to its proximity to the main access route for early expeditions to the ice sheet, a decadal and smaller resolution. This historic record is supplemented by data from satellites and ground based radar interferometry for deriving front positions and flow velocities in the two recent decades.

The front and flow speed of Eqi Sermia was more or less stable between 1912 with aslow retreat phase between 1920 to the 1960, followed by a slight readvance in the 1980s. In 2007 the terminus started to retreat very rapidly, retreated 3 km since and in a step wise fashion and almost quadrupled its flow speed at the terminus. A comparison with surface mass balance and temperature records suggests a close relation of the long-term evolution of Egi Sermia to atmospheric forcing rather than oceanic, perhaps reflecting the relatively shallow fjord depths. In contrast, the recent rapid retreat and acceleration may be due to a changing regime in the calving process and geometric effects.