

The ice-dammed lake Isvand, West Greenland, has lost its water

Isvand is an ice-dammed lake situated on the western flank of Kangiata Nunaata Sermia, a large ice stream from the Inland Ice, producing calf ice into Kangersuneq fjord at the head of Godthåbsfjord (Nuup Kangerlua), West Greenland (Fig. 1). This outlet of the Inland Ice is the only significant calving outlet of the ice sheet met with between 62° and 69° N.

Updating and revision of geological and historical knowledge of the neoglacial fluctuations of the Inland Ice margin in central West Greenland has shown that the area around Kangiata Nunaata Sermia is characterized by large fluctuations in the period after the Wisconsinan ice age. As early as ~10 000 years ago the ice margin in the Kangersuneq area was already situated east of its present position, but then the glacier again filled the entire length of Kangersuneq fjord during an advance, presumably ~8200 years ago (the Kapisigdlit stade (Kelly, 1985)). A recession followed during the Holocene climatic optimum 5000–6000 years ago and the ice margin was again situated east of the present position. A subsequent advance during the Little Ice Age (LIA) at AD 1500–1900 again caused the front of Kangiata Nunaata Sermia to largely fill Kangersuneq. Whereas the LIA maximum expansion was dated to the second half of the 19th century (Weidick, 1994), at Kangiata Nunaata Sermia it seems to have occurred in the 18th century, though followed by a minor but marked advance through parts of Kangersuneq around 1920. This is in contrast with the ice-margin behaviour just south and north of Kangersuneq. Little is known of the position of the ice margin here before the 19th century, but during the last 200–150 years it has shown minor fluctuations, and in some places even a steady advance for much of the period.

Isvand has a unique history in relation to the large LIA expansion of Kangiata Nunaata Sermia: from the very start of

its formation the lake had a constant drainage over a pass down to Ameralik fjord to the west, and it was only with the final tapping in 2004 that it first disappeared to the east, via Kangiata Sermia. This contrasts with some of the large ice-dammed lakes at the nearby Inland Ice margin: the periodic tapping of Iluliartooq and Ujarattooq through Narssap Sermia (near Ivisaartoq in Fig. 1) is already mentioned by Jensen (1889, p. 88). These periodic tapings may be related to the more stable behaviour of the ice margin at Narssap Sermia.

Isvand is also of special historical interest for its description by F. Nansen during the first crossing of the Inland Ice. The ice-dammed lakes Langvand and Isvand and the connecting valley Austmannadalen (Fig. 2) to the fjords Ameralla and Ameralik were all named by Nansen after his crossing of the Inland Ice from east to west in 1888. He and five companions on skis started on 15 August from the east coast and ended on the west coast near Isvand on 24 September.

Isvand is the best-described ice-dammed lake in Greenland, appearing in written sources as early as the beginning of the 18th century. These, together with information from adjacent archaeological investigations of mediaeval Norse settlements (Vesterbygden), provide an environmental history of the area reaching back to the 'Mediaeval Warm Epoch'. Norse farms found on the eastern side of Kangiata Nunaata Sermia as well as in Austmannadalen and Ameralla indicate an environment totally different to what exists today. These remote farms were reached by boat, a journey now impeded by extensive tidal flats in Ameralla and the advance of Kangiata Nunaata Sermia into Kangersuneq (Roussel, 1941).

The onset of the LIA around 1500 resulted in a change in climate and the dramatic advance of Kangiata Nunaata Sermia. In mediaeval times the glacier may have been of lesser extent than today; it then advanced >20 km into Kangersuneq fjord, filling the valley containing Isvand.

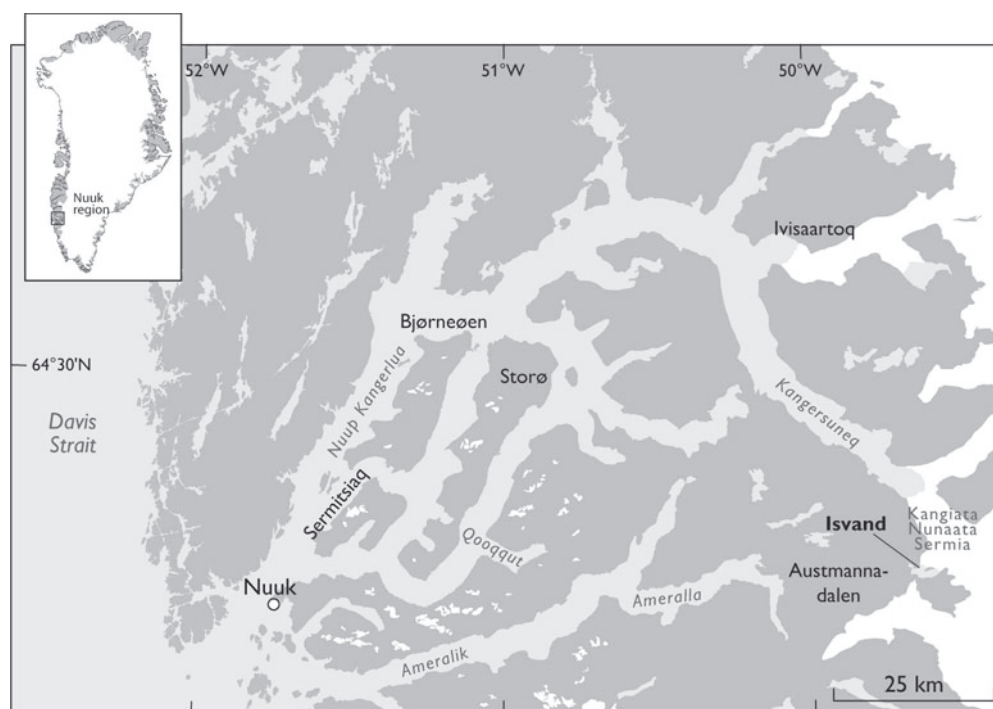


Fig. 1. Location of Isvand and damming glacier Kangiata Nunaata Sermia.

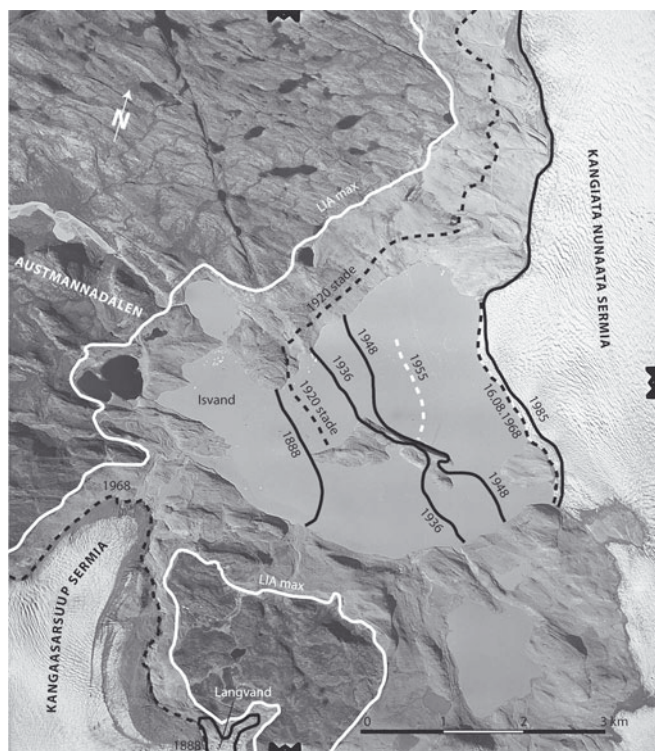


Fig. 2. Isvand and its discharge into the river through Austmannadalen. Vertical aerial photograph 16 August 1968 (Geodetic Institute route 281T, No. 85). The recession of the damming ice margin is given by approximate positions of the ice margins with years of observations from 1888 to 1985. The recession has probably been interrupted by minor advances, with the most pronounced culminating just before 1920 (marked '1920 stade'). The most impressive change occurs in the area between the present glacier margin and the limit of the maximum ice coverage during the LIA. This limit is marked 'LIA max', and the area behind is still barren even though major parts of this 'trimline zone' have been free of ice since the 18th century.

Written sources from the early 18th century indicate that the glacier reached the head of the pass between Austmannadalen and the valley enclosing Isvand, at 360 m a.s.l. which, according to the trimline zone around the glacier, was the LIA maximum. At this period, meltwater from the glacier poured directly down Austmannadalen (Weidick, 1959). Throughout the 18th century the sources speak of the advance of the ice margin of the glacier but also of lakes in front of the ice margin. It is presumed that the ice margin in the early 18th century occasionally produced minor ice-dammed lakes and that it generally had a position close to the LIA maximum until later in the century. Thinning of Kangiata Nunaata Sermia in the 18th century resulted in the formation of the present lake Isvand.

The thinning of Kangiata Nunaata Sermia and the contemporaneous recession of the ice margin to Isvand (Fig. 2) was followed by a gradual growth of the ice-dammed lake from $\sim 2 \text{ km}^2$ in 1888 to $\sim 10 \text{ km}^2$ around 1960. The recession of the ice margin at Isvand and of the glacier front of Kangiata Nunaata Sermia was interrupted by a marked readvance in the early 20th century, culminating around 1920 (the '1920 stade'; Fig. 3). The magnitude of the recession of the glacier front preceding this stade is unknown, but the stade left its mark as a ridge of ice-contact features throughout the trimline zone.

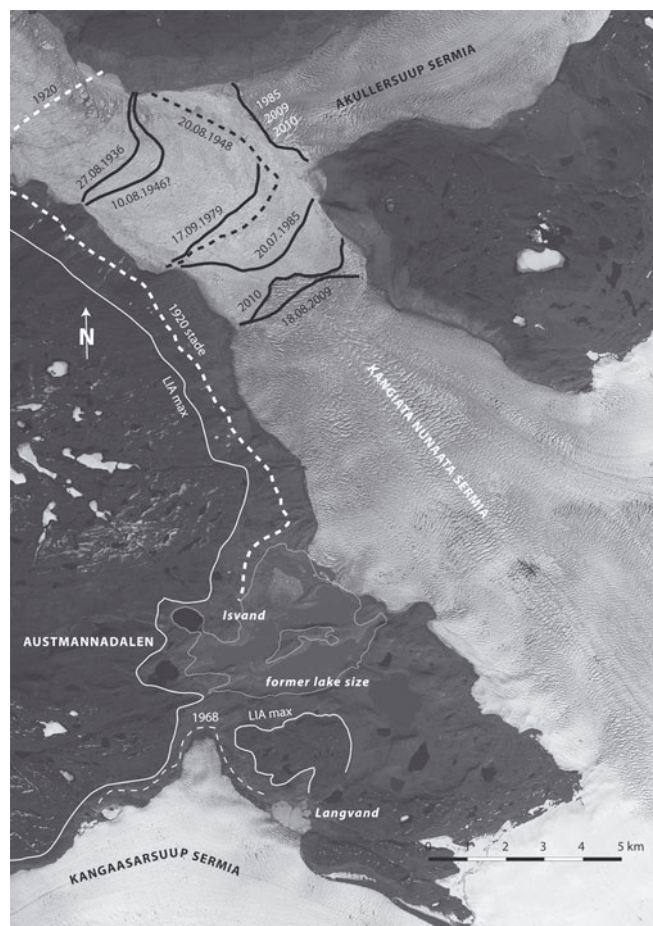


Fig. 3. The Advanced Spaceborne Thermal Emission Reflection Radiometer (ASTER) satellite scene of the area in the front of Kangiata Nunaata Sermia and former areas of Isvand showing the situation in 2010. Contours of former lake Isvand for 1968 are shown with white lines (cf. Fig. 2). Approximate positions of the front of Kangiata Nunaata Sermia are shown for the period ~ 1920 –2010. Date format is day/month/year. The split of Kangiata Nunaata Sermia and its tributary Akullersuup Sermia took place around 1980. Since then the position of the front of Akullersuup Sermia appears to be rather stable for the period 1985–2010, whereas the front of the main glacier, Kangiata Nunaata Sermia, has mainly shown recession throughout this period.

In the decades 1960–90 the position of the ice margin at Isvand stabilized. Presumably the ice margin now stands at the edge of the U-shaped valley where Kangiata Nunaata Sermia is situated, so a change in the ice cover during this period is more a question of thinning of the glacier body than a recession of the ice front in the valley with Isvand.

Therefore emptying of the lake via Kangiata Nunaata Sermia was to be expected. Satellite scenes show that lake remnants were emptied via Kangiata Nunaata Sermia at least twice in the first decade of the 21st century, around 2004 and 2009. After ~ 250 years of permanent drainage to Ameralla fjord, the drainage of the valley of Isvand now, as in the mediaeval epoch, is via Kangiata Nunaata Sermia to Kangersuneq fjord.

The water discharge through Austmannadalen is now reduced to a modest size as in mediaeval times, leaving only a memory of Isvand and the great discharge of meltwater through Austmannadalen; the area of the former Isvand and the head of Ameralla is now covered in a layer of silt.

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