



Technical Report 14-06

SW Greenland temperature data 1784-2013

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Ilulissat August 2006. Photo: John Cappelen.



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Abstract

The purpose of this report is to present the longest available instrumental Greenland temperature record 1784-2013. Three individual data series that forms this long series are also attached.

Resumé

Formålet med denne rapport er at præsentere den længste tilgængelige grønlandske temperaturserie 1784-2013. Tre individuelle dataserier, som er brugt til at konstruere serien, er også inkluderede.

1. Introduction

Continuous instrumental temperature records for Greenland reach back to the late 19th century at a limited number of coastal sites [2]. Combining early observational records from locations along the south and west coasts it has been possible to extend the overall record back to the year 1784. This extended southwest (SW) Greenland series 1784-2005 was first published in an early work [1]. Here we update the series up to 2013.

This longest available instrumental Greenland temperature record is around 9% incomplete in the oldest parts. There are however sufficient data (an additional 74 complete winters and 52 complete summers) to provide a valuable indication of late 18th century and 19th century seasonal trends.

A long homogeneous southwest Greenland instrumental temperature record is of considerable public and scientific interest. This longest available instrumental Greenland temperature record are of importance for the interpretation of the growing number of Greenland ice core records and for the calibrating and validating of the ice sheet models that are used to predict the response of the Greenland ice sheet to global warming.

Greenland temperatures have been on the rise since the mid 1980s. The earlier study extending SW Greenland temperature records back to 1784 found that despite the recent temperature rise the 1930s and 1940s were the warmest decades in SW Greenland. Including the newest observations it is evident that the first decade of the 21st century was record warm in SW Greenland, with 2010 being by far the warmest year observed. 2010 was warmer than any other year in the SW Greenland temperature record and the decade 2001-2010 was warmer than any other 10 year period.

2. Description of the data

The long SW Greenland temperature series is formed by merging three master series, all having been made complete back to 1873 through infilling with separate subgroups of neighboring stations [1]. The three master series are from 04221 Ilulissat, 04250 Nuuk and 04272 Qaqortoq (see Figure 1 for locations; the station numbers represent the newest locations) and the earliest year of data in the three records are 1807, 1784 and 1807 respectively.

The three master series as well as the long SW Greenland temperature series 1784-2013 based on the three series are all shown in Figure 2 and in Figure 3 the seasonal average are displayed.

In Appendix 1 - Supplementary material details concerning updates and revisions of each of the individual series since the early study [1] are shown.

The 2010 and 2001-10 record warmth is seen in all three master series as well as in the merged SW Greenland series and in all seasons. Hence, the record warmth is observed at locations spanning more than 1000 km from southern to western Greenland underscoring the spatial extent and temporal robustness of the warming.

It is a common picture that 2010 was record breaking warm most places in West Greenland and near record breaking warm other places like Tasiilaq in SE Greenland (second warmest, 2003 being the warmest). The decade 2001-10 was the warmest 10-year period everywhere in Greenland.

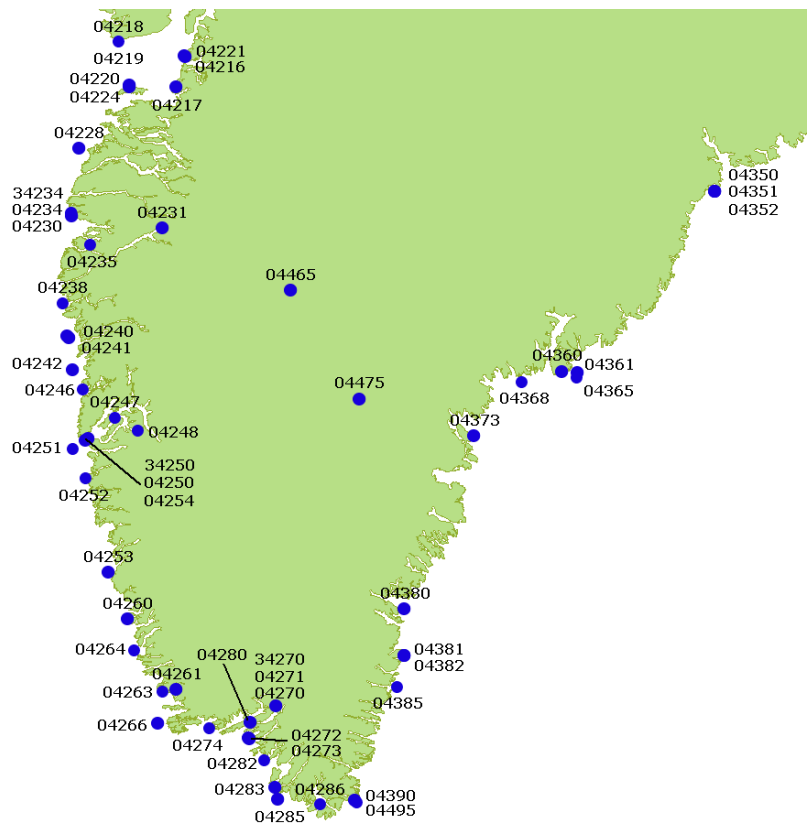


Figure 1. Locations of observation sites for all recent DMI Greenland temperature records in the southern parts (since 1958) [3]. Sites forming the basis of the merged SW Greenland temperature record are 04221 Ilulissat, 04250 Nuuk and 04272 Qaqortoq. See figure 2 for more details concerning locations of observation sites used in the construction of the SW Greenland temperature record.

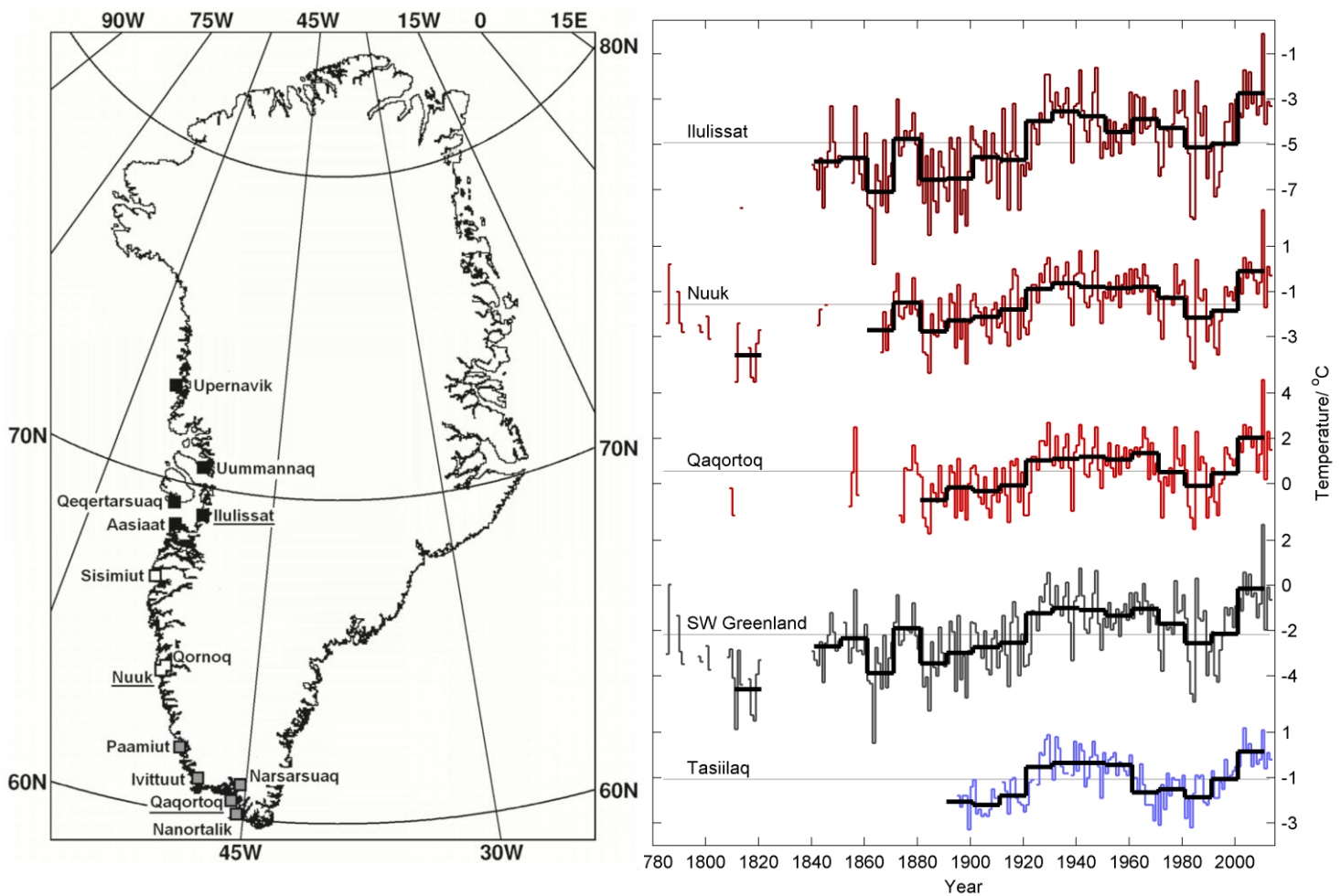


Figure 2. Left: Locations of observation sites used in this study and earlier study [1]. Colors indicate groupings. Ilulissat group stations are black, Nuuk group stations are white and Qaqortoq group stations are grey. The three stations providing master records are underlined. Right: Annual and decadal (in black) averages of Greenland temperature observations 1784-2013 from Ilulissat, Nuuk and Qaqortoq as well as the SW Greenland merged temperature record. The thin horizontal lines show the 1880-2010 averages.

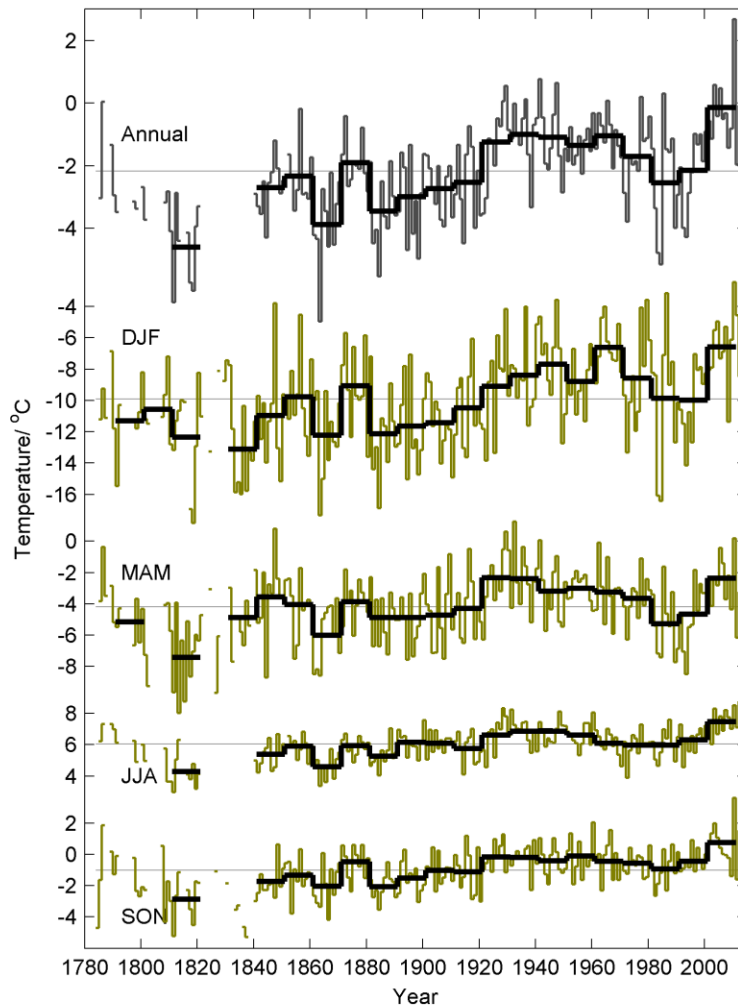


Figure 3. Annual average and seasonal averages for the merged SW Greenland temperature record 1784-2013. Decadal averages are given in black while the thin horizontal lines show the 1880-2010 averages. Note that the annual average temperatures are shown on a different scale than the seasonal values.

3. Data format

Five files can be downloaded with this report:

- 1) **Qaqortoq_1784_2013.txt**: Qaqortoq monthly temperatures 1784-2013 based on observations from four sites (Ivittuut, Nanortalik, Narsarsuaq and Paamiut) infilled with regressed values/in recent times with values from Qaqortoq Heliport if missing data. All sites are situated along the south coast of Greenland.
- 2) **Nuuk_1784_2013.txt**: Nuuk monthly temperatures 1784-2013 based on observations from two sites (Qornoq and Sisimiut) infilled with regressed values/in recent times with values from Mitt. Nuuk if missing data. All sites are situated along the west coast of Greenland.
- 3) **Ilulissat_1784_2013.txt**: Ilulissat monthly temperatures 1784-2013 based on observations from four sites (Aasiaat, Qeqertarsuaq, Upernavik and Uummannaq) infilled with regressed values if missing data. All sites are situated along the west coast of Greenland.
- 4) **Merged_sw_greenland_1784_2013.txt**: Merged SW Greenland monthly temperatures 1784-2013 based on infilled temperature series from Ilulissat, Nuuk and Qaqortoq situated along the south and west coasts of Greenland.
- 5) **vintheretal2006.pdf**: The early study [1] in pdf-format.

All temperatures in the files are given in degrees Celsius times 10.

Data are only to be used with proper reference to the accompanying report:

Cappelen, J. and Vinther, B. M. (2014): SW Greenland temperature data 1784-2013, DMI Technical Report, 14-06. Copenhagen.

Important note: The mean monthly temperature data forming the tree master series 04221 Ilulissat, 04250 Nuuk and 04272 Qaqortoq in this report are coordinated with the new updated data published in [2]. Changes can for that reason have been introduced in [2], compared with older versions of DMI Monthly Climate Data Collection for Greenland.

References

[1] Vinther, et al. (2006): Extending Greenland temperature records into the late eighteenth century, J. Geophys. Res., 111, doi:10.1029/2005JD006810, JGR, 111, D11105
<http://www.cru.uea.ac.uk/cru/data/greenland/>

[2] Cappelen, J. (ed) (2014). DMI Monthly Climate Data Collection 1784-2013, Greenland, DMI Technical Report 14-04. Copenhagen.

[3] Cappelen, J. (ed) (2014): Weather observations from Greenland 1958-2013. Observation data with description. DMI Technical Report 14-08. Copenhagen.

Previous reports

Previous reports from the Danish Meteorological Institute can be found on:

<http://www.dmi.dk/laer-om/generelt/dmi-publikationer/>

Appendix 1 – Supplementary Material

The SW Greenland combined temperature series and the three master temperature records (Qaqortoq, Nuuk and Ilulissat) which it has been based on presented in [1] are updated through December 2013 in this report. Minor necessary corrections/revisions in the previous material [1] have also been done. Since the early study [1] following have been done:

Qaqortoq

The Qaqortoq record has been updated from January 2006 to December 2013 using observations from the Danish Meteorological Institute (DMI) station 04272 (Qaqortoq) for all months except: Feb. 2006 (04273), Oct. 2006 (linear regression with DMI stations 04270 (Narsarsuaq) and 04260 (Paamiut) consistent with the method described in [1]). May and Dec. 2007 (04273 Qaqortoq Heliport). Feb. and Apr. 2009 (linear regression with DMI stations 04270 (Narsarsuaq) and 04260 (Paamiut) consistent with the method described in [1]). May, Jul., Aug., Sep. and Nov. 2009 (04273 Qaqortoq Heliport). May, Jul. and Aug. 2010 (04273 Qaqortoq Heliport). Mar., Jul., Aug., Nov. and Dec. 2011 (04273 Qaqortoq Heliport). Jan., Feb. and Apr. 2012 (04273 Qaqortoq Heliport). May 2013 (04273 Qaqortoq Heliport).

Furthermore Nov. 2005 has been changed compared to [1] using the value from 04273 Qaqortoq Heliport.

The Ivigtut series 1873-1960 that have been used in the construction of the Qaqortoq series have been changed compared to [1]. The monthly mean temperatures in the Ivigtut series are now calculated as $(\text{mean } T_n + \text{mean } T_x)/2$ in the whole period 1873-1960, because these values are available in the longest period. All corrections introduced in [1] due to the changes in observations hours are for that reason cancelled.

Nuuk

The Nuuk record has been updated from January 2006 to December 2013 using observations from the DMI station 04250 (Nuuk) for all months except for the full years 2007, 2008, Sep. 2009 and the full years 2011, 2012 and 2013. For these months values are based on DMI station 04254 (Mitt. Nuuk (Airport)).

Furthermore Dec. 2000 has been changed compared to [1] using the value from 04254 Mitt. Nuuk.

Ilulissat

The Ilulissat record has been updated from January 2006 to December 2013 using observations from the DMI station 04221 (Ilulissat) for all months [2].

Furthermore an investigation into temperature observation values from Ilulissat available in DMI archives revealed a problem with the homogenization of Ilulissat data presented in [1]. A correction for station change (from Ilulissat stations 34216 to 04216) in [1] was based on values from August 1966 to October 1971 thought to be from station 34216. The values were, however, based on weighted averages of observations from 3 distinct times (00, 12, 18 GMT) carried out at station 04216.

Removing the erroneous corrections and refining the November 1936 – August 1946 corrections to independent monthly values (rather than a 0.7°C correction for all months), leads to the following monthly corrections (replacing all Ilulissat corrections displayed in tables 2 and 5 in [1], all given in °C):

Nov. 1835 – Dec. 1872: 0.0; -0.1; 0.0; -0.4; 0.0; -0.8; -0.7; -0.7; -0.1; 0.0; -0.1; 0.0;

Nov. 1936 – Aug. 1946: 0.7; 0.7; 0.7; 0.7; 0.6; 0.5; 0.4; 0.5; 0.6; 0.9; 0.9; 0.9;

Combined SW Greenland temperature series

The three updated master temperature records have then been used to create the common SW Greenland temperature series using the methodology described in [1], but using 1880-2010 rather than 1880-2004 as the new base period for the calculations.