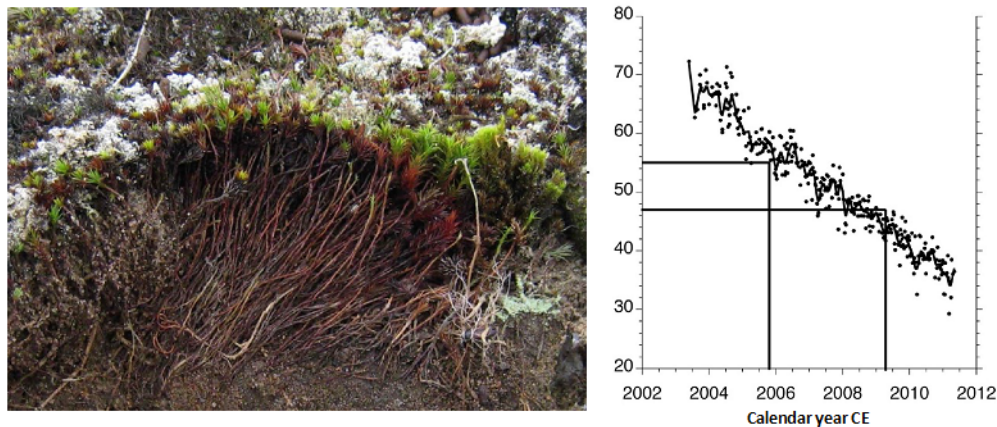


SUPPLEMENTAL FIGURES



A) The ^{14}C activity of a single strand of the living clump of *Polytrichum* moss shown in the photo above, collected from central Baffin Island in summer 2009 CE (M09-B213V) is $51 \pm 4\text{‰}$ ($\pm 2\sigma$, CURL-11658). Comparison to direct measurements of D^{14}C in CO_2 from the relatively well-mixed free troposphere over North America (Niwot Ridge, Colorado at 3523 m asl) indicate that the sample was well equilibrated with the contemporary atmosphere and that the bulk of the sample carbon was assimilated within a few years before collection. Sustained atmospheric D^{14}C gradients from mid- to high-latitudes of the Northern Hemisphere of a few years may lead to a bias in the projected age solution of about 1 year (i.e., moving the gradient-corrected solution to the right). Atmospheric results are from Lehman et al., 2016. Modified from Miller et al. 2013b.

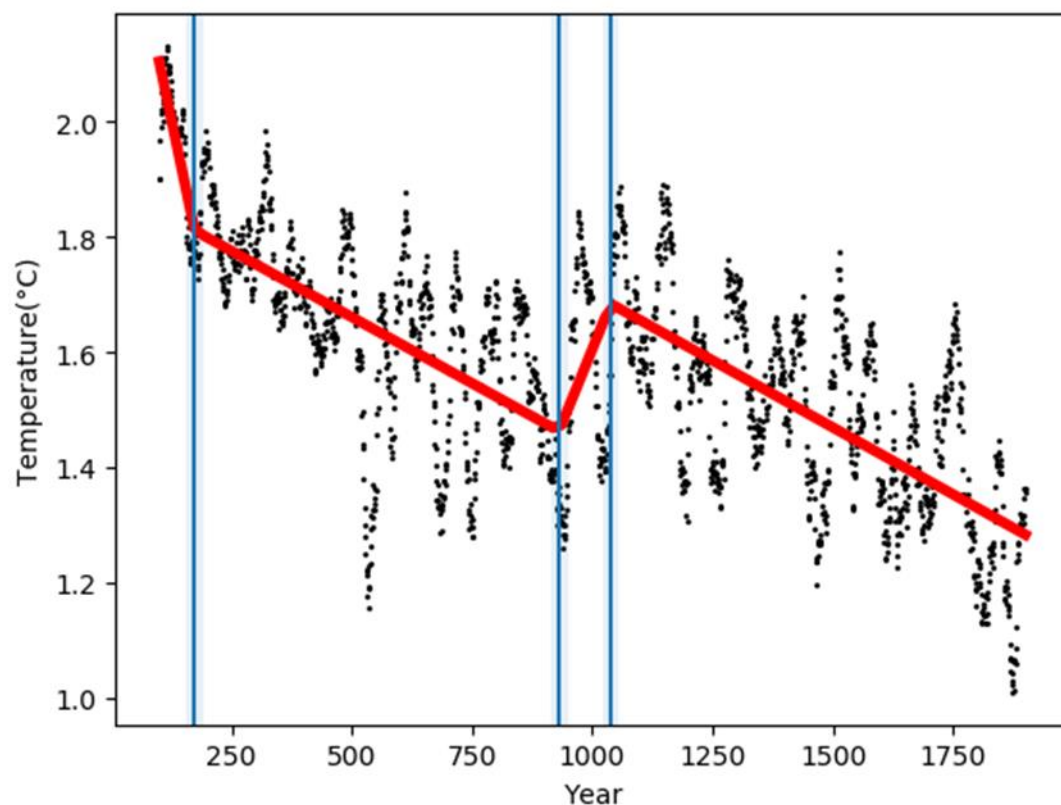
Lab ID	^{14}C date $\pm 1\sigma$
CURL-8202	1150 ± 15
CURL-8891	1140 ± 15
CURL-8892	1135 ± 15

B) ^{14}C dates on different individual strands of *Polytrichum* from a single clump collected at the ice margin of the Orion ice complex, show that *Polytrichum* grows quickly, within the precision of radiocarbon dating. Sample 05ORN-03; 71.5906 N; -78.2032W at 803 m asl. (from Miller et al., 2013b)

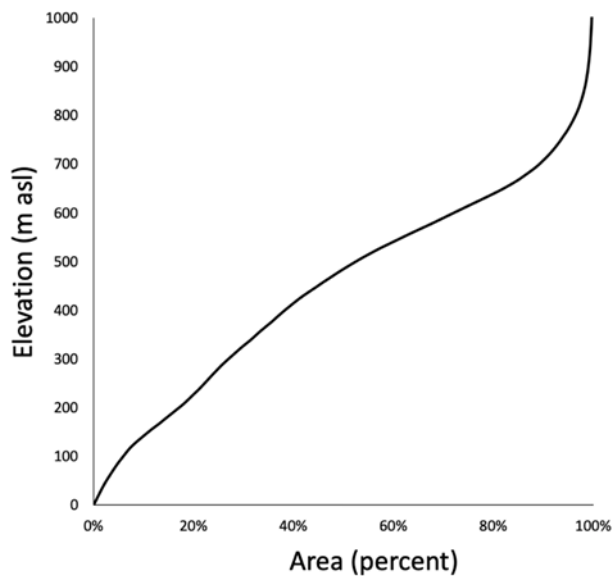
Lab ID	^{14}C date $\pm 1s$	N Latitude	W Longitude
OS-114915	1820 ± 25	66.062	51.659
OS-114916	1850 ± 30	66.062	51.659
OS-114917	1880 ± 25	66.062	51.659
OS-113559	1840 ± 20	66.062	51.659

C) ^{14}C dates on *Polytrichum* strands, each collected from different tundra patches over 200 m along the margin of a small ice cap in West Greenland (from Schweinsberg et al., 2018). 0

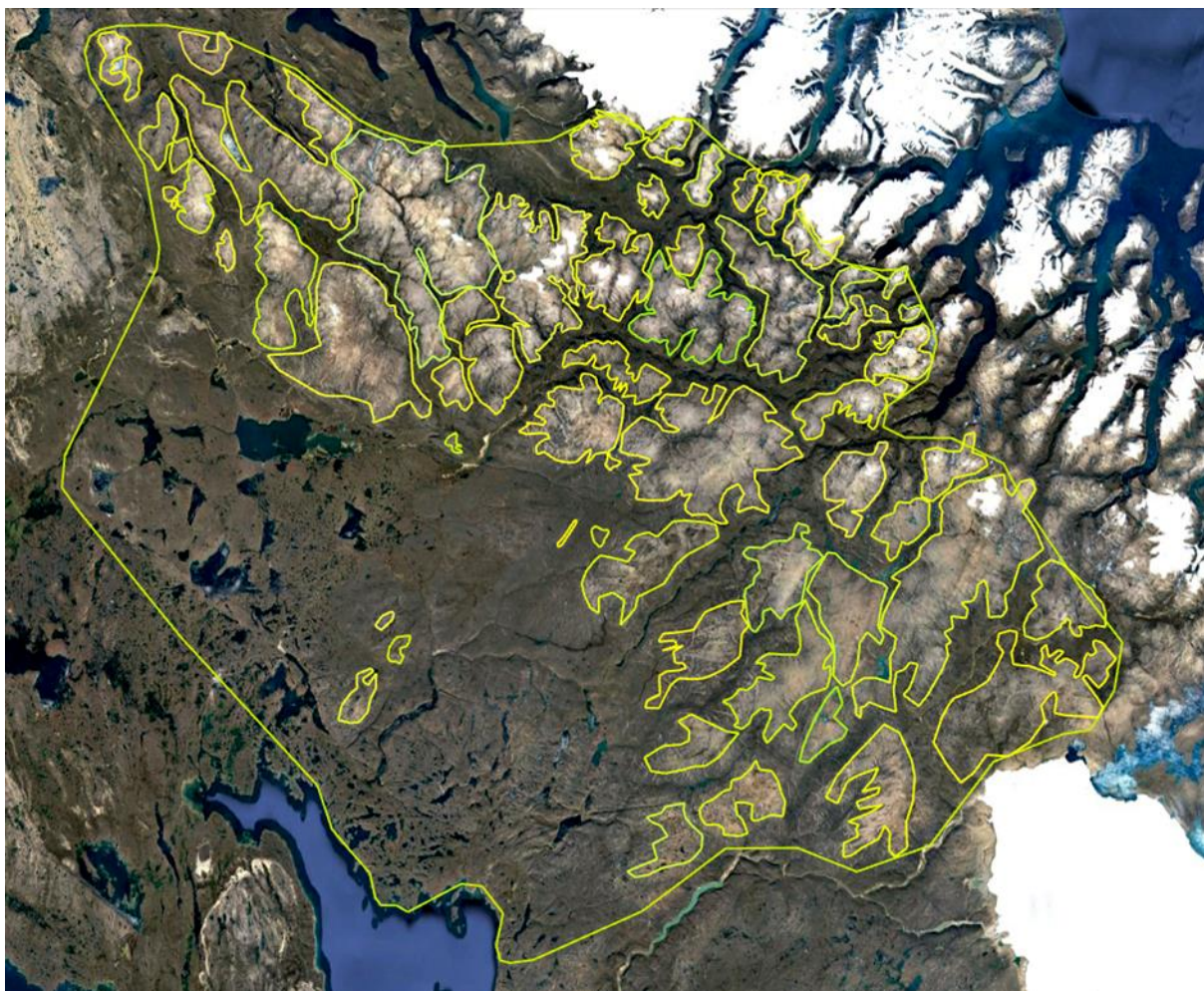
Supplemental Figure 1 Evidence confirming that A) *Polytrichum* moss is fast growing and equilibrated with atmospheric $^{14}\text{CO}_2$, B) different strands of a *Polytrichum* moss have indistinguishable ^{14}C concentrations, and C) *Polytrichum* moss collected along the margin of a simple ice cap have statistically indistinguishable ^{14}C activity, as long as a buried ice cap is not intercepted.



Supplemental Figure 2: Piece-wise linear regression through 30-year running means of summer (J, J, A) temperature in the past2k output from 1-1900 CE, showing a general 2-step decline in summer temperature, dominated by First Millennium and Second Millennium decline, separated by modest warming during Medieval times, although not as warm as the early First Millennium.



Supplemental Figure 3: Area-Elevation plot for the area inscribed by the solid line in Figure 1-1, which captures a large portion of the north-central Baffin Island uplands. The curve shows the cumulative proportion of the study area at or below a given elevation



Supplemental Figure 4: Sparsely vegetated regions that define areas within our prescribed field area that were occupied by ice caps 1780 – 1880 CE are outlined in yellow. The sum of those areas (11,144 km²), is 36% of the area within the inscribed yellow line that defines our primary field area (Fig. 1; 30,811 km²). Basemap ©Google Earth.