Supplementary material for:
Evaluation of Greenland near surface air temperature datasets

J. E. Jack Reeves Eyre[1] and Xubin Zeng[1]

[1]Department of Hydrology and Atmospheric Sciences, University of Arizona, Tucson, 85721, USA

5   *Correspondence to*: J. E. Jack Reeves Eyre (jeyre@email.arizona.edu)
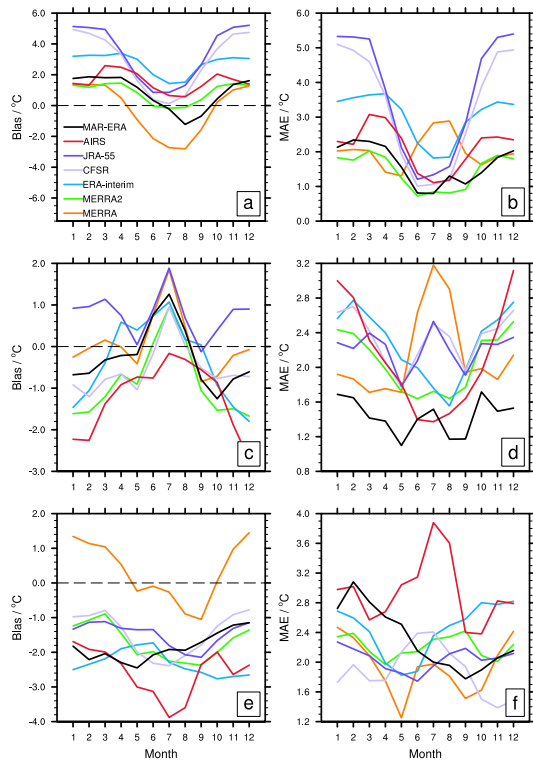
Figure S1: Mean over station-months of bias (a, c, e) and absolute error (b, d, f) relative to monthly mean SAT at: ice sheet stations above 1500 m (a and b); ice sheet stations below 1500 m (c and d); and coastal (DMI) stations (e and f). Ice sheet stations are from GC-Net, PROMICE and K-transect. All available station months from 1979 onwards are used. This figure is the same as Fig. 4 except that elevation corrections are not applied to any datasets.
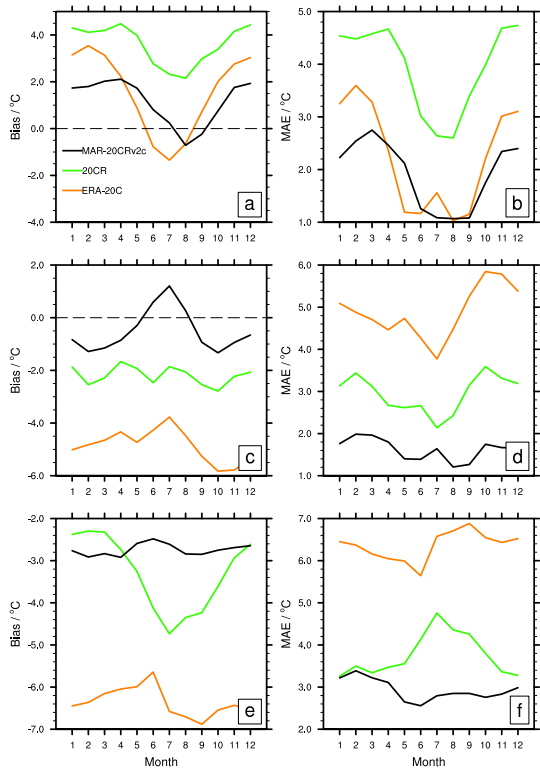
Figure S2: As Fig. S1 but for the two longer reanalyses and MAR-20CR.

Table S1: Names and locations of weather stations used in this study. The DMI stations shown here represent the compilation of multiple stations at slightly different locations, with differing names (e.g., the Danish name for Ittoqqortoormiit is Scoresbysund). See Cappelen (2013) for more details.

Station name	Latitude (North)	Longitude (West)	Elevation / m	Station name	Latitude (North)	Longitude (West)	Elevation / m
Coastal							
DMI							
Danmarkshavn	76.77	18.67	11	Nuuk	64.18	51.73	80
Ittoqqortoormiit	70.48	21.95	70	Pituffik	76.53	68.75	77
Ilulissat	69.24	51.07	29	Qaqortoq	60.72	46.05	57
Ivittuut	61.20	48.18	30	Tasiilaq	65.61	37.64	54
Narsarsuaq	61.17	45.42	34	Upernavik	72.78	56.13	126
Ice sheet							
GC-Net							
Swiss Camp	69.56	49.33	1176	South Dome	63.15	44.82	2901
Crawford Point	69.88	47.00	2022	NASA-E	75.00	30.00	2614
NASA-U	73.84	49.51	2334	Crawford P2	69.91	46.85	1990
GITS	77.14	61.04	1869	NGRIP	75.10	42.33	2941
Humboldt	78.53	56.83	1995	NASA-SE	66.48	42.50	2373
Summit	72.58	38.51	3199	KAR	69.70	33.01	2579
Tunu-N	78.02	33.98	2052	JAR 2	69.41	50.09	507
DYE-2	66.48	46.28	2099	KULU	65.76	39.60	878
JAR 1	69.50	49.70	932	JAR3	69.39	50.31	283
Saddle	66.00	44.50	2467				
PROMICE							
KPC_L	79.91	24.08	370	NUK_U	64.51	49.27	1130
KPC_U	79.83	25.17	870	NUK_K	64.16	51.36	710
SCO_L	72.22	26.82	470	NUK_N	64.95	49.89	920
SCO_U	72.39	27.24	980	KAN_B	67.13	50.18	350
MIT	65.69	37.83	450	KAN_L	67.10	49.95	680
TAS_L	65.64	38.90	260	KAN_M	67.07	48.83	1270
TAS_U	65.70	38.87	570	KAN_U	67.00	47.02	1840
TAS_A	65.78	38.90	900	UPE_L	72.89	54.30	220
QAS_L	61.03	46.85	290	UPE_U	72.89	53.57	940

QAS_U	61.18	46.82	900	THU_L	76.40	68.27	570
QAS_A	61.24	46.73	1010	THU_U	76.42	68.15	770
NUK_L	64.48	49.53	550				
K-transect							
S5	67.10	50.12	490	S9	67.05	48.24	1520
S6	67.08	49.39	1020				
Ohmura87							
North Ice	78.07	38.48	2343	Station Centrale	70.92	40.63	2993
Sierra	77.23	62.33	1719	Eismitte	70.90	40.70	3030
Camp Century	77.18	61.15	1885	Hiran 28	70.62	36.17	3139
Site2	77.00	56.08	2128	EGIG4	69.67	49.63	1004
North Ice Cap Station 2	76.92	66.97	650	Hiran 30	69.55	43.17	2558
North Ice Cap Station 3	76.93	66.98	700	Hiran 27	69.38	35.92	2755
Tuto East	76.38	67.92	801	Hiran 26	68.25	36.50	2925
Camp Watkins	74.67	47.50	2659	Hiran 29	68.07	42.33	2593
Jarl Joset Dumont	71.47	33.35	2867	Ice Cap Station Watkins	67.05	41.82	2440
Weststation Wegener	71.18	51.12	954	Mint Julep	66.28	47.77	1829

Table S2: Summary of CMIP5 models used in this work. Unless otherwise indicated in the first column, results are from historical and historical extended experiments. Average SAT is the 1901-2000 mean of ice sheet annual average: for reference, the same value calculated from MERRA2 climatology and GISTEMP anomalies is -21.85 ^{o}C.

Model (experiment)	Institute	Period	Average SAT / ^{o}C
FGOALS-g2	LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences; and CESS, Tsinghua University	1850–2005	-16.47
MIROC-ESM-CHEM	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies	1850–2005	-16.69
MIROC-ESM		1850–2005	-16.74
MIROC-ESM (ESM historical)		1850–2005	-16.77
MIROC5	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology	1850–2012	-19.13
MIROC4h		1950–2005	-19.17
CMCC-CESM	Centro Euro-Mediterraneo per I Cambiamenti Climatici	1850–2005	-19.38
CESM1-BGC	National Science Foundation, Department of Energy, National Center for Atmospheric Research	1850–2005	-19.53
CCSM4	National Center for Atmospheric Research	1850–2005	-19.71
CESM1-FASTCHEM	National Science Foundation, Department of Energy, National Center for Atmospheric Research	1850–2005	-19.8
GFDL-CM2p1	Geophysical Fluid Dynamics Laboratory	1861–2005	-19.89
INM-CM4	Institute for Numerical Mathematics	1850–2005	-19.91
GISS-E2-H	NASA Goddard Institute for Space Studies	1850–2012	-20.03
CESM1-WACCM	National Science Foundation, Department of Energy, National Center for Atmospheric Research	1850–2005	-20.1
GFDL-ESM2M	Geophysical Fluid Dynamics Laboratory	1861–2005	-20.52
MPI-ESM-P	Max Planck Institute for Meteorology (MPI-M)	1850–2005	-20.64
MPI-ESM-MR	Max Planck Institute for Meteorology (MPI-M)	1850–2005	-20.78
IPSL-CM5A-MR	Institut Pierre-Simon Laplace	1850–2005	-20.92
GISS-E2-H-CC	NASA Goddard Institute for Space Studies	1850–2012	-21.16
GFDL-CM3	Geophysical Fluid Dynamics Laboratory	1860–2005	-21.19
GISS-E2-R	NASA Goddard Institute for Space Studies	1850–2012	-21.37
GISS-E2-R-CC	NASA Goddard Institute for Space Studies	1850–2010	-21.43

GFDL-ESM2G	Geophysical Fluid Dynamics Laboratory	1861–2005	-21.55
CESM1-CAM5	National Science Foundation, Department of Energy, National Center for Atmospheric Research	1850–2005	-22.07
CMCC-CMS	Centro Euro-Mediterraneo per I Cambiamenti Climatici	1850–2005	-22.59
IPSL-CM5A-LR	Institut Pierre-Simon Laplace	1850–2005	-22.69
IPSL-CM5A-LR (ESM historical)	Institut Pierre-Simon Laplace	1850–2005	-22.81
CNRM-CM5	Centre National de Recherches Meteorologiques / Centre Europeen de Recherche et Formation Avancees en Calcul Scientifique	1850–2012	-23.15
CMCC-CM	Centro Euro-Mediterraneo per I Cambiamenti Climatici	1850–2005	-23.33
CNRM-CM5-2	Centre National de Recherches Meteorologiques / Centre Europeen de Recherche et Formation Avancees en Calcul Scientifique	1850–2005	-24.86
IPSL-CM5B-LR	Institut Pierre-Simon Laplace	1850–2005	-26.29

Data availability

DMI weather station data (Cappelen, 2014) were downloaded from the DMI website (DMI, 2015). GC-Net weather station data (Steffen and Box, 2001) were obtained from the Cooperative Institute for Research in Environmental Sciences (CIRES,

5   2015). Data from the Programme for Monitoring of the Greenland Ice Sheet (PROMICE) and the Greenland Analogue Project (GAP) were provided by the Geological Survey of Denmark and Greenland (GEUS) (PROMICE, 2016).

20CR v2c data (Compo et al., 2011) were downloaded from the NOAA Earth System Research Laboratory Physical Sciences Division (ESRL PSD, 2015) website. Support for the Twentieth Century Reanalysis Project version 2c dataset is provided by the U.S. Department of Energy, Office of Science Biological and Environmental Research (BER), and by the

10   National Oceanic and Atmospheric Administration (NOAA) Climate Program Office. MERRA (Rienecker et al., 2011) and MERRA2 (Molod et al., 2015) data were produced by the NASA Global Modelling and Assimilation Office (GMAO) and obtained from the NASA Goddard Earth Sciences Data and Information Services Center (GES DISC; GMAO 2011, 2015). ERA–Interim (Dee et al., 2011) and ERA–20C (Poli et al., 2016) data are produced by and obtained from the European Centre for Medium-Range Weather Forecasts (ECMWF, 2011, 2016). CFSR (Climate Forecast System Reanalysis; Saha et

15   al., 2010) and CFSv2 (Climate Forecast System version 2; Saha et al., 2014) datasets were produced by NCEP and downloaded from the Research Data Archive (RDA) at the National Center for Atmospheric Research (NCAR), Computational and Information Systems Laboratory (CISL) (NCEP 2010, 2014). JRA-55 data (Kobayashi et al., 2015) were also obtained from the NCAR RDA (Japan Meteorological Agency/Japan, 2013). JRA-55 data are from the Japanese 55-year Reanalysis project carried out by the Japan Meteorological Agency (JMA).

GISTEMP (Hansen et al., 2010) was obtained from the NASA Goddard Institute for Space Studies (GISTEMP Team, 2016). Berkeley Earth data (Rohde et al., 2013) were downloaded from the Berkeley Earth website (Berkeley Earth, 2016). CRU TS3.23 data (Harris et al., 2014) are from the University of East Anglia Climatic Research Unit (UEA CRU, 2016) and were downloaded from the British Atmospheric Data Centre (BADC). NANSENSAT data (Kuzmina et al., 2008) were provided by the Nansen Centers in St. Petersburg (Russia) and Bergen (Norway) (Nansen Centers, 2015).

AIRS data were obtained from GES DISC (AIRS Science Team/Joao Texeira, 2013). MAR version 3.5 data (both forcings) were downloaded from the Laboratory of Climatology at the University of Liége (Fettweis, 2016). We acknowledge the World Climate Research Programme's Working Group on Coupled Modelling, which is responsible for CMIP, and we thank the climate modeling groups (listed in Table S2) for producing and making available their model output. For CMIP the U.S. Department of Energy's Program for Climate Model Diagnosis and Intercomparison (PCMDI) provides coordinating support and led development of software infrastructure in partnership with the Global Organization for Earth System Science Portals. CMIP5 data were downloaded from the PCMDI portal (PCMDI, 2016).

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