I ghiacci dell'Antartide e della Groenlandia

Acqua su acqua

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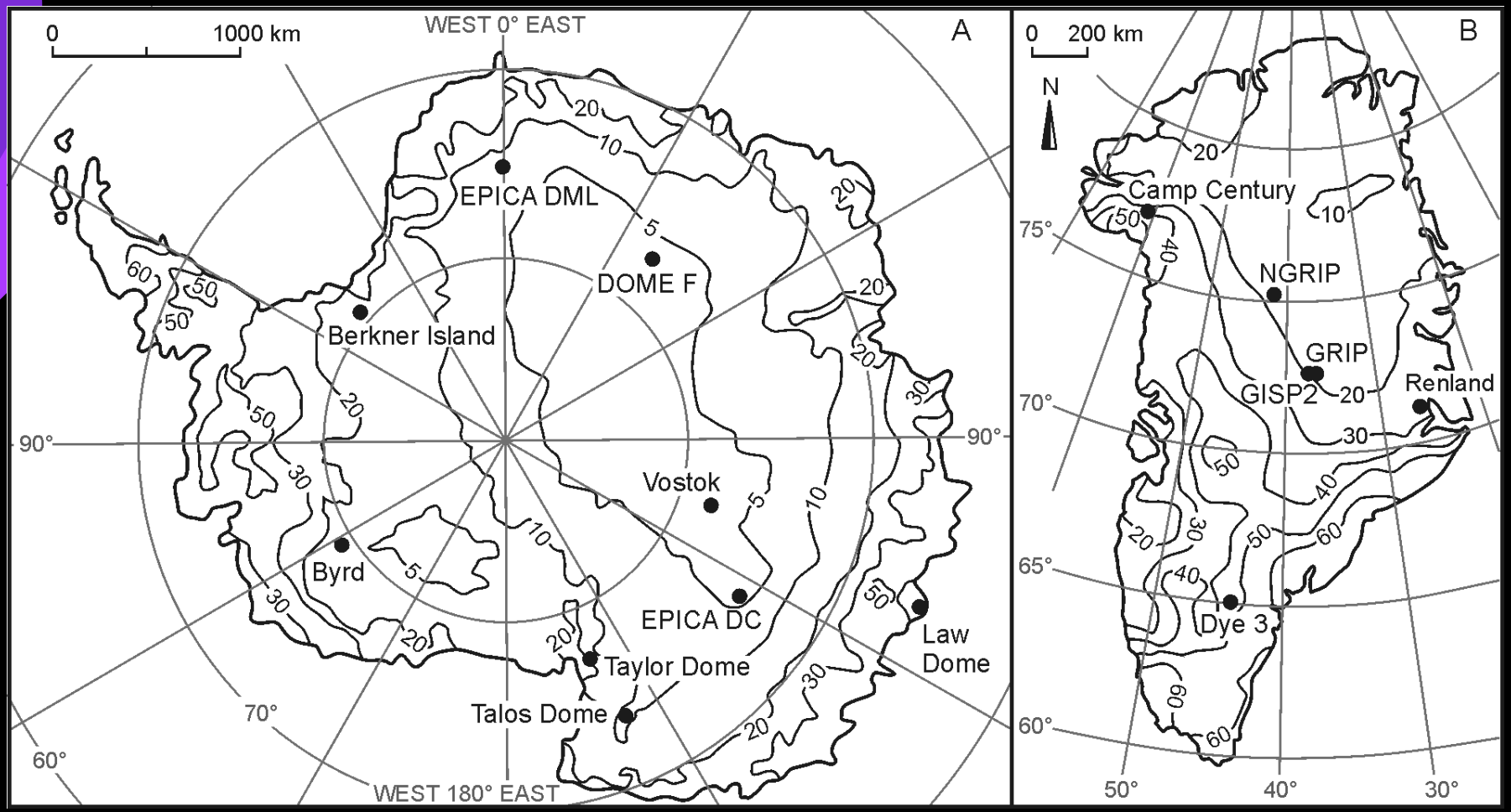
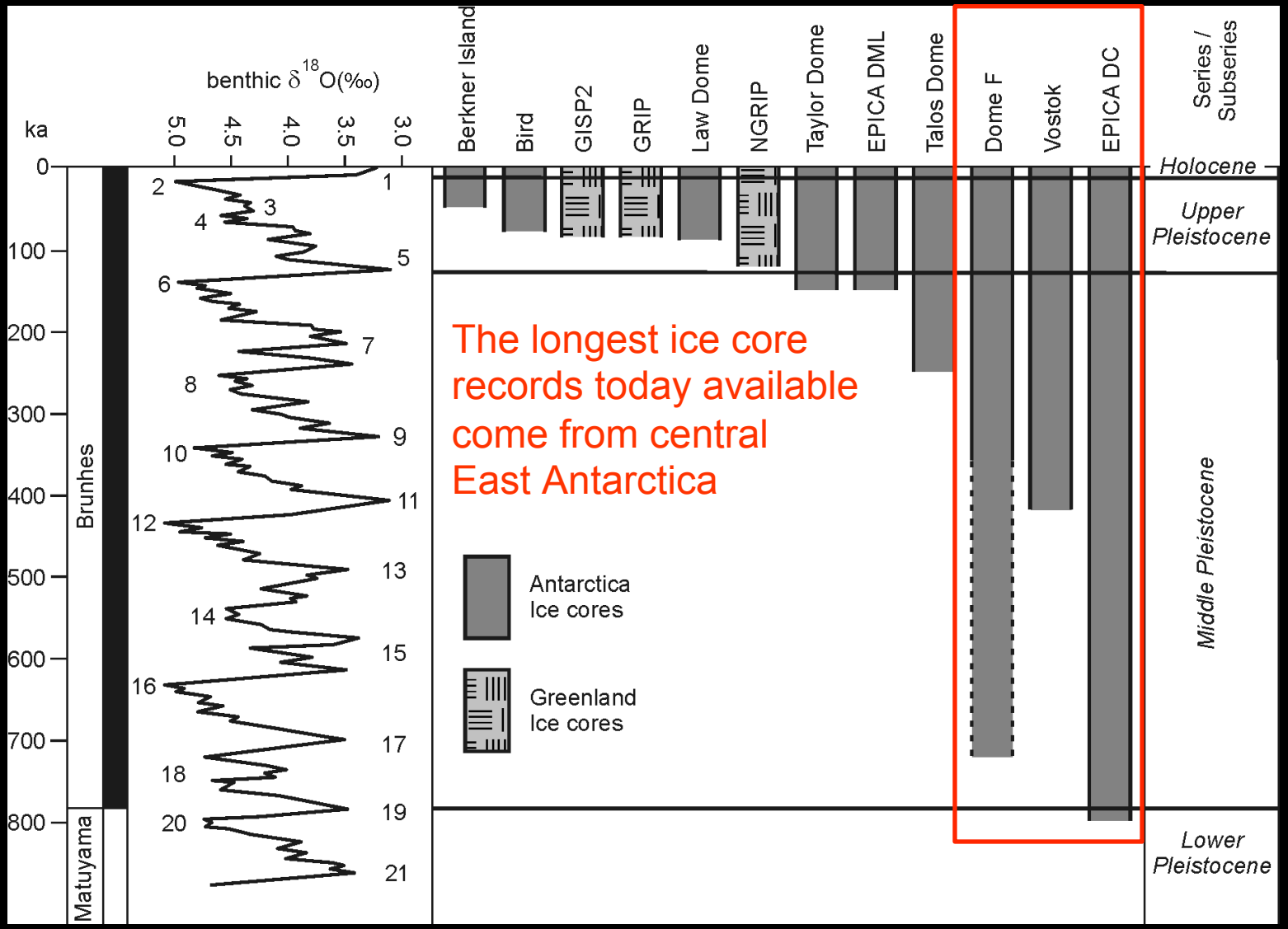
Antartica and Greenland represent the largest Ice Sheets of Earth



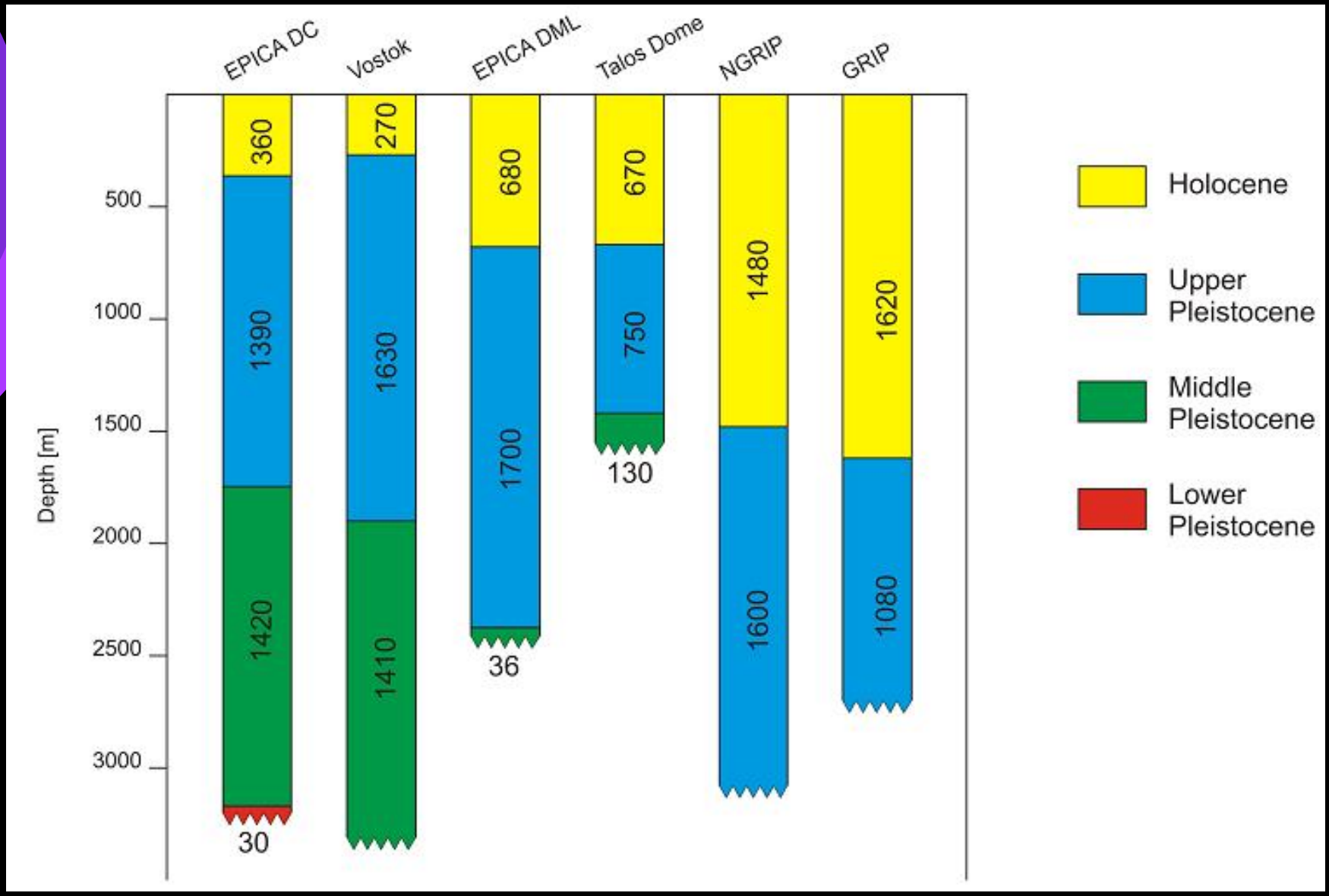
Orombelli et al., 2010

Location	Volume (km^3)	Potential sea-level rise (m)
East Antarctic ice sheet	26,039,200	64.80
West Antarctic ice sheet	3,262,000	8.06
Antarctic Peninsula	227,100	.46
Greenland	2,620,000	6.55
All other ice caps, ice fields, and valley glaciers	180,000	.45
Total	32,328,300	80.32

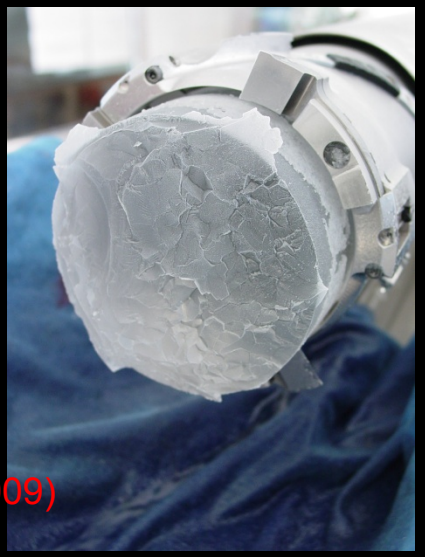
Time and chronostratigraphic extent of ice cores

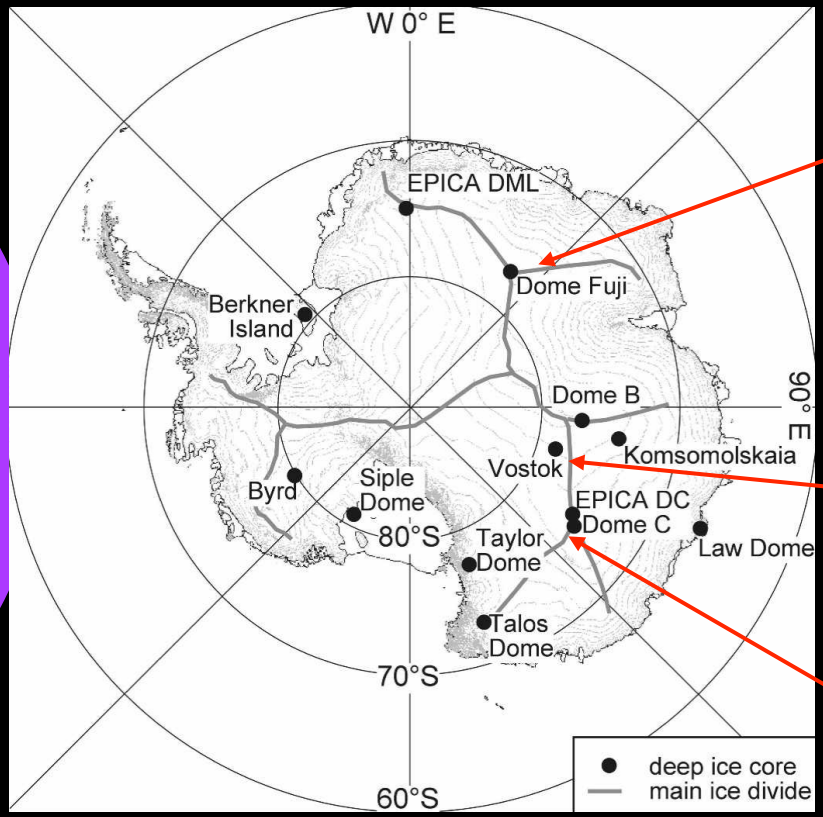


Orombelli et al., 2010


EPICA DC
Vostok
EPICA DML
Talos Dome
NGRIP
GRIP
Depth [m]
500
1000
1500
2000
2500
3000
360
1390
1420
30
270
1630
1410
680
1700
36
670
750
130
1480
1600
1620
1080
Holocene
Upper Pleistocene
Middle Pleistocene
Lower Pleistocene

The longest ice core records available today come from East Antarctica:





Dome Fuji
ice core
~740 kyrs
(Goto-Azuma et al., 2009)

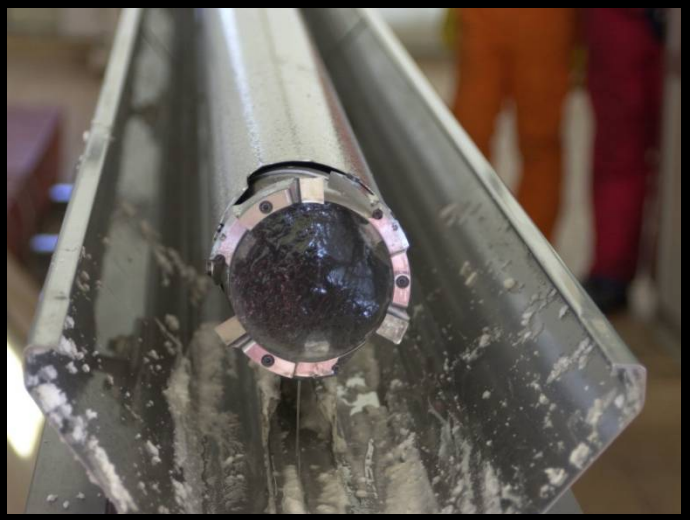
Vostok ice core
>420 kyr B.P. (Petit et al., 1999)

EPICA-Dome C
>800 kyr B.P.
(e.g. Jouzel et al., 2007; EPICA Community, 2004)

The Vostok, Dome Fuji, and Dome C Antarctic ice core records provide a coherent picture of climate and atmospheric changes during G/I cycles (Watanabe et al., 2003)

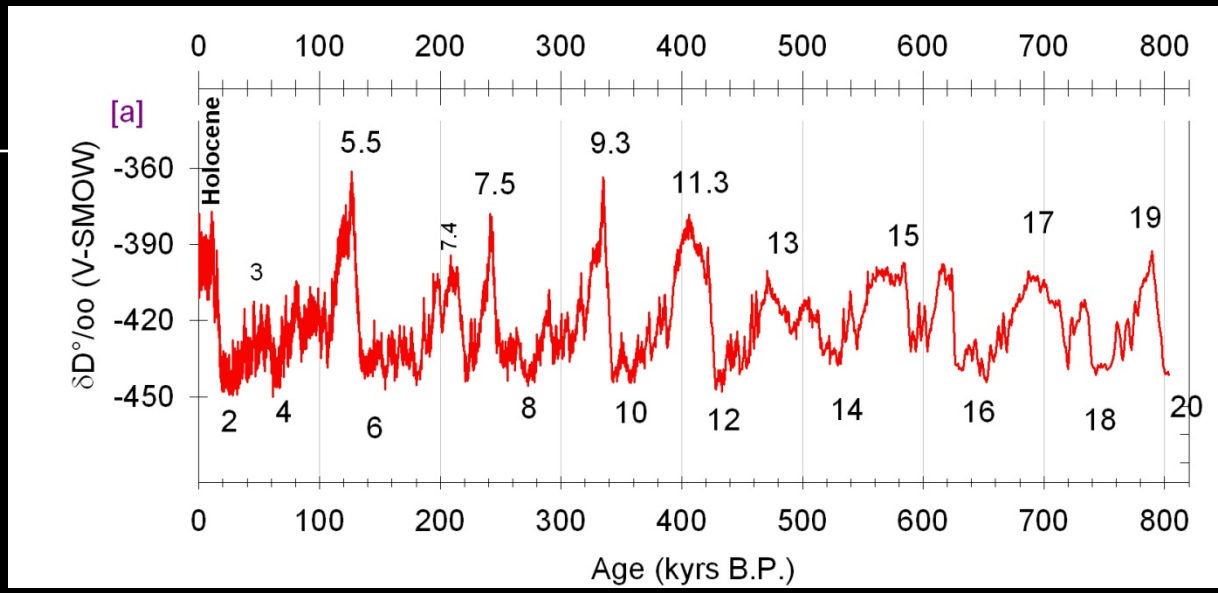
EPICA-Dome C summer camp (75° 06'S, 123° 21'E, 3233 m a.s.l.)

The cores



The DEP on site

EPICA-Dome C

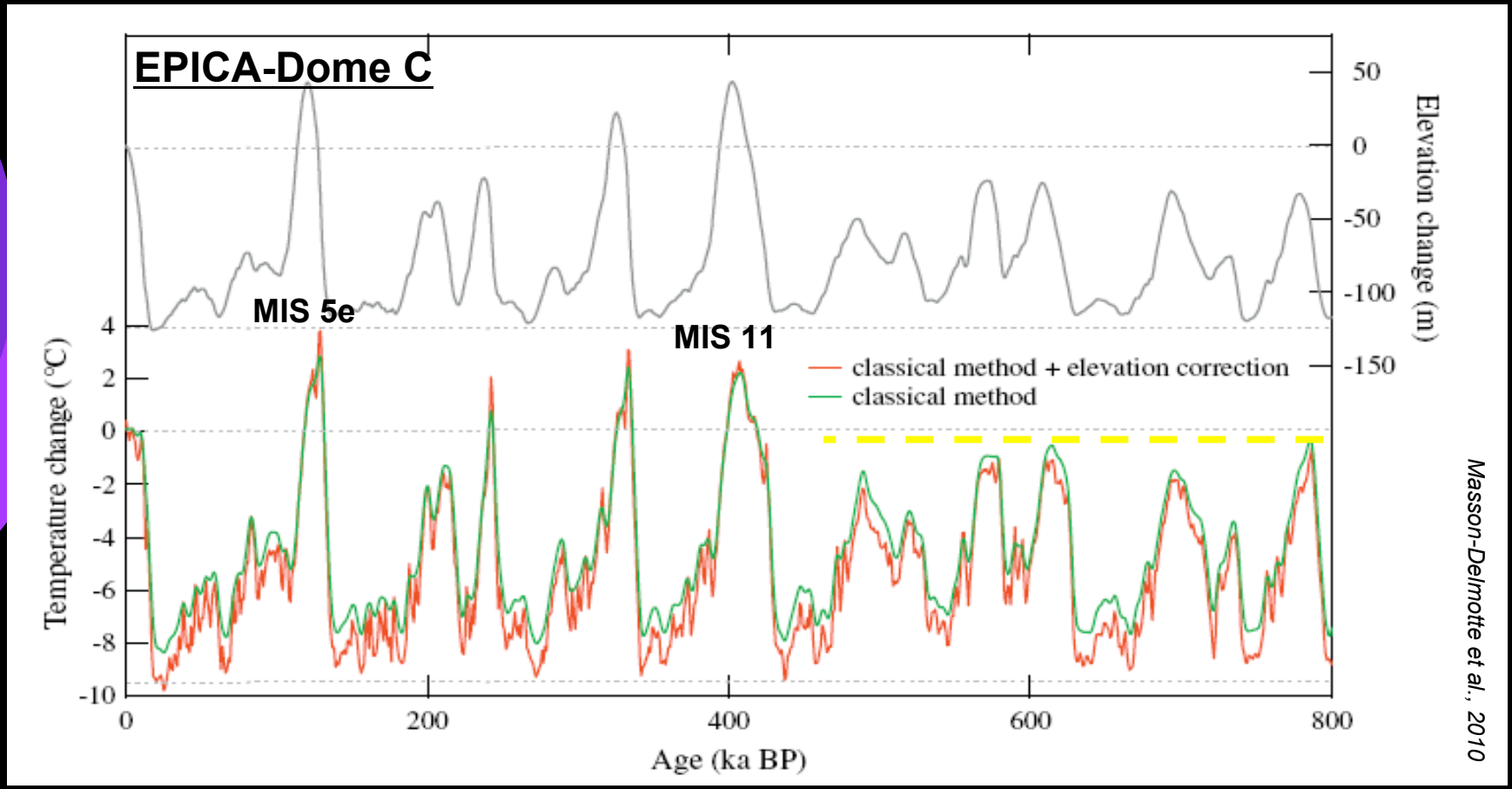


(Jouzel et al., 2007;
EPICA Community Members, 2004, modidfied)

EPICA-Dome C ice core extended the climate sequence back to **MIS 20.2** (ca. 810 kyr B.P.), providing the longest climate record available from ice cores.

The Antarctic climate is marked by glacial–interglacial variations reaching 8–10 °C.

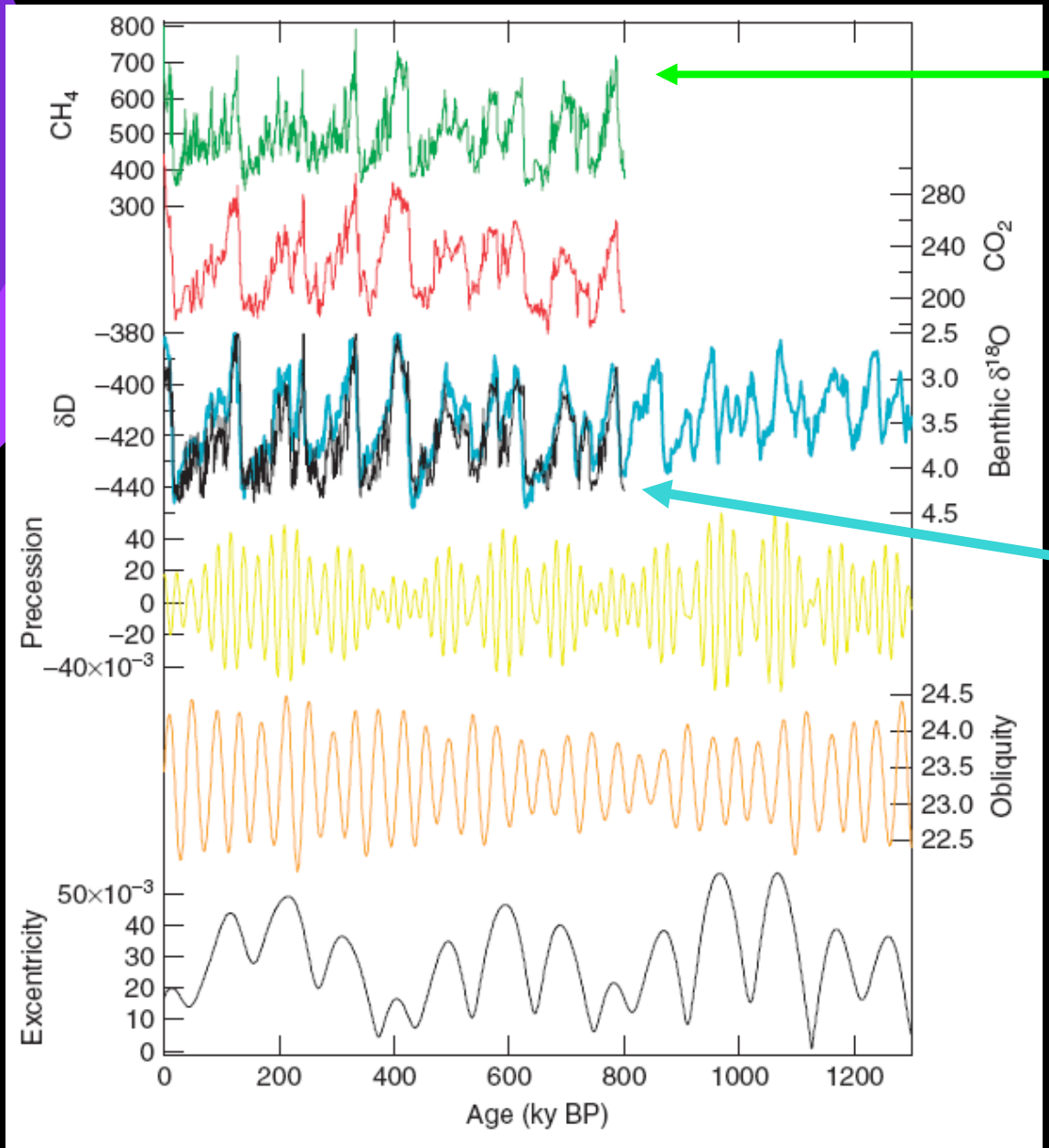
Glacial temperatures are relatively stable from one glacial period to the next, while temperature shows large variations among interglacials.



Before 400,000 years ago, interglacials were about 1–3 °C colder than the Holocene. Some authors (Jouzel et al., 2007) related the warmer interglacial climate from past to present to the long-term modulation of the amplitude of Earth's obliquity changes.

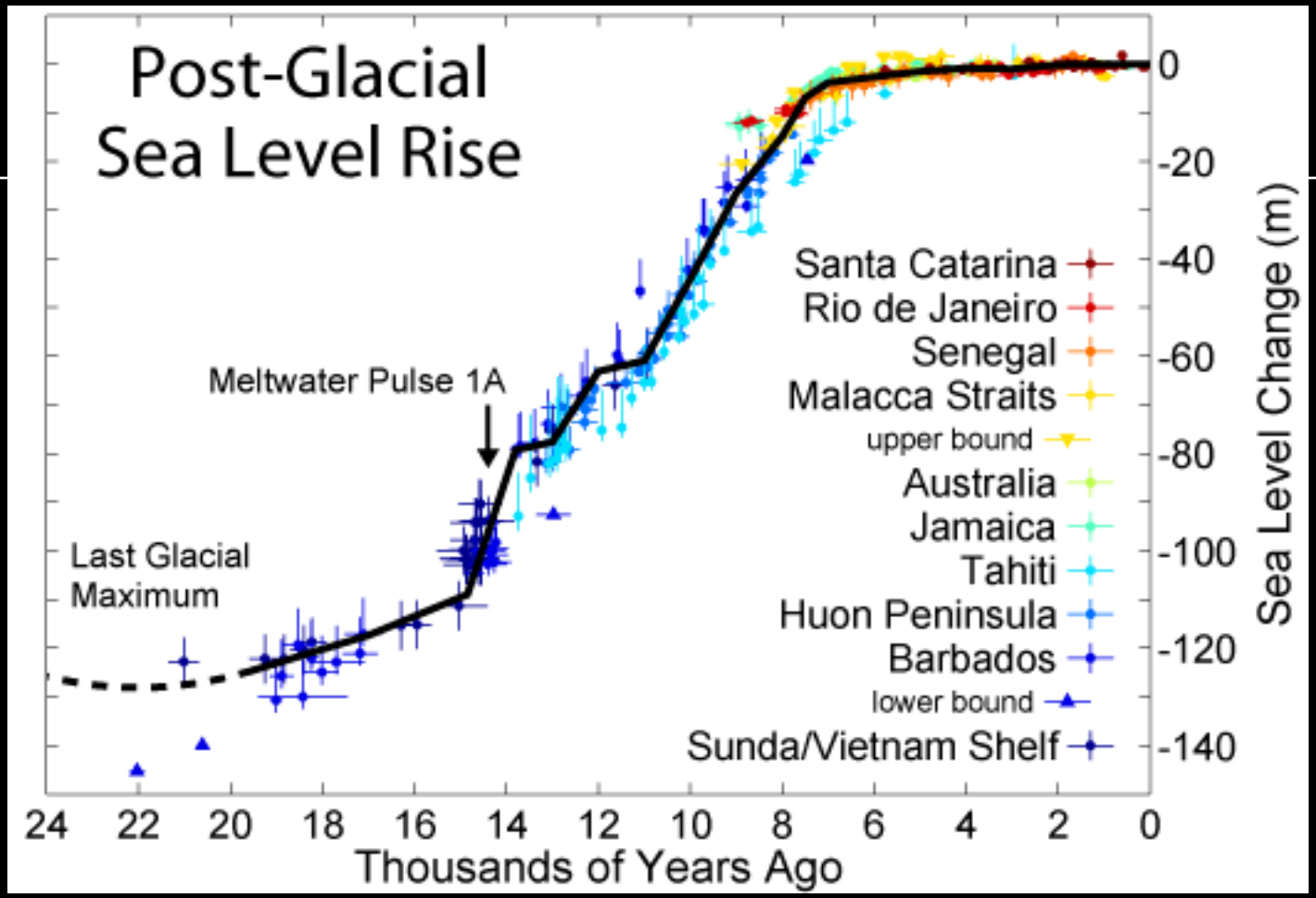
MIS 11 appears to be the longest interglacial;
MIS 5e (ca. 130 kyrs B.P.) was probably the warmest interglacial (about 5°C above present-day in Central Antarctica)

Antarctic records and Northern Hemisphere climate



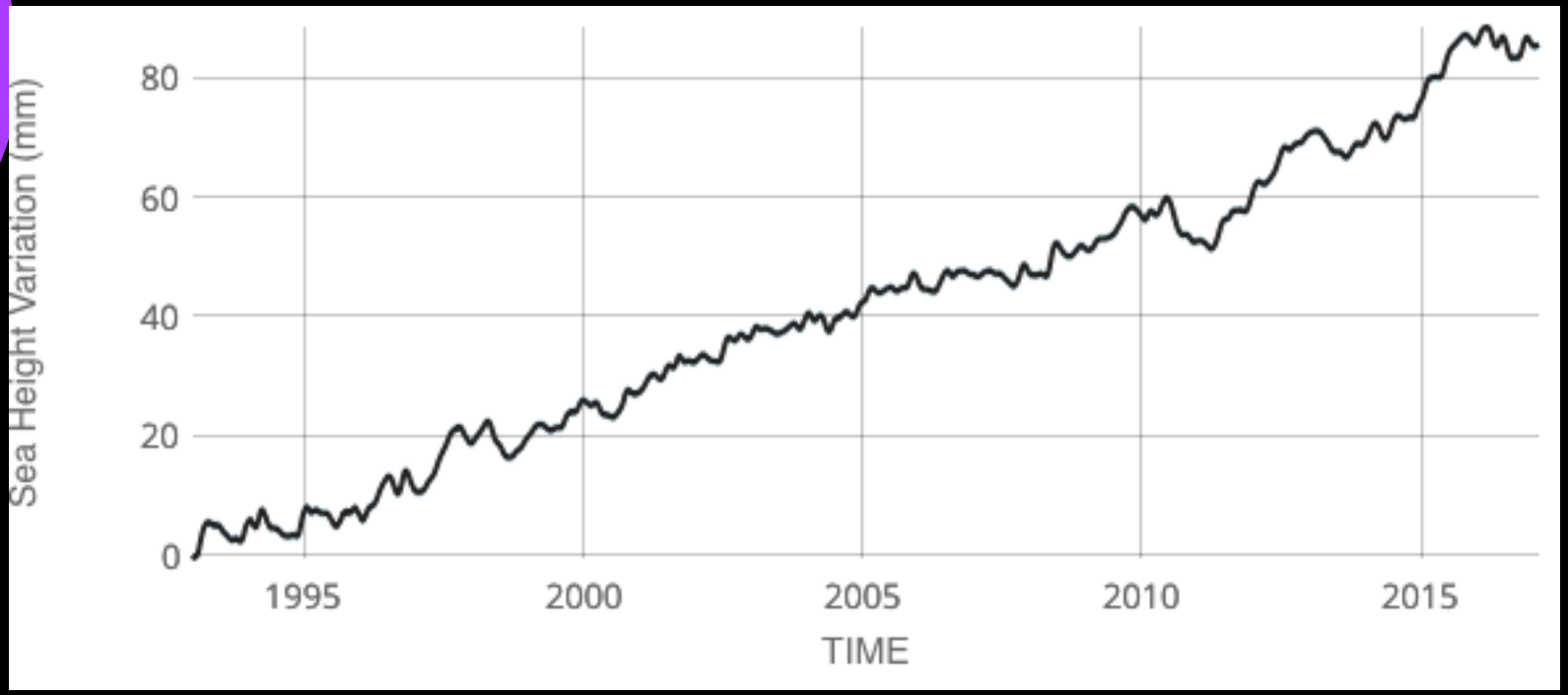
atmospheric CH_4 concentration is related to wetlands, mainly located in the Northern Hemisphere

Antarctic temperature record is similar to the global ice volume variability, mainly linked with northern hemisphere glaciations



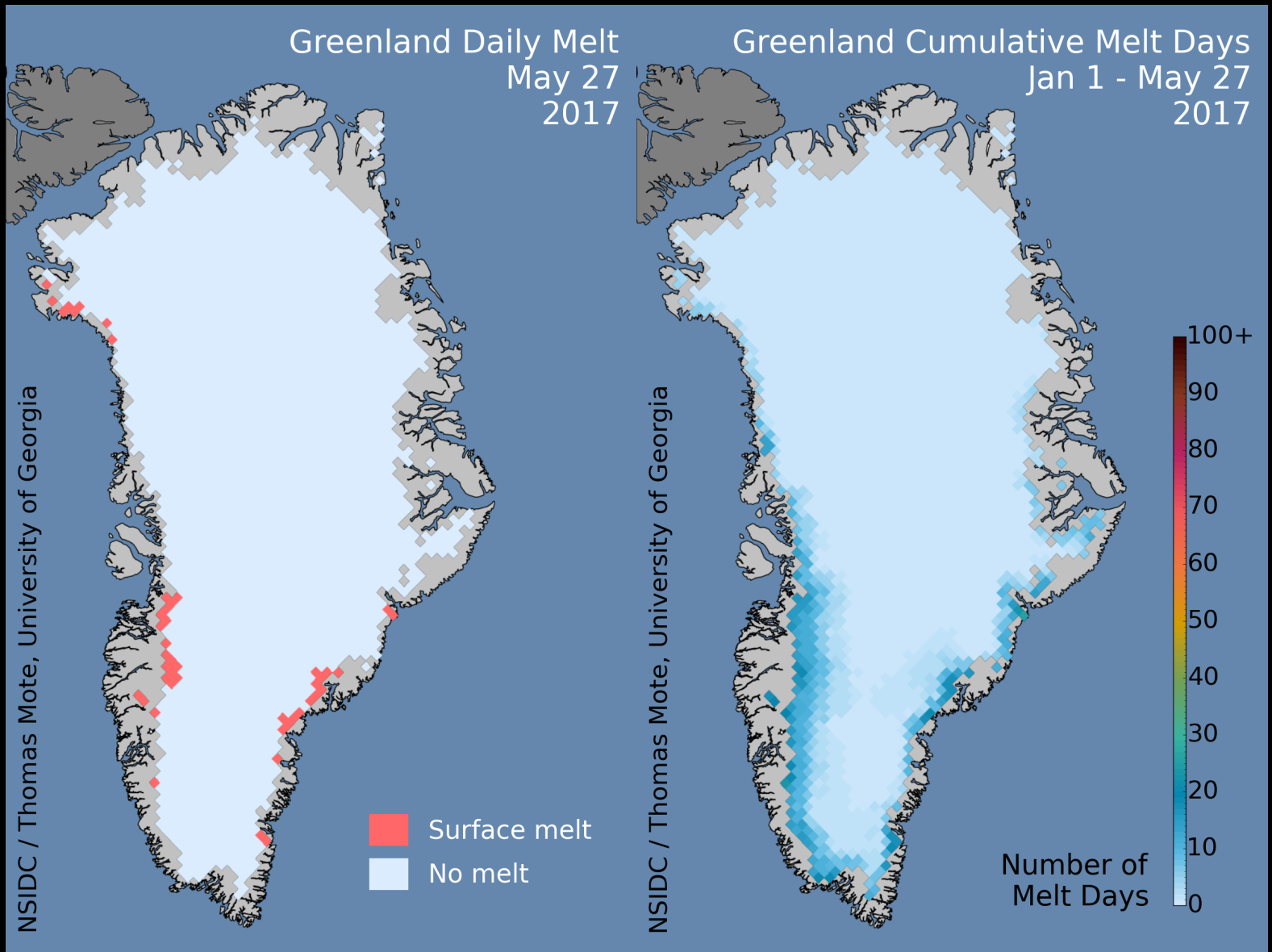
Hayes et al., 2012

Sea level change from GRACE satellite

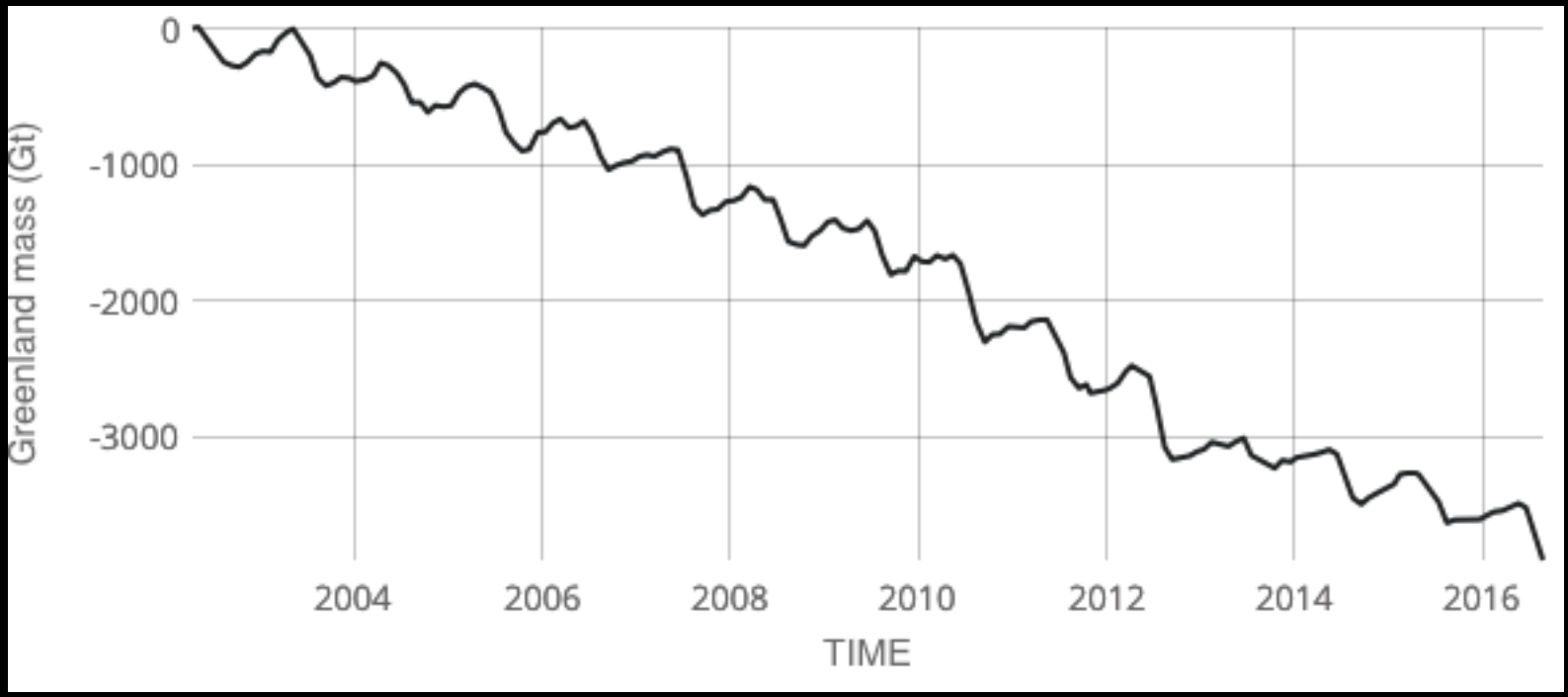


NASA - 2017

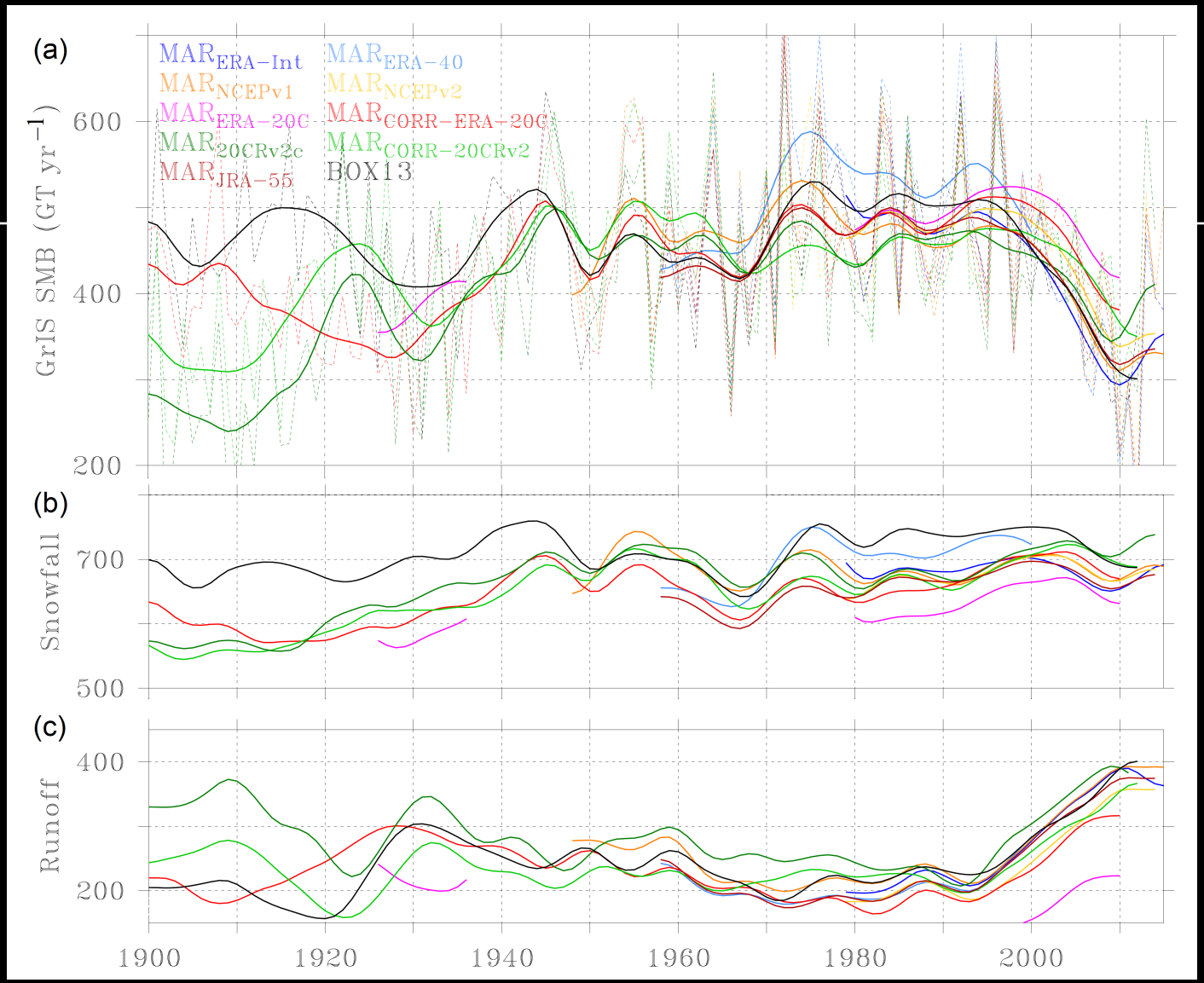
Recent Greenland changes from satellites



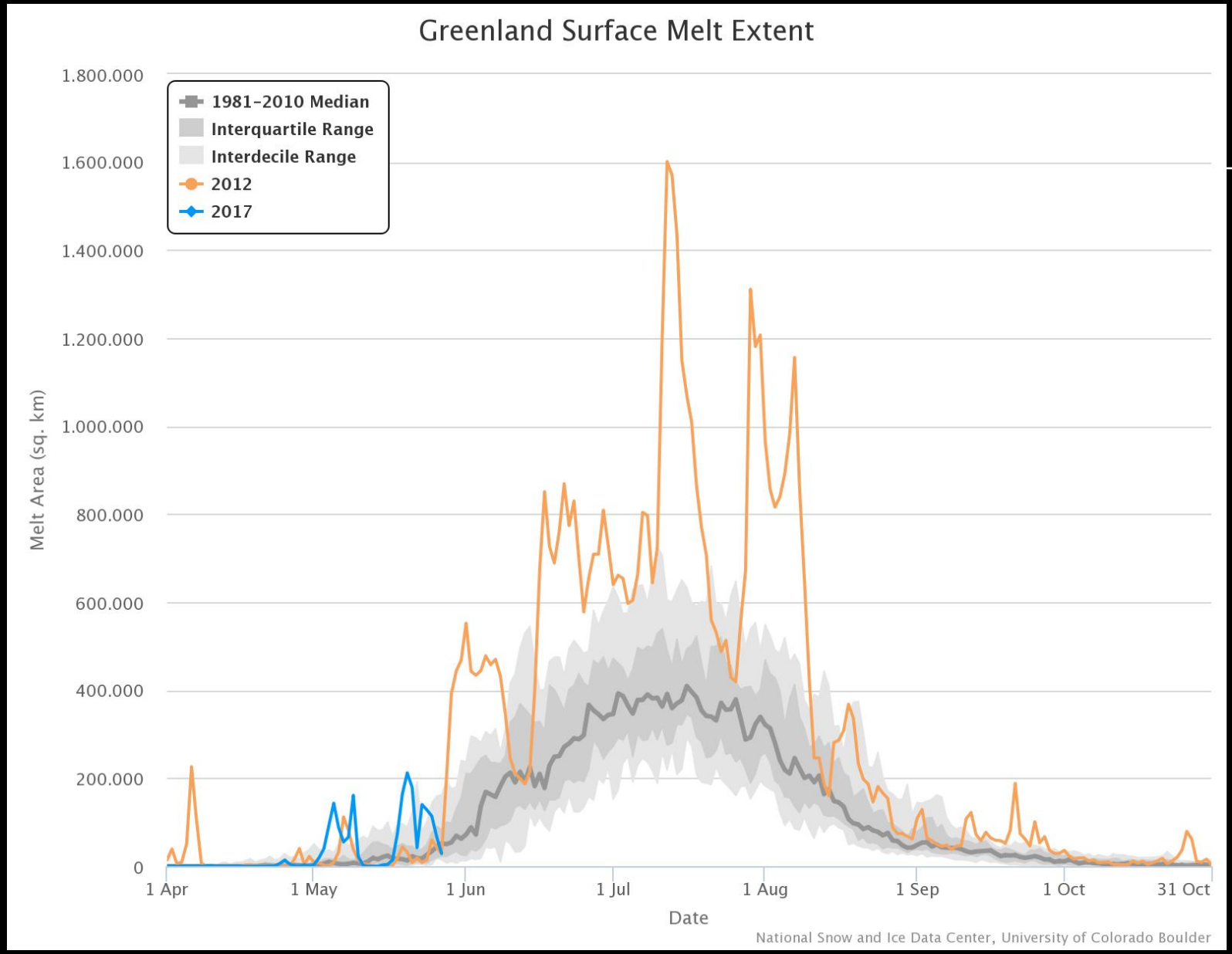
Greenland mass change from GRACE satellite

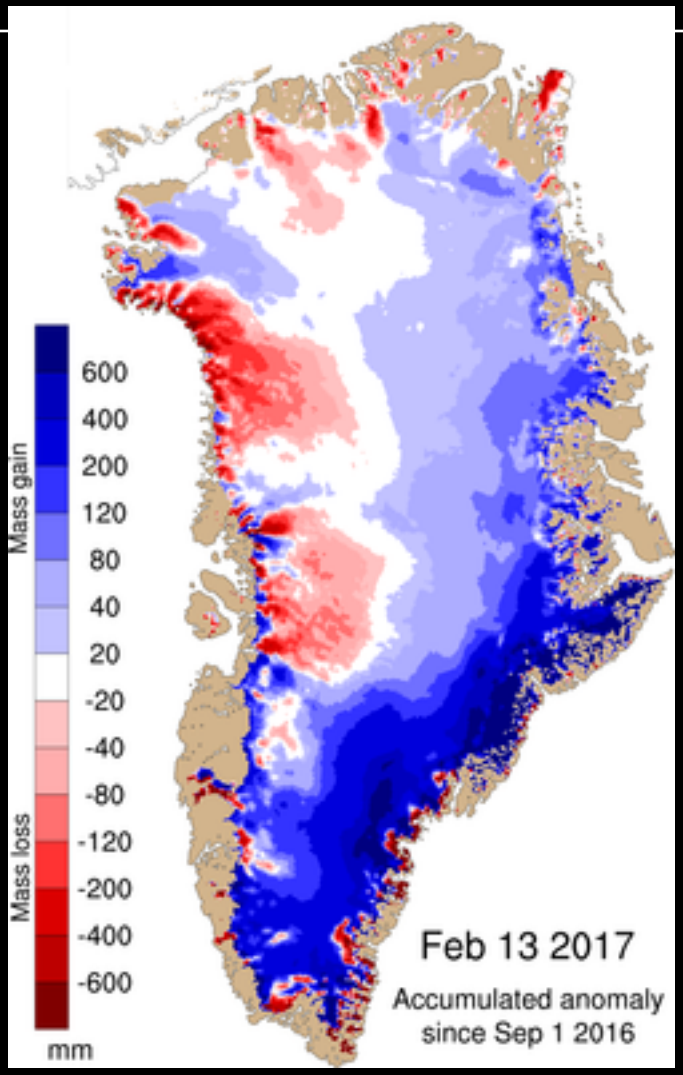


NASA - 2017

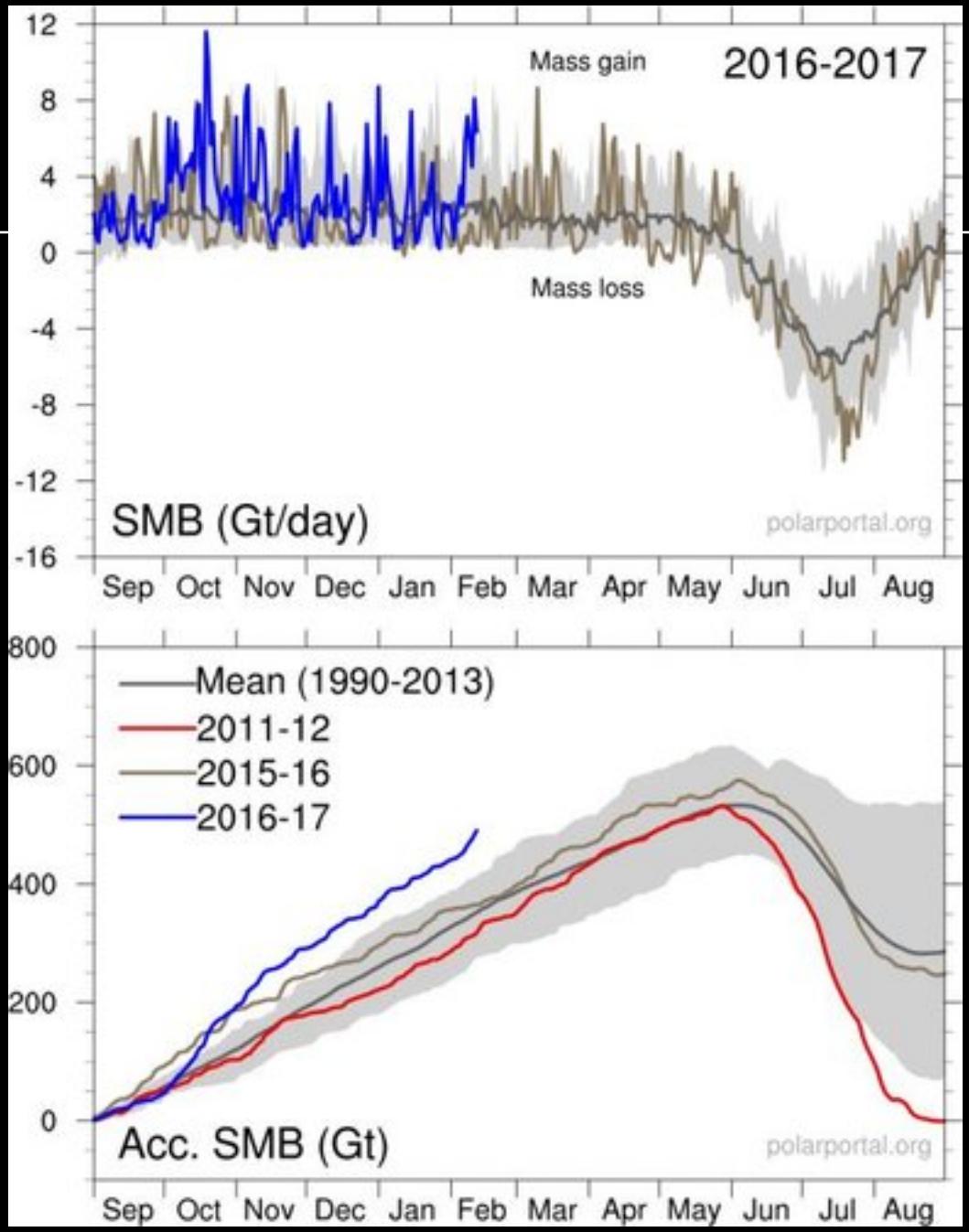


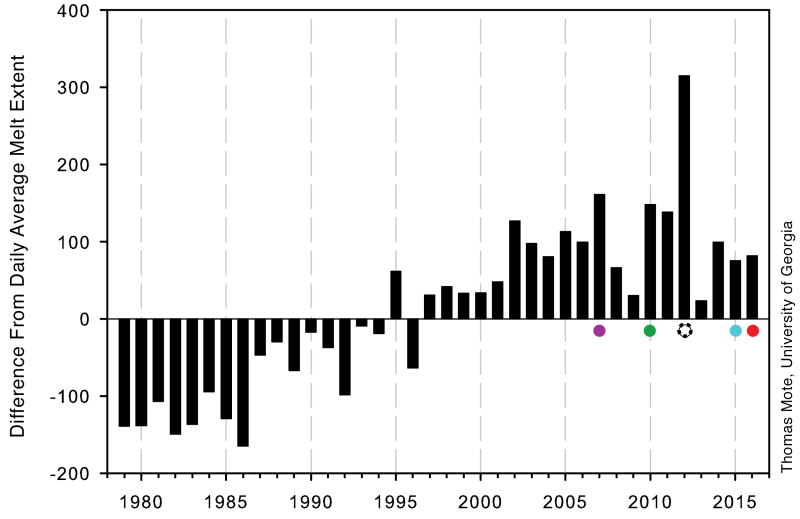
Fettweis et al., 2017

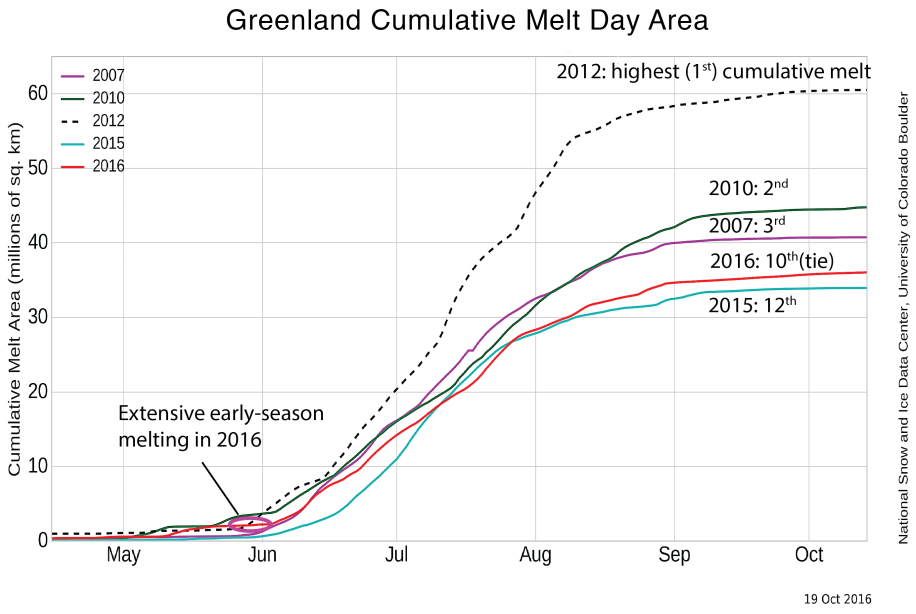

Greenland Surface Melt Extent
1.800.000
1.600.000
1.400.000
1.200.000
1.000.000
800.000
600.000
400.000
200.000
0
Melt Area (sq. km)
1981–2010 Median
Interquartile Range
Interdecile Range
2012
2017
1 Apr
1 May
1 Jun
1 Jul
1 Aug
1 Sep
1 Oct
31 Oct
Date
National Snow and Ice Data Center, University of Colorado Boulder

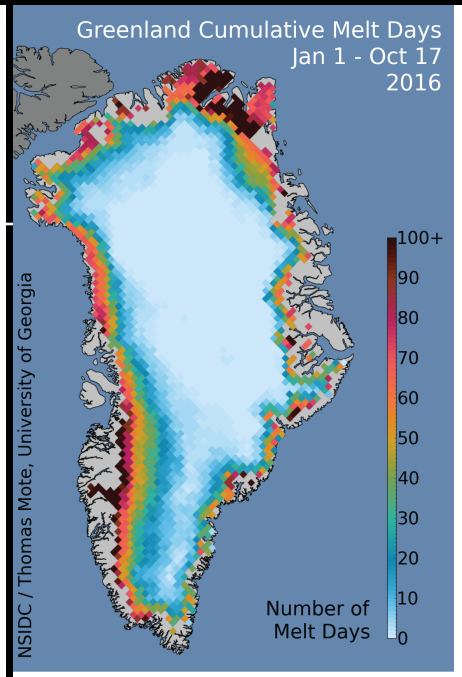

Mass gain
600
400
200
120
80
40
20
-20
-40
-80
-120
-200
-400
-600
Mass loss
mm
Feb 13 2017
Accumulated anomaly
since Sep 1 2016

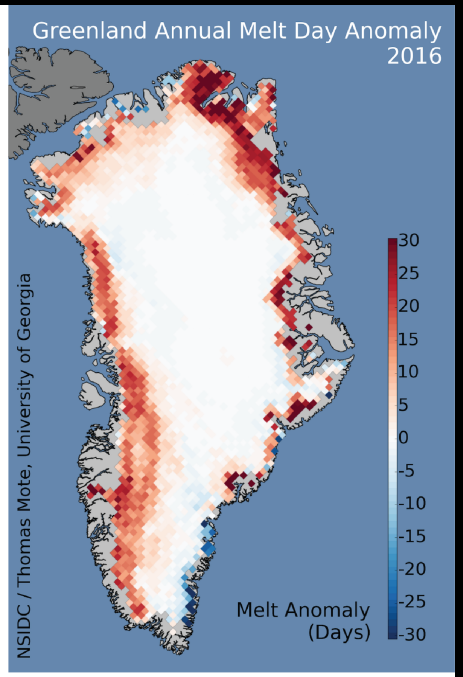
NSIDC 2017

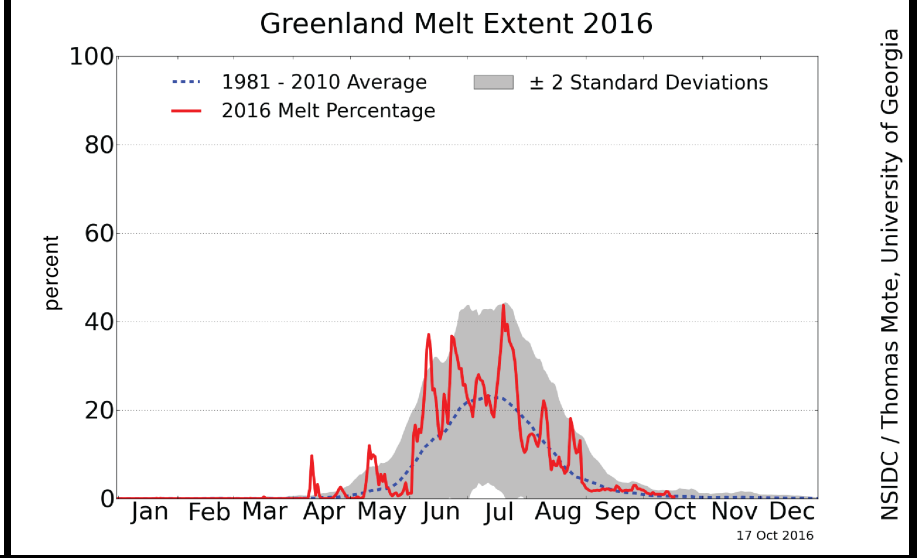

12
8
4
0
-4
-8
-12
-16
Mass gain
2016-2017
Mass loss
SMB (Gt/day)
polarportal.org
Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug
800
600
400
200
0
Mean (1990-2013)
2011-12
2015-16
2016-17
Acc. SMB (Gt)
polarportal.org
Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug


Greenland Average Melt Day Area Anomaly
Difference From Daily Average Melt Extent
400
300
200
100
0
-100
-200
1980
1985
1990
1995
2000
2005
2010
2015
Thomas Mote, University of Georgia


Greenland Cumulative Melt Day Area
2007
2010
2012
2015
2016
2012: highest (1st) cumulative melt
2010: 2nd
2007: 3rd
2016: 10th(tie)
2015: 12th
Extensive early-season melting in 2016
Cumulative Melt Area (millions of sq. km)
60
50
40
30
20
10
0
May
Jun
Jul
Aug
Sep
Oct
19 Oct 2016
National Snow and Ice Data Center, University of Colorado Boulder


Greenland Cumulative Melt Days
Jan 1 - Oct 17
2016
NSIDC / Thomas Mote, University of Georgia
Number of Melt Days
100+
90
80
70
60
50
40
30
20
10
0


Greenland Annual Melt Day Anomaly
2016
NSIDC / Thomas Mote, University of Georgia
Melt Anomaly (Days)
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30

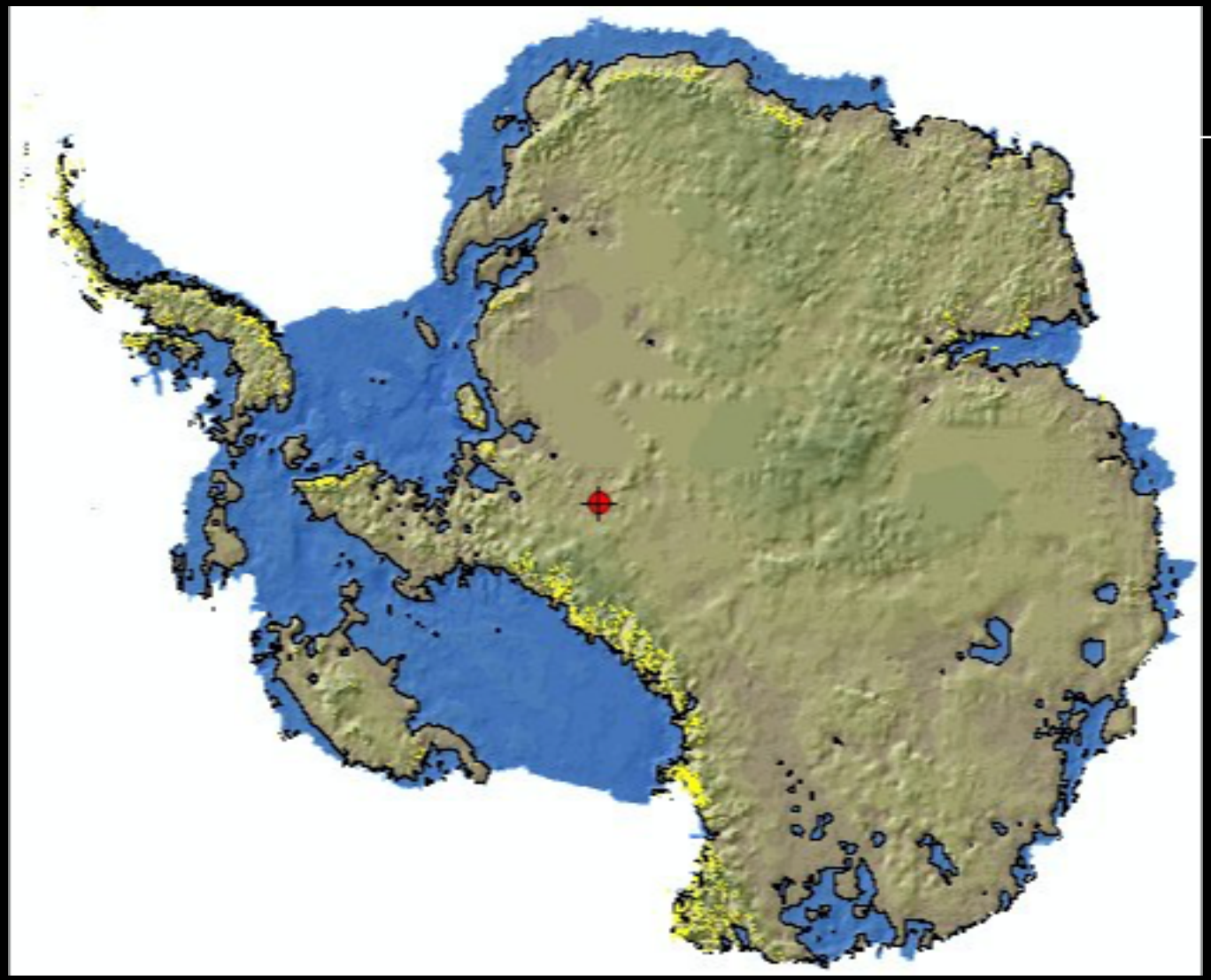

Greenland Melt Extent 2016
1981 - 2010 Average
± 2 Standard Deviations
2016 Melt Percentage
percent
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
17 Oct 2016
NSIDC / Thomas Mote, University of Georgia

NSIDC 2017

Present subglacial topography

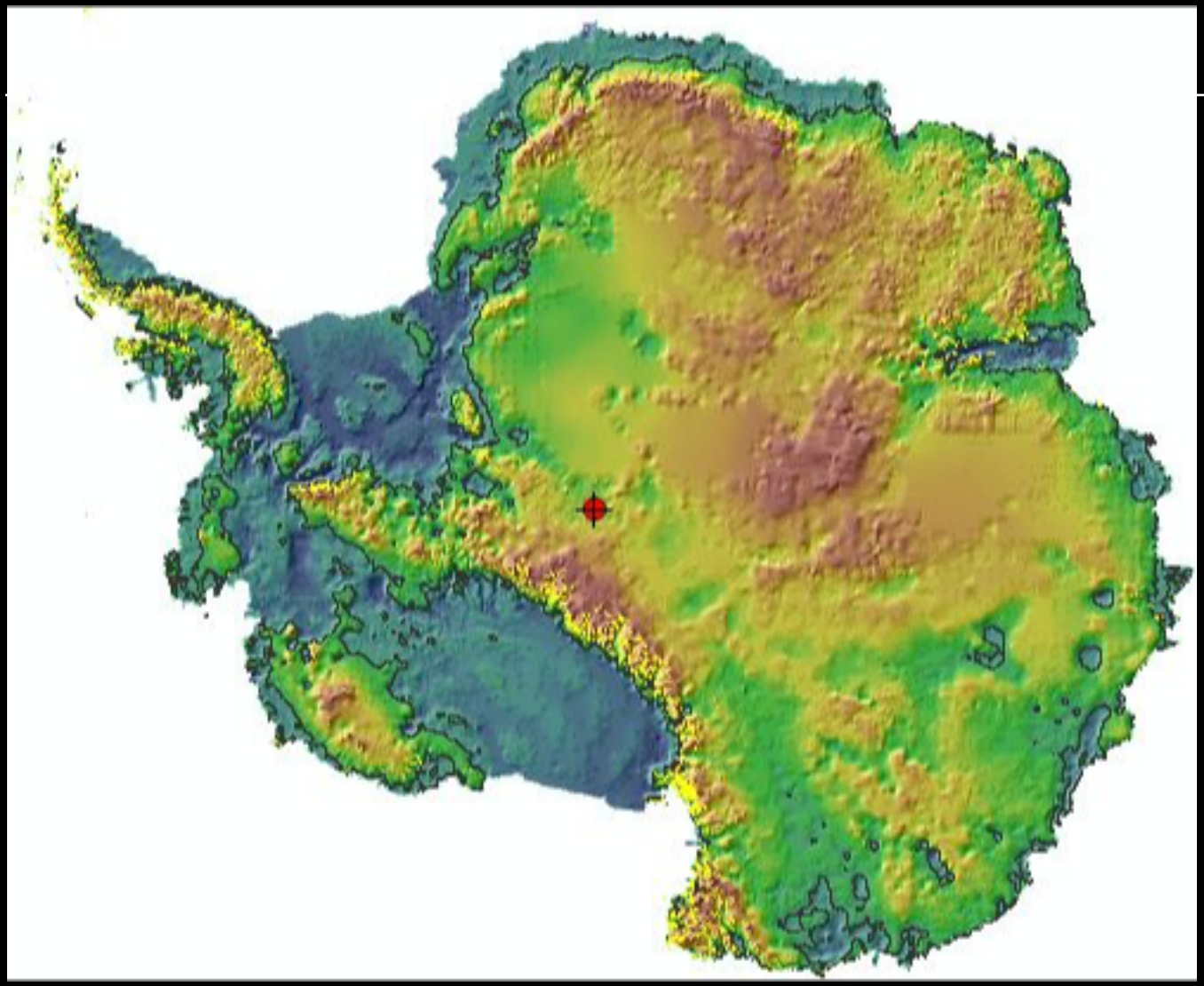
USGS 2017

Topography after isostatic rebound



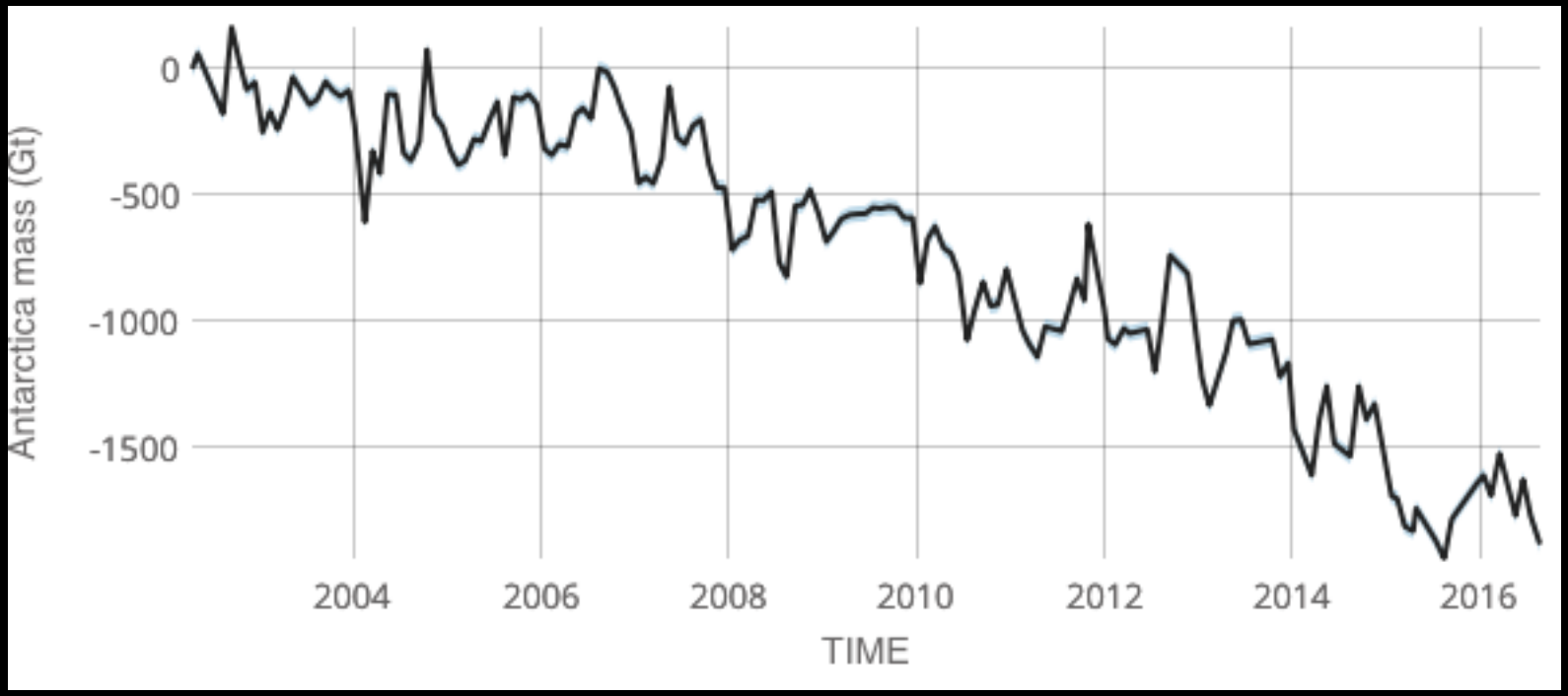
USGS 2017

Topography after isostatic rebound Altimetry



USGS 2017

Antarctica mass change from GRACE satellite



NASA - 2017

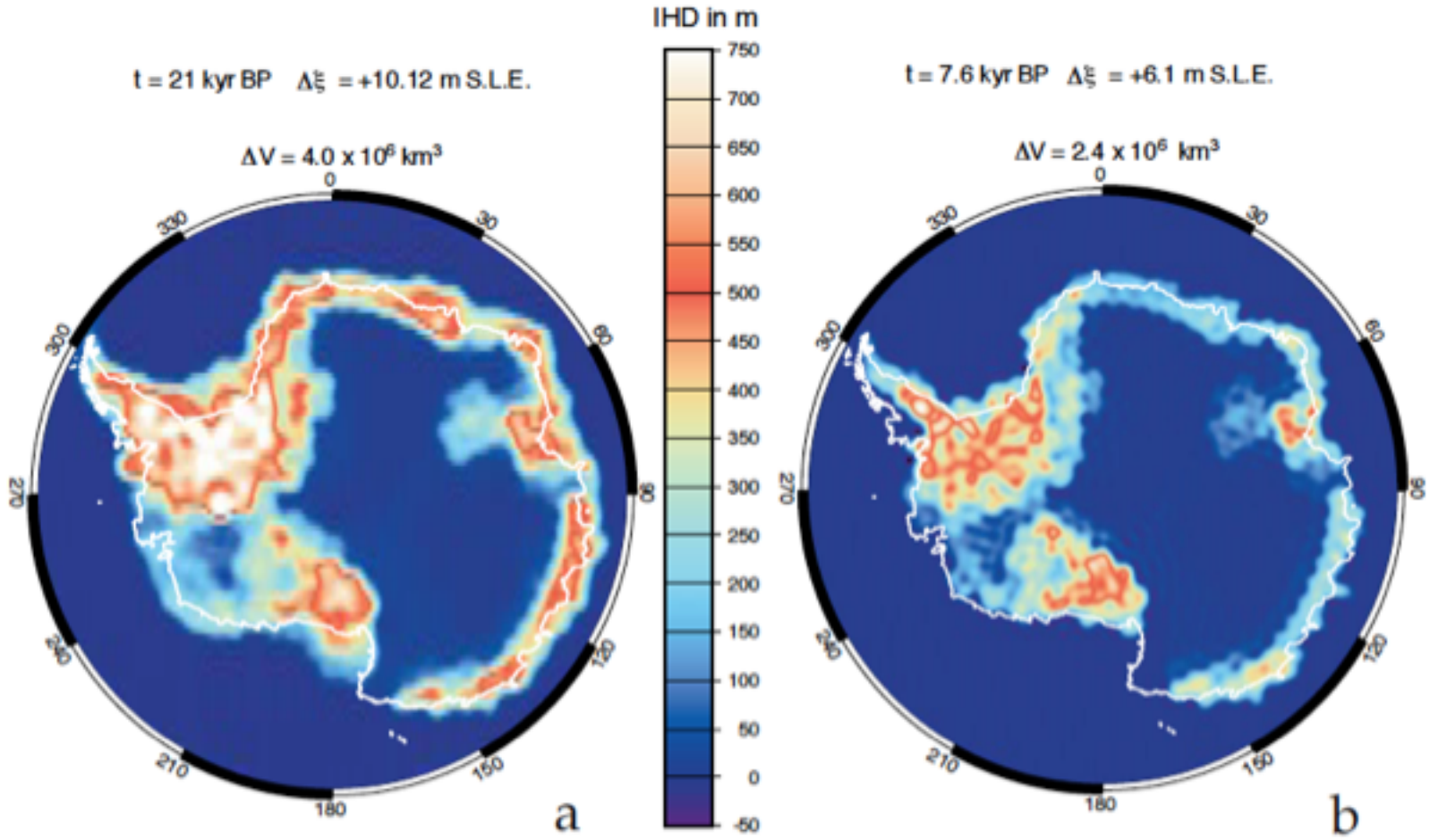


Fig. 2. Ice height differences (IHD) for the 'IJ05' ice history model at **a.** LGM at 21 kyr, and at **b.** 7.6 kyr BP. The differential ice height assumes zero values at present-day (modelled as AD 2000) and at 102 kyr BP. These maps are constructed via a disk representation (James & Ivins 1998, Ivins *et al.* 2003) and expanded in spherical harmonics with truncation at degree and order 256.

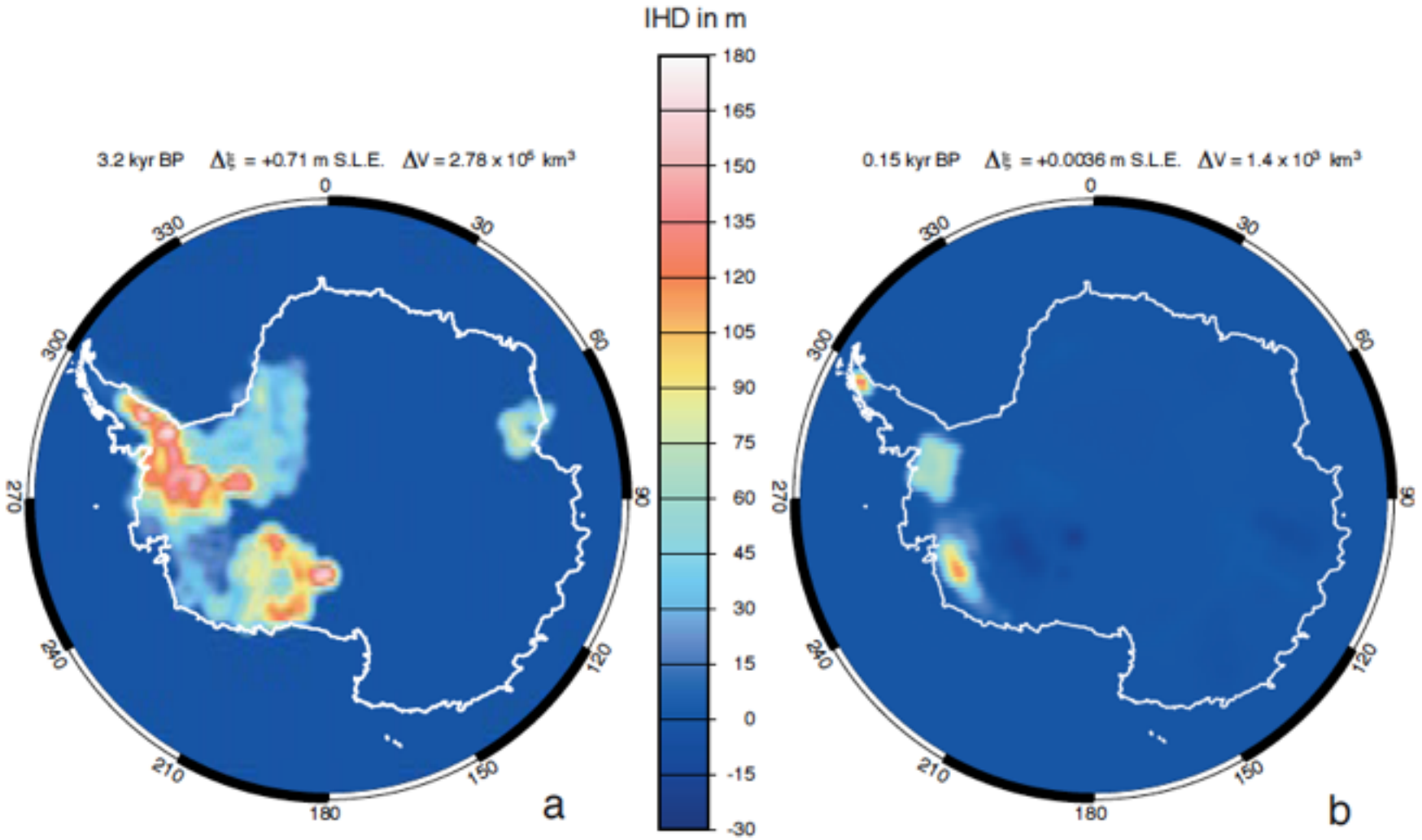


Fig. 3. Same as Fig. 2, but for ice height differences (IHD) at **a.** 3.2 kyr, and at **b.** 0.15 kyr BP. The negative heights in (b) indicate mass increase.

Thank you