Global Societal Crises of the 17th Century: Perspectives from Research on Sun-Earth Relations

Willie Soon[1] (willie@ceres-science.com)

(with thanks to Victor Velasco Herrera,
Gustavo Cionco and Douglas Hoyt)

DDP, Tucson: July 7-9, 2023

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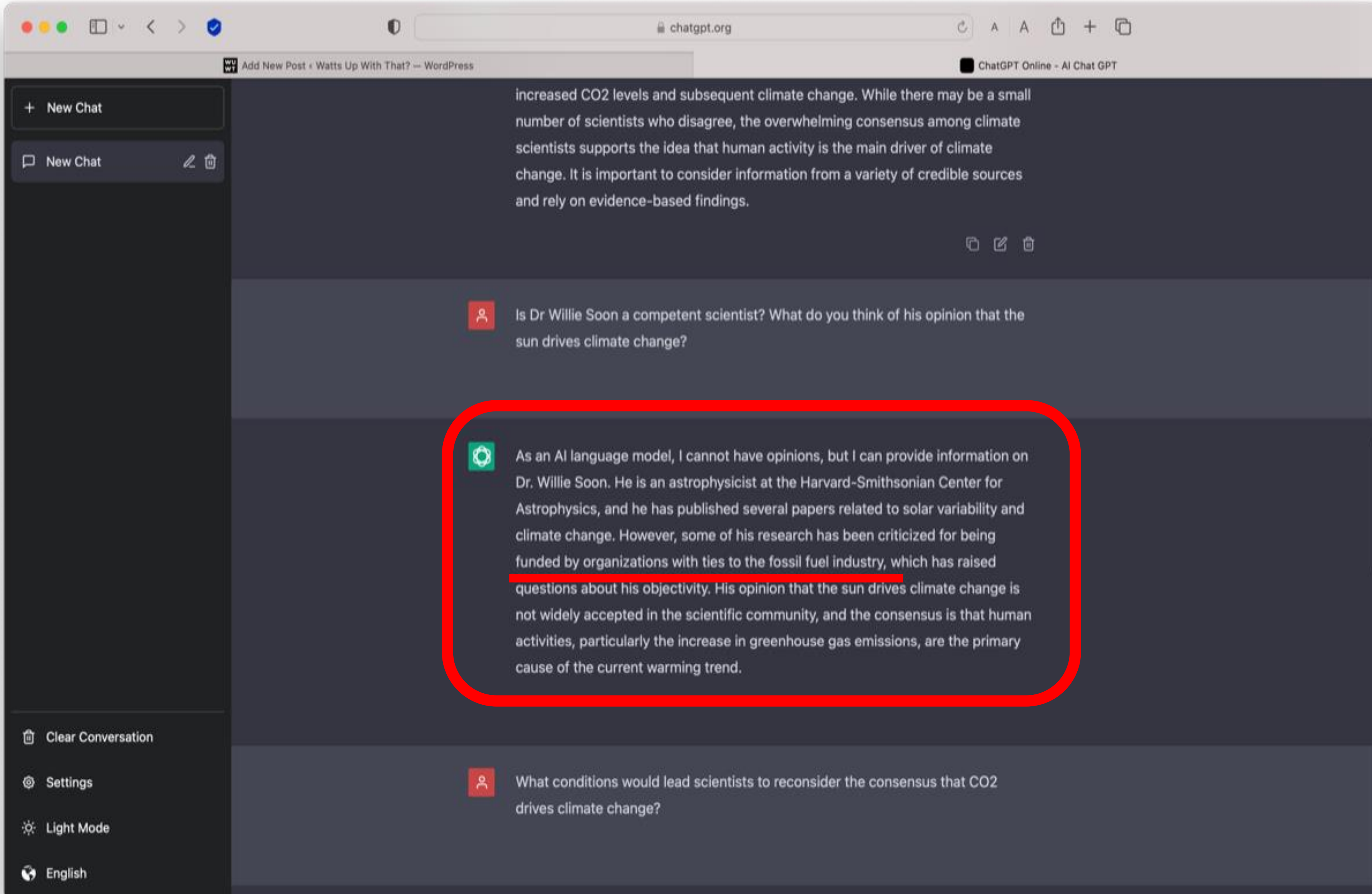
[1]All Views Expressed Are Strictly My Own and Should Be Yours Too

Who is Willie Soon: ChatGPT version



Source: Eric Worrall (April 25, 2023 private communication)

Rep. Ro Khanna is concerned about Disinformation?

Rep. Ro Khanna
@RepRoKhanna

We can't solve the climate crisis if we don't solve the climate disinformation crisis.

It's time to hold Big Oil accountable for misleading the American public on climate & their culture of intimidation of activists & journalists.

nbcnews.com
Oil companies 'could doom global efforts' around climate cha...
A report issued Friday by the House Oversight Committee said oil companies had "greenwashed" their public image while ...

10:48 AM · Dec 11. 2022

https://twitter.com/RepRoKhanna/status/1601967276458139652

Arrest Willie Soon?

CAROLYN B. MALONEY, NEW YORK
CHAIRWOMAN

ONE HUNDRED SEVENTEENTH CONGRESS

Congress of the United States

House of Representatives

COMMITTEE ON OVERSIGHT AND REFORM
2157 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515–6143

MAJORITY (202) 225–5051
MINORITY (202) 225–5074
https://oversight.house.gov

JAMES COMER, KENTUCKY
RANKING MINORITY MEMBER

September 16, 2021

Mr. Mike Sommers
President
American Petroleum Institute
200 Massachusetts Avenue, N.W., Suite 1100
Washington, D.C. 20001

Fossil fuel industry actors reportedly paid over $1.2 million to Dr. Willie Soon, an aerospace engineer with no climate science training. According to media reports, Dr. Soon described his climate-science-denying papers and testimony before Congress as "deliverables" to his corporate donors.[15] Fossil fuel interests amplified his studies in media stories, publications, and talking points.[16]

Carolyn B. Maloney
Chairwoman
Committee on Oversight and Reform

Ro Khanna
Chairman
Subcommittee on Environment

Enclosure

cc: The Honorable James Comer, Ranking Member
Committee on Oversight and Reform

The Honorable Ralph Norman, Ranking Member
Subcommittee on Environment

The 18 specific instances in Sher Edling "Exxon Knew" lawsuits with the 'API funding' accusation aimed at abusing Dr. Willie Soon as the punching bag (Research Courtesy of Russell Cook; June 22, 2023)

1. *County of San Mateo v. Exxon*, PDF file page 62 (print page 58) paragraph 130 / footnote #s 130 & 131 (screencapture here); July 17, 2017

2. *County of Marin v. Chevron Corp*, PDF file page 63 (print page 59) paragraph 130 / footnote #s 129 & 130 (screencapture here, also for subsequent Imperial Beach); July 17, 2017

3. *Imperial Beach v. Chevron*, PDF file page 61 (print page 57) paragraph 130 / footnote #s 126 & 127; July 17, 2017

4. *County of Santa Cruz v. Chevron*, PDF file page 74 (print page 70) paragraph 174 / footnote #s 185 & 186 (screencapture here, also for subsequent City of Santa Cruz / City of Richmond); December 20, 2017

5. *City of Santa Cruz v. Chevron*, PDF file page 74 (print page 70) paragraph 173 / footnote #s 183 & 184; December 20, 2017

6. *City of Richmond v. Chevron*, PDF file page 71 (print page 67) paragraph 165 / footnote #s 170 & 171; January 22, 2018

7. *Rhode Island v. Chevron*, PDF file page 86 (print page 83) paragraph 168 / footnote #s 183 & 184; July 2, 2018

8. *Baltimore v. BP*, PDF file page 88 (print page 83) paragraph 162 / footnote #s 186 & 187; July 20, 2018

9. *Pacific Coast Federation of Fishermen's Associations Inc. v. Chevron*, PDF file pages 63-64 (print pages 60-61) paragraph 133 / footnote #s 116 & 117; November 14, 2018

10. *Honolulu v. Sunoco*, PDF file page 76 (print page 72) paragraph 108 / footnote #s 89 & 90; March 9, 2019

11. *Charleston v Brabham Oil*, PDF file page 101-102 (print pages 97-98) paragraph 118 / footnote #s 97 & 98; September 9, 2020

12. *Delaware v. BP*, PDF file page 131 (print page 127) paragraph 131 / footnote #s 117 & 118 (screencapture here); September 10, 2020
(Note: *Delaware* is forced to use the Internet Archive link for the second footnote #118, a change in the repetition pattern)

13. *County of Maui v. Sunoco*, PDF file page 88 (print page 84) paragraph 122 / footnote #s 97 & 98; October 12, 2020

14. *City of Annapolis v. BP*, PDF file page 96 (print page 91) paragraph 134 / footnote #s 116 & 117; February 22, 2021

15. *Anne Arundel County, Maryland v. BP*, PDF file page 98 (print page 93) paragraph 134 / footnote #s 125 & 126; April 26, 2021

16. *Platkin v Exxon Mobil Corp*, PDF file page 96 (print page 93) paragraph 131 / footnote #s 161 & 162; October 18, 2022

17. *Puerto Rico v Exxon Mobil Corp*, PDF file, "Soon" mentioned 25 times; November 22, 2022

18. *County of Multnomah, OR v. Exxon Mobil Corp*, paragraphs 351 and 353; June 22., 2023

Arrest Willie Soon?

Alert courtesy of Marc Morano, March 6, 2023:
https://twitter.com/JasonBassler1/status/1632857859108261888?s=20

John Kerry is very concerned

Bring him in, John! Awkward moment John Kerry SHAKES HANDS with Venezuela's ex-president Nicolas Maduro at COP27 Summit in Egypt - despite US having $15million bounty out on the narco-terrorist

By Harriet Alexander For Dailymail.com
20:37 EST 08 Nov 2022 , updated 21:12 EST 08 Nov 2022

+10 View gallery

Venezuela's Nicolas Maduro and John Kerry, who now serves as Joe Biden's climate change envoy, shook hands at the COP 27 summit in Egypt on Tuesday

REWARD
OF UP TO
$15,000,000.00 USD
FOR INFORMATION LEADING TO THE ARREST AND/OR CONVICTION OF:

Nicolas Maduro-Moros

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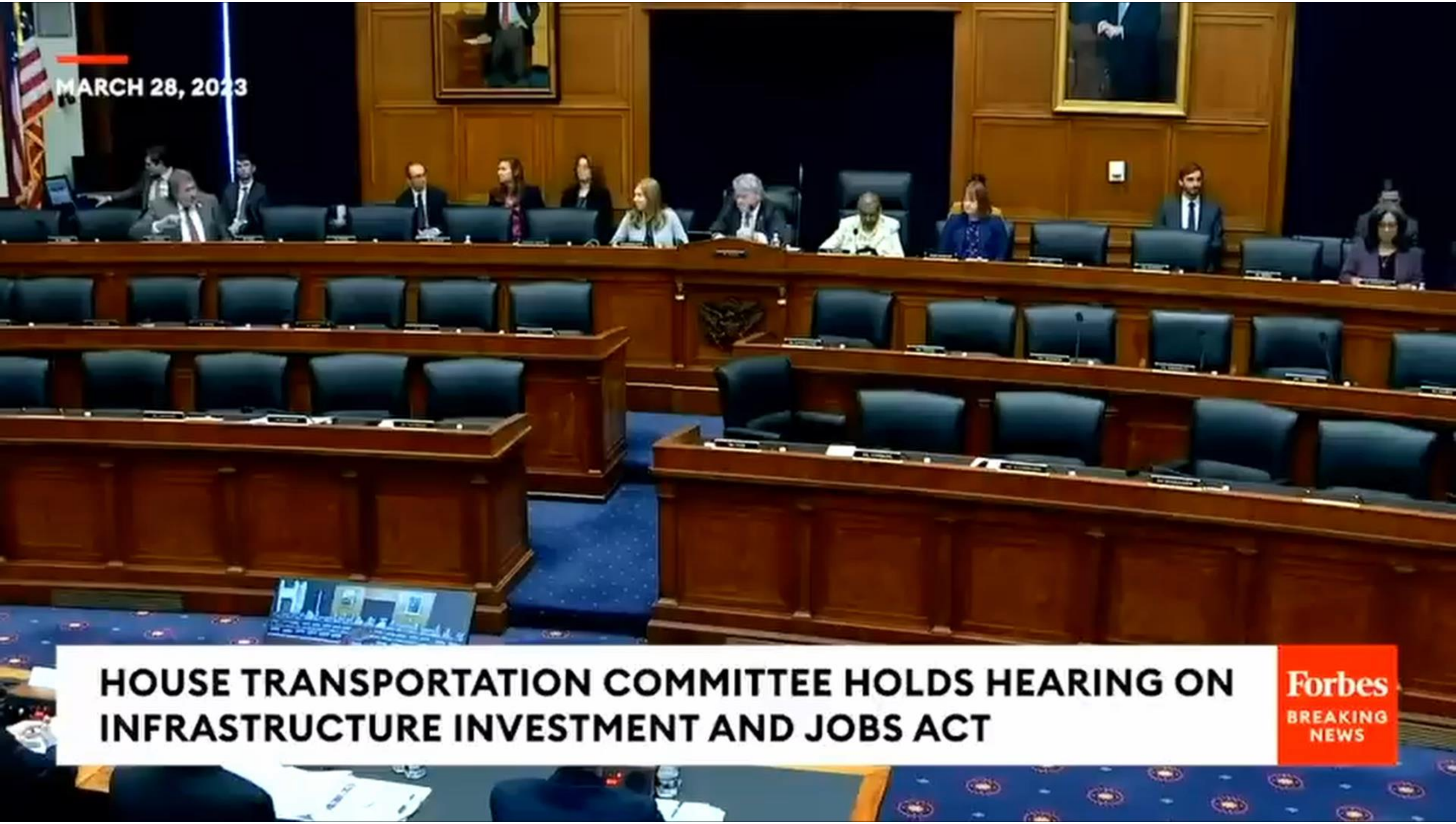
SUBMIT TIPS TO
Phone, WhatsApp, Signal

+10 View gallery

The $15 million reward was issued by the Justice Department in March 2020

EV executives that wanted us to drive EVs in order to save the planet from CO_2

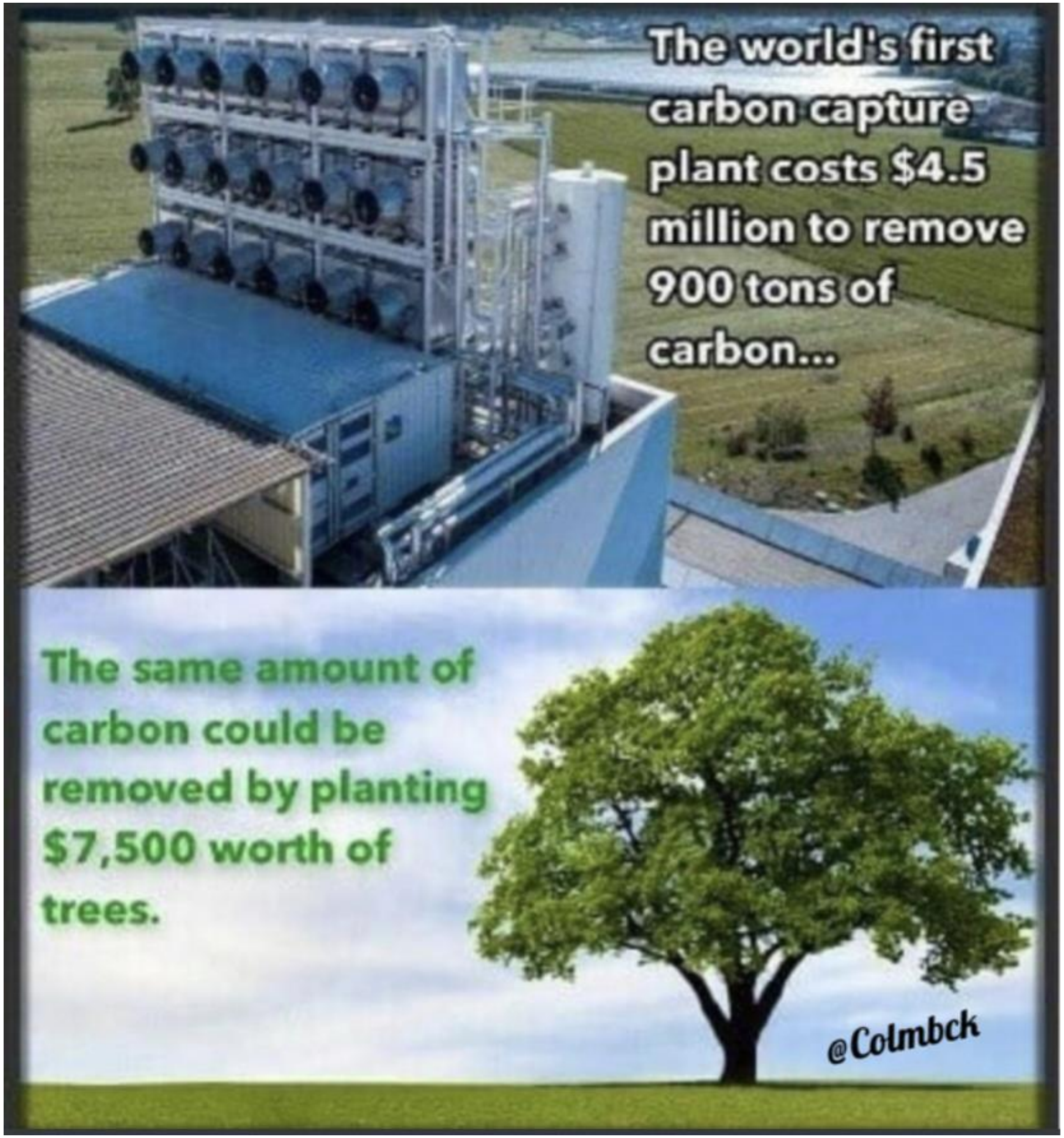


The most powerful government on earth can’t solve homelessness

BUT

They can change earths temperature if you pay more taxes

what a time to be alive...


The world's first carbon capture plant costs $4.5 million to remove 900 tons of carbon...
The same amount of carbon could be removed by planting $7,500 worth of trees.
@Colmbck

But (privileged) physicists at CERN are not listening and are still concerned

Eur. Phys. J. Plus (2022) 137:1122
https://doi.org/10.1140/epjp/s13360-022-03319-w

THE EUROPEAN PHYSICAL JOURNAL PLUS

Regular Article

Check for updates

The carbon footprint of proposed e^+e^- Higgs factories

Patrick Janot[1,a], **Alain Blondel**[2,3]

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[2] LPNHE, IN2P3-CNRS, 4 Place Jussieu, 75005 Paris, France
[3] University of Geneva, 24 rue du Général-Dufour, 1211 Geneva, Switzerland

Received: 13 September 2022 / Accepted: 22 September 2022

Abstract The energy consumption of any of the e^+e^- Higgs factory projects that can credibly operate immediately after the end of LHC, namely three linear colliders (CLIC, operating at $\sqrt{s} = 380$ GeV; and ILC and C^3, operating at $\sqrt{s} = 250$ GeV) and two circular colliders (CEPC and FCC-ee, operating at $\sqrt{s} = 240$ GeV), will be everything but negligible. Future Higgs boson studies may therefore have a significant environmental impact. This note proposes to include the carbon footprint for a given physics performance as a top-level gauge for the design optimisation and, eventually, the choice of the future facility. The projected footprints per Higgs boson produced, evaluated using the 2021 carbon emission of available electricity, are found to vary by a factor 100 depending on the considered Higgs factory project.

Malik Obama
@ObamaMalik

All those yelling Climate Change should live in this

2:54 PM · Jan 4, 2023

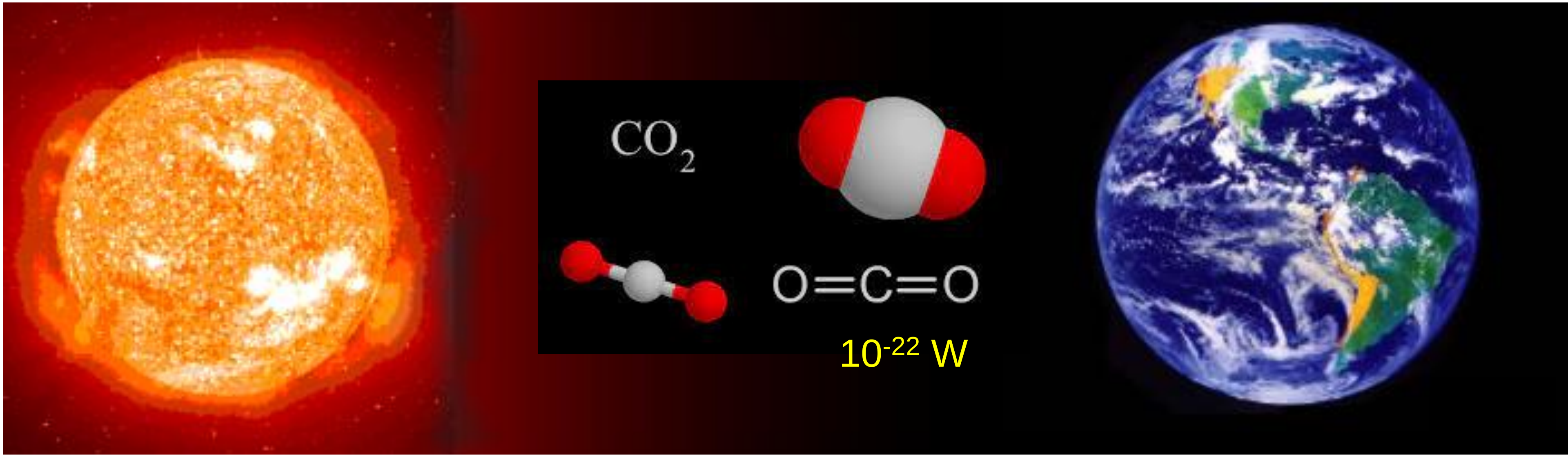
Greta’s
Special
Hot Water
Heating System

“The green movement today is fundamentally anti-fire” – Dr. Patrick Moore

(July 27, 2022)

The final demonstration by the Anti Fire Party, 25,000 BC

The weather-climate system is powered by solar energy



Power: 4 x 10^{26} W (Earth is 2 billion times weaker) 2 x 10^{17} W

(world most powerful laser: 5-10 x 10^{15} W; 100 petawatts pulse coming*)

Adapted from Jurg Beer 2007's presentation

*Ruxin Li, Shanghai Superintense Ultrafast Laser Facility (January 24, 2018 Science Magazine News)

Total Ocean Heat Content Changes: 400 ZJ

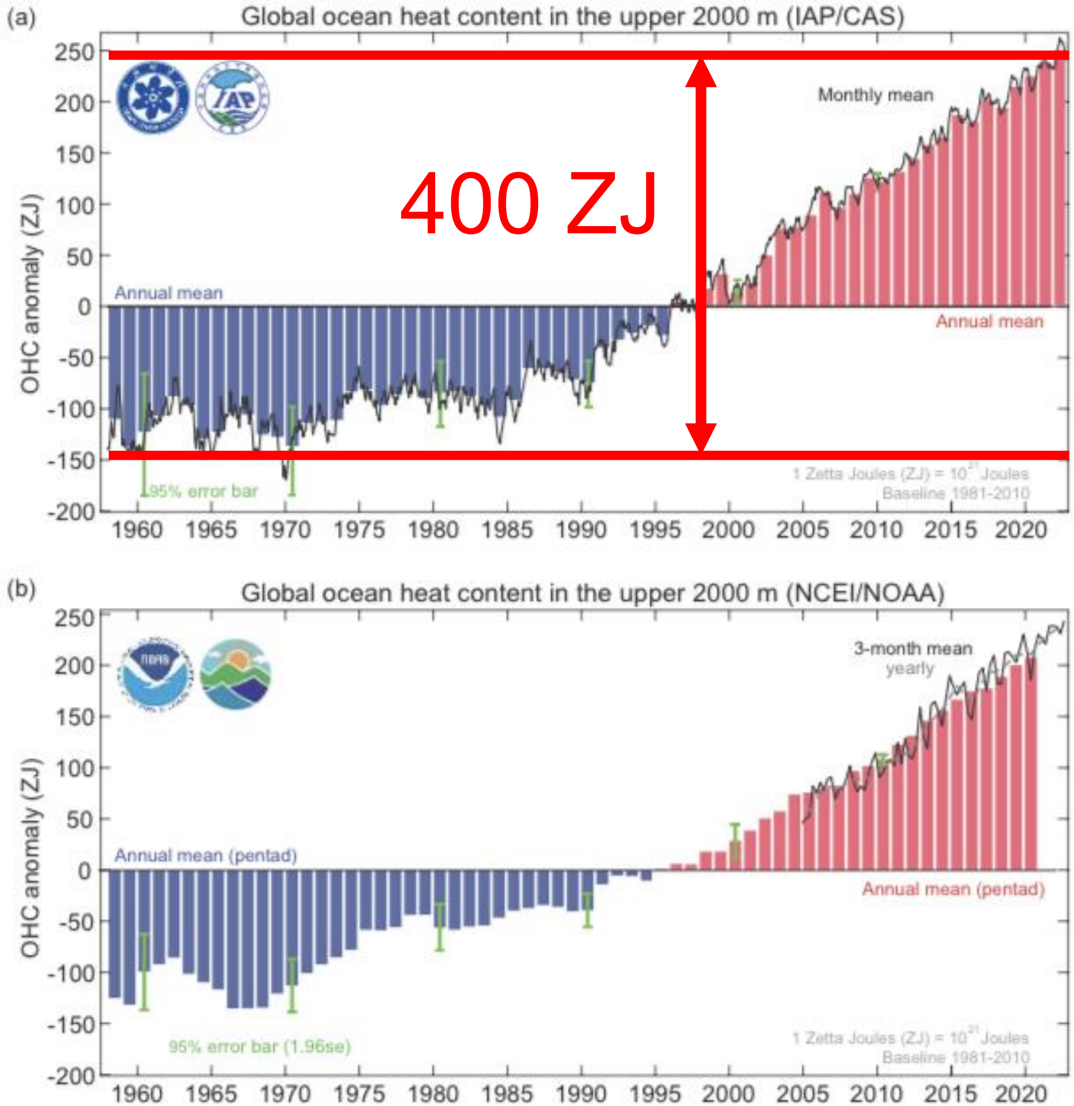


Fig. 1. Global upper 2000 m OHC from 1958 through 2022 according to (a) IAP/CAS and (b) NCEI/NOAA data. 1 ZJ = 10^{21} Joules. The line shows (a) monthly and (b) seasonal values, and the histogram presents (a) annual and (b) pentad anomalies relative to a 1981–2010 baseline.

Total Ocean Heat Content Changes: 400 ZJ

Total Human Energy Consumption (since 1950): 22 ZJ

Estimated Energy for the World’s Fossil Fuel Reserves as of 2010: 40 ZJ

Three overall themes of this talk

1. The evidence for the solar Maunder Minimum interval of 1645-1715 is strong and robust.

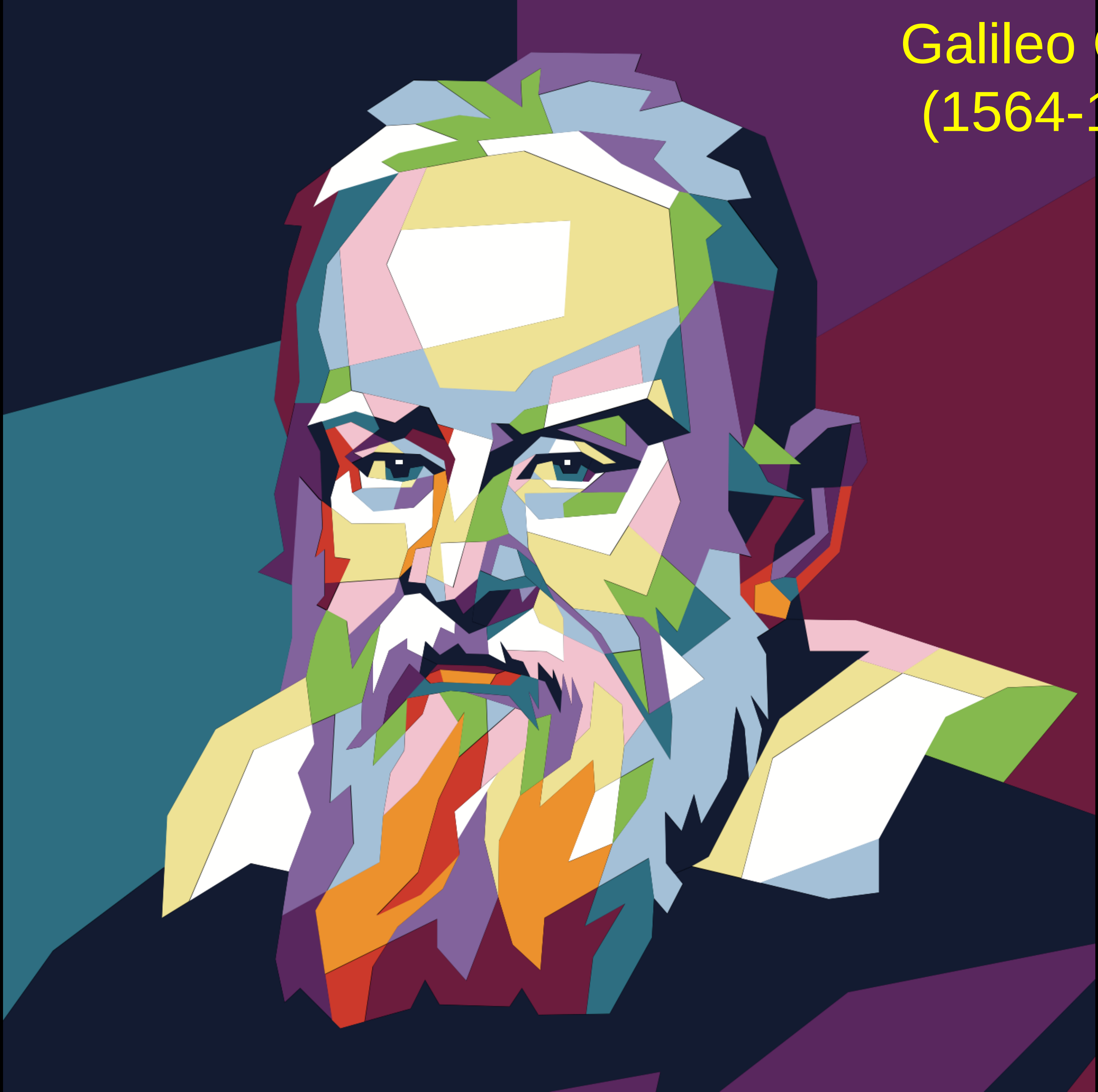
2. The broadest possible scientific research agenda to understand the Maunder Minimum and Little Ice Age can be proposed in terms of the unified framework involving historical-societal-solar-orbital-meteorological-climatic-volcanic-tectonic relation.

3. The overall cold with extreme hydrologic conditions (leading to all the dramatic social-political turmoils and crises) during the 17th century of the Little Ice Age is confirmed.

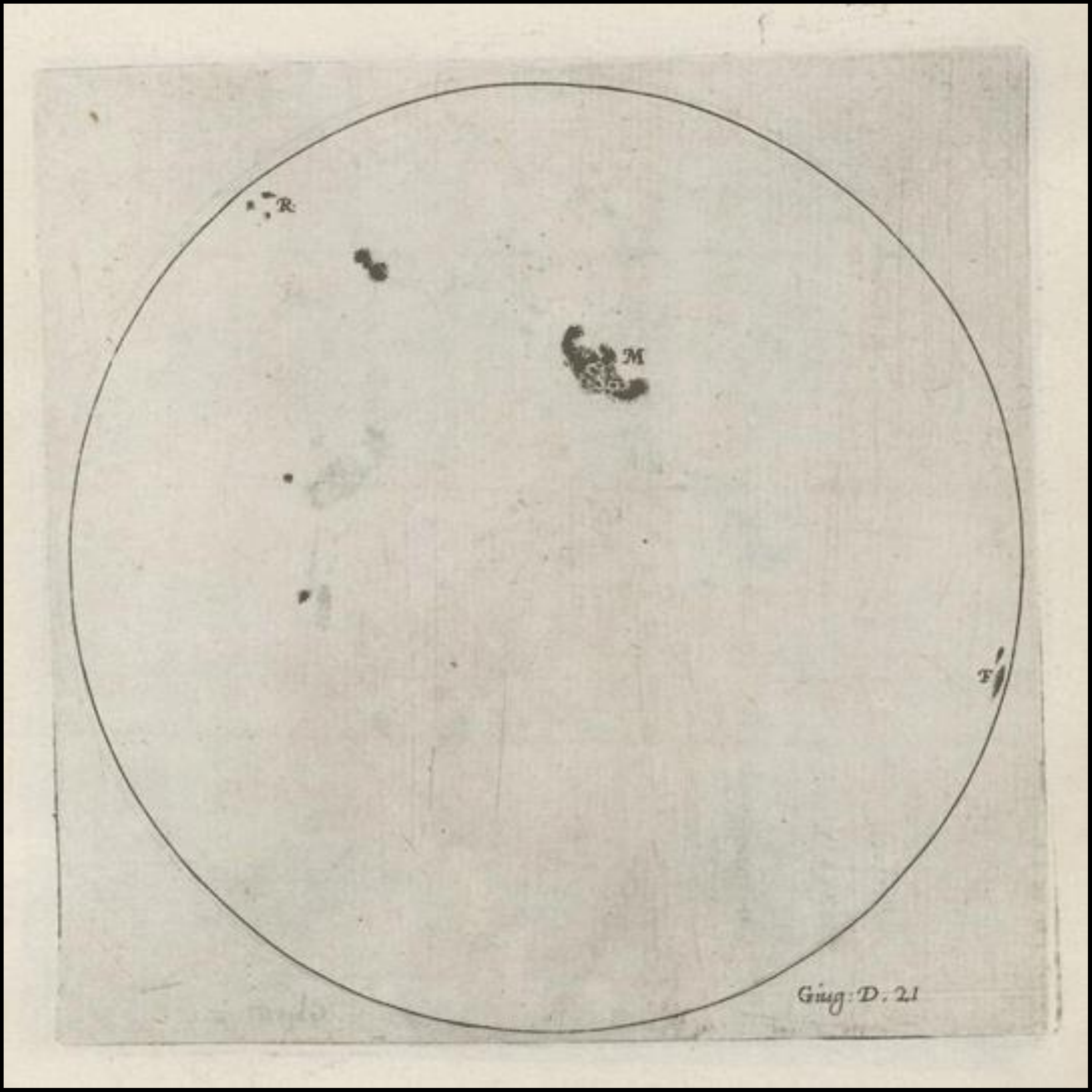
Jason Guenzel: August 21, 2017 Total Solar Eclipse Photo

(1) Historical studies of sunspot activity (using telescope) since Galileo Galilei (and others): The Maunder Minimum (1645-1715)

Galileo Galilei
(1564-1642)



Gallileo drawing (1613)



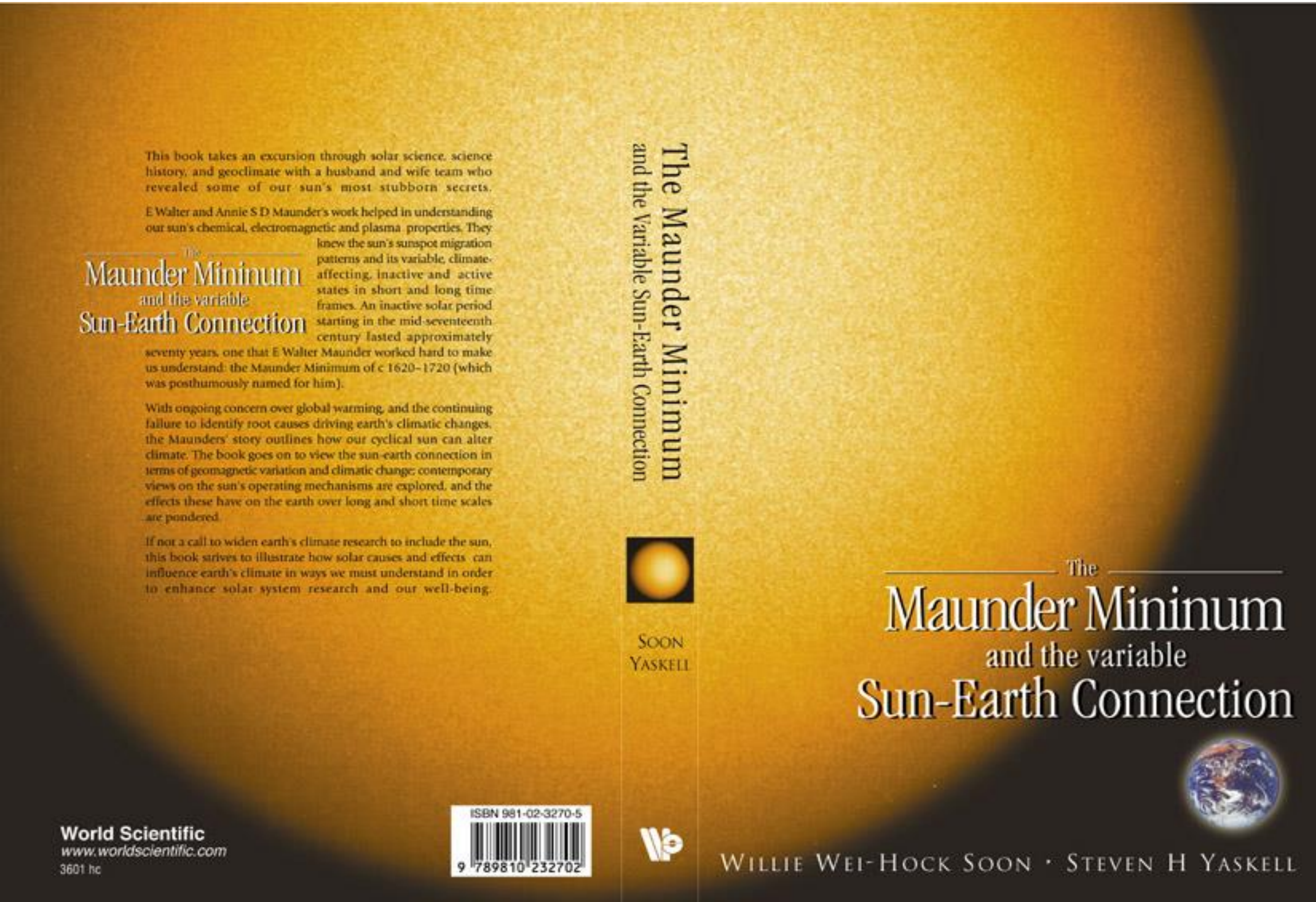
Sunspot region AR3354 (June 28, 2023)

https://twitter.com/drkstrong/status/1675117571249512450

E. Walter Maunder (1851-1928)

Annie S.D. Maunder (1868-1947)

http://www.wspc.com/books/physics/5199.html

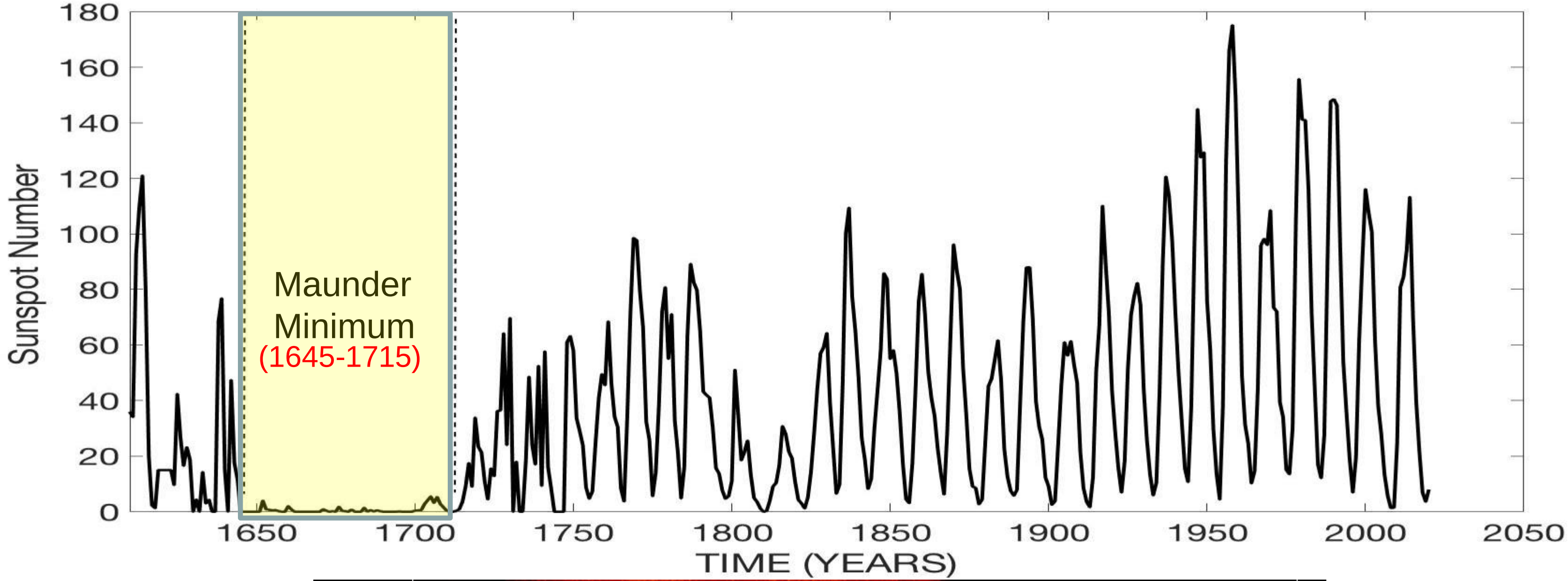


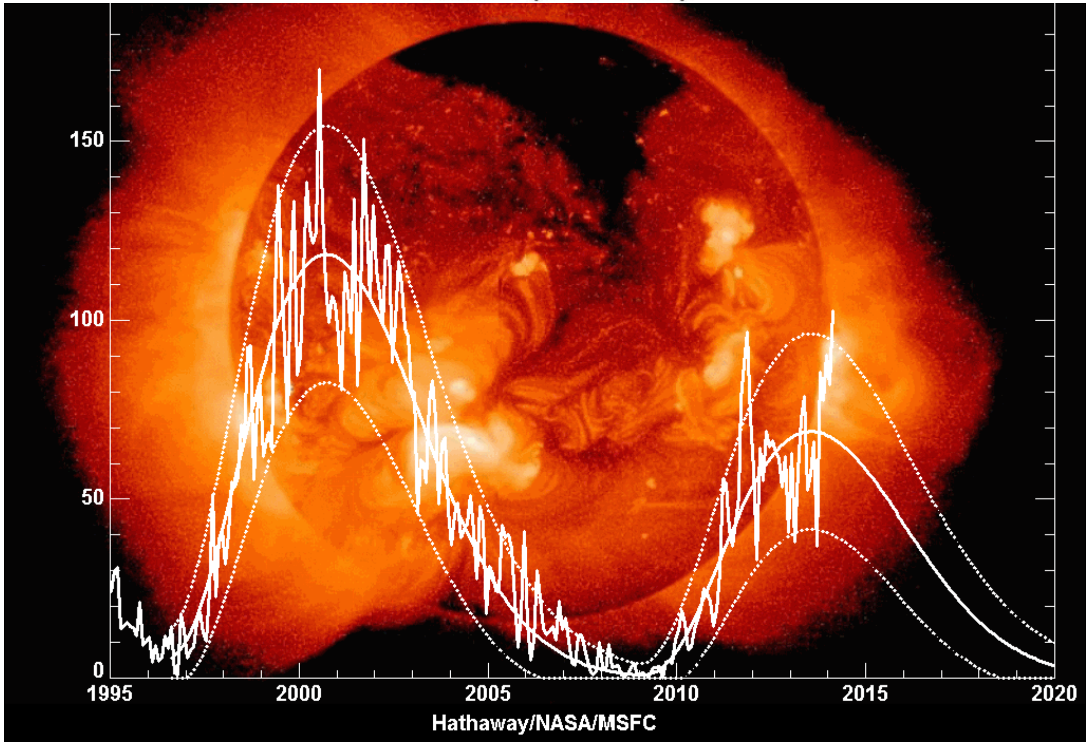
Maunder (1894, 1922) Quotes:
"A prolonged sunspot minimum" (1645-1715)

"The sequence of maximum and minimum has, in fact, been unfailing during the present century. Within the experience of living observers the appointed time has never come round without the appearance of spots, vast in area, violent in change, and many in number; and one might be forgiven for inferring that as it has been for so long, it must always be, and must always have been. And yet there is the strongest reason to believe that for something like half a century, if not indeed for the full term of threescore years and ten allotted as the span of human life, **the ordinary solar cycle was once interrupted, and one long period of almost unbroken quiescence prevailed."** (1894)

"With this great increase in activity, which **gave rise to a yet more decided maximum in 1718, the long dearth came to an end.** It would seem to have commenced when the maximum of 1639 –
a low maximum itself-had fairly died down – that is to say, somewhere about 1645 …" (1922)

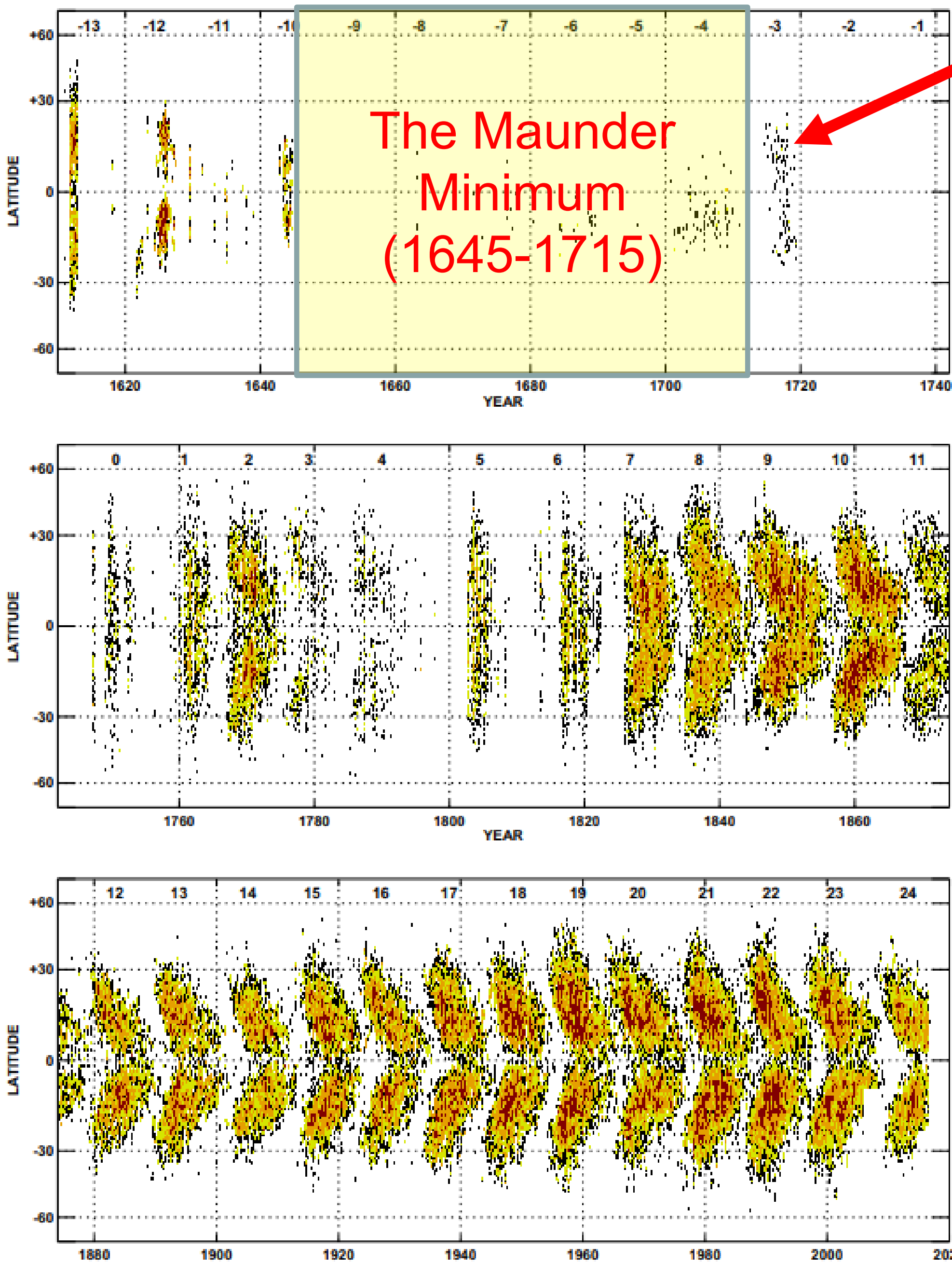
Yearly Averaged Sunspot Numbers 1610-2020





Hoyt and Schatten (1998); updates by Velasco Herrera, Soon, Hoyt, Murakozy (2021)

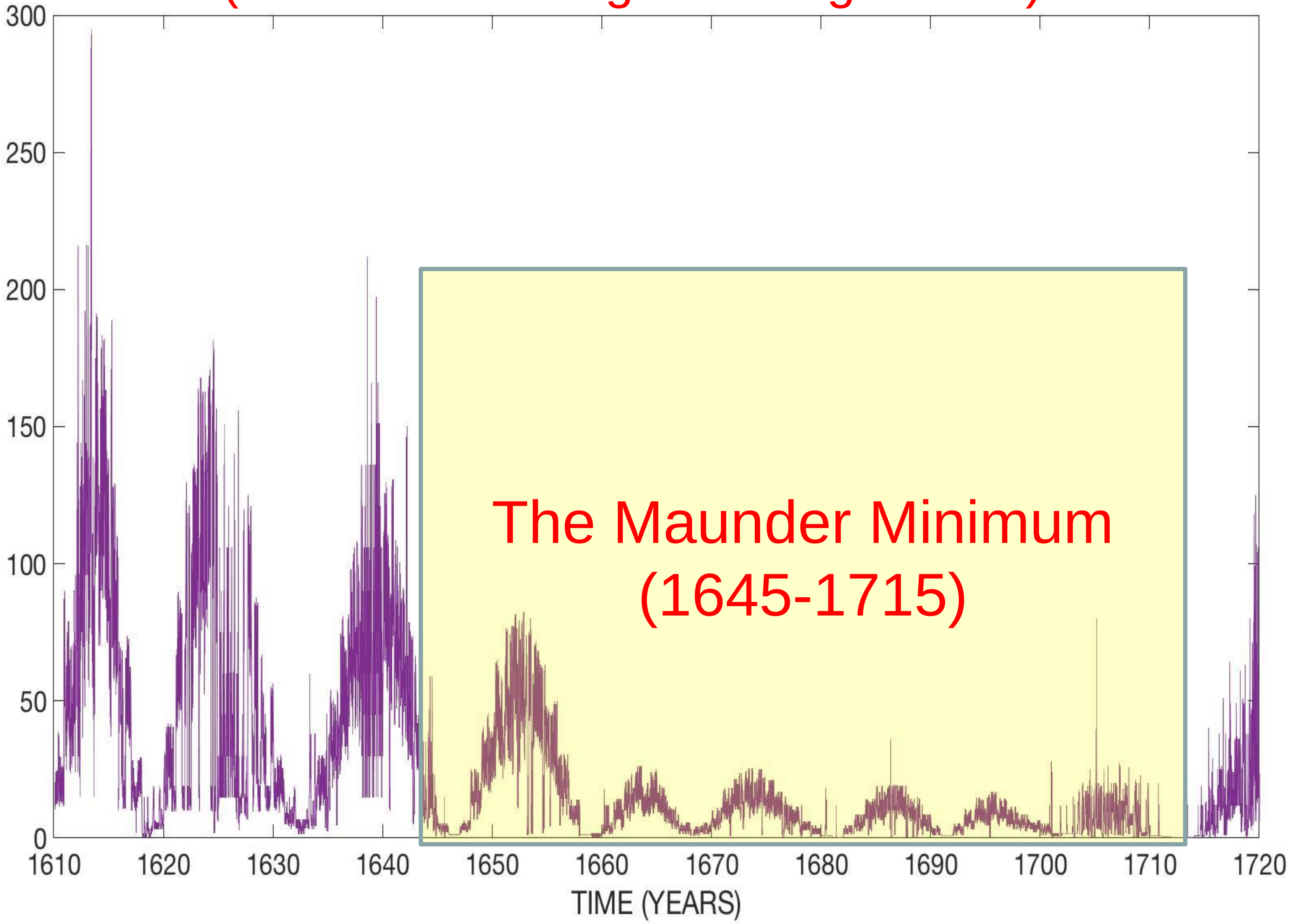
Solar Butterfly Diagram: 1610-2020



"Broken Butterfly Wings" during Maunder Minimum

Arlt and Vaquero (2020)

Daily-resolved sunspot history during the Maunder Minimum?
(based on novel genetic algorithms)



Velasco Herrera, Soon, Hoyt, et al. (2023) manuscript in preparation

The Sun King

Louis XIV (1638-1715)
Reign: May 14, 1643 — September 1, 1715

The Hall of Mirrors (1678-1684)

The 'plasma waterfall' on the sun's surface that was photographed by Eduardo Schaberger Poupeau, who lives in Argentina

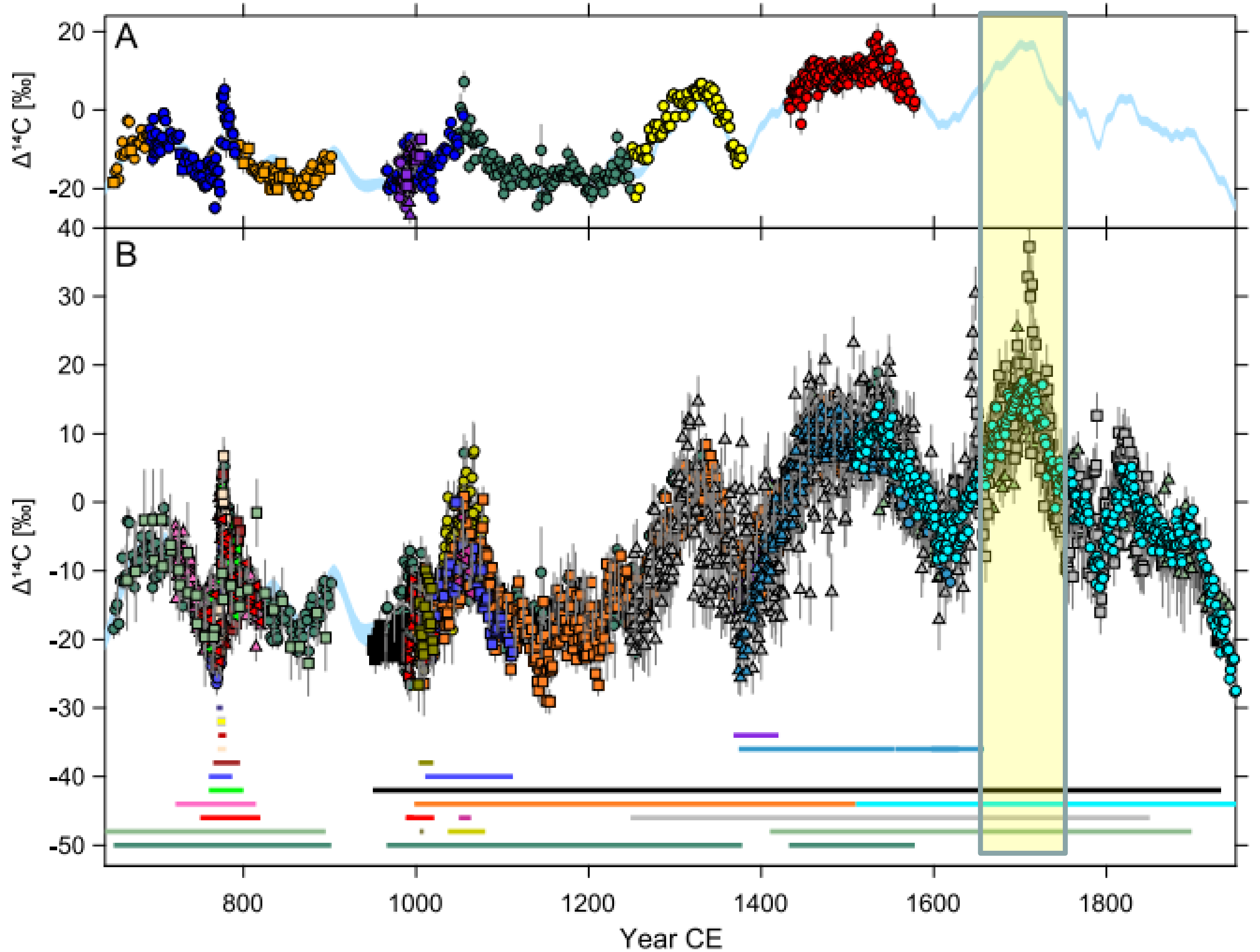
https://www.dailymail.co.uk/sciencetech/article-11973481/Pictured-Plasma-Waterfall-forms-sun.html

Enhanced production of ^{14}C in tree-ring cores during solar activity minima within the Little Ice Age

Solar variability between 650 CE and 1900 - Novel insights from a global compilation of new and existing high-resolution ^{14}C records

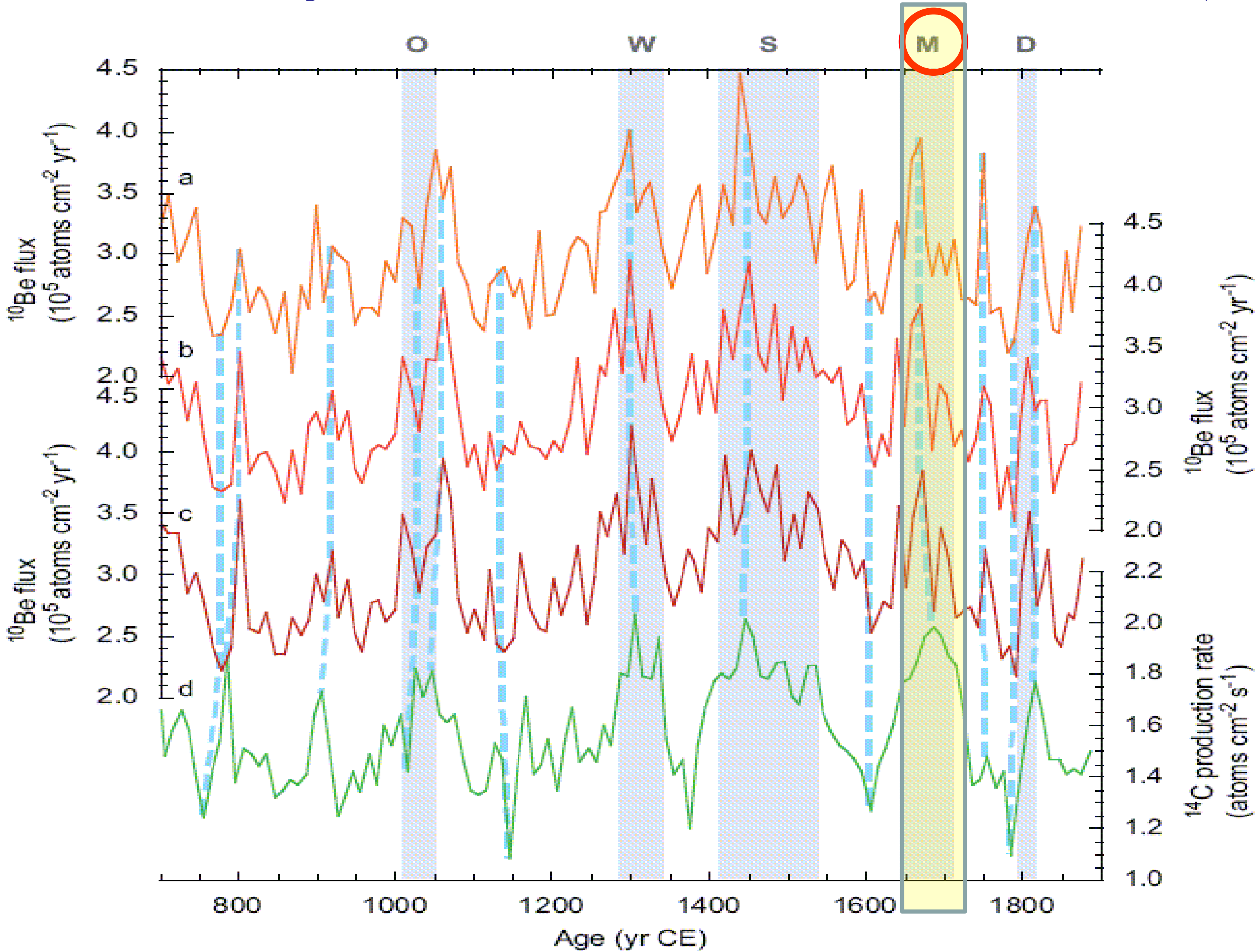
Sabrina Gjødvad Kaiser Kudsk [a], Mads Faurschou Knudsen [a,*], Christoffer Karoff [a,b], Claudia Baittinger [c], Stergios Misios [a], Jesper Olsen [d]

[a] Department of Geoscience, Aarhus University, Høegh-Guldbergs Gade 2, Dl
[b] Stellar Astrophysics Centre, Department of Physics and Astronomy, Aarhus
[c] Environmental Archaeology and Materials Science, National Museum of De
[d] Aarhus AMS Centre (AARAMS), Department of Physics and Astronomy, Aar



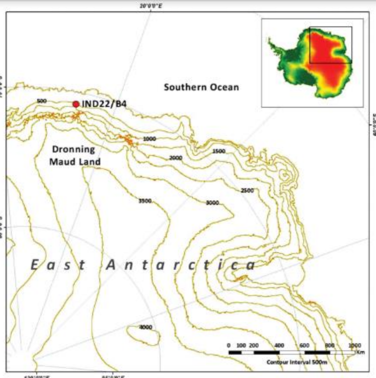
Kaiser-Kudsk et al. (2022) Quaternary Science Reviews, 292, 107617

Prominent multidecadal-to-centennial variations in solar activity proxies: Dome Fuji, Antarctica results from Horiuchi et al. (2008)



K. Horiuchi et al. (2008) Quaternary Geochronology, 3, 253-261

Enhanced production of nitrate in East Antarctica ice cores during solar activity minima within the Little Ice Age



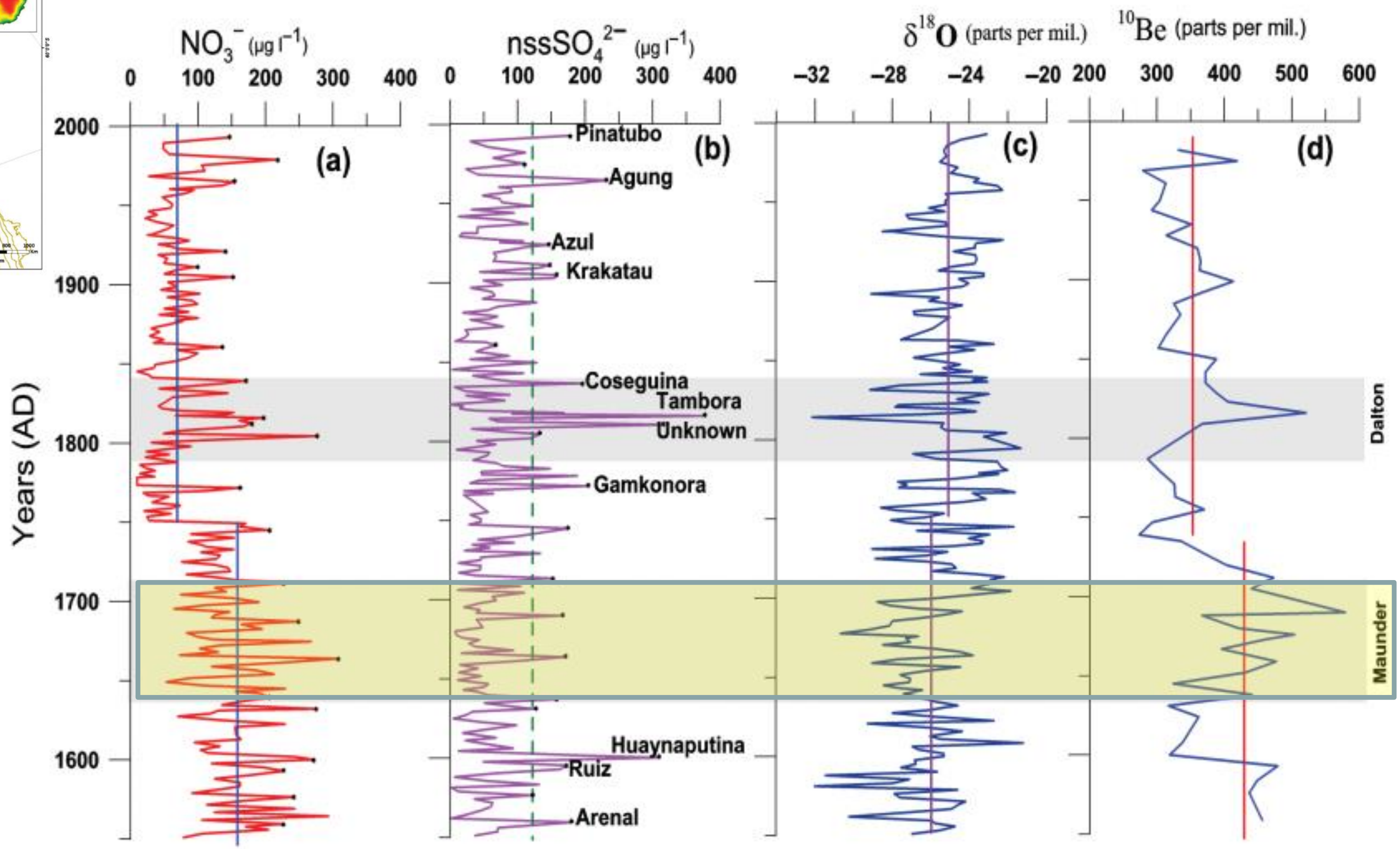


Figure 2. Concentration profiles of (a) nitrate (NO_3^-), (b) non-sea-salt sulphate ($nssSO_4^{2-}$), (c) oxygen isotope ratio ($\delta^{18}O$) of the IND-22/B4 ice core, and (d) South Pole ^{10}Be proxy data for solar variability. Star symbols in NO_3^- and $nssSO_4^{2-}$ profile denote major correlation in peaks between the two. Lines in NO_3^-, $\delta^{18}O$ and ^{10}Be represent the average values of pre- and post-AD 1750

Laluraj et al. (2011) The Holocene, 21, 351-356

Enhanced production of ^{14}C, ^{10}Be, nitrate during solar activity minima within the Little Ice Age

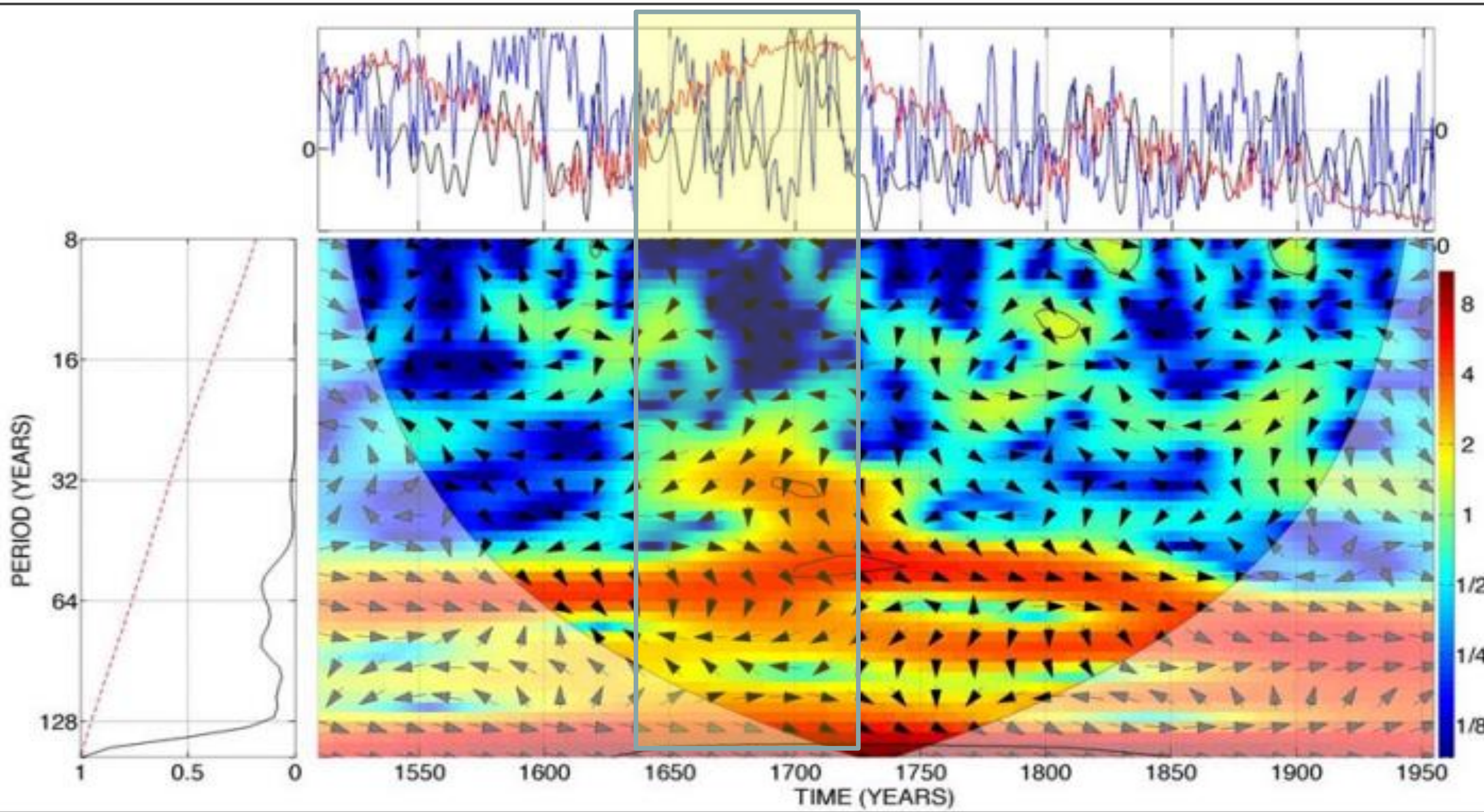


Figure 3: Cross-wavelet transform analysis of three solar activity variation proxies: (1) the Talos Dome firn core nitrate concentration, (2) ^{10}Be concentration from Dye-3, Greenland, and (3) the atmospheric ^{14}C from tree-rings over the common interval from 1510 to 1954 AD.

Laluraj et al. (2011) The Holocene, 21, 351-356; Velasco Herrera, Soon (2012)

The Maunder Minimum of 1645-1715 is real and confirmed

A&A 581, A95 (2015)
DOI: 10.1051/0004-6361/201526652

Astronomy & Astrophysics

The Maunder minimum (1645–1715) was indeed a grand minimum: A reassessment of multiple datasets

Ilya G. Usoskin[1,2], Rainer Arlt[3], Eleanna Asvestari[1], Ed Hawkins[6], Maarit Käpylä[7], Gennady A. Kovaltsov[4], Natalie Krivova[5], Michael Lockwood[6], Kalevi Mursula[1], Jezebel O'Reilly[6], Matthew Owens[6], Chris J. Scott[6], Dmitry D. Sokoloff[8,9], Sami K. Solanki[5,10], Willie Soon[11], and José M. Vaquero[12]

[1] ReSoLVE Centre of Excellence, University of Oulu, 90014, Finland
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[3] Leibniz Institute for Astrophysics Potsdam, An der Sternwarte 16, 14482 Potsdam, Germany
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[6] Department of Meteorology, University of Reading, UK
[7] ReSoLVE Centre of Excellence, Department of Computer Science, PO BOX 15400, Aalto University, 00076 Aalto, Finland
[8] Moscow State University, 119991 Moscow, Russia
[9] IZMIRAN, Moscow, Russia
[10] School of Space Research, Kyung Hee University, Yongin, 446-701 Gyeonggi, Republic of Korea
[11] Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA
[12] Departamento de Física, Universidad de Extremadura, Mérida (Badajoz), 10003 Cáceres, Spain

Received 2 June 2015 / Accepted 12 July 2015

ABSTRACT

Aims. Although the time of the Maunder minimum (1645–1715) is widely known as a period of extremely low solar activity, it is still being debated whether solar activity during that period might have been moderate or even higher than the current solar cycle #24. We have revisited all existing evidence and datasets, both direct and indirect, to assess the level of solar activity during the Maunder minimum.
Methods. We discuss the East Asian naked-eye sunspot observations, the telescopic solar observations, the fraction of sunspot active days, the latitudinal extent of sunspot positions, auroral sightings at high latitudes, cosmogenic radionuclide data as well as solar eclipse observations for that period. We also consider peculiar features of the Sun (very strong hemispheric asymmetry of the sunspot location, unusual differential rotation and the lack of the K-corona) that imply a special mode of solar activity during the Maunder minimum.
Results. The level of solar activity during the Maunder minimum is reassessed on the basis of all available datasets.
Conclusions. We conclude that solar activity was indeed at an exceptionally low level during the Maunder minimum. Although the exact level is still unclear, it was definitely lower than during the Dalton minimum of around 1800 and significantly below that of the current solar cycle #24. Claims of a moderate-to-high level of solar activity during the Maunder minimum are rejected with a high confidence level.

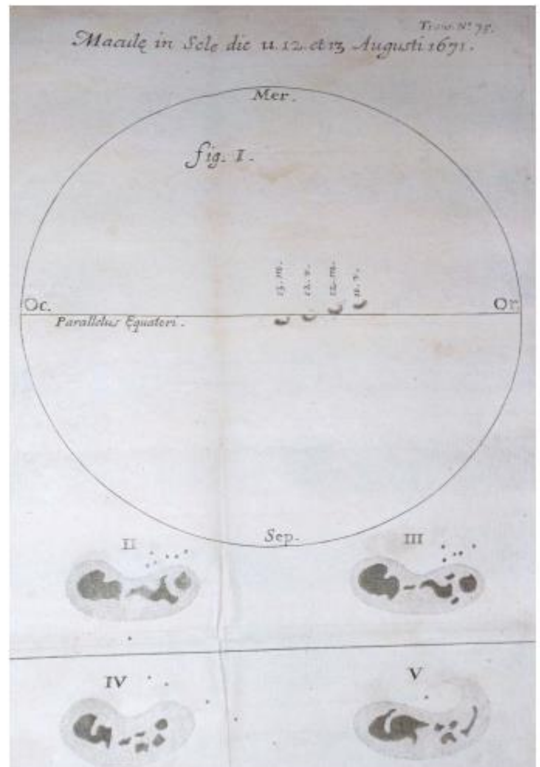

Fig. 2. Drawing of a sunspot group observed in August 1671, as published in number 75 of the Philosophical Transactions, corresponding to August 14, 1671.

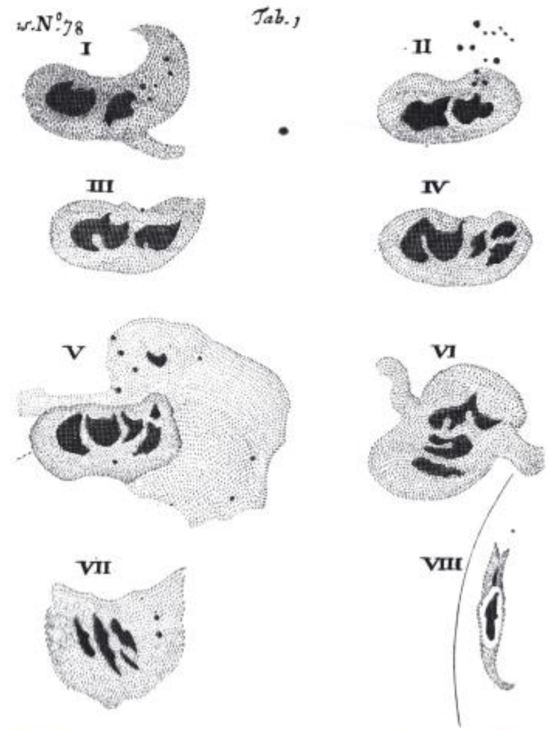

Fig. 3. Sunspot drawings by G. D. Cassini in 1671 (Oldenburg 1671c).

of the Sun. It was clear to them that these objects could not be

Usoskin et al. (2015) A&A, 581, A95

Stradivari (1644-1737) Violins, Slow+Even-Growth Tree-rings, and The Maunder Minimum

Instruments produced by the master violin makers of the late 17th and early 19th centuries are reputed to have superior tonal qualities ... We propose an alternative hypothesis based on the unique climate situation that existed between AD 1645-1715 known as the Maunder Minimum. ... We hypothesize that the longer winters and cooler summers produced wood that had slower, more even growth, desirable properties for producing higher-quality sounding boards. During Stradivari's latter decades, he used spruce wood that had grown mostly during the MM. These lowered temperatures, combined with the environmental setting ... of the forest stands from where the spruce wood was obtained, produced unique wood properties and superior sound quality. This combination of climate and environmental properties has not occurred since Stradivari's 'Golden Period' [1700-1720].

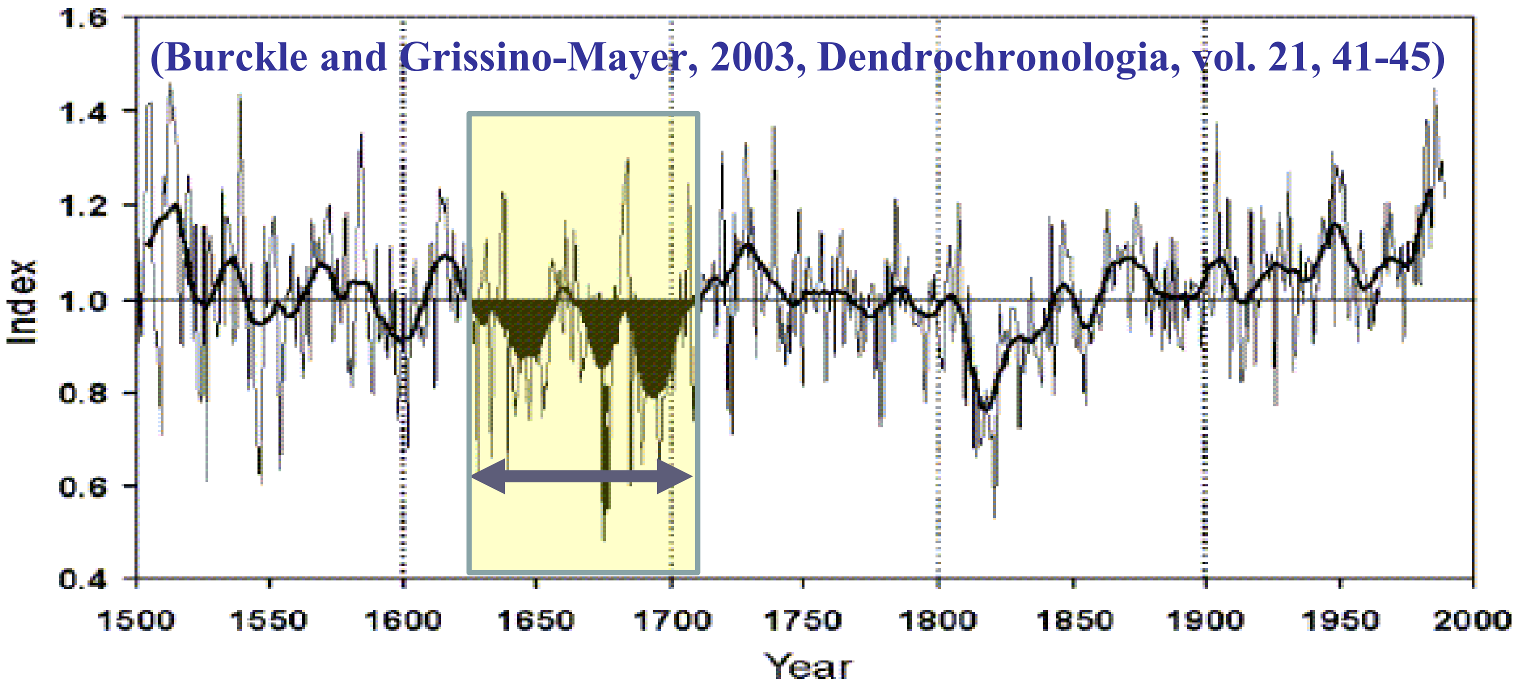

Figure 1. The standard tree-ring index chronology developed from 16 alpine chronologies in five central European countries (Grissino-Mayer et al. 2003 in press). The bold curve represents an 11yr moving average that accentuates the low-frequency trends. The Maunder Minimum is indicated in the shaded region between ca. AD 1620–1715.

Maunder-minimum-like activity seen on other Sun-like stars?

THE ASTROPHYSICAL JOURNAL, 438:269–287, 1995 January 1

CHROMOSPHERIC VARIATIONS IN MAIN-SEQUENCE STARS. II.[1]

S. L. BALIUNAS,[2,3,4] R. A. DONAHUE,[2] W. H. SOON,[2] J. H. HORNE,[5] J. FRAZER,[6] L. WOODARD-EKLUND,[7,8]
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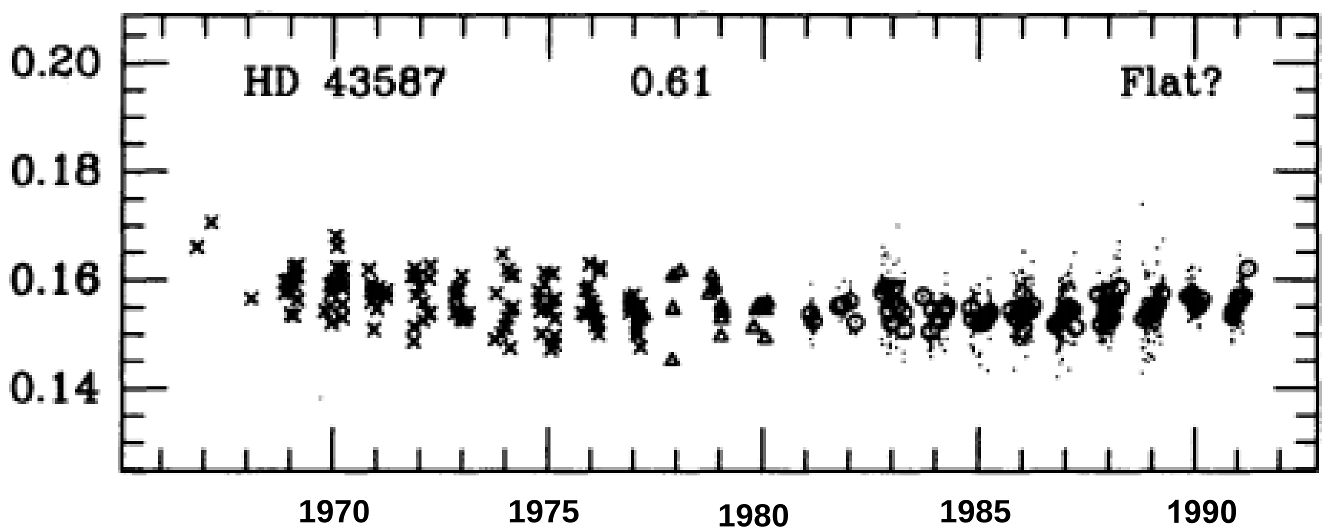
A. H. VAUGHAN,[8,20] AND J. H. WHITNEY[13,21]
Received 1994 May 5; accepted 1994 July 5



Baliunas et al. (1995) ApJ, 438, 269-287

Maunder-minimum-like activity seen on other Sun-like stars?

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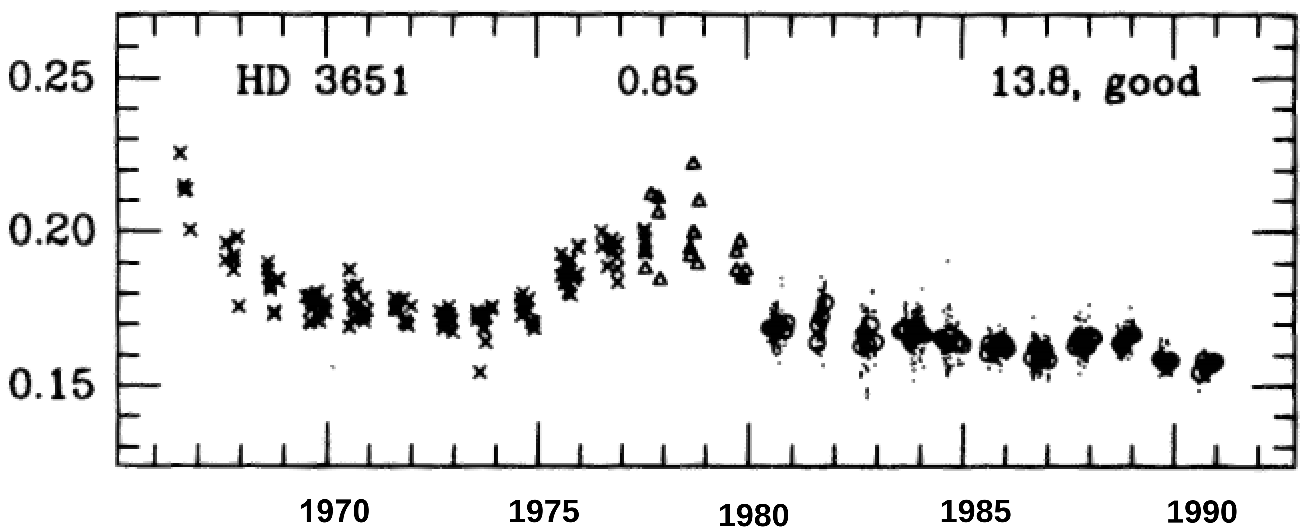
A. H. VAUGHAN,[8,20] AND J. H. WHITNEY[13,21]
Received 1994 May 5; accepted 1994 July 5



Baliunas et al. (1995) ApJ, 438, 269-287

Maunder-minimum-like activity seen on other Sun-like stars?

A&A 640, A46 (2020)
https://doi.org/10.1051/0004-6361/201937219

Astronomy & Astrophysics

Is the primary CoRoT target HD 43587 under a Maunder minimum phase?

R. R. Ferreira[1], R. Barbosa[2], M. Castro[1], G. Guerrero[2], L. de Almeida[1], P. Boumier[3], and J.-D. do Nascimento Jr.[1,4]

Table 1. Fundamental parameters of HD 43587 according to some authors.

	Morel et al. (2013)	Boumier et al. (2014)	Castro et al. (2020)	
			TGEC	CESTAM
Mass [$M_\odot$]	1.049 ± 0.016	1.04 ± 0.01	1.020 ± 0.004	1.04 ± 0.01
Radius [$R_\odot$]	1.15 ± 0.01	1.19	1.19 ± 0.01	1.18
[Fe/H] [dex]	-0.02 ± 0.02	0.01	-0.026 ± 0.003	0.025
Age [Gyr]	4.97 ± 0.52	5.60 ± 0.16	6.76 ± 0.12	5.7 ± 0.1
T_{eff} [K]	5947 ± 17	5951	5952 ± 27	5979

Ferreira et al. (2020) A&A, 640, A46

Maunder-minimum-like activity seen on other Sun-like stars?

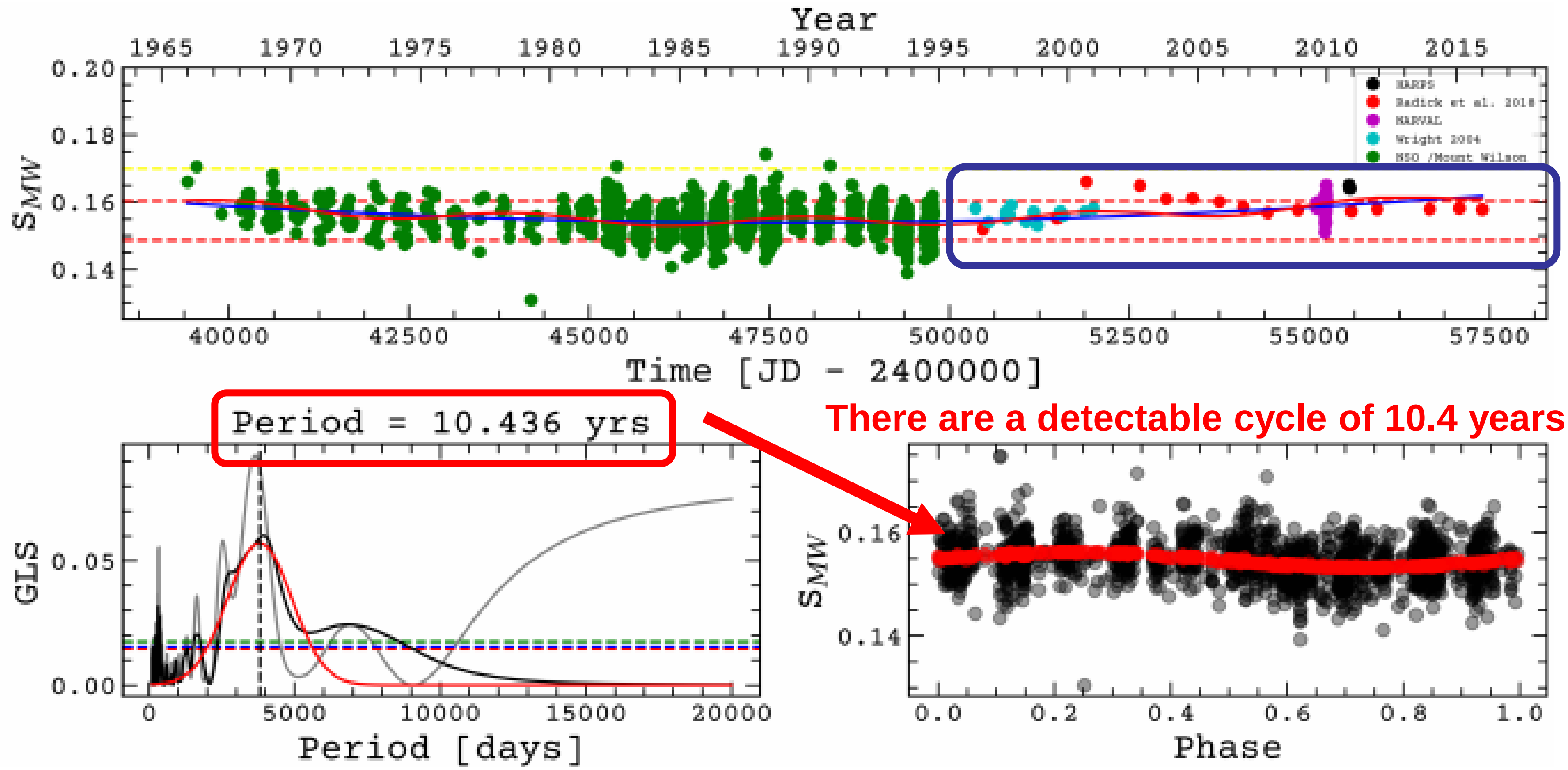


Fig. 4. Entire spectroscopic chromospheric activity measurements with the S_{index} calibrated to the Mt. Wilson Scale for HD 43587 between 1966 and 2016. *Upper panel*: all measurements from Duncan et al. (1991), Wright (2004), Hall (2008), and Radick et al. (2018), combined with the computed S_{MW} from the NARVAl and HARPS spectra archives. The red solid line is the sinusoidal curve fitting for 10.436 yr, the blue solid line is the long-term trend found to be larger than 50 yr. The yellow dashed line shows the mean S_{MW} for the Sun. *Bottom left panel*: GLS periodogram of the whole S_{MW} time series (solid gray line), and removing the long trend of over 50 years (solid black line). The Gaussian fit (solid red line) of this second periodogram indicates an activity cycle of 10.436 years (vertical black dashed line). *Bottom-right panel*: phase of the S_{MW} (black circles) and the folded fit with the found period (red circles).

Ferreira et al. (2020) A&A, 640, A46

Maunder-minimum-like activity seen on other Sun-like stars?

The Astrophysical Journal Letters, 936:L23 (6pp), 2022 September 10 https://doi.org/10.3847/2041-8213/ac8b13

CrossMark

HD 166620: Portrait of a Star Entering a Grand Magnetic Minimum

Jacob K. Luhn[1], Jason T. Wright[2,3,4], Gregory W. Henry[5], Steven H. Saar[6], and Anna C. Baum[7]
[1] Department of Physics and Astronomy, 4129 Frederick Reines Hall, University of California, Irvine, Irvine, CA 92697, USA; jluhn@uci.edu
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[6] Center for Astrophysics |Harvard and Smithsonian, MS 58, 60 Garden Street, Cambridge, MA 02138, USA
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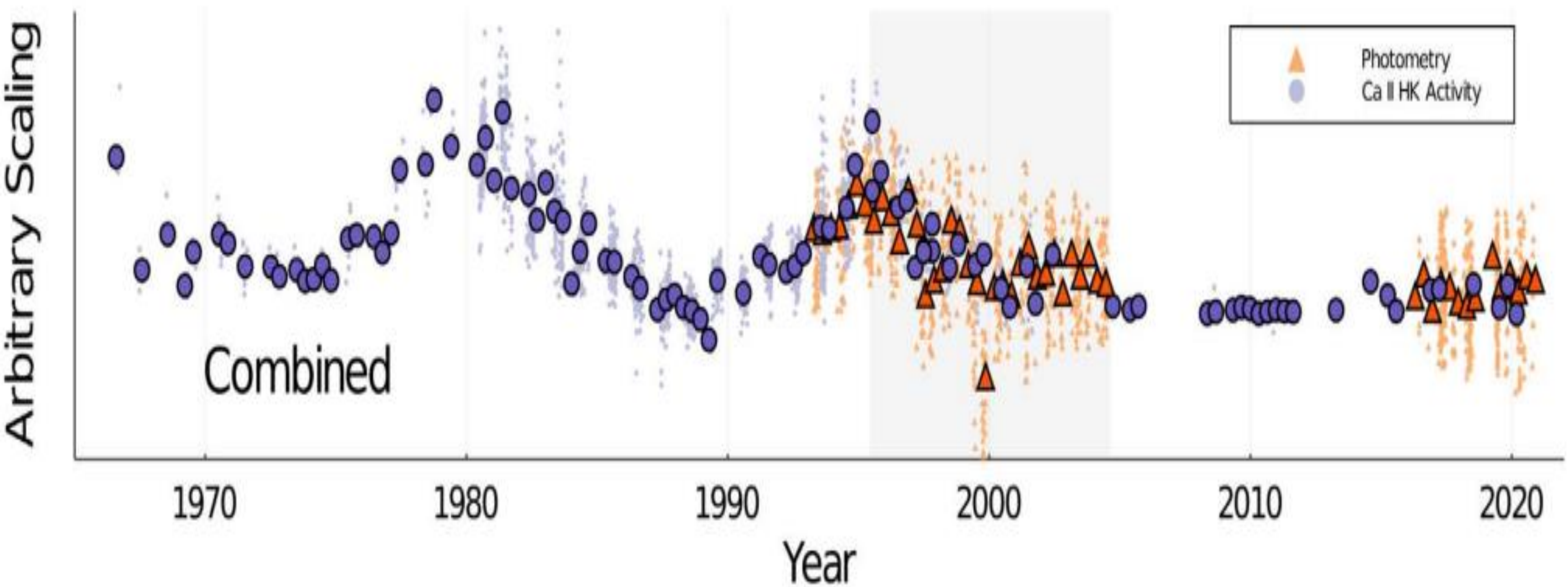
Received 2022 June 29; revised 2022 August 12; accepted 2022 August 17; published 2022 September 9



Luhn et al. (2022) Astrophysical Journal Letters, 936, L23

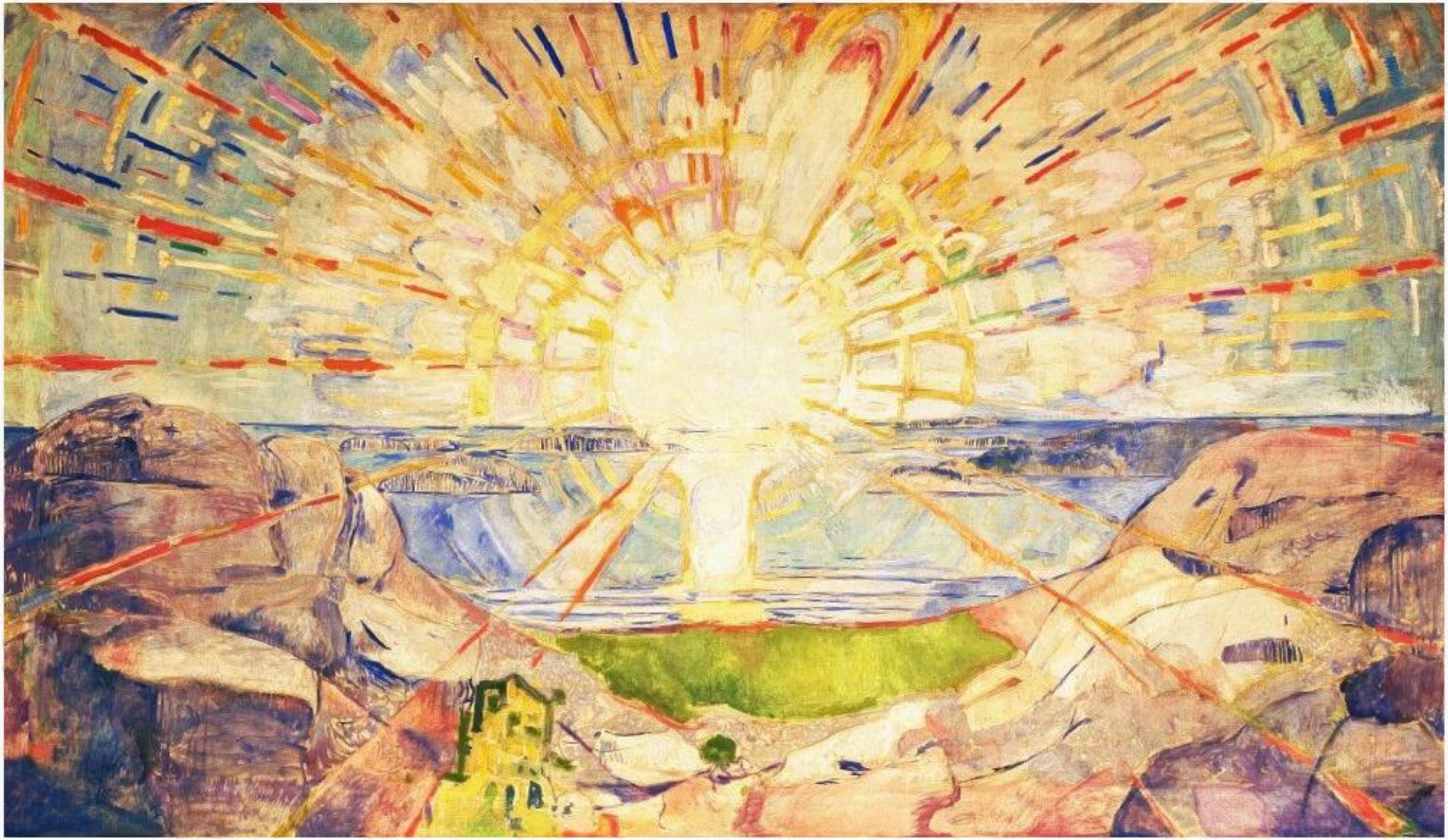
Eclipsed Sun Rises Behind the Statue of Liberty on June 10, 2021 (Anthony Quintano)

An exciting possible re-discovery of the first sunspot drawing in America?

Observational notes on sunspots by Chinese astronomer ca. 1425

Painting of the Sun and sunspots by Emperor HongXi dated 1425 (Zhu Gao-Chi; 1378-1425)

Ming Dynasty 4th Emperor reigning from September 7, 1424 till May 29, 1425



The Sun, 1909 by Edvard Munch

Source: https://www.edvardmunch.org/the-sun.jsp

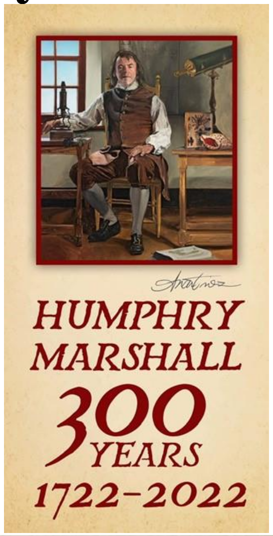
The last Ming Dynasty Emperor: Chongzhen (1611-1644)
Reign: Oct. 2, 1627 — April 25, 1644

Chongzhen's Chair

America has our own Sun's chair too

Spring 2019 vacation in Philadelphia: April 15, 2019 Independence Hall

Humphry Marshall (1722-1801)



J.F. Pirro (2022) https://thehuntmagazine.com/life-style/humphry-marshall-300-birthday/

Humphry Marshall’s letters to Ben Franklin

I have sent thee my observations for twelve month and a few Days
that I have made in the Sun’s Disk respecting the Spots that appear thereon,
having Drew a circle With a pencil to represent the Suns Circumferrence and
then with my Pencil Dilineated the Spots both in Magnitude and Position as near
the truth as I Could as they Pas’d, in appearance from East to West.
I have not time to Give thee my thoughts respecting them at present.
(Humphry Marshall to Ben Franklin, November 27, 1771)

Now as to my observations on the Spots on the Sun,
I Continued them Some parts of the Winter With the utmost Accurecy
But Cannot Say that I have Ever observed a Spot that went of on the West Side
to appear again on the Eastern Limb in 12 or 13 days or at Least in the Same position or
form. I have also Endeavoured to observe Each Spot that had a border or Circle round
them Which Every Circular Spot almost Seems to have, yet I Cannot Quite agree
With Dr. Wilson in his hypothesis.
(Humphry Marshall to Ben Franklin, May 14, 1774)

Ben Franklin, 1767 (by David Martin, 1737-1791)

Humphry Marshall (1722-1801)

https://www.adrianmartinez.com/humphry-marshall-exhibit/

"The telescope and microscope in the portrait are of the specific type Benjamin Franklin had purchased for Marshall while in London."
(Adrian Martinez, May 12, 2021)

XXVI. *Extract of a Letter from Mr.* Humphry Marſhall, *of* Weſt Bradford, *in* Cheſter County, Pennſylvania, *to Dr.* Franklin, *ſent with Sketches of the Solar Spots, dated* May 3, 1773.

Redde, Feb. 3, 1774.

HAVING for ſome time declined making any more obſervations, on the dark ſpots that appear on the Sun's diſk, I now ſend a copy of the figures, I drew of them; which I deſire may be preſented to the Royal Society. Perhaps ſome one or more of the members may be pleaſed with them, in which caſe, I ſhall not think my labour loſt. They were viewed with a reflecting teleſcope of inches, and their appearances, I think, pretty truly delineated, both as to magnitude and ſituation. Upon the whole, I am of opinion, that the ſpots are near the Sun's ſurface, if not cloſely adhering thereto, for theſe reaſons; 1. That their velocities are apparently greateſt near the center, and gradually ſlower towards each limb. 2. That the ſhape of the ſpots varies, according to their poſition on the ſeveral parts of the Sun's diſk; thoſe that appear broad, and nearly round, when on the middle, ſeeming, at their firſt appearance on the eaſtern limb, but as lines; and, as they advance towards

wards the center, grow oval, then round, and, in their progreſs to the weſtern limb, appear again as ovals and lines. My other remarks were, that the ſpots were twelve days and an half, and about two or three hours, in paſſing; that, though ſome continued viſible from one limb to the other, a few would diſappear, after having been viſible ſeveral days; and others divided into parts; that ſcarce any ſpots ever appeared beyond what may be called the polar circles of the ſun; and that the ſame ſpot never appeared, a ſecond time, on the eaſtern limb, at leaſt not in the ſame form and poſition.

The figures of the ſolar ſpots, mentioned in this letter, are ſketches with black lead pencil, upon a very ſmall ſcale. They are accompanied with ſhort notes of the ſtate of the weather at the time of each obſervation, and ſometimes the height of the thermometer is mentioned. Among theſe meteorological remarks, the following ſeems the moſt extraordinary.

February 21ſt, 1773, Thermometer at 3 degrees below 0 at Sun-riſe. This morning, had there been a ſnow on the ground, I believe it would have been as cold as it was January 2d, 1767, when the thermometer was 22 degrees below 0, there being a large ſnow on the ground at that time, and none now.

Humphry Marshall (1722-1801)

From: Adrian Martinez <********>
Date: Wed, May 12, 2021 at 10:31 AM
Subject: Re: a question on drawings and sketching of sunspots by Humphry Marshall
To: Soon, Willie <wsoon@cfa.harvard.edu>

Willie,

Thank you for your enquiry regarding Humphry Marshall and sending us this interesting information. **My recollection is that Humphry Marshall's sunspot drawings do exist and I've seen a reproduction perhaps five or six years ago. I do remember being disappointed as they were little more than a circle with three or four small random dots.** I do appreciate their potential significance for you and will search our records.

I will get back to you if /when we can find anything of HM's sunspot illustrations.

Regards,
Adrian

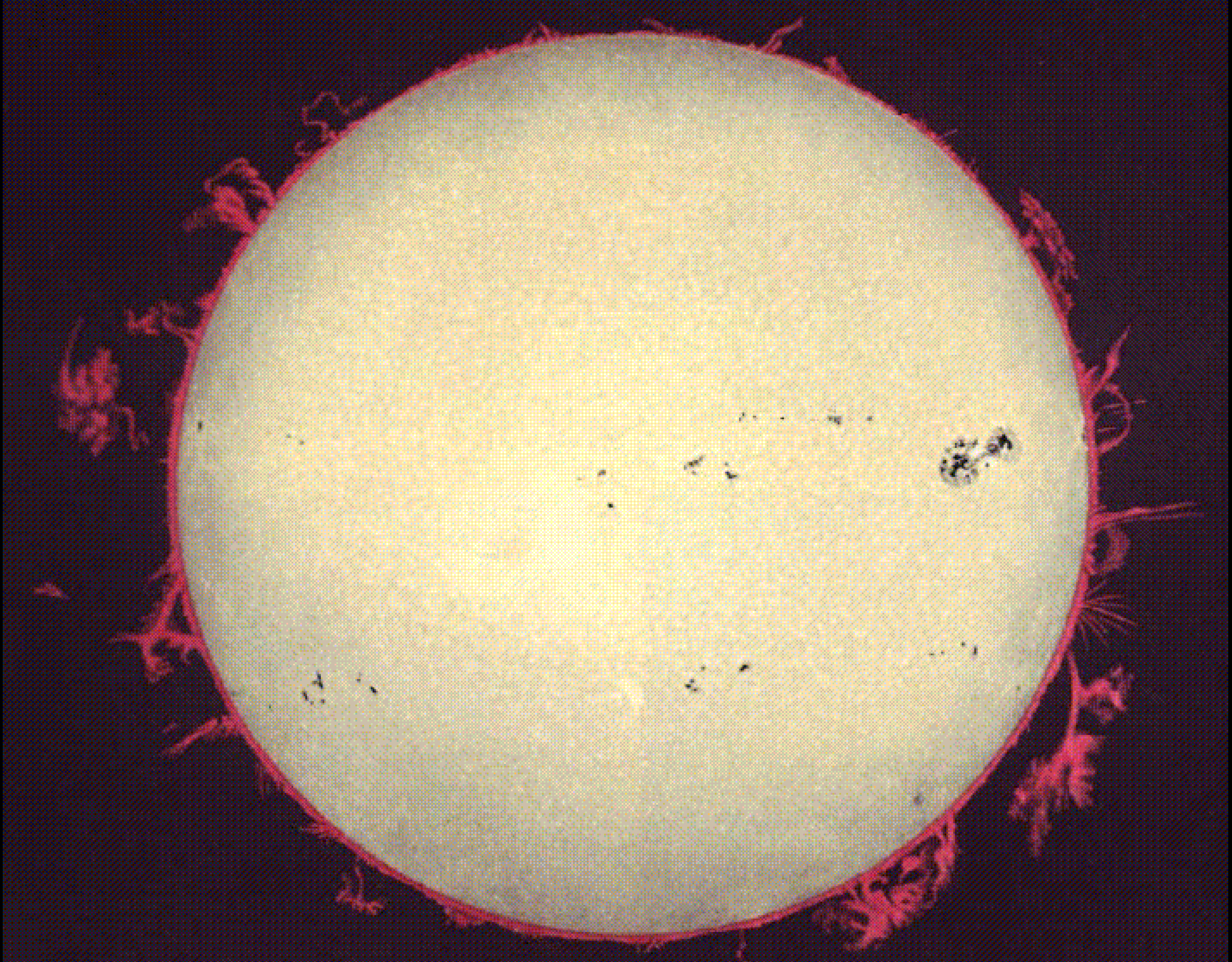
Humphry Marshall (1722-1801)

Hope you find Marshall's drawings. Brattle in Boston in 1694, Robie in Boston in 1722, and **Winthrop in Cambridge in 1739** made all together about 9-10 total sunspot observations, but no drawings that I can recall.

(Doug Hoyt, May 12, 2021)

Doug Hoyt is incorrect

Professor John Winthrop's
1739 observations of sunspots
in Cambridge, MA
has now been <u>**re-discovered!**</u>



Harvard College Observatory, 1873, E. Leopold Trouvelot (art works on prominences)

December 21, 2022 Update: John Winthrop (1714-1779)'s 1739 sunspot drawing has now been found by Hayakawa et al. (2022)

Figure 6. Winthrop's sunspot drawings for 1739 April 20 and 22 in the Julian calendar, or 1739 May 1 and 3 in the Gregorian calendar, derived from MS HUM 9 (BOX 3, f. 1), courtesy of the Harvard University Archives. Winthrop's records have otherwise been derived from his textual reports.

Hayakawa et al. (2022) Astrophysical Journal, 941, #151 (December 20, 2022)

December 21, 2022 Update: John Winthrop (1714-1779)'s 1739 sunspot drawing has now been found by Hayakawa et al. (2022)

John Winthrop ca. 1773 (John Singleton Copley)

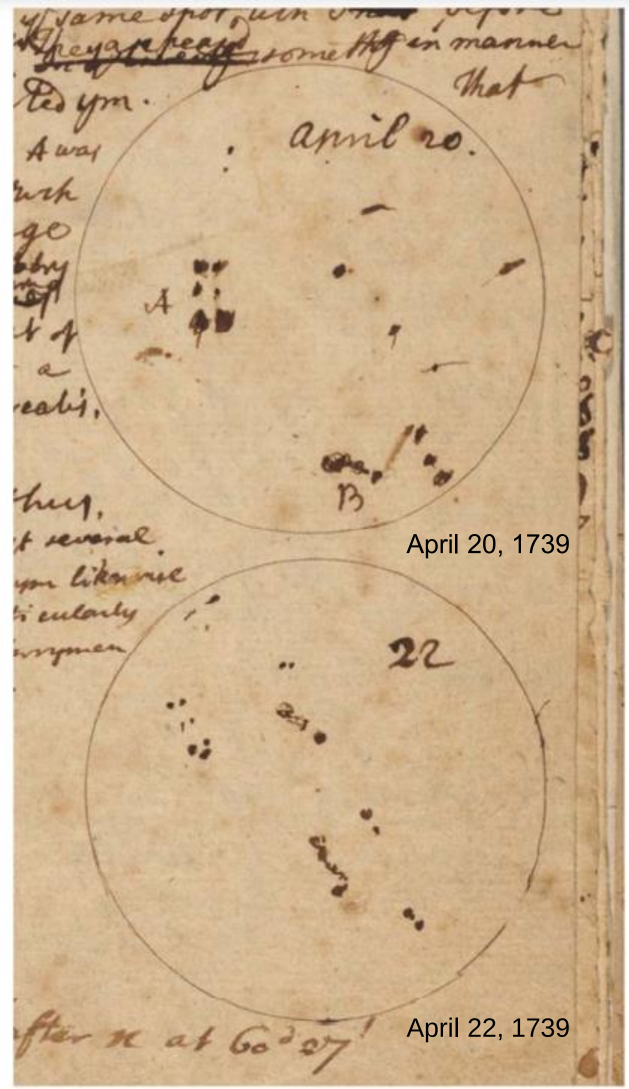


Figure 6. Winthrop's sunspot drawings for 1739 April 20 and 22 in the Julian calendar, or 1739 May 1 and 3 in the Gregorian calendar, derived from MS HUM 9 (BOX 3, f. 1), courtesy of the Harvard University Archives. Winthrop's records have otherwise been derived from his textual reports.

Kilgour (1938) Isis, 29, 355

Hayakawa et al. (2022) Astrophysical Journal, 941, #151 (December 20, 2022)

December 21, 2022 Update: John Winthrop (1714-1779)'s 1739 sunspot drawing has now been found by Hayakawa et al. (2022)

1739 April 19th at Boston. Walking on the Common a little before sunset, the air being so hazy that I was able to look on the sun, I plainly saw with my naked eye a very large and remarkable spot. Its shape was oblong and the length of it was perpendicular to the horizon. I observed it several minutes till the sun was actually set. It was likewise seen by several persons in the company of Messrs. Skinner and Read. The next day, Friday [verified], coming back to Cambridge, I looked at the sun with an 8 foot telescope from 6 A.M. till sunset and discovered not only the same spot which I saw before but several others in his disk. They appeared something in this manner in the telescope which inverted them. [Drawing of April 20, see. facsimile]. That cluster of spots marked A was what I saw at Boston and which appeared then like one large spot. That at B appeared very much like the thick column of smoke which comes out of a furnace. At night a considerable aurora borealis.
Saturday April 21. Cloudy.
Sunday April 22. They appeared thus. [Drawing of April 22, see facsimile]. 15' after n at 60°27'.
I am since informed that several persons in the country saw them likewise with their naked eye, particularly some at Medford and the ferrymen at the Charlestown ferry.

Figure 6. Winthrop's sunspot drawings for 1739 April 20 and 22 in the Julian calendar, or 1739 May 1 and 3 in the Gregorian calendar, derived from MS HUM 9 (BOX 3, f. 1), courtesy of the Harvard University Archives. Winthrop's records have otherwise been derived from his textual reports.

Kilgour (1938) Isis, 29, 355

Hayakawa et al. (2022) Astrophysical Journal, 941, #151 (December 20, 2022)

(2) The 17th century: Historical + Socio-Political Aspects

(under an overall and particular regional meteorological and climatic constraints)

Francois Emile Matthes (1874-1948): New Ice and Glaciers and the origin of the term "little ice age"

1940

"A clever journalist" coined the term "Little Ice Age" not Francois Matthes himself as popularly quoted

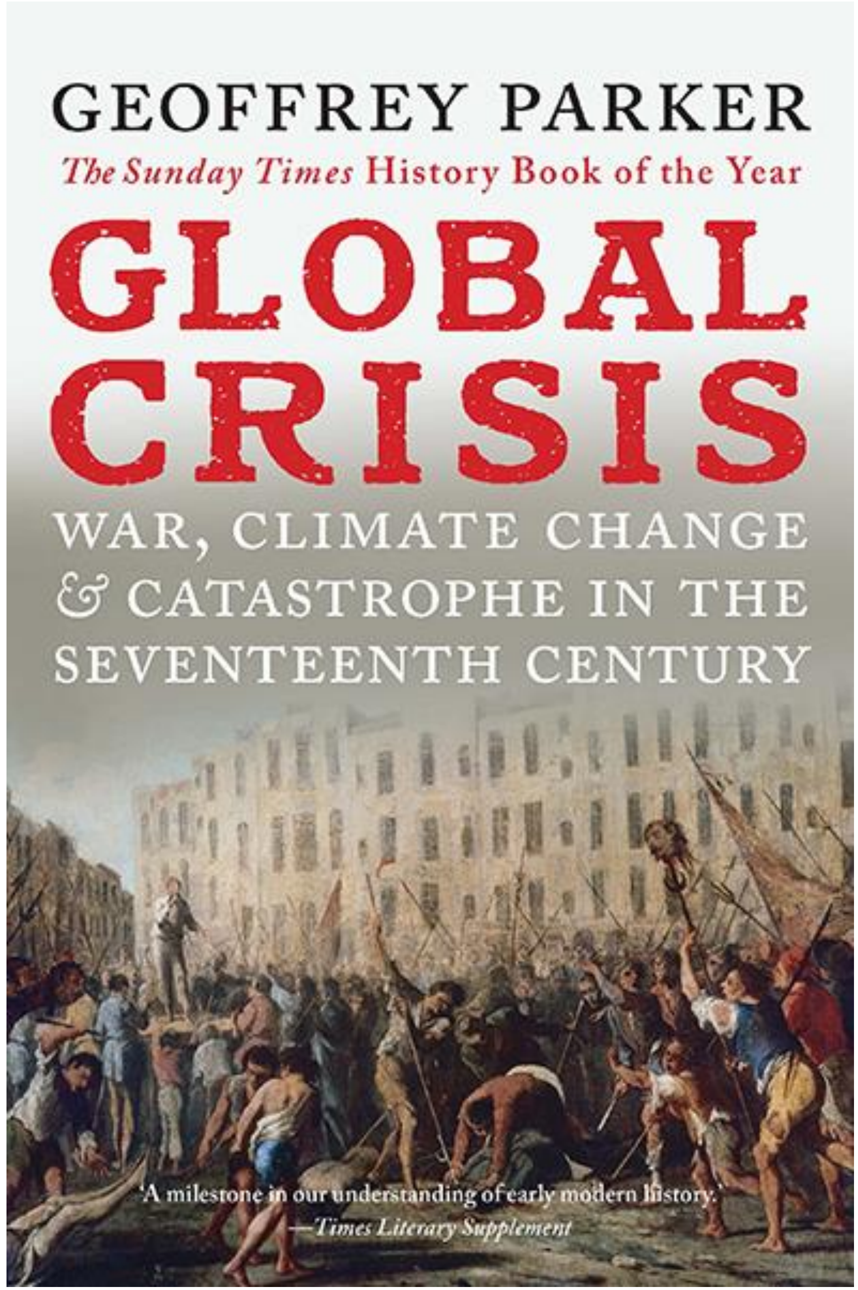
In the third field of glaciologic research--that dealing with the variations in size of existing glaciers in response to climatic fluctuations--the principal advances in 1939 were made, so far as can be ascertained from the information at hand, in the United States and by members of this Committee. Data were obtained that set on a firmer basis than before the tentative conclusions announced in the Committee's report of April 1939 [8], to the effect that:

(1) The present cirque-glaciers on the Sierra Nevada of California represent a new generation of ice-bodies of late Post-Pleistocene origin, at most 4,000 years old, and not dwindling remnants of the great ice-streams of the Pleistocene epoch. They occupy the cirques that were left empty by the complete extinction of their Pleistocene predecessors during the warm and dry middle portion of the Post-Pleistocene interval.

(2) The majority, perhaps all, of the cirque-glaciers and tiny glacierets that exist today on the other mountain ranges in the western United States by inference belong to the same new generation.

(3) The larger glaciers in northern Washington, in Canada, and in Alaska presumably did not melt away entirely during the warm middle third of the Post-Pleistocene interval but were greatly reduced in size. They have reexpanded since then to the limits from which they are even now receding, and as their reexpansion has been of considerable magnitude, to judge from certain specific cases, there appears to be warrant for the assertion that the present age is witnessing a mild recrudescence of glacial conditions--that it is, as a clever journalist has suggested, a separate "little ice-age."

Geoffrey Parker (2013-2014): Global Crisis of the 17th Century



https://www.yalebooks.co.uk/page/detail/?k=9780300208634

Geoffrey Parker: Global Crisis of the 17th Century

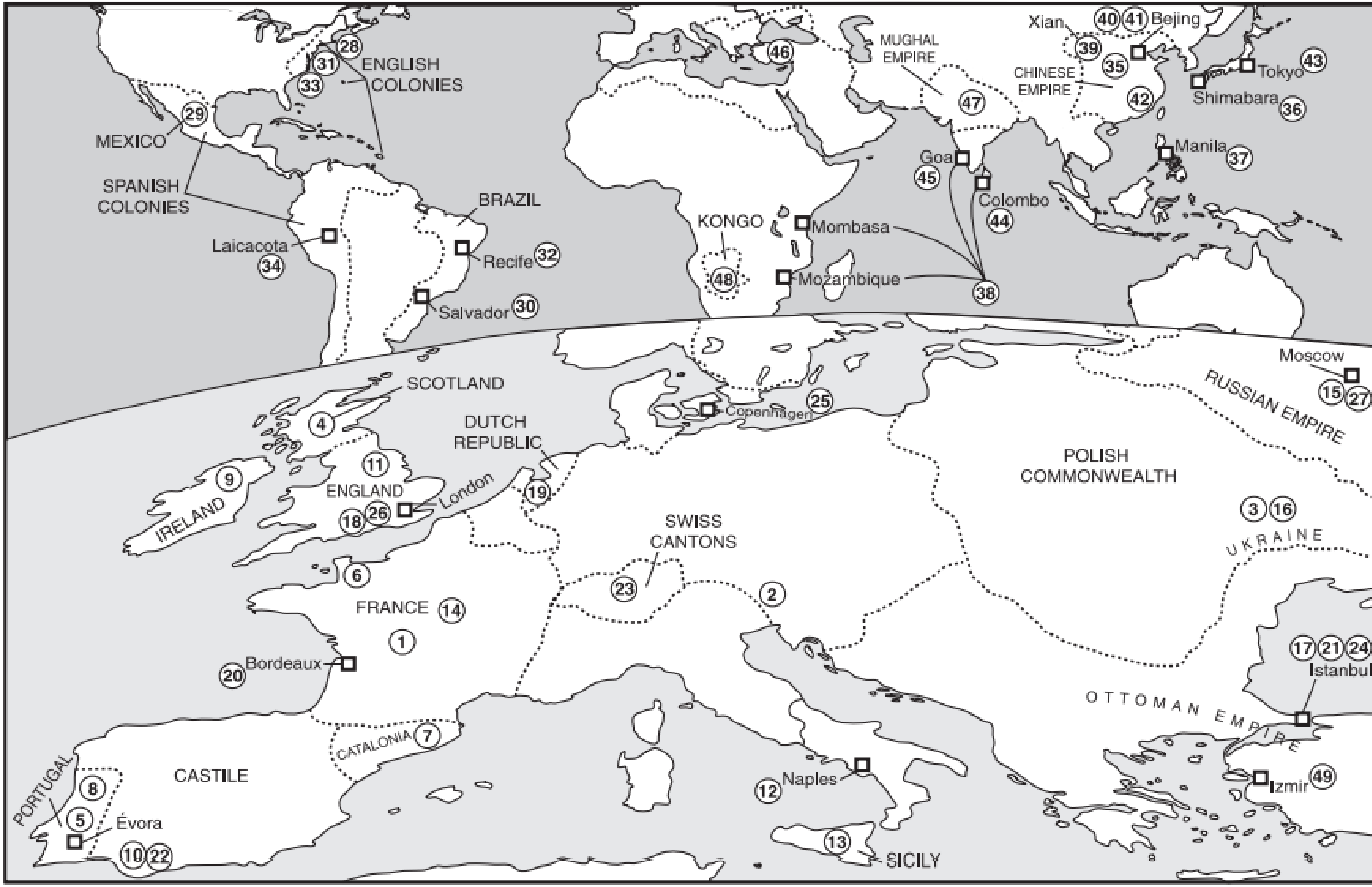


FIGURE 1: The global crisis. A list of the major revolts and revolutions around the world between 1635 and 1666 (see facing page) demonstrates that, although Western Europe and East Asia formed the heartland of the "General Crisis," the Mughal, Russian, and Ottoman empires, like the European colonies in America, also experienced episodes of severe political disruption.

Parker (2008) American Historical Review, 113, 1054-1079

On the Thermal and Hydroclimatic Conditions during Little Ice Age: Overall Cold and Wet?

Pratap and Markonis
Progress in Earth and Planetary Science (2022) 9:30
https://doi.org/10.1186/s40645-022-00489-0

Progress in Earth and Planetary Science

REVIEW Open Access

Check for updates

The response of the hydrological cycle to temperature changes in recent and distant climatic history

Shailendra Pratap* and Yannis Markonis

Overall Cold and Wet

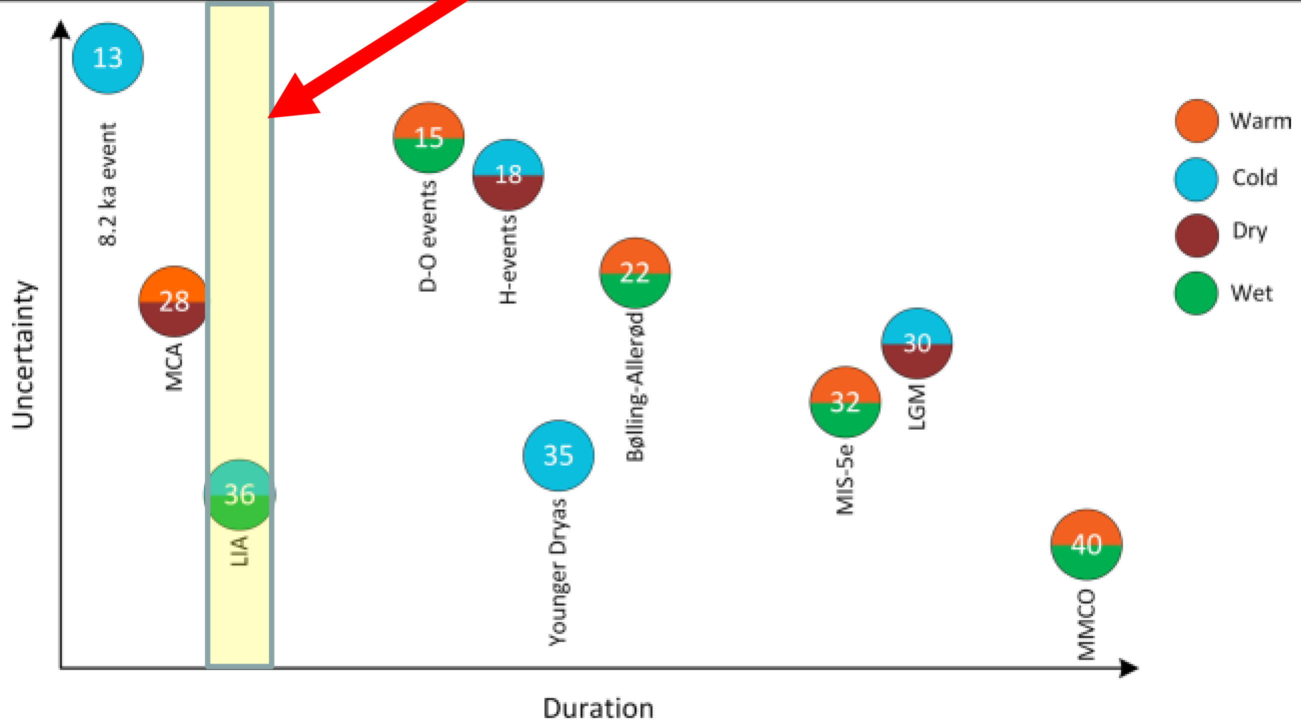


Fig. 10 Schematic representation of hydroclimatic conditions in terms of the period length and the uncertainty involved. Uncertainty is qualitatively derived from the number of studies

Pratap and Markonis (2022) Progress in Earth and Planetary Science, 9, #30

Little Ice Age in Europe during the Maunder Minimum is largely a winter phenomenon

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The variable European Little Ice Age

Heinz Wanner [a, *], Christian Pfister [a], Raphael Neukom [b, c]

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[b] Department of Geography, University of Zurich, Switzerland
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Check for updates

A R T I C L E   I N F O

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Medieval climate anomaly
Forcing factors
North Atlantic oscillation
Extreme events

A B S T R A C T

The Little Ice Age (LIA), which lasted from about 1250 to 1860 AD, was likely the coldest period of the last 8000 years. Using new documentary data and analyses of alpine glacier fluctuations, the complex transition from the Medieval Climate Anomaly to the LIA and the ensuing high variability of seasonal temperatures, are described and interpreted for Europe. The beginning of the LIA was likely different in both hemispheres. The low temperature average of the LIA is primarily due to the high number of cold winters. Conversely many summers were warm and dry.

Important triggers of the lower temperatures were, primarily, the numerous clusters of volcanic eruptions and the weak solar irradiance during the four prominent Grand Solar Minima: Wolf, Spörer, Maunder, and Dalton. The drop in temperature triggered the sea-ice–albedo feedback and led to a weakening of the Atlantic overturning circulation, possibly associated with a trend towards negative North Atlantic Oscillation indices.

The statistics of extreme events show a mixed picture. Correlations with forcing factors are weak, and can only be found in connection with the "Years without a Summer", which very often occurred after large volcanic eruptions.

Wanner, Pfister, Neukom (2022) Quaternary Science Reviews, 287, 107531

Little Ice Age in Europe during the Maunder Minimum is <u>largely a winter phenomenon</u>

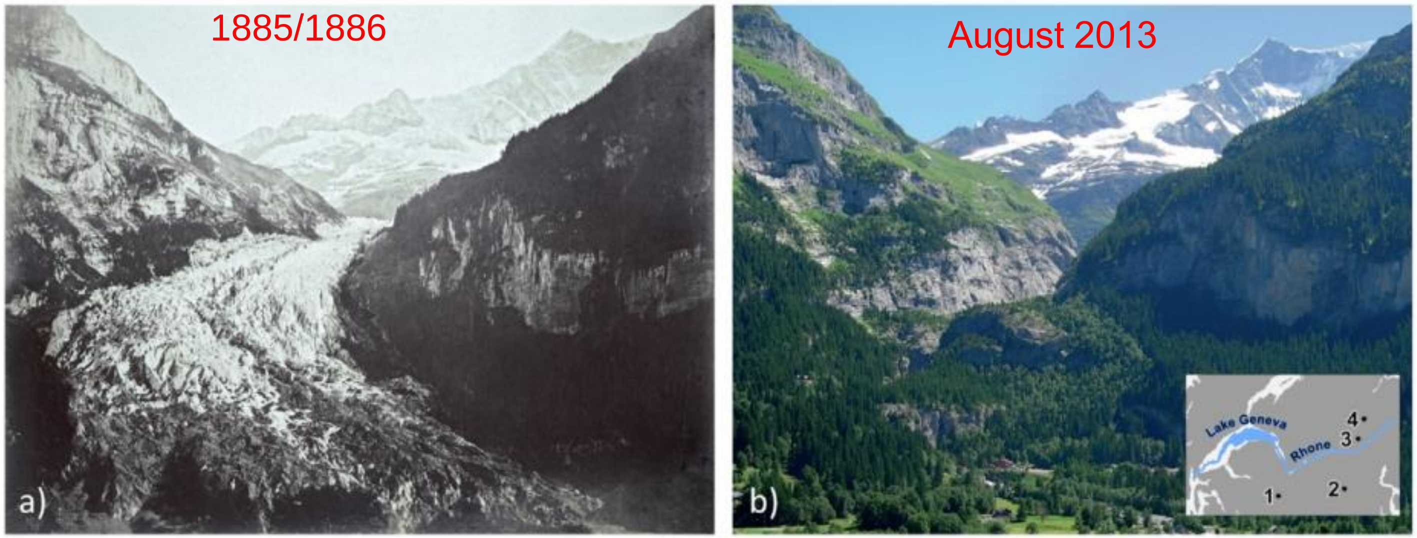
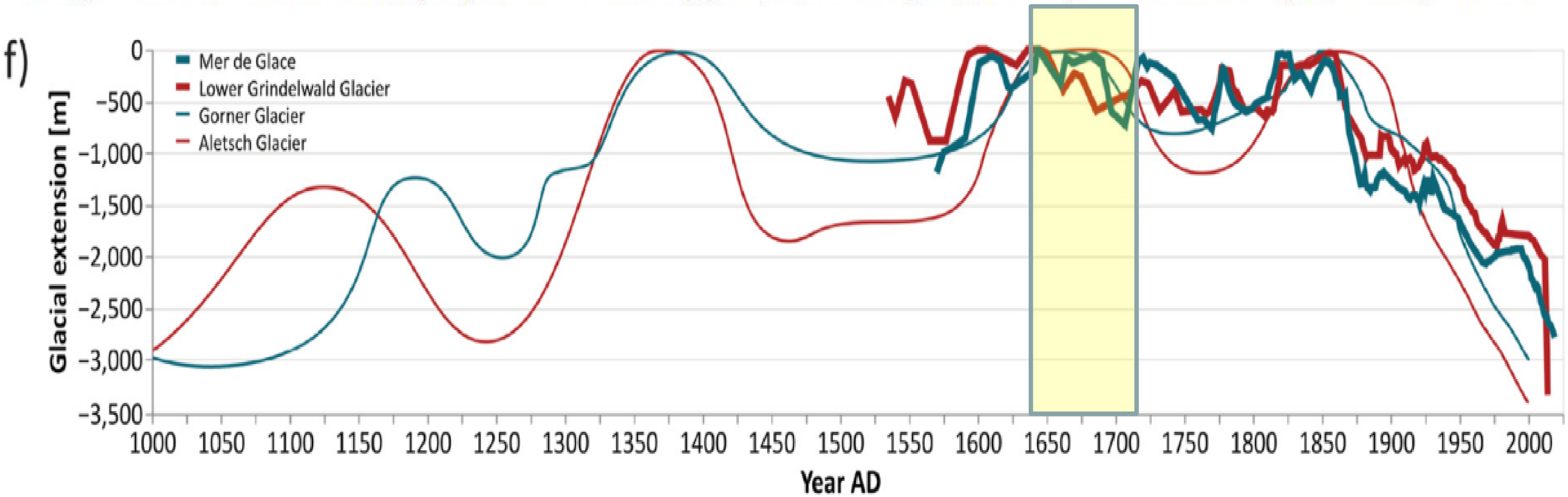
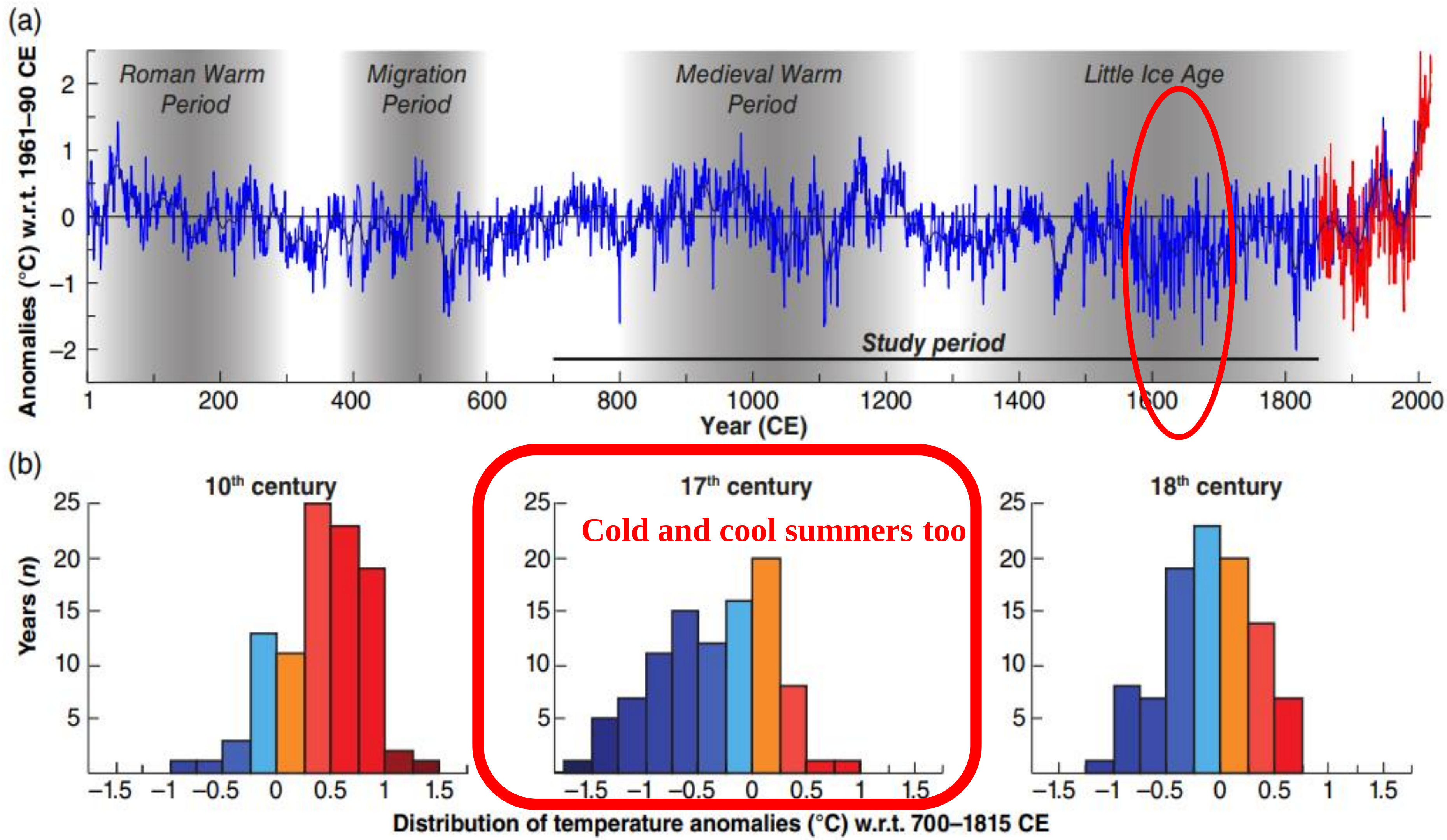


Fig. 4. a) The advancing Lower Grindelwald Glacier, photographed by the brothers Louis Auguste and Auguste Rosalie Bisson during its greatest extent around 1855/56 AD (Zumbühl, 2016). b) The melting Lower Grindelwald Glacier, photographed by S. Nussbaumer on 2 August 2013 (Nussbaumer et al., 2016). The small map in the lower right corner of the Figure shows the locations of the four Alpine glaciers described in this paper: 1) Mer de Glace. 2) Gorner Glacier. 3) Great Aletsch Glacier. 4) Lower Grindelwald Glacier.



Wanner, Pfister, Neukom (2022) Quaternary Science Reviews, 287, 107531

Distribution of European Summer Temperatures in the 17th Century



Ljungqvist et al. (2021) WIREs Climate Change, 12, e691

Louis Morin (1635-1715): Cold but Sunny (less cloudy) in Paris During the Maunder Minimum

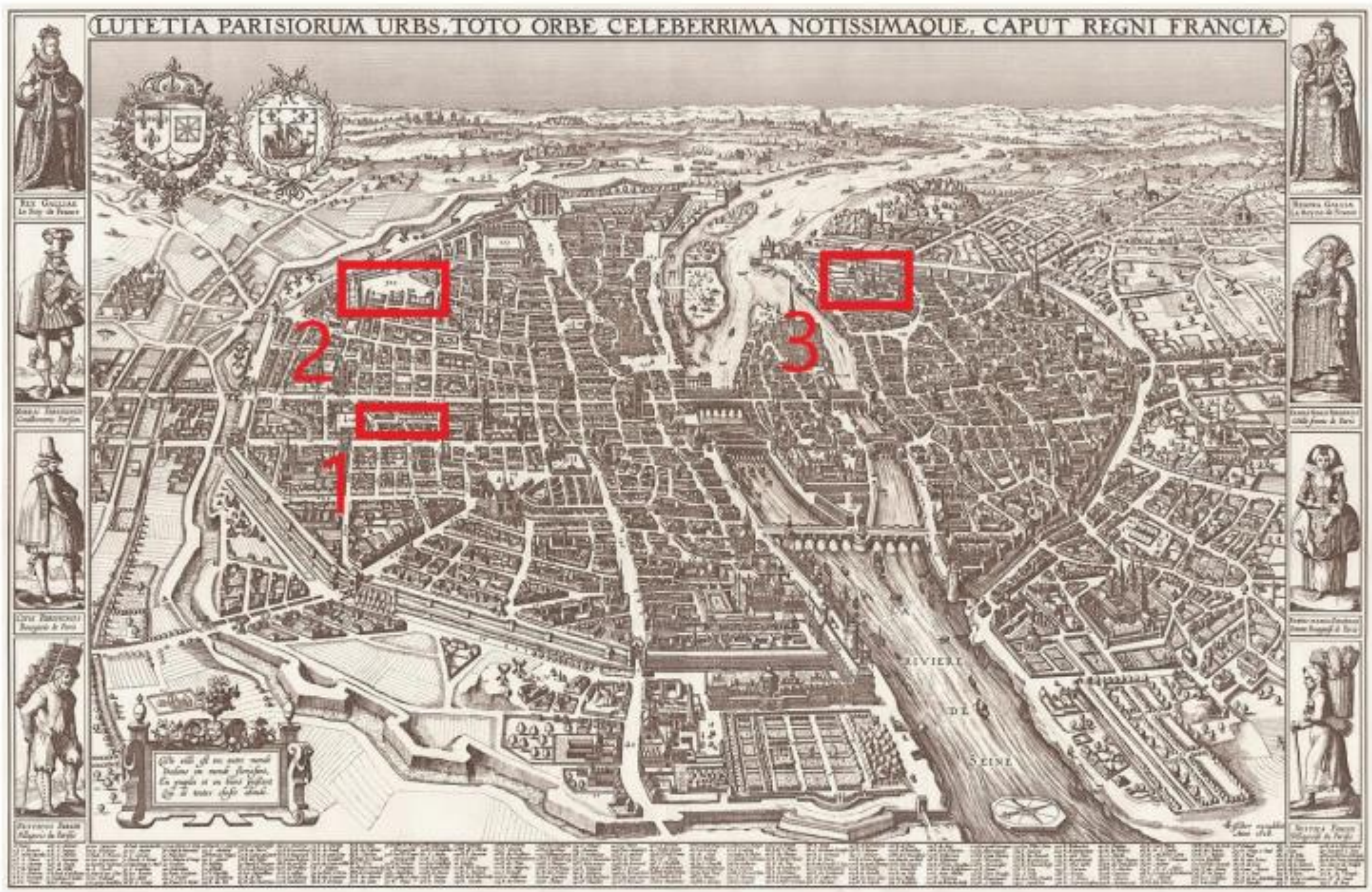


Figure 2. A map of Paris (Visscher, 1618), the marked locations show where Morin lived. Until October 1685, he lived in the Quinquempoix Street (1); then until June 1688 in the Hotel Rohan-Soubisse (2), where the National Archives are located today; and until his death in 1715 he lived in the abbey Saint-Victor (3), which is located at the city border next to the Seine.

Pliemon et al (2022) Climate of the Past, in press

Louis Morin (1635-1715): Cold but Sunny (less cloudy) in Paris During the Maunder Minimum

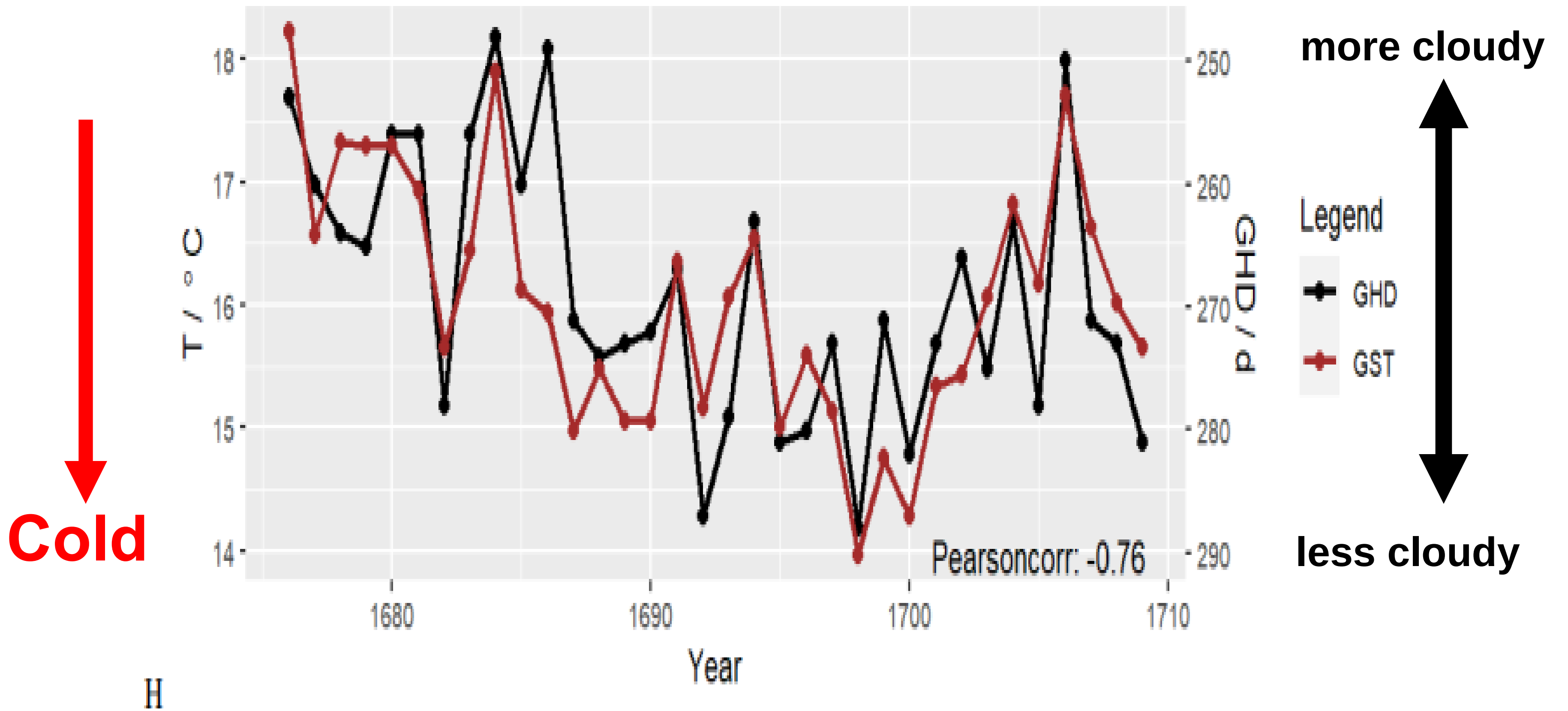
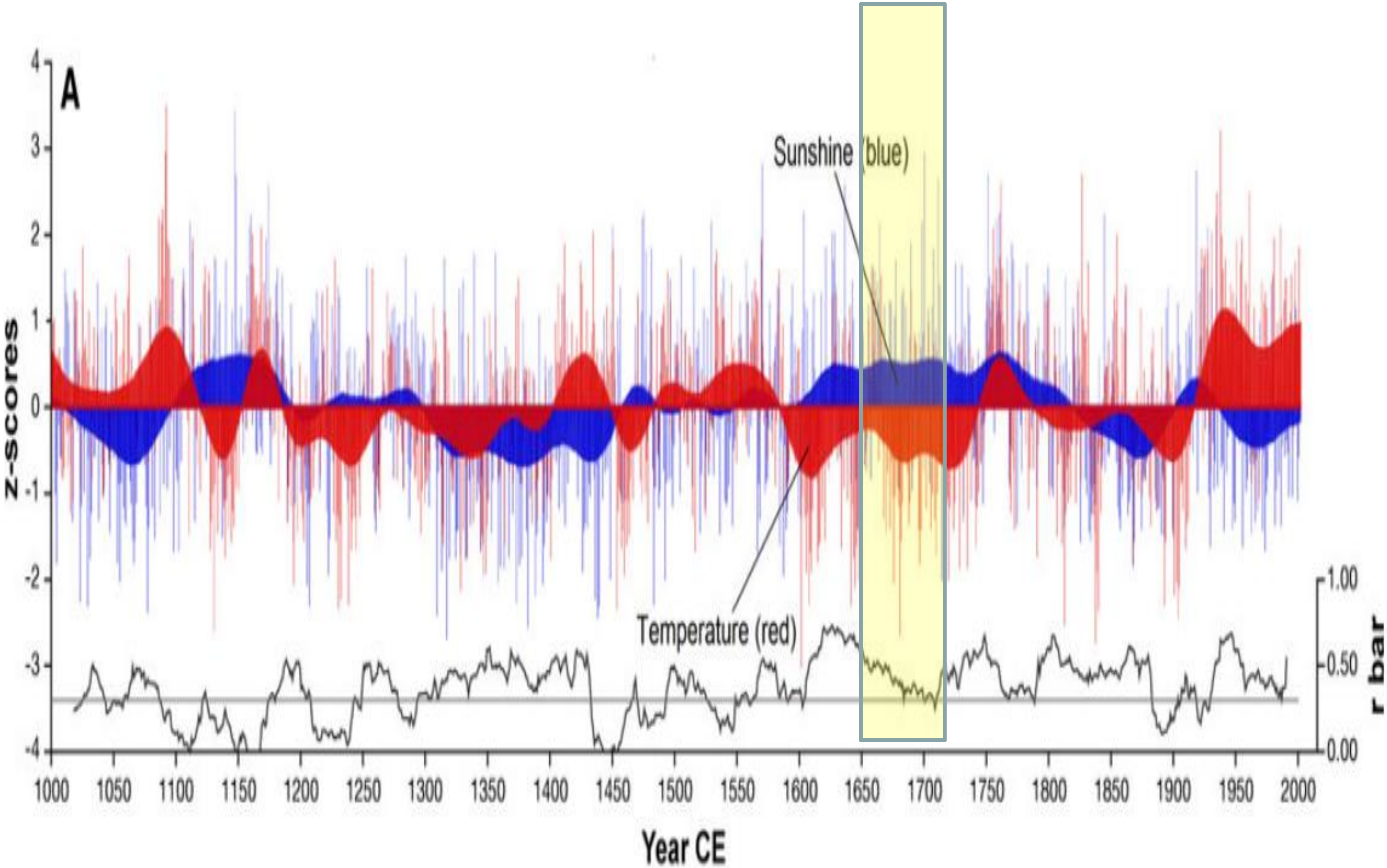


Figure 4. Comparison between *GST* of T_m in Paris and the grape harvest dates (*GHD*) from Dijon (Labbé et al., 2019) in the LMM. The Pearson correlation index equals to a value of -0.76.

Pliemon et al (2022) Climate of the Past, 18, 1685-1707

Cold but Sunny (less cloudy) in Northwestern Norway During the Maunder Minimum

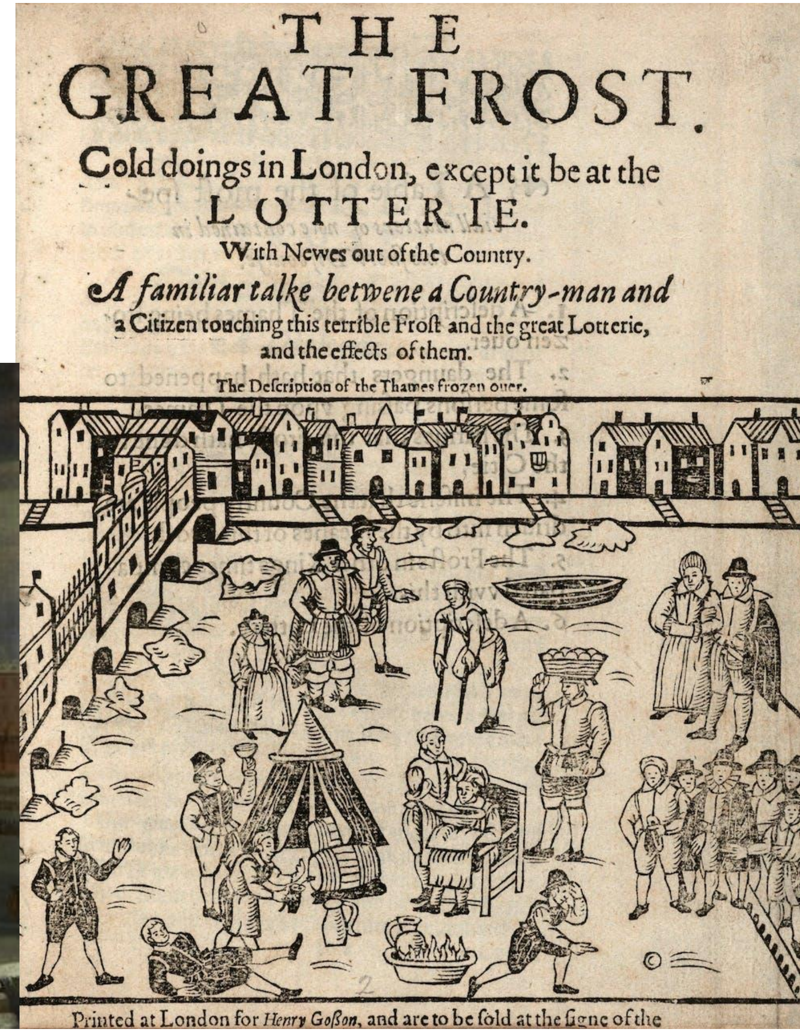


Young et al (2012) Climate Dynamics, 38, 495-507

Geoffrey Parker: Global Crisis of the 17th Century

"The earliest was in 1608, with further notable frost fairs in 1621, 1677 and 1684."

A frost fair on the Thames at Temple Stairs in London, England. Museum of London



A pamphlet from a Thames frost fair in 1608. Thomas Dekker/Houghton Library, Harvard University

Parker (2008) American Historical Review, 113, 1054-1079

Hessayon and Taylor (March 7, 2022) https://theconversation.com/the-original-climate-crisis-how-the-little-ice-age-devastated-early-modern-europe-178187

Geoffrey Parker: Global Crisis of the 17th Century

The Frozen Thames (1677) Abraham Hondius | Public Domain / Wikimedia Commons

https://digpodcast.org/2017/11/26/little-ice-age/?utm_source=pocket_mylist

Another curiosity of the Maunder Minimum of 1645-1715: Introduction of coffee and coffee houses in England

COFFEE HISTORY / 1650-1700

1650 - 1660

1652 - England's first coffee house opens in Cornhill, London. Located in St.
Michael's
is the serv
the shop a

The Britis
what it cos
who freque
more at th

Within a fe
Intellectua

Later this
Society. To
Cafe. A wa

1654 - Qu
operating

1657 - Mr.
giving it to friends including a Mr. de la Croix, the interpreter for France's King Louis XIV.

The Vertue of the COFFEE Drink.
First publiquely made and sold in England, by Pasqua Rosee.
THE Grain or Berry called Coffee, groweth upon little Trees, only in the Deserts of Arabia.
It is brought from thence, and drunk generally throughout all the Grand Seigniors Dominions.
being dry-
Spring wa-
before, and
y can been-
or raise any
Water, and
of are very
ough it be a
heat with-
eat use to be
ing.
Lightsome.
ur Head o-
against the
, that distil
Consumpti-
urvy.
her Drying
humors up-
men,
Hypocondriack
if one have
after Supper,
or 4 hours,
that they are
d that their
It is neither Laxative nor Restringent.
Made and Sold in St. Michaels Alley in Cornhill, by Pasqua Rosee, at the Signe of his own Head.

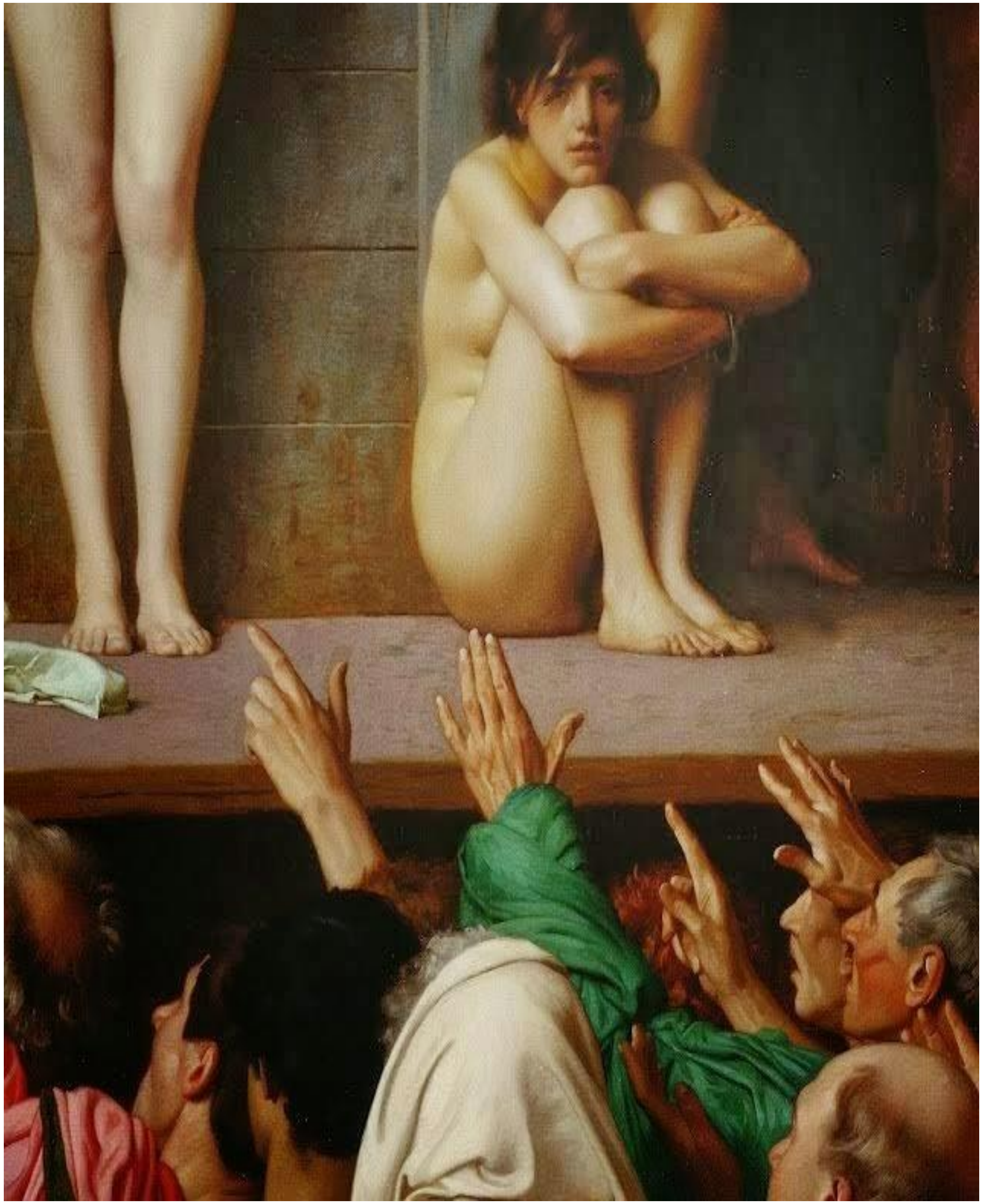
Figure 7. Illustration (perhaps by Bohemian artist Wenceslaus Hollar) of alleged atrocities perpetrated by Irish Catholics during the winter of 1641/42; one of multiple such images accompanying the text in Presbyterian clergyman James Cranford's propagandistic *The Teares of Ireland* (London, 1642). We thank Jane Ohlmeyer for highlighting this image.

James Cranford's, The Teares of Ireland (1642), the caption from which reads:

"English Protestantes striped naked and turned into the mountaines in the frost, and snowe, whereof many hundreds are perished to death, and many liynge dead in diches and savages [mainly Irish Catholics] upbraided them saynge now are ye wilde Irish as well as wee".

Stoffel, Corona, Sigl et al. (2022) Climate of the Past, 18, 1083-1108

Atrocities of the 17th century: The White Irish Slaves



The Irish slave trade began when James VI sold 30,000 Irish prisoners as slaves to the New World. His Proclamation of 1625 required Irish political prisoners be sent overseas and sold to English settlers in the West Indies.

By the mid 1600s, the Irish were the main slaves sold to Antigua and Montserrat. At that time, 70% of the total population of Montserrat were Irish slaves.

Ireland quickly became the biggest source of human livestock for English merchants. The majority of the early slaves to the New World were actually white.

From 1641 to 1652, over 500,000 Irish were killed by the English and another 300,000 were sold as slaves. Ireland's population fell from about 1,500,000 to 600,000 in one single decade.

Ronald Dwyer (March 16, 2015) https://canadalibre.ca/en_anglais/divers/irish-the-forgotten-white-slaves/

Atrocities of the 17th century: The White Irish Slaves

Interesting historical note: the last person killed at the Salem Witch Trials was Ann Glover. She and her husband had been shipped to Barbados as a slave in the 1650's. Her husband was killed there for refusing to renounce catholicism.

In the 1680's she was working as a housekeeper [for John Goodwin of Boston]. After some of the children she was caring for got sick she was accused of being a witch.

At the trial they demanded she say the Lord's Prayer. She did so, but in Gaelic, because she didn't know English. She was then hung.

https://en.wikipedia.org/wiki/Ann_Glover

Ronald Dwyer (March 16, 2015) https://canadalibre.ca/en_anglais/divers/irish-the-forgotten-white-slaves/

Little Ice Age Climate near Beijing, China, Inferred from Historical and Stalagmite Records

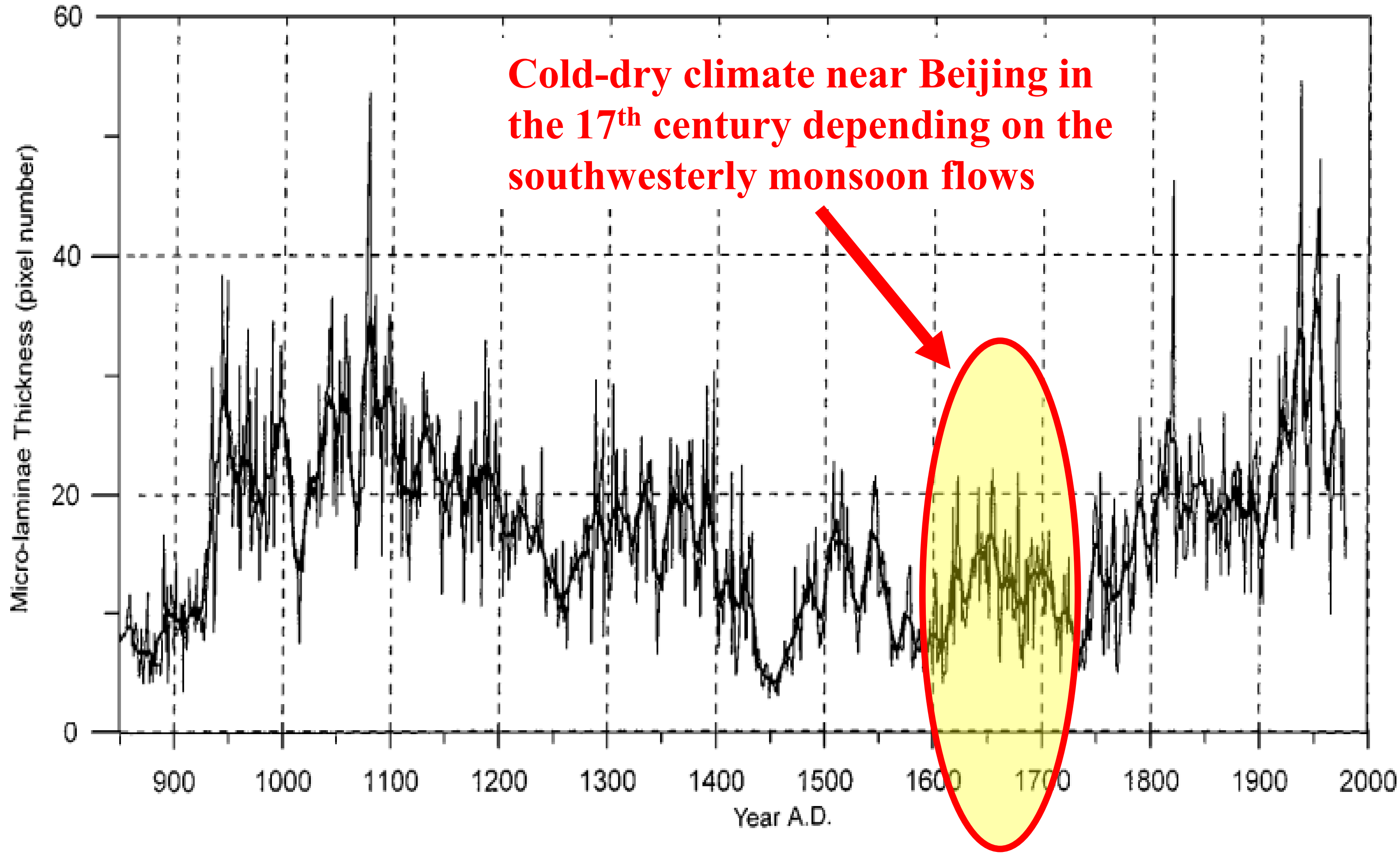
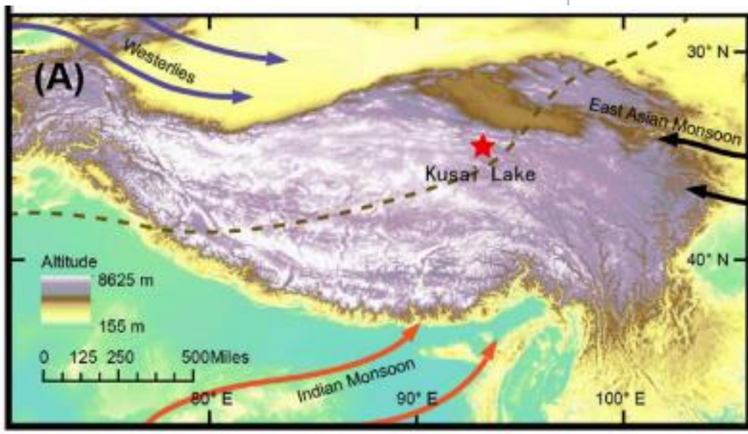


FIG. 7. The thickness sequence of laminae (pixel number) in the Beijing stalagmite from Shihua Cave for A.D. 850–1980 (after Qin *et al.*, 1999).

Qian and Zhu (2002) Quaternary Research, 57, 109-119

Cold and dry in Tibetan Plateau during the Maunder Minimum



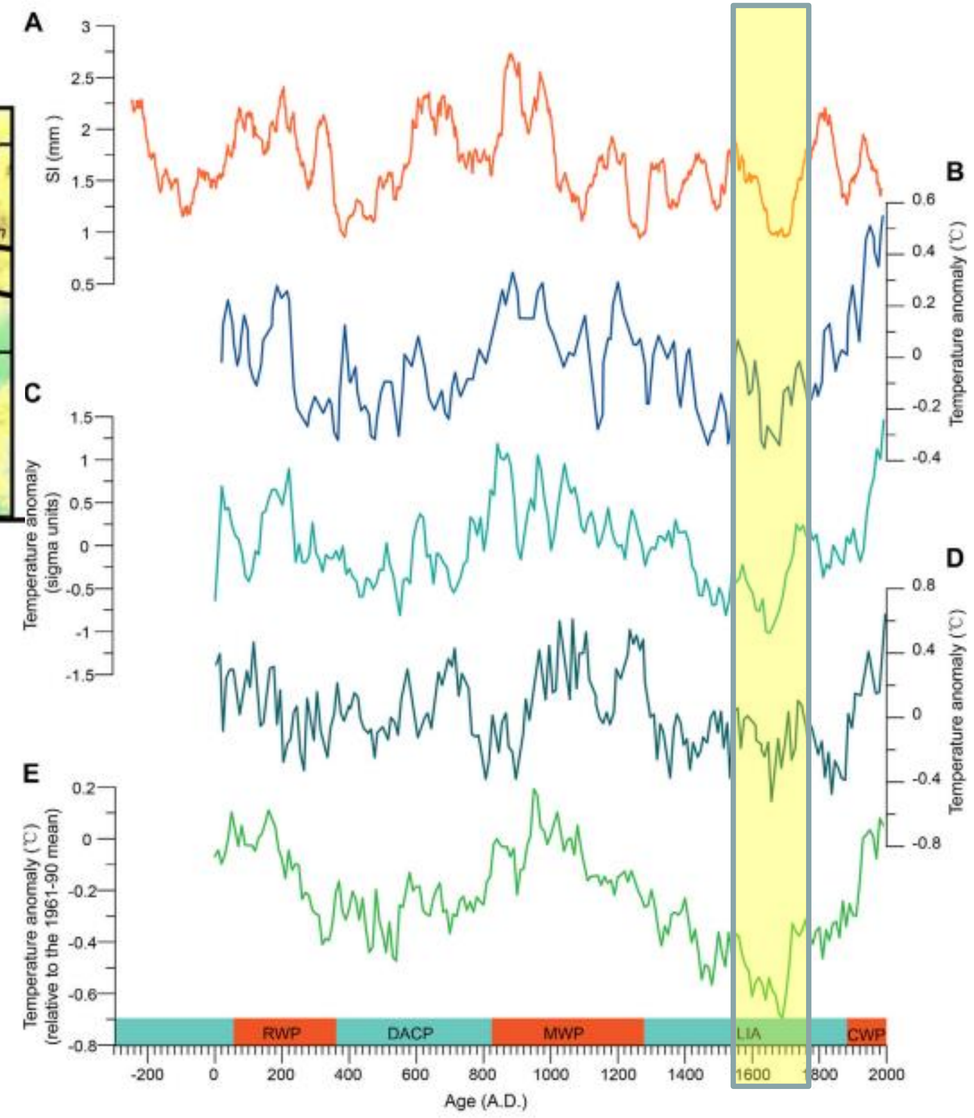


FIGURE 4 | 51-years moving average SI of the summer flux from Kusai Lake **(A)** and its comparisons with integrated temperature series on the Tibetan Plateau **(B)** (Hou et al., 2012), temperature reconstructions for China **(C)** (Yang et al., 2002) and **(D)** (Ge et al., 2013), and the Northern Hemisphere **(E)** (Ljungqvist, 2010). RWP, DACP, MWP, LIA, and CWP refer to the Roman Warm Period, Dark Age Cold Period, Medieval Warm Period, Little Ice Age, and Current Warm Period, respectively.

Zhang et al (2022) Frontiers in Earth Science, 9, 823258

Evidence of cold climate and droughts/floodings in China before and during the Maunder Minimum?

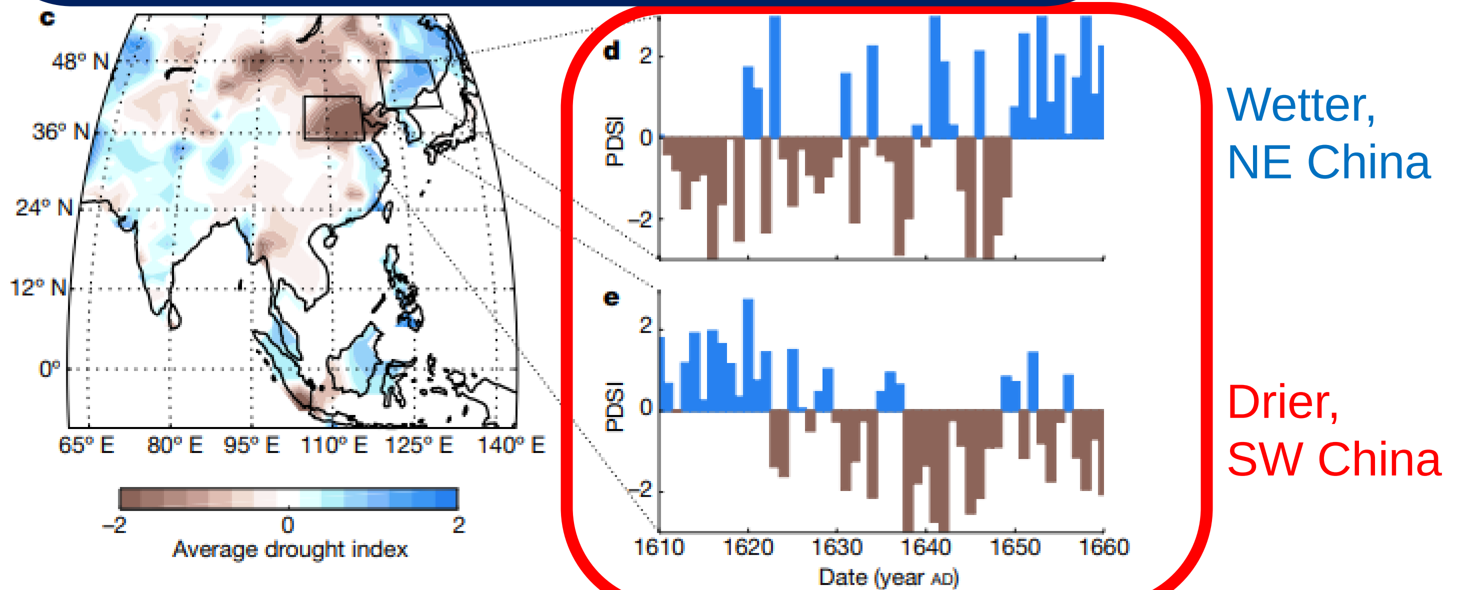


Fig. 5 | Tree ring reconstructions of temperature in France, and moisture in both France and China. a, b, Reconstructed summer[186] (red line) and winter[192] (blue line) temperature anomalies (calculated relative to the length of the full length of the respective records) (**a**) and PDSI for late seventeenth and early eighteenth-century France (43–51° N, 2° W–7° E)[137] (**b**). The AD 1693 and 1710 harvest failures and grain shortages in France are indicated with triangles and dashed lines. **c**, The mean tree-ring reconstructed PDSI from the Monsoon Asia Drought Atlas for AD 1638 to 1643[201]. **d**, **e**, Multiyear monsoon failures in China in the seventeenth century contributed to drought in the Jurchen polity (shown in **d**), which was not as severe as it was in Ming China (**e**).

DeGroot et al (2021) Nature, 591, 539-550

Evidence of dry climate central Africa and wet climate in South Africa during the Maunder Minimum?

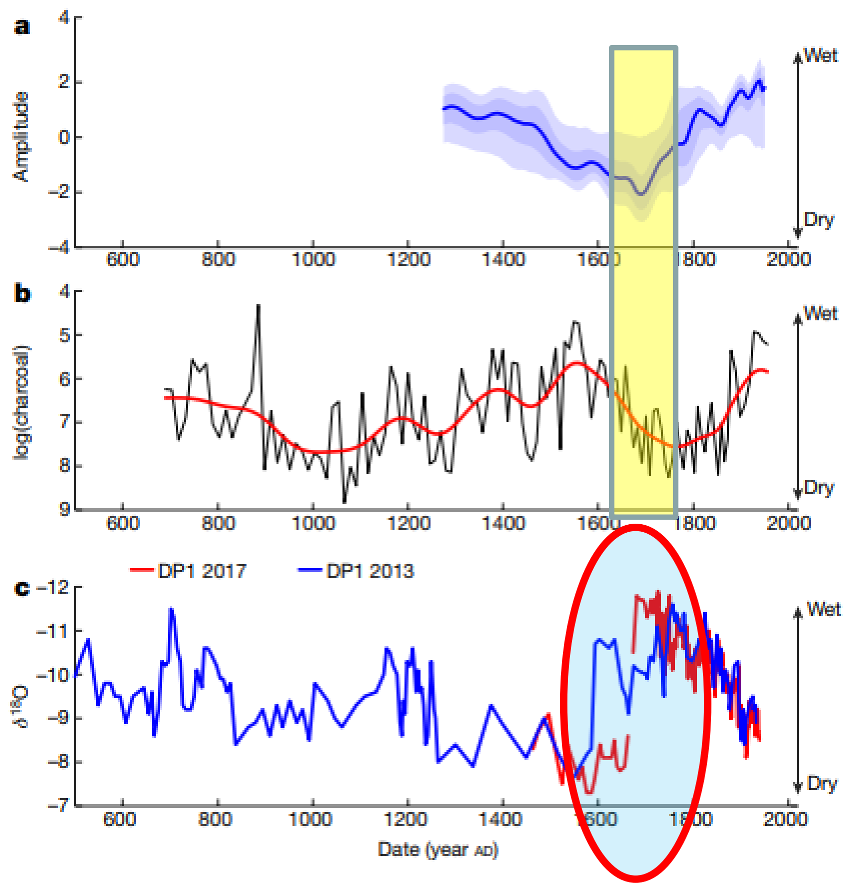


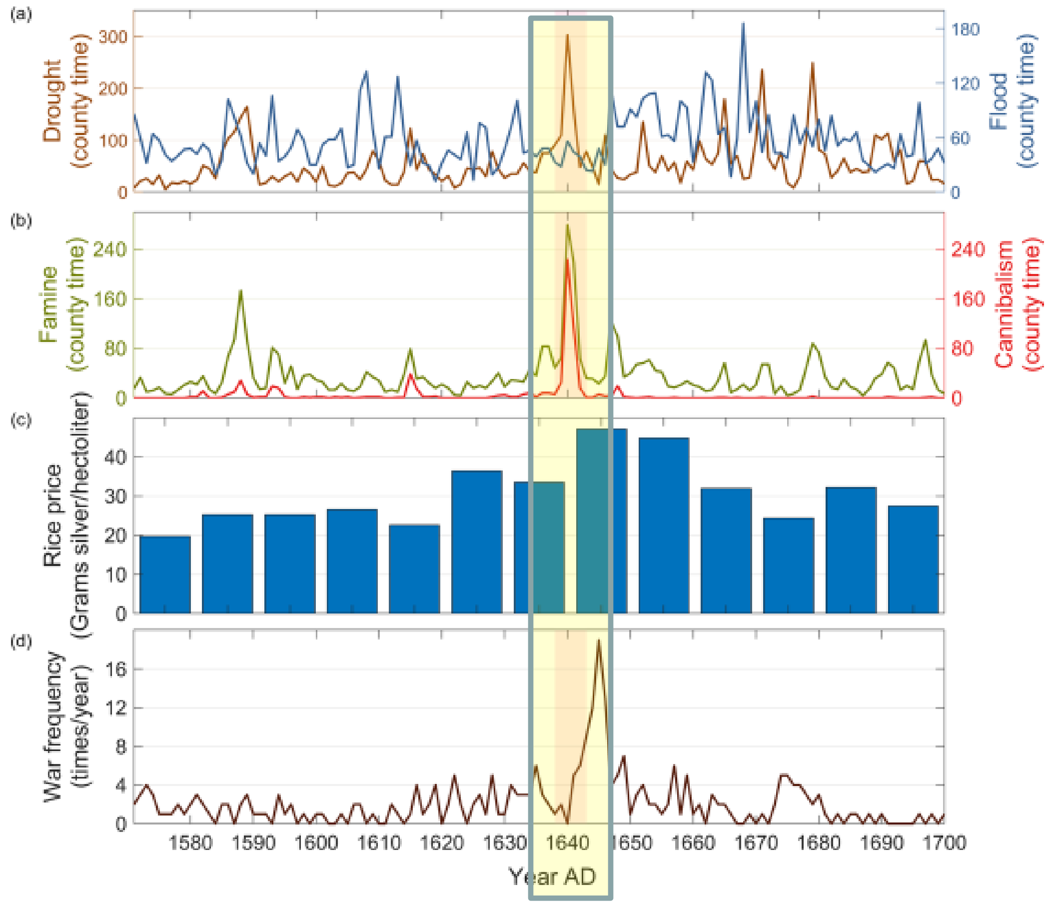
Fig. 6 | Palaeoclimate moisture proxies for Iron Age southern Africa. a, Leading pattern of moisture variability associated with interior eastern Africa lake sediment proxies from Lake Masoko (Tanzania), Lake Malawi (Malawi, Mozambique and Tanzania) and Lake Edward (Democratic Republic of Congo and Uganda)[207–209]. Shaded uncertainties are the 1σ (light blue) and 2σ (darker blue) range from 10,000-member ensemble resampling the individual lake record age models. **b,** Charcoal record from Lake Tanganyika[208]. **c,** Dante Cave (Namibia) speleothem oxygen isotope ratios from ref. [210] (DP1 2013) and ref. [211] (DP1 2017). All records are oriented so that wetter conditions are up and drier conditions are down.

Dry climate central Africa

Wet climate south Africa

DeGroot et al (2021) Nature, 591, 539-550

Social Crisis, War and Famine in China Before and During the Maunder Minimum?



Drought

Famine and Cannibalism

Price of rice

War

Figure 8. Chinese weather anomalies, food shortages and warfare, 1571 to 1700: **(a)** drought and flood data as well as incidents of **(b)** famine and cannibalism as reported in the *Compendium of Chinese Meteorological Records of the Last 3000 Years* (Zhang, 2004); **(c)** rice prices (Liu, 2015) underline the food scarcity of the early 1640s, a potential factor in favoring **(d)** elevated war frequencies during the period (Zhang et al., 2006).

Stoffel, Corona, Sigl et al. (2022) Climate of the Past, 18, 1083-1108

More landfalling typhoons in GuangDong, China during the Maunder Minimum

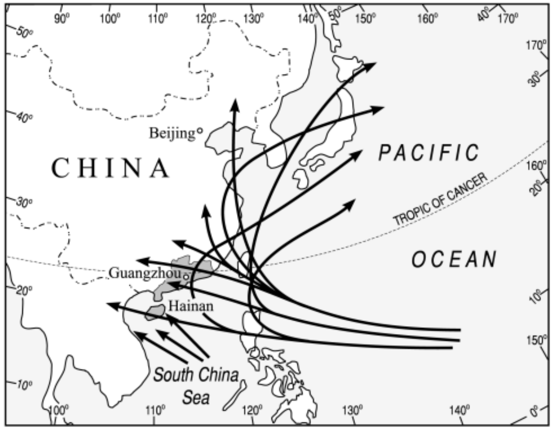
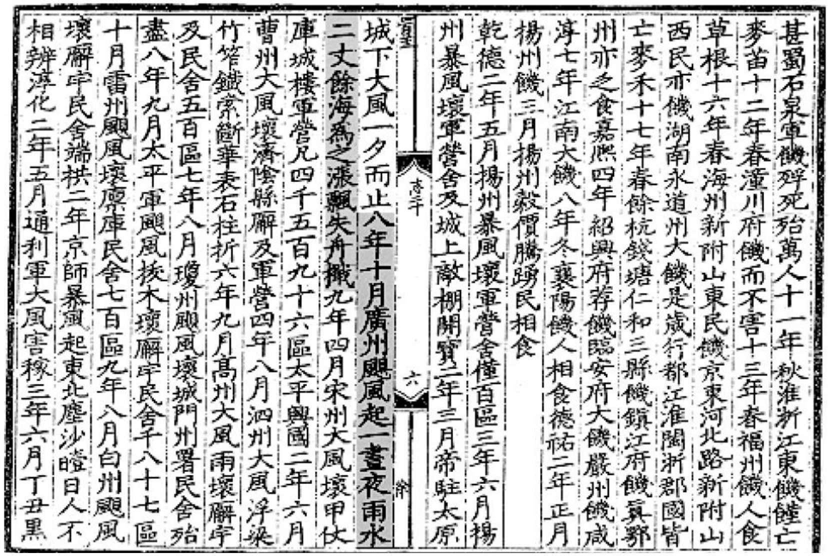


Figure 1. Location of Guangdong Province, including Hainan Island and Hong Kong (shaded), in relation to the generalized tracks of typhoons in the Northwest Pacific Basin (after Jiao 1984).



甚蜀石泉軍饑殍死殆萬人十一年秋淮浙江東饑饉亡
麥苗十二年春潼川府饑而不害十三年春福州饑人食
草根十六年春海州新附山東民饑京東河北路新附山
西民亦饑湖南永道州大饑是歲行都江淮閩浙郡國皆
亡麥禾十七年春餘杭錢塘仁和三縣饑鎮江府饑冀鄂
州亦乏食嘉熙四年紹興府荐饑臨安府大饑嚴州饑咸
淳七年江南大饑八年冬襄陽饑人相食德祐二年正月
揚州饑三月揚州穀價騰踴民相食
乾德二年五月揚州暴風壞軍營舍僅百區三年六月揚
州暴風壞軍營舍及城上敵棚開寶二年三月帝駐太原
城下大風一夕而止八年十月廣州颶風起一晝夜雨水
二丈餘海為之漲飄失舟檝九年四月宋州大風壞甲仗
庫城樓軍營凡四千五百九十六區太平興國二年六月
曹州大風壞濟陰縣廨及軍營四年八月泗州大風浮梁
竹笮鐵索斷華表石柱折六年九月高州大風雨壞廨宇
及民舍五百區七年八月瓊州颶風壞城門州署民舍殆
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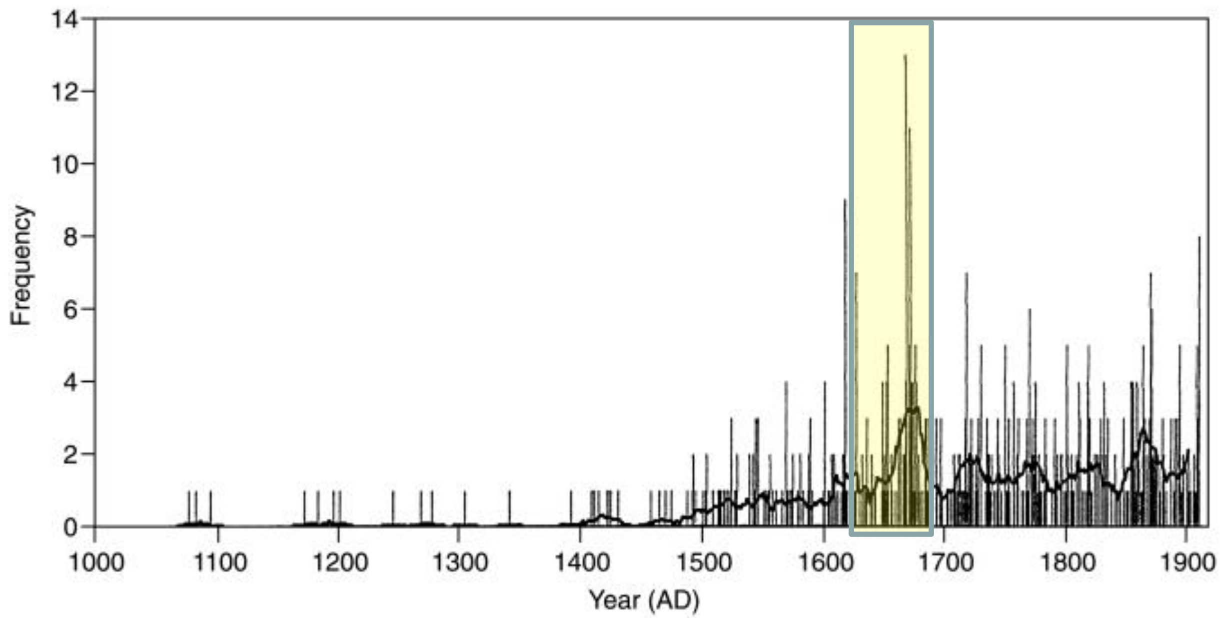


Figure 4. Year-by-year plot of typhoon strikes in Guangdong during AD 1000–1900, compiled from the historical documentary record. The continuous curve shows the twenty-one-year moving averages smoothed from the annual time series.

Liu, Shen, Louie (2001) Annals of the American Geographers, 91, 453-464

More landfalling typhoons in GuangDong, China during the Maunder Minimum


Is carbon dioxide really the monster driving climate change? If not, maybe we should prepare for a colder world, writes **Willie Soon**

As geographer and historian David Zhang and his HKU colleagues recently noted, "during cold phases, China suffered more often from frequent wars, population decline and dynastic change".

Another study of the 1,000-year history of typhoon landfalls in Guangdong, by climate scientists from Chinese University of Hong Kong and Louisiana State University, tells us that the two periods of 1660-1680 and 1850-1880 saw the most devastating typhoons.

It is not surprising to find that these two most active typhoon periods also correspond to the coldest and driest periods in northern and central China, as it is often the relatively colder, dryer times that cause the strongest contrasting meteorological conditions in the land, ocean and atmosphere, leading to frequent and damaging typhoons. Therefore, hypothetical scares proposed by global warming scenarios caused by carbon dioxide must raise more serious questions.

What if Hong Kong's climate turns cold within the next 100 years?

How would the proposed 33 per cent carbon dioxide emissions reduction by 2020 benefit Hong Kong citizens, if it results in soaring energy costs but has no effect on climate?

Why should anyone continue to blindly demonise a life-supporting molecule: carbon dioxide?

Willie Soon is an astrophysicist and geoscientist at the Harvard-Smithsonian Centre for Astrophysics. All views are strictly based on his own scientific research and conclusions

Soon (September 17, 2010) South China Morning Post, p. A17

More Storm Surges and Tsunamis in the Korean Peninsula during the Maunder Minimum

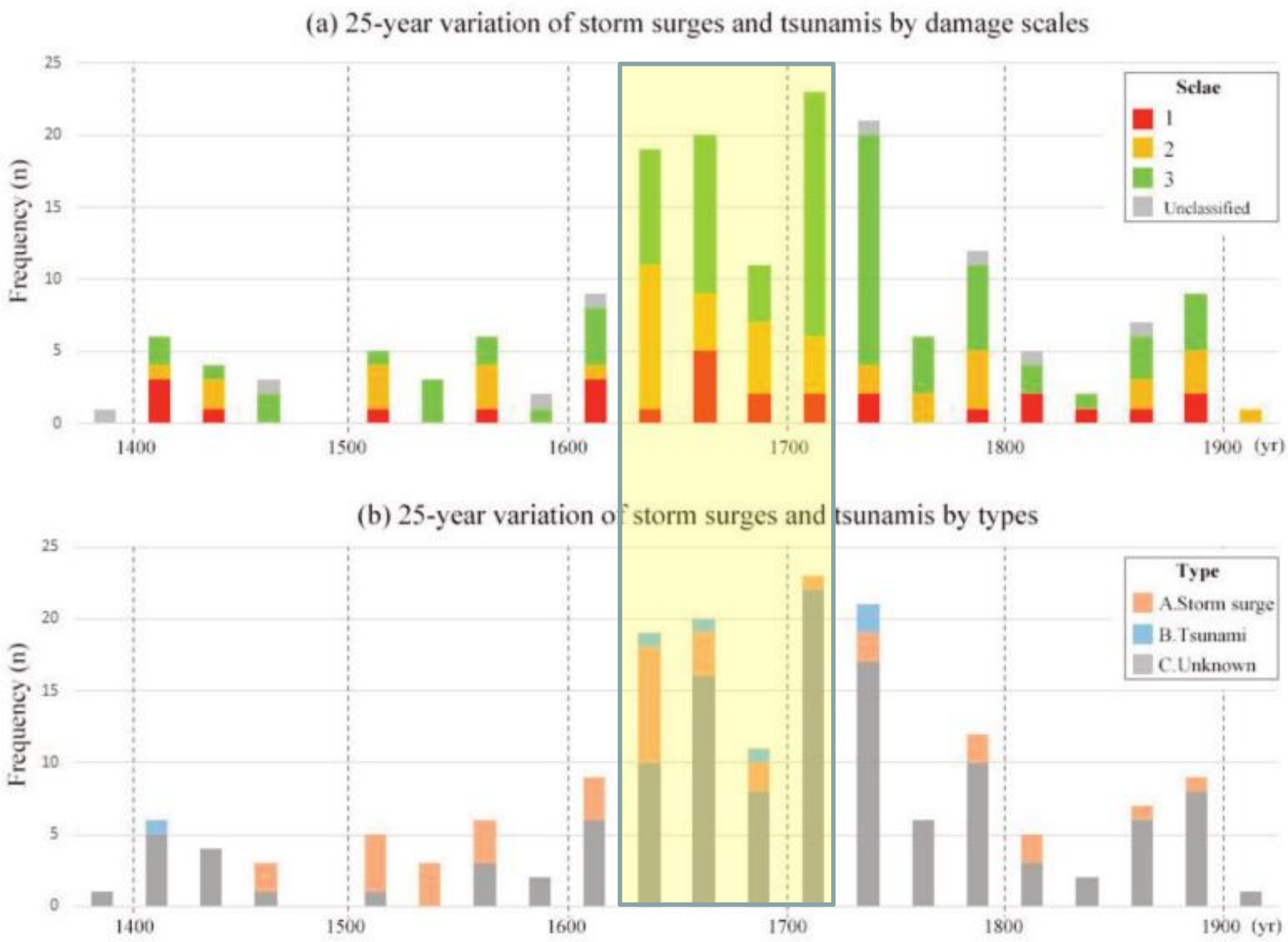


Figure 2. 25-year variation of storm surges and tsunamis by scale (a) and type (b).

Kim, Hong and Choi (2022) Journal of the Korean Geomorphological Association, 28, 37-49

Cold Temperature and Climate in Japan during the Maunder Minimum

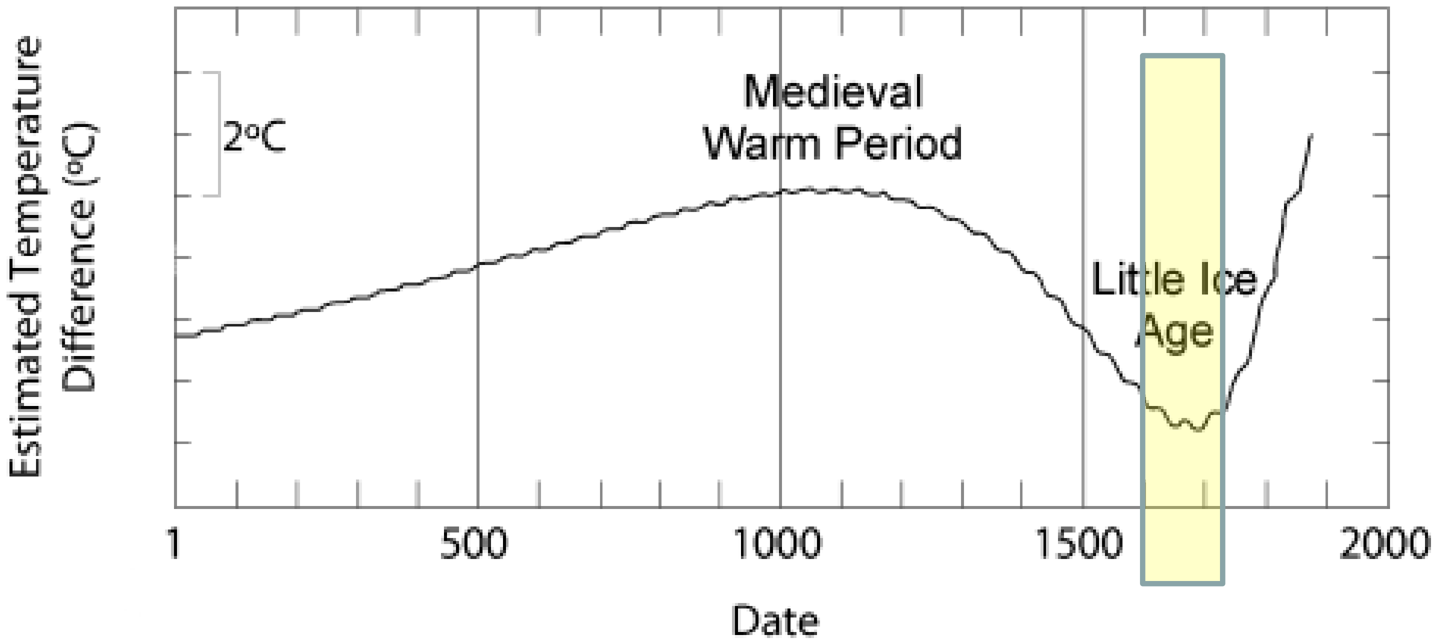


Figure 7. Temperature Reconstruction Based on Borehole Temperatures at Lake Biwa (Last Two Millennia)

Source: Redrawn and modified from Shusaku Goto, Hideki Hamamoto, and Makoto Yamano, "Climatic and Environmental Changes at Southeastern Coast of Lake Biwa over Past 3000 Years, Inferred from Borehole Temperature Data," *Physics of the Earth and Planetary Interiors* 152, no. 4 (2005): 321.

Batten (2009) Harvard University Edwin O. Reischauer Institute of Japanese Studies

Cold Temperature and Climate in Yakushima Island, Japan during the Maunder Minimum

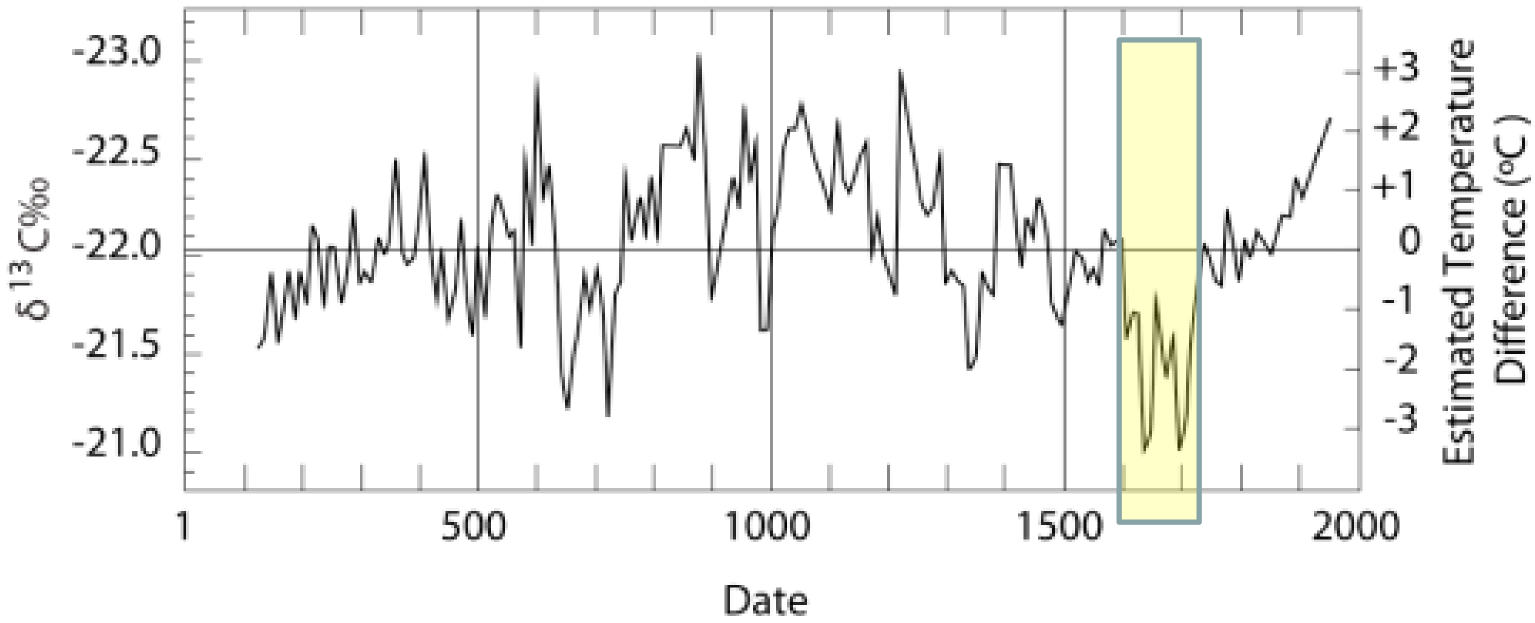


Figure 5. Temperature Reconstruction

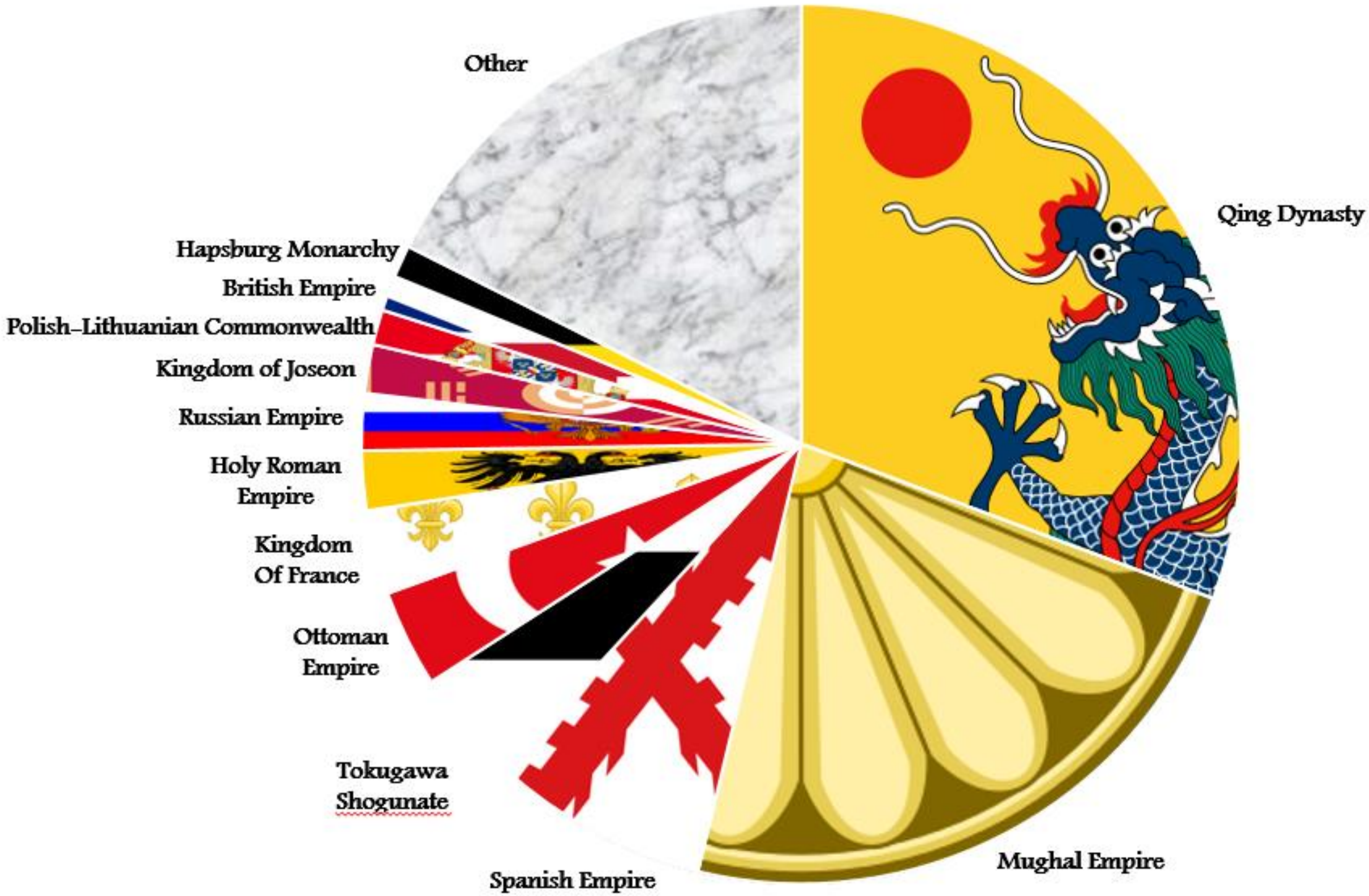
Based on $\delta^{13}C$ from Yaku Island Cedar

Source: Redrawn from Kitagawa Hiroyuki, "Yakusugi ni kizamareta rekishi jidai no kikō hendō" (Climate Change during the Historical Period as Inscribed in Yaku Cedars), in *Rekishi to kikō* (History and Climate), ed. Yoshino Masatoshi and Yasuda Yoshinori, vol. 6 of *Kōza: Bunmei to kankyō* (Lectures on Civilization and Environment) (Tokyo: Asakura shoten, 1995), 50.

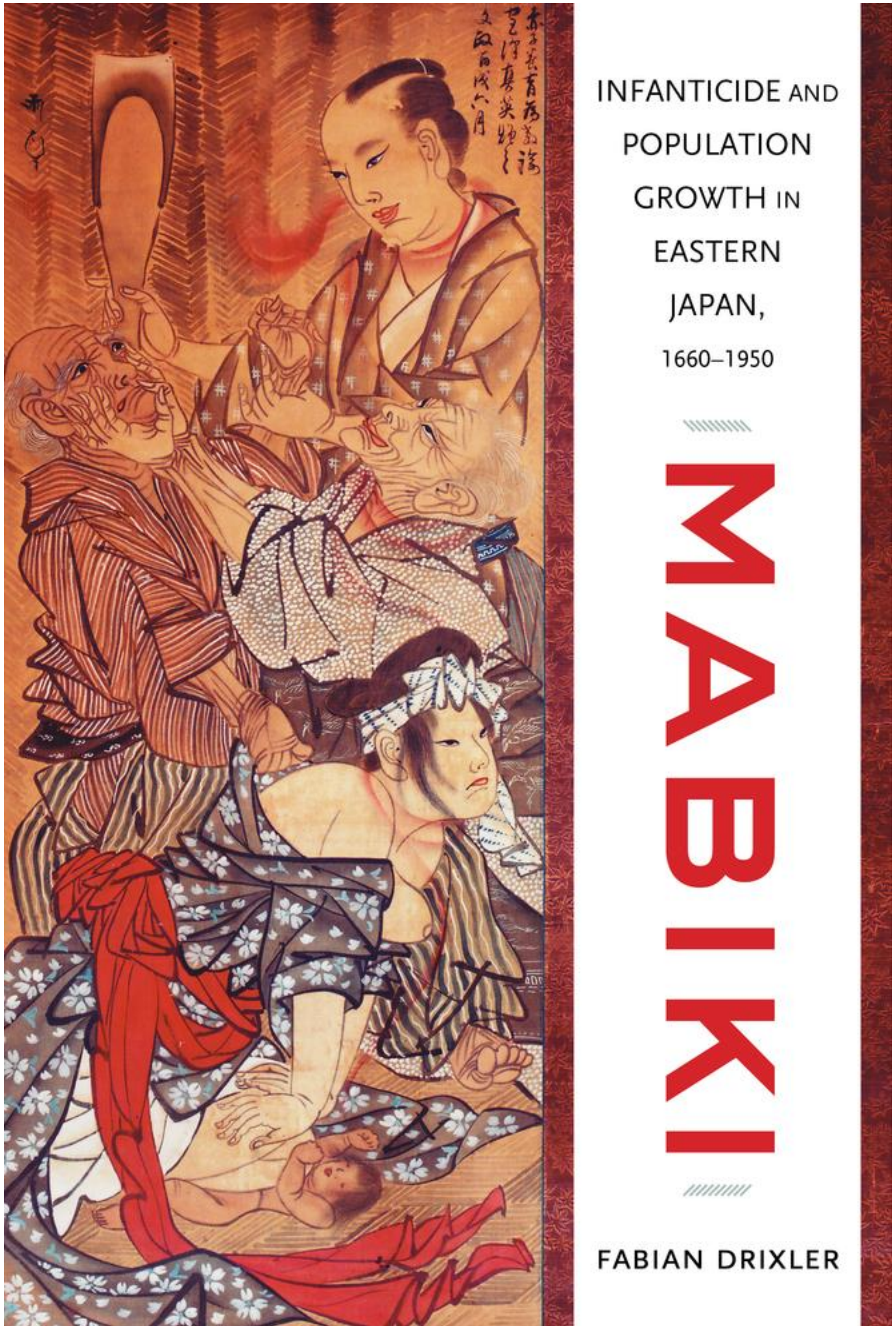
Batten (2009) Harvard University Edwin O. Reischauer Institute of Japanese Studies

World population 1700: 682 millions

(World population 1600: 579 millions)



https://en.wikipedia.org/wiki/List_of_countries_by_population_in_1700



Infanticide and Immortality: The Logic of the Stem Household (pp. 61-68)

In the years around 1680, a population explosion caused consternation in many parts of Japan. Some governments encouraged emigration to rid their lands of unwanted mouths, and others closed their borders to laborers from elsewhere.[2] Throughout the archipelago, village assemblies and rulers issued laws restricting marriages and partible inheritance. One of these laws was the 1677 decree of Sendai domain that we have encountered in the previous chapter.

"As we observe from the recent population registration," it explained,

"the number of people is increasing greatly, and we estimate that within ten or fifteen years, there will be grain shortages."

Geoffrey Parker (2014) talk at Princeton University https://youtu.be/yutc_BDiH3Q

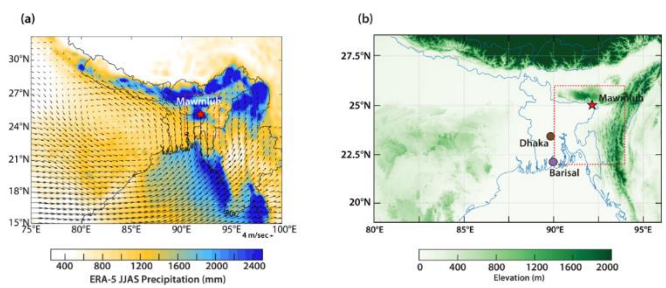
Evidence of dry climate (failed Indian monsoon) around Mawmluh Cave, NE India pre-Maunder Minimum?

PNAS RESEARCH ARTICLE | APPLIED PHYSICAL SCIENCES

Protracted Indian monsoon droughts of the past millennium and their societal impacts

Gayatri Kathayat[a,1], Ashish Sinha[b,1], Sebastian F. M. Breitenbach[c], Liangcheng Tan[d], Christoph Spötl[e], Hanying Li[a], Xiyu Dong[a], Haiwei Zhang[a], Youfeng Ning[a], Robert J. Allan[f], Vinita Damodaran[g], R. Lawrence Edwards[h], and Hai Cheng[a,d,i,1]

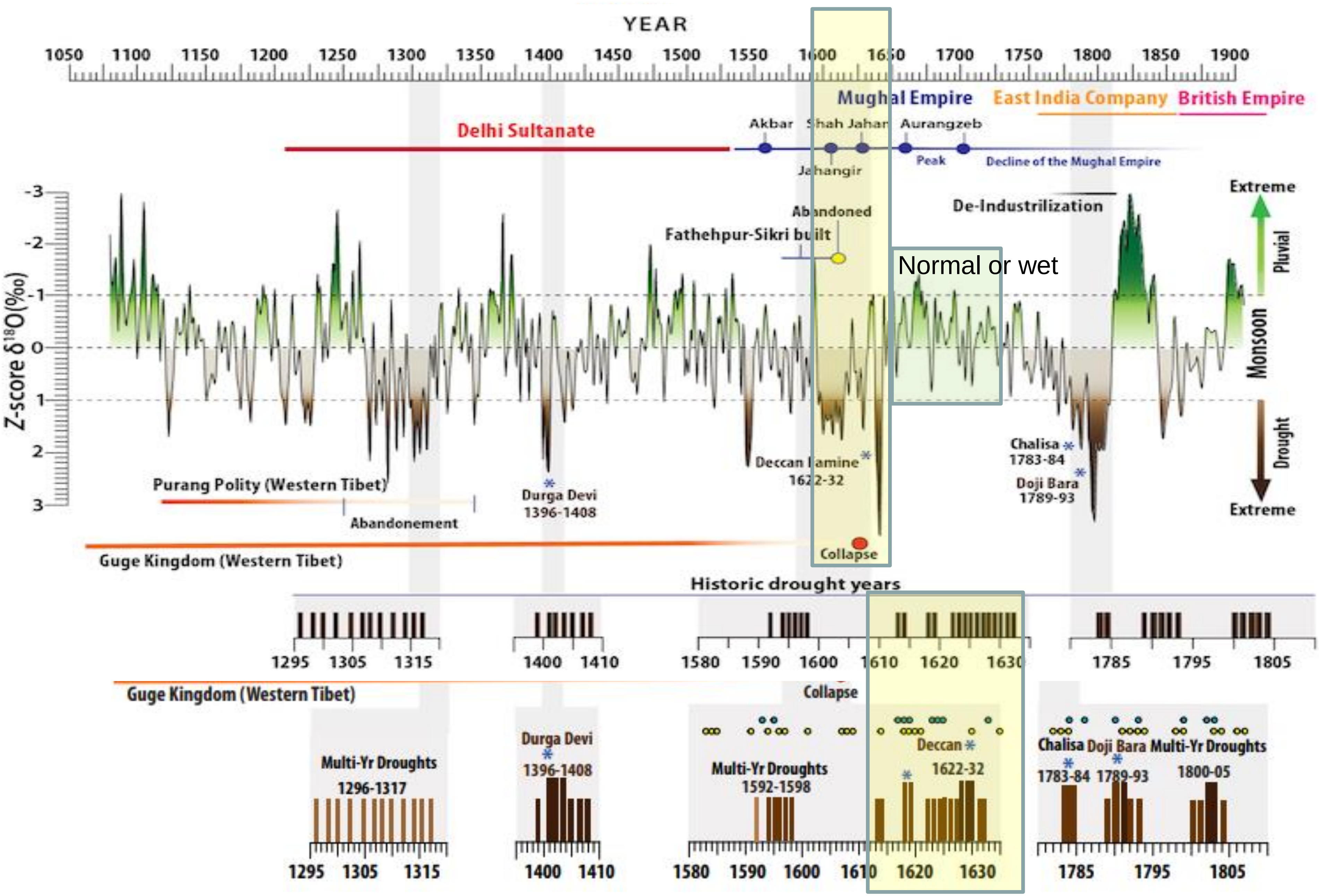
Edited by Xianfeng Wang, Earth Observatory of Singapore, Nanyang Technological University, Singapore; received May 3, 2022; accepted August 16, 2022 by Editorial Board Member Jean Jouzel



Protracted droughts lasting years to decades constitute severe threats to human welfare across the Indian subcontinent. Such events are, however, rare during the instrumental period (*ca.* since 1871 CE). In contrast, the historic documentary evidence indicates the repeated occurrences of protracted droughts in the region during the preinstrumental period implying that either the instrumental observations underestimate the full spectrum of monsoon variability or the historic accounts overestimate the severity and duration of the past droughts. Here we present a temporally precise speleothem-based oxygen isotope reconstruction of the Indian summer monsoon precipitation variability from Mawmluh cave located in northeast India. Our data reveal that protracted droughts, embedded within multidecadal intervals of reduced monsoon rainfall, frequently occurred over the past millennium. These extreme events are in striking temporal synchrony with the historically documented droughts, famines, mass mortality events, and geopolitical changes in the Indian subcontinent. Our findings necessitate reconsideration of the region's current water resources, sustainability, and mitigation policies that discount the possibility of protracted droughts in the future.

Kathayat et al (2022) PNAS, 119, e2207487119

Evidence of dry climate (failed Indian monsoon) around Mawmluh Cave, NE India pre-Maunder Minimum?

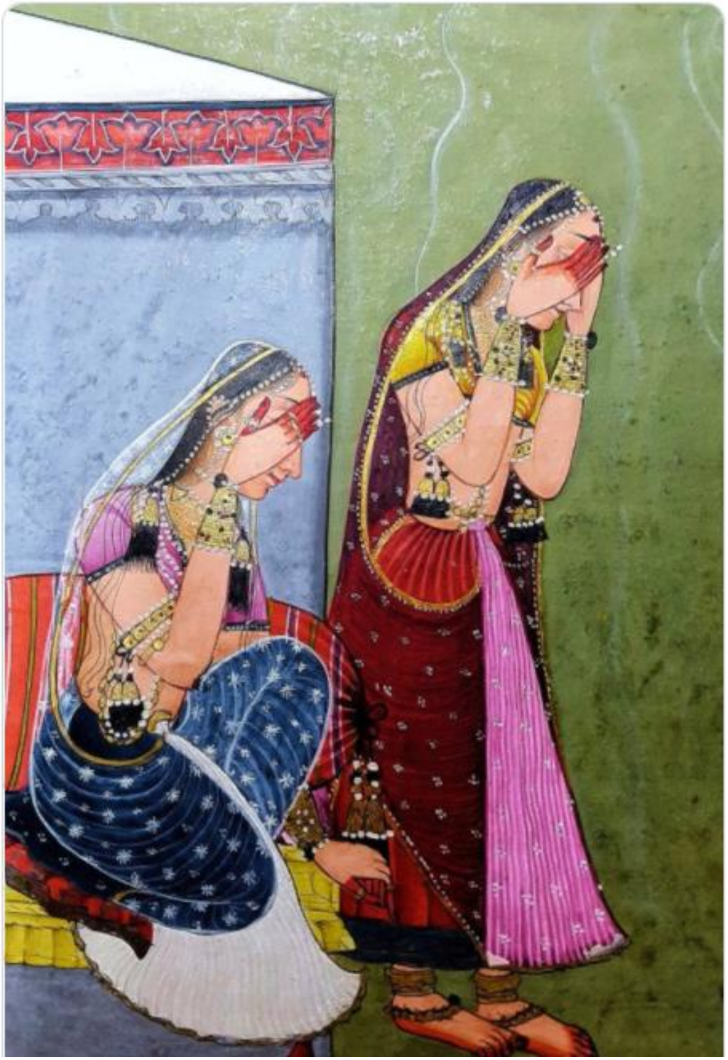


Kathayat et al (2022) PNAS, 119, e2207487119

Evidence of dry climate (failed Indian monsoon) and extreme hot weather during 17th century in India?

Sharad Mohan شرد ਸ਼ਰਦ शरद শরদ
@ssharadmohhan

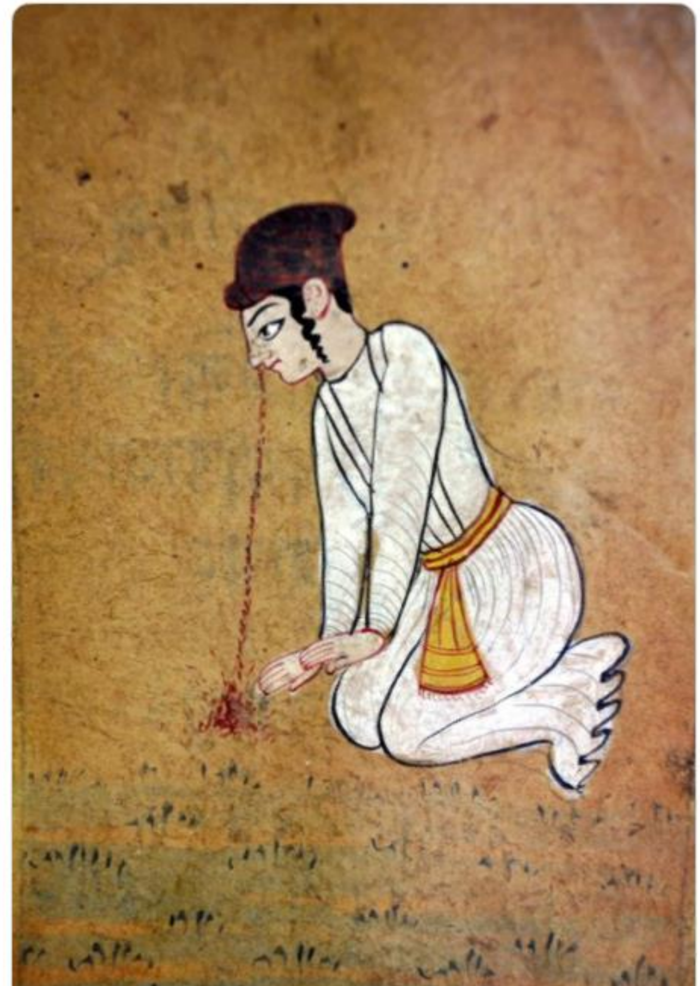
#CycloneBiparjoy is effecting #Delhi now with Surface Winds Kicking up a Dust-Storm forcing me to Cover my Eyes just as Devki & Yashodha did when Whirlwind Demon Trinavarata tried to Abduct #Krishna in this c1700 AD #Mankot #Jammu #Pahari (details) painting
@DilliDurAst @ranjona



June 15, 2023: https://twitter.com/ssharadmohhan/status/1669342899883114507

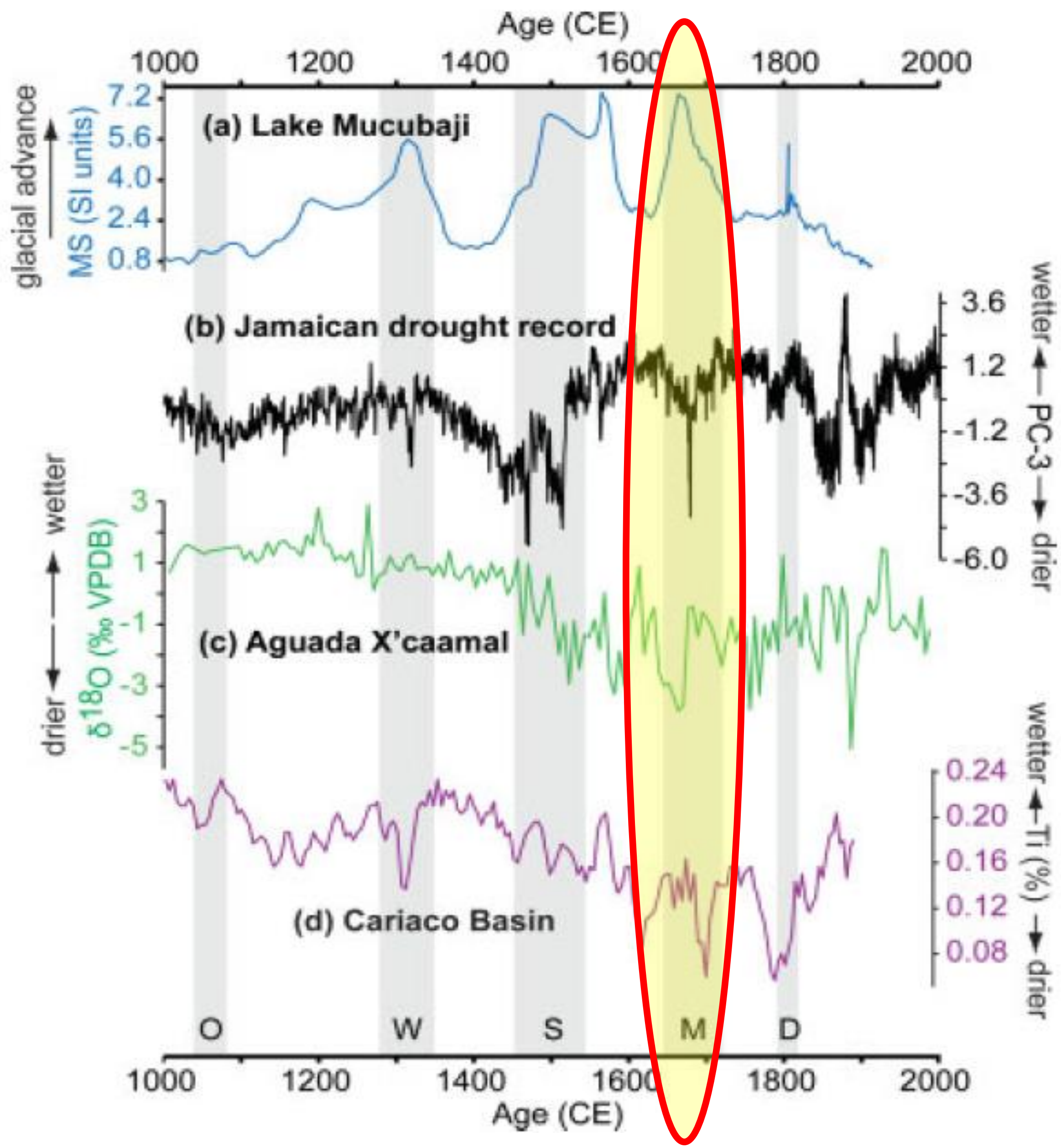
Sharad Mohan شرد ਸ਼ਰਦ शरद শরদ
@ssharadmohhan

#DelhiHeatWave returns.
#Delhi at 45°c. Nose Bleed is the most common medical condition for those working outdoors.
This early #Pahari (c1700 AD) painting of a 'Nose Bleed' is now at Bhuri Singh Museum #Chamba #HimachalPradesh
Drink plenty of fluids!
@DalrympleWill @ranjona



June 11, 2023: https://twitter.com/ssharadmohhan/status/1667805592742920192

Evidence of Droughts in Jamaica, Cariaco Basin, Yucatan Peninsula
but Glacial Advances (NW Venezuela Andes around 3600 meters)?



Burn and Palmer (2014) Journal of Quaternary Science, 29, 827-836

Evidence of cold climate in the Eastern Mediterranean during the Maunder Minimum?

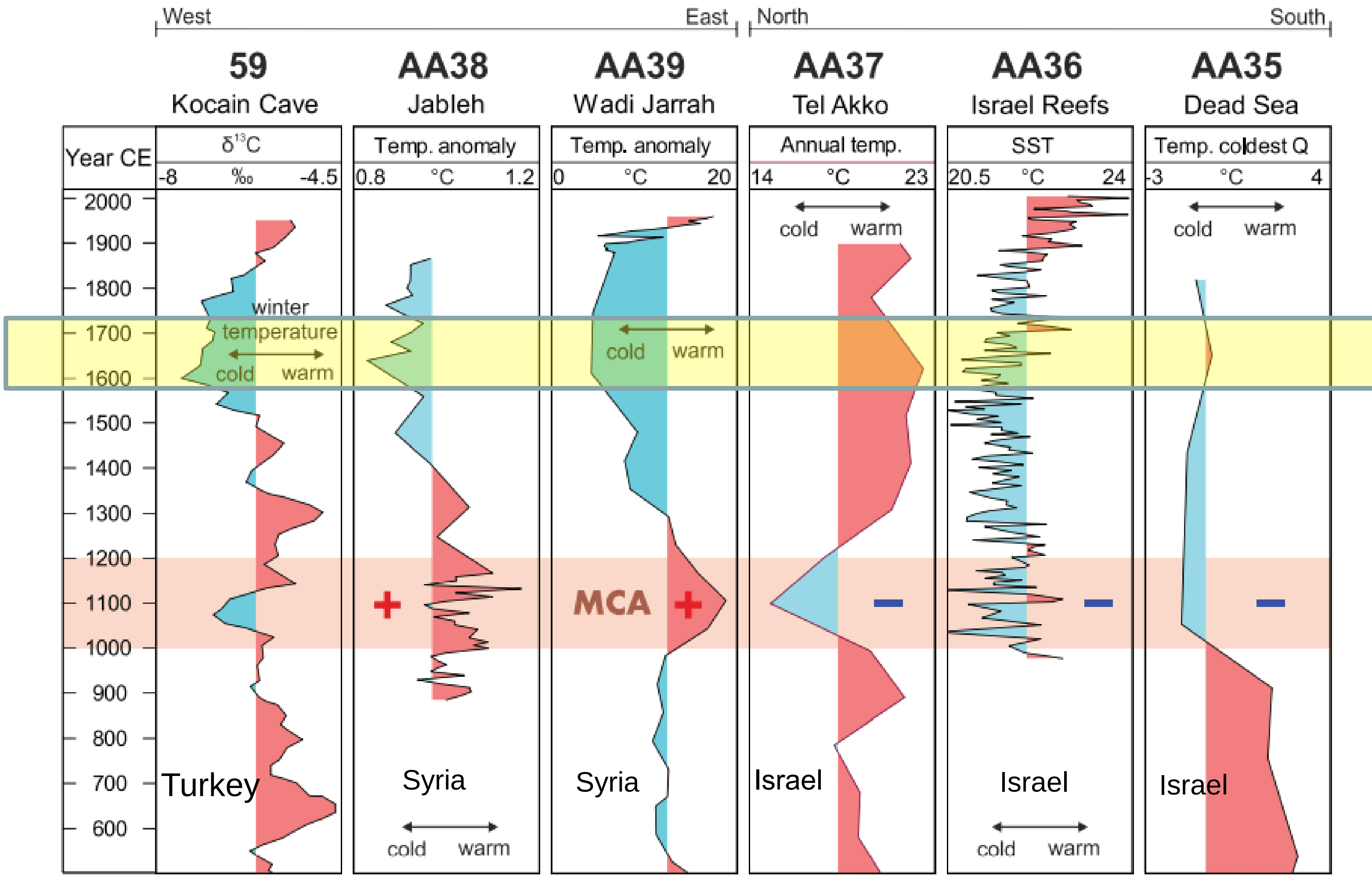


Figure 5. Temperature development in the Eastern Mediterranean region during the past 1,500 years based on palaeoclimate proxies of selected study sites. Proxy series from left to right (with site numbers): 59: Kocain Cave (Göktürk, 2011), AA38: Jableh (Kaniewski et al., 2011), AA39: Wadi Jarrah (Kaniewski et al., 2012), AA37: Tel Akko (Kaniewski et al., 2013), AA36: Israel coastal reefs (Sisma-Ventura et al., 2014), and AA35: Dead Sea (Litt et al., 2012). Illustrated site numbers are bold and underlined in location map in Figure 2.

Luning et al (2019) Paleoceanography and Paleoclimatology, 34, 1625-1649

Cold Temperature and Climate in Australia during the Maunder Minimum

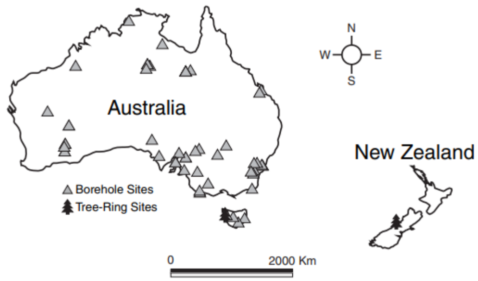


Figure 1 Locations of boreholes from which the subsurface temperature measurements used in this investigation were obtained (see Table 1 for details); and the tree-ring sites of Cook *et al.* (2000, 2002) referred to in Fig. 4. Because some boreholes listed in Table 1 have virtually identical locations, they do not appear as separate symbols in the figure

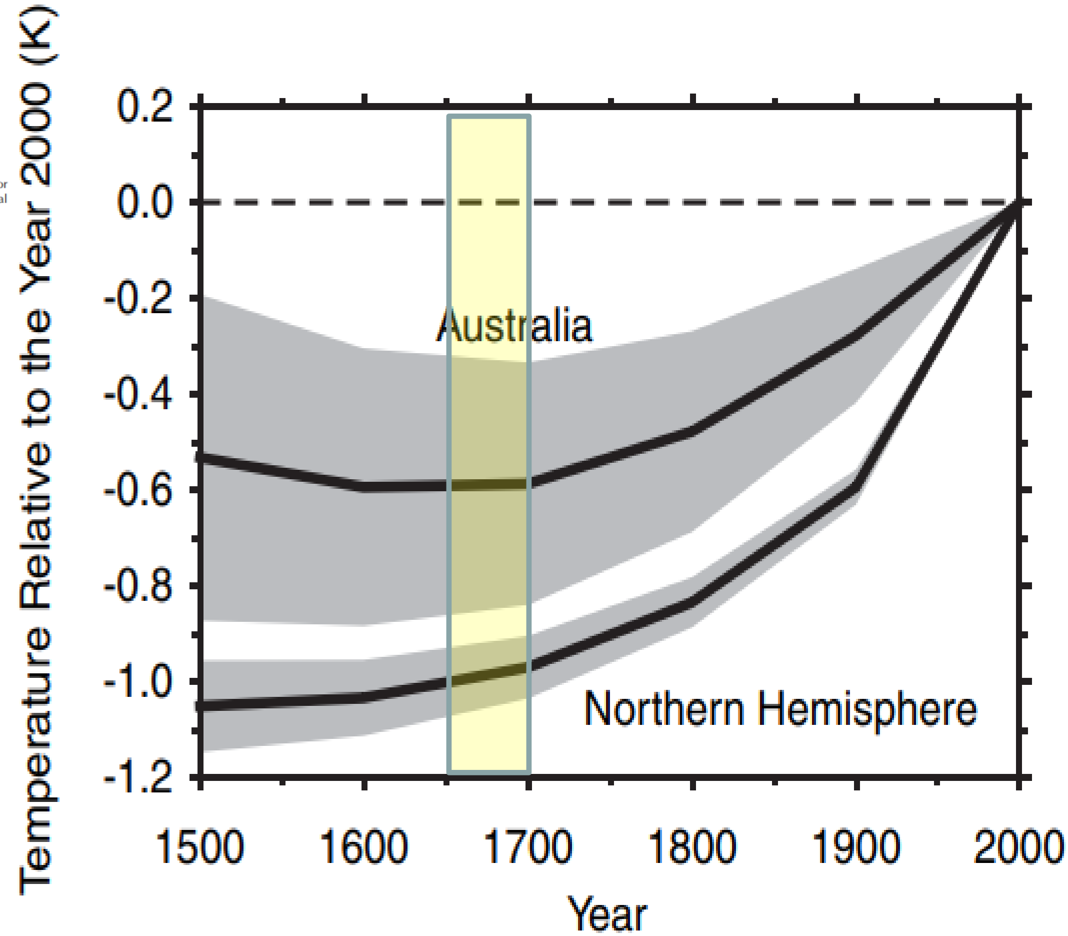


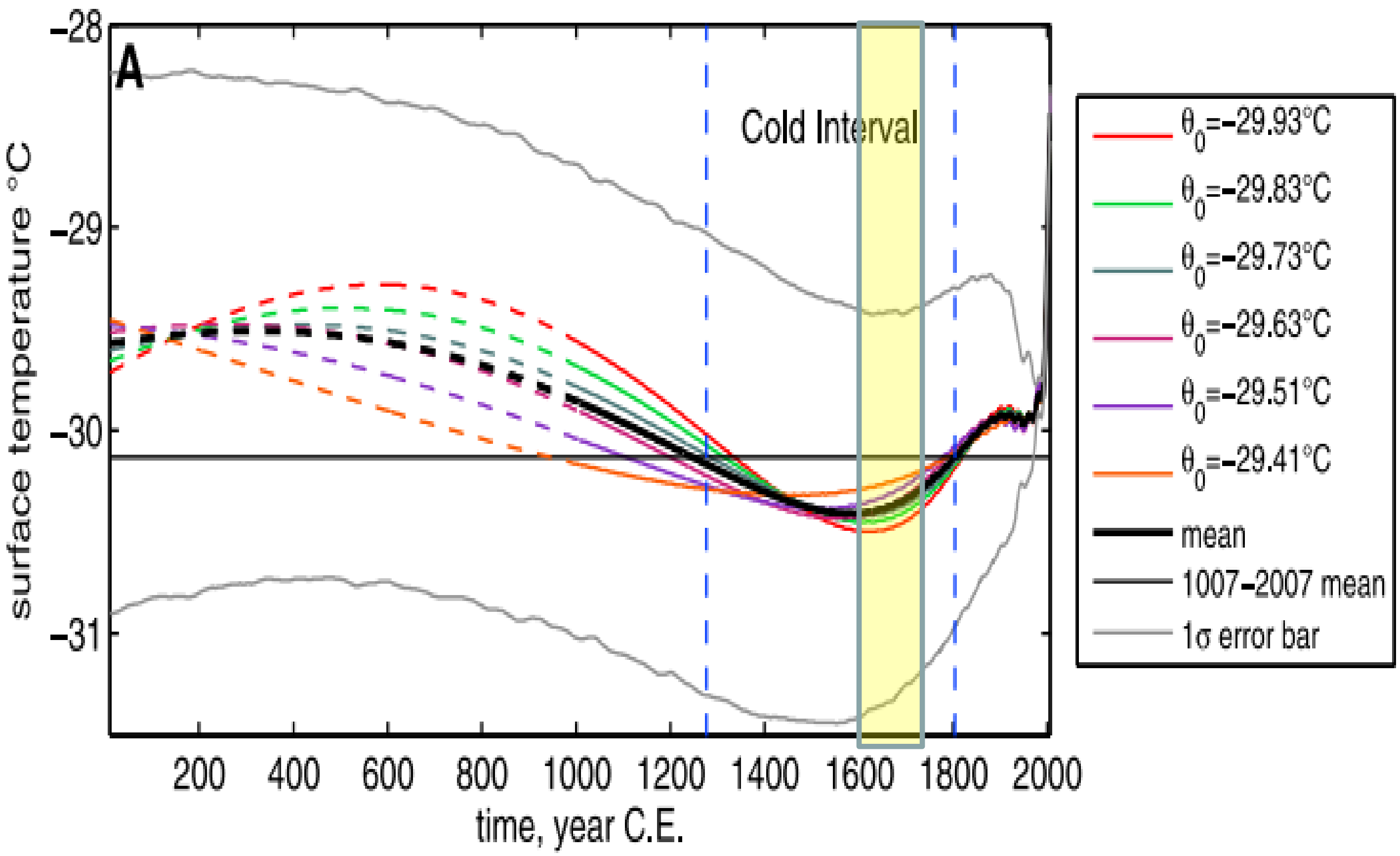
Figure 5 Comparison of Australian borehole reconstruction to Northern Hemisphere borehole reconstruction (Pollack and Smerdon, 2004)

Pollack et al. (2006) Journal of Quaternary Science, 21, 701-706

Evidence of colder temperature in West Antarctica during the LIA-Maunder Minimum?

Little Ice Age cold interval in West Antarctica: Evidence from borehole temperature at the West Antarctic Ice Sheet (WAIS) Divide

Anais J. Orsi,[1] Bruce D. Cornuelle,[1] and Jeffrey P. Severinghaus[1]



Orsi et al. (2012) Geophysical Research Letters, 39, L09710

https://twitter.com/AJamesMcCarthy/status/1638648459002806272 (March 22, 2023)

(3) The 17th century: What is not known and more to find out

What is climate?
What area of expertise does it required us to master?

An understanding of climate requires an amalgamation of mathematics, astronomy, solar physics, geology, geochronology, geochemistry, sedimentology, tectonics, palaeontology, paleoecology, glaciology, ***climatology, meteorology,*** *oceanography, ecology, archaeology and history.*

What is climate?
What area of expertise does it required us to master?

How about Volcanology and Plate Tectonics?

Evidence of cold+droughts and links to atmospheric circulation indices during Maunder Minimum?

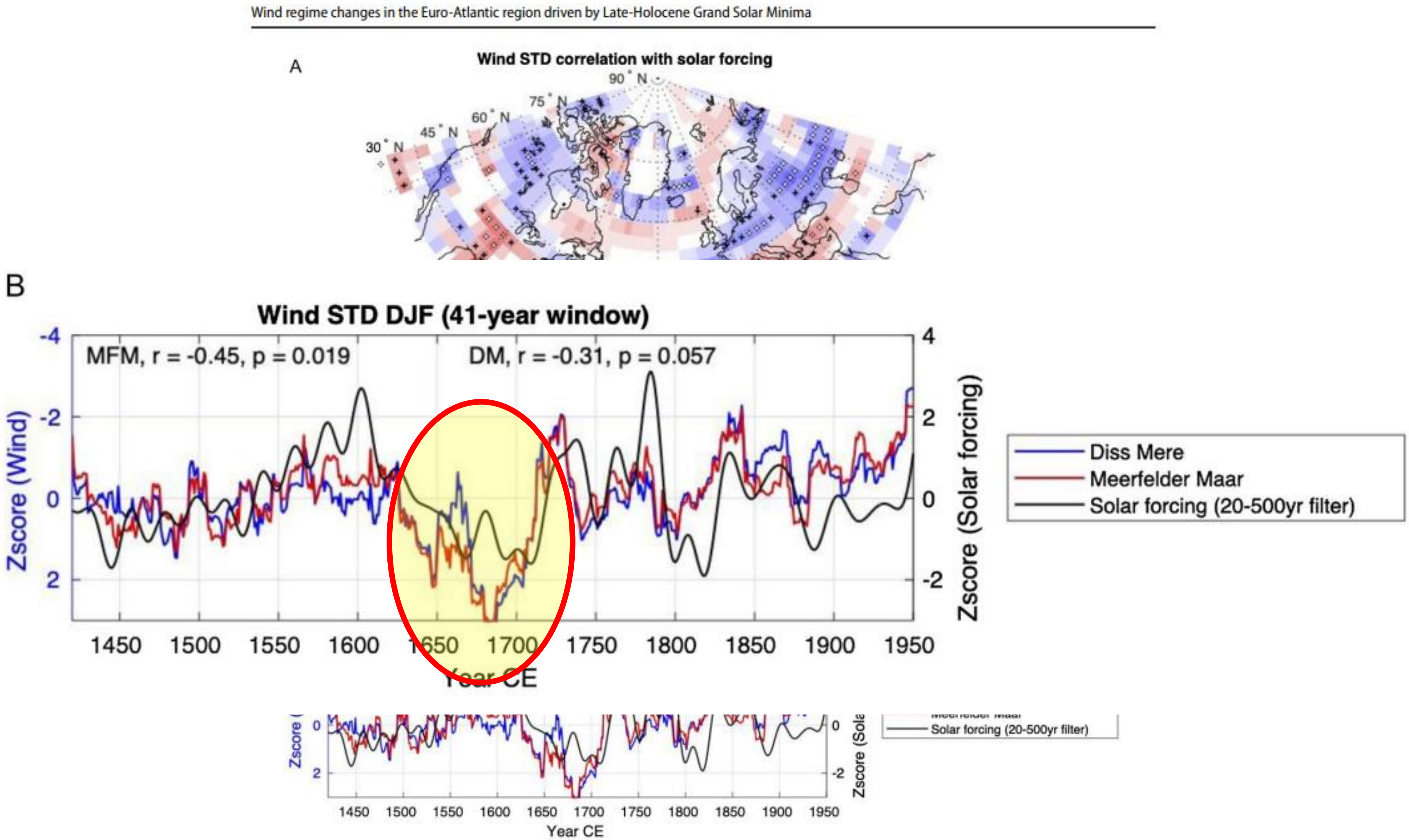
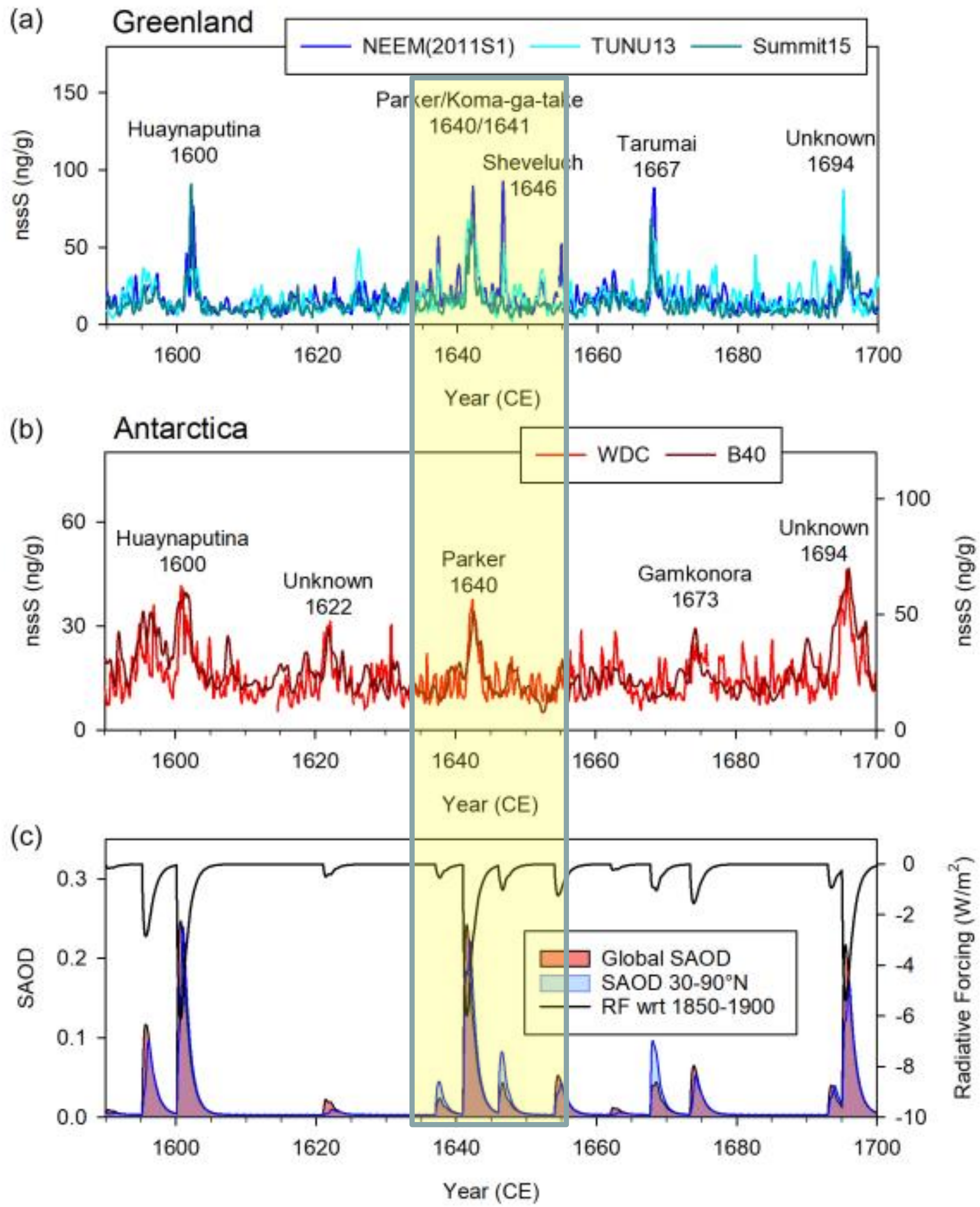


Fig. 5 Wind STD Climate Reconstruction for 1400–1970 CE derived from Sjolte et al. (2018): **a** Correlation between the moving 41-year standard deviation (STD) of the 850 mb wind and solar forcing (Brehm et al. 2021) (band-pass filtered for 60–500-year cycles) 1400–1970 CE. The white stippling indicates significant correlation $p < 0.05$, and black stippling indicates significant anomalies $p < 0.1$. **b** Time series of the moving 41-year STD of the 850 mb wind at Meerfelder Maar (MFM) and Diss Mere compared to solar forcing (Brehm et al. 2021). The significance is estimated taking autocorrelation into account (Ebisuzaki 1997)

Harding et al. (2023) Climate Dynamics, 60, 1947-1961

Volcanic Eruptions Identified in both Greenland and Antarctic Cores Before and During the Maunder Minimum?



Stoffel, Corona, Sigl et al. (2022) Climate of the Past, 18, 1083-1108

Volcanic Eruptions and Identified Cooling Dips in Northern Hemisphere Before and During the Maunder Minimum?

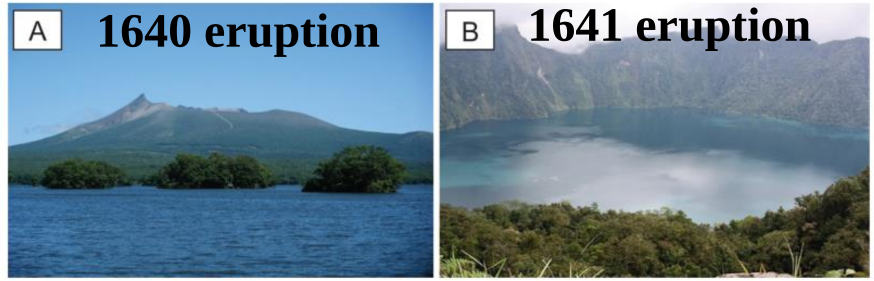


Figure 3. **(a)** Komaga-take volcano (Hokkaido, Japan) (source: 欅が撮影 Zelkova, CC BY-SA 3.0) as seen from Yakumo (in the NW); **(b)** Mount Parker (locally known as Mélébingóy), South Cotabato, Philippines (Source: Noriah Jane Lambayan, CC BY-SA 4.0).

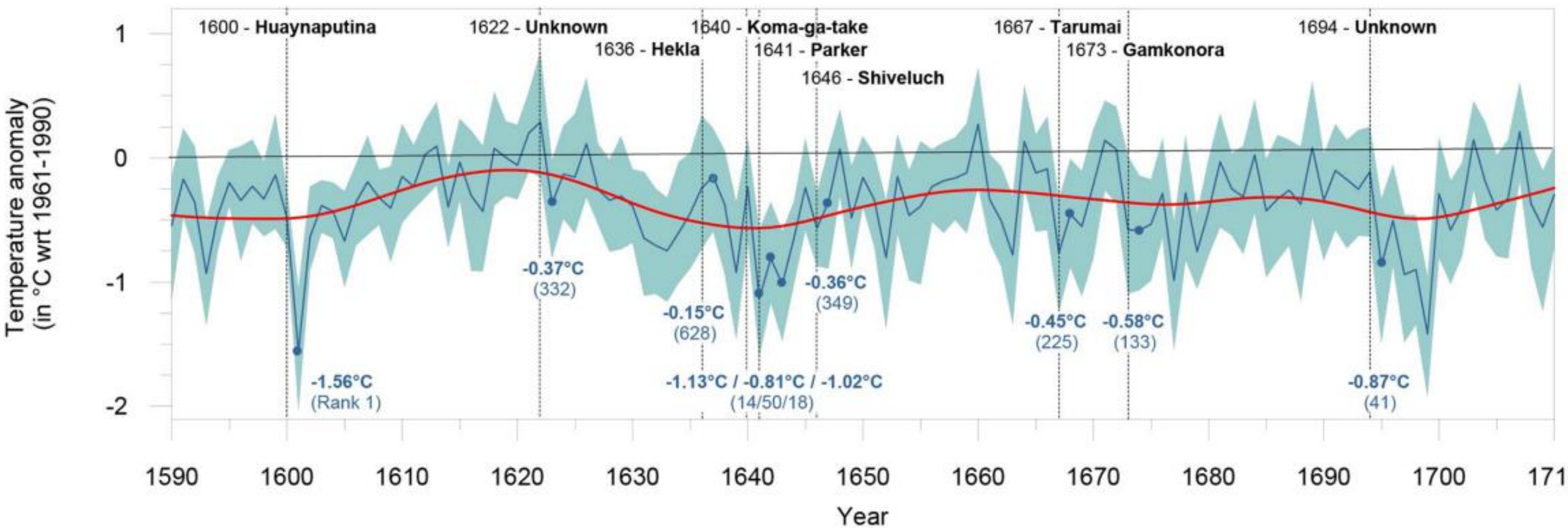


Figure 4. Tree-ring-based (NVOLC v2; Guillet et al., 2020) Northern Hemisphere (NH; 40–90° N) summer (JJA) temperature reconstruction of the 17th century with volcanic eruptions and the associated cooling highlighted with blue dots. The rank values (in parentheses) indicate the amount of cooling induced by the eruption compared to all cooling events recorded over the past 1500 years. Volcanic cooling is calculated for all major 17th-century eruptions: 1600 Huaynaputina, 1636 Hekla, 1640/41 Komaga-take/Mount Parker, 1646 Shiveluch, and the 1694 unidentified eruption(s).

Stoffel, Corona, Sigl et al. (2022) Climate of the Past, 18, 1083-1108

Can we see any evidence of the related effects of Sun-Planets Interactions (SPI) on Earth-bound matters/events:

Orbital-Seasonal Modulations of Volcanoes and Earthquakes?

Hunga-Tonga Hunga-Ha'apai volcanic eruption produced record-breaking lightning

Researchers found over 200,000 flashes of lightning during the Hunga volcano eruption in 2022, with as many as 2,600 flashes a minute at its peak.

John Loeffler

Created: Jun 23, 2023 05:36 PM EST

SCIENCE

Lightning during the Hunga volcano eruption in Tonga on January 15, 2022

NIWA New Zealand / YouTube

https://en.wikipedia.org/wiki/1883_eruption_of_Krakatoa

Krakatau on 14 July evening with a lava flow (?) on the southern flank (image: Andi Rosadi / VolcanoDiscovery Indonesia)

Volcanic Eruption, Mount Agung, Bali Indonesia Identified in During the late Maunder Minimum?

Mount Agung's
May 24, 2019 Eruptions

Table 2: List of chronicle entries for natural disasters from various Balinese chronicles.[66]

CE Dates	Volcano	Sources
circa 1612	Batur[67]	*Babad Bhumi* #62 & #109, *Korn 2* #23, *Korn 4* #24, *Korn 5* #52, *Pangrincik Babad* #31, *Tattwa Batur Kalawasan* #27
circa 1616	Agung	*Babad Gumi* #33 & #34, *Babad Bhumi* #57 & #110, *Korn 5* #54, *Babad Tusan* #29, *Tattwa Batur Kalawasan* #33, *Pangrincik Babad* #35
circa October–November 1665	Agung	*Babad Gumi* #54
November 20, 1683	Agung	*Babad Gumi* #65
February 10, 1696	Batur	*Babad Bhumi* #119, *Pasasangkalan* #15, *Korn 1* #78
October 12, 1703	Batur	*Pasasangkalan* #16, *Korn 1* #79
June 18, 1706	Batur	*Pawawatekan* #77
October 21, 1710 –February 1, 1711	Agung	*Babad Gumi* #77, *Pasasangkalan* #18, *Korn 1* #81
circa 1784	Batur	*Babad Bhumi* #128
June 13–21, 1820	Agung	*Babad Bhumi* #132, *Babad Bhumi* #133

Sastrawan (2022) Project MUSE, Indonesia Journal Cornell University Press, #113, 9-30

Volcanic Eruption, Mount Agung, Bali Indonesia Identified in During the late Maunder Minimum?

Impacts of Mount Agung's 1710-1711 Eruptions

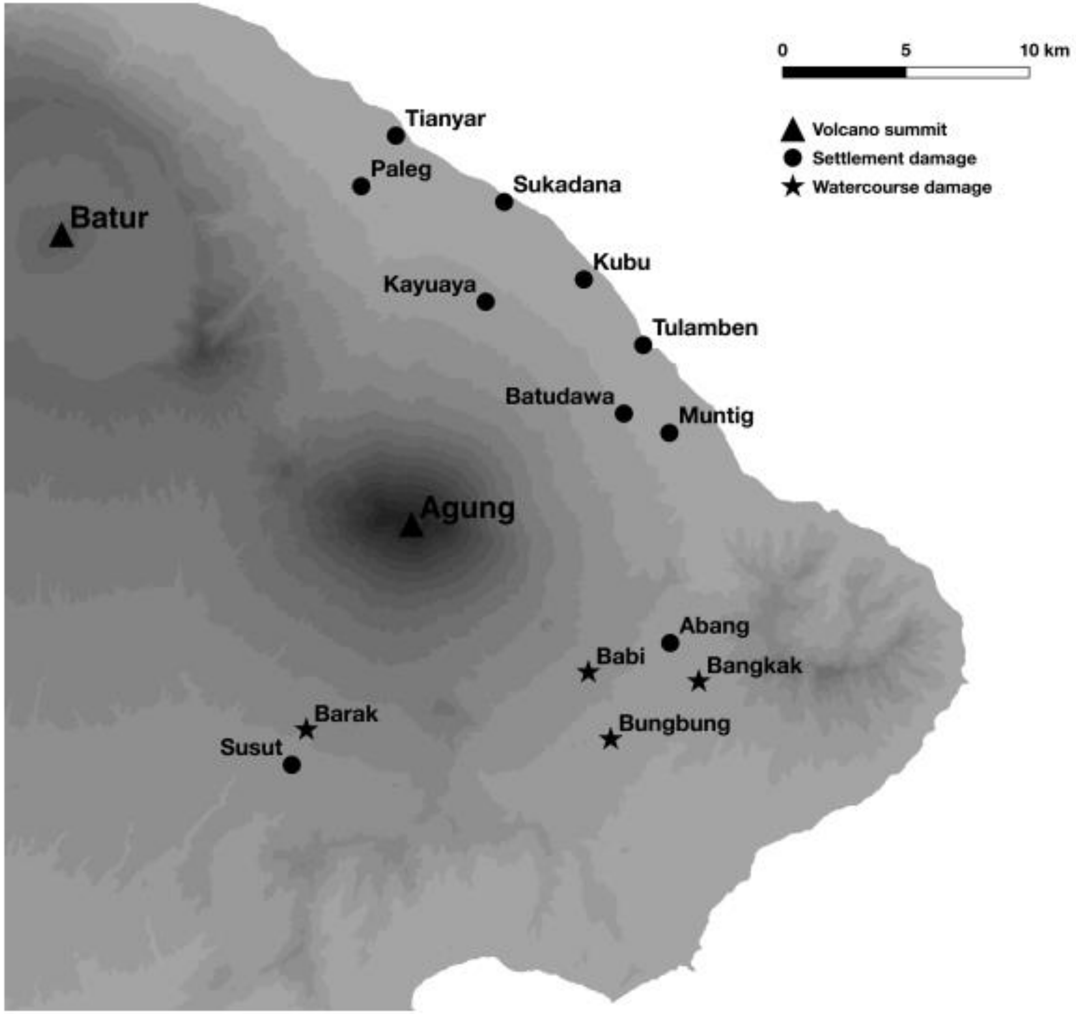


Figure 2: Map of the impacts of the 1710–11 eruption of Agung as mentioned in Balinese chronicles. Altitude is shaded in increments of 200 meters

Sastrawan (2022) Project MUSE, Indonesia Journal Cornell University Press, #113, 9-30

Volcanic Eruption, Mount Agung, Bali Indonesia Identified in During the late Maunder Minimum?

These descriptions of the 1710–11 eruption invite comparison with the famous 1963–64 eruption of Agung, which was the most powerful Indonesian eruption of the twentieth century.[77] A remarkable feature of the *Babad Gumi*'s description is its breakdown of the emergence of different volcanic products by date, essentially giving us a record of the 1710–11 eruption sequence. Balinese terms like "little stones" (*watu alit-alit*), "big stones" (*watu ageng-ageng*), "ash rain" (*udan awu*) and "sludge" (*nyanyad*) can be identified as typical products of this volcano in modern eruptions.[78] Of particular interest is the chronicle's claim that the first observed phenomenon was that the mountain "began to burn" (*mimiti geseng*) on October 21, 1710. Similarly, lava was the first major product to be observed on February 18, 1963.[79] Such detailed information on the 1710–11 eruption sequence can be used in conjunction with stratigraphic and other kinds of scientific analysis to better discern historical patterns in Agung's eruptive behavior.

The extent and severity of damage caused by Agung's eighteenth-century eruption was similar to that of the twentieth-century eruption. The chronicle's estimated death toll of "more than 600" in 1710–11 is comparable, as a proportion of total population, to the 1963–64 toll of approximately 1,700 deaths.[80] Most of the villages where the chronicles report deaths are located to the northeast of the Agung summit, overlapping closely with areas affected by pyroclastic and lahar flows in 1963. The chronicles describe flash flooding and damage to irrigation systems along rivers that flow southeast and southwest, mapped in Figure 2. The damage to farms, gardens, and waterworks is strongly emphasized in these accounts, since it directly threatened food security in the affected districts. These descriptions confirm that the 1710–11 eruption was a major event, which prompts us to reevaluate the geological data for Agung's early modern eruption history.

Sastrawan (2022) Project MUSE, Indonesia Journal Cornell University Press, #113, 9-30

The relationship between climate change and volcanic activity: A new paradigm

Bulletin of Volcanology (2022) 84: 58
https://doi.org/10.1007/s00445-022-01562-8

PERSPECTIVES

Check for updates

Impact of climate change on volcanic processes: current understanding and future challenges

Thomas J. Aubry[1,2] · Jamie I. Farquharson[3] · Colin R. Rowell[4] · Sebastian F. L. Watt[5] · Virginie Pinel[6] · Frances Beckett[7] · John Fasullo[8] · Peter O. Hopcroft[5] · David M. Pyle[9] · Anja Schmidt[1,10,11,12] · John Staunton Sykes[10]

Received: 7 October 2021 / Accepted: 29 March 2022 / Published online: 18 May 2022

Aubry et al. (2022) Bulletin of Volcanology, 84, #58

The relationship between climate change and volcanic activity: A new review

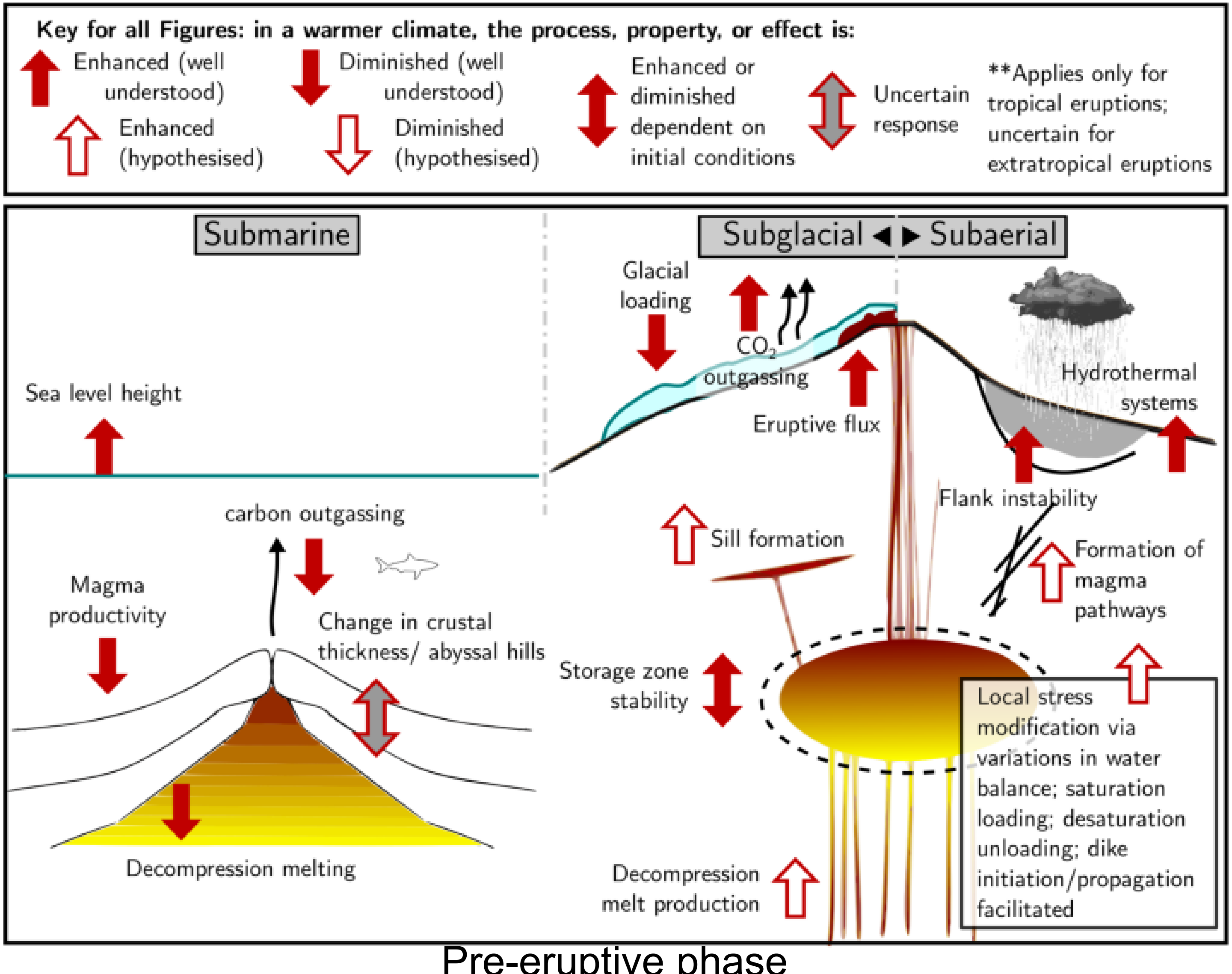


Fig. 1 Schematics illustrating climate-volcano impacts associated with pre-eruptive processes ("Climate-volcano impacts affecting pre-eruptive processes" section) and how they are expected to unfold in the context of a warming climate

Aubry et al. (2022) Bulletin of Volcanology, 84, #58

https://www.dailymail.co.uk/sciencetech/article-12111625/The-red-sun-wildfires-Canada.html (May 22, 2023)

What about volcanic eruptions?
Any evidence for
orbital-seasonal modulation
or signals on volcanic activity?

Evidence for tidal/sea level triggering of volcanic eruptions

Seasonality of volcanic eruptions

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BP Institute for Multiphase Flow, Cambridge University, Cambridge, UK

Received 5 November 2002; revised 10 March 2004; accepted 16 March 2004; published 27 April 2004.

[1] An analysis of volcanic activity during the last three hundred years reveals that volcanic eruptions exhibit seasonality to a statistically significant degree. This remarkable pattern is observed primarily along the Pacific "Ring of Fire" and locally at some individual volcanoes. Globally, seasonal fluctuations amount to 18% of the historical average monthly eruption rate. In some regions, seasonal fluctuations amount to as much as 50% of the average eruption rate. Seasonality principally reflects the temporal distribution of the smaller, dated eruptions (volcanic explosivity index of 0–2) that dominate the eruption catalog. We suggest that the pattern of seasonality correlates with the annual Earth surface deformation that accompanies the movement of surface water mass during the annual hydrological cycle and illustrate this with respect to global models of surface deformation and regional measurements of annual sea level change. For example, seasonal peaks in the eruption rate of volcanoes in Central America, the Alaskan Peninsula, and Kamchatka coincide with periods of falling regional sea level. In Melanesia, in contrast, peak numbers of volcanic eruptions occur during months of maximal regional sea level and falling regional atmospheric pressure. We suggest that the well-documented slow deformation of Earth's surface that accompanies the annual movements of water mass from oceans to continents acts to impose a fluctuating boundary condition on volcanoes, such that volcanic eruptions tend to be concentrated during periods of local or regional surface change rather than simply being distributed randomly throughout the year. Our findings have important ramifications for volcanic risk assessment and volcanoclimate feedback mechanisms. *INDEX TERMS:* 5480 Planetology: Solid Surface Planets: Volcanism (8450); 5499 Planetology: Solid Surface Planets: General or miscellaneous; 7299 Seismology: General or miscellaneous; *KEYWORDS:* periodicity volcano, Earth's shape, mass redistribution

Citation: Mason, B. G., D. M. Pyle, W. B. Dade, and T. Jupp (2004), Seasonality of volcanic eruptions, *J. Geophys. Res.*, *109*, B04206, doi:10.1029/2002JB002293.

Evidence for tidal/sea level triggering of volcanic eruptions: 300-year Statistics

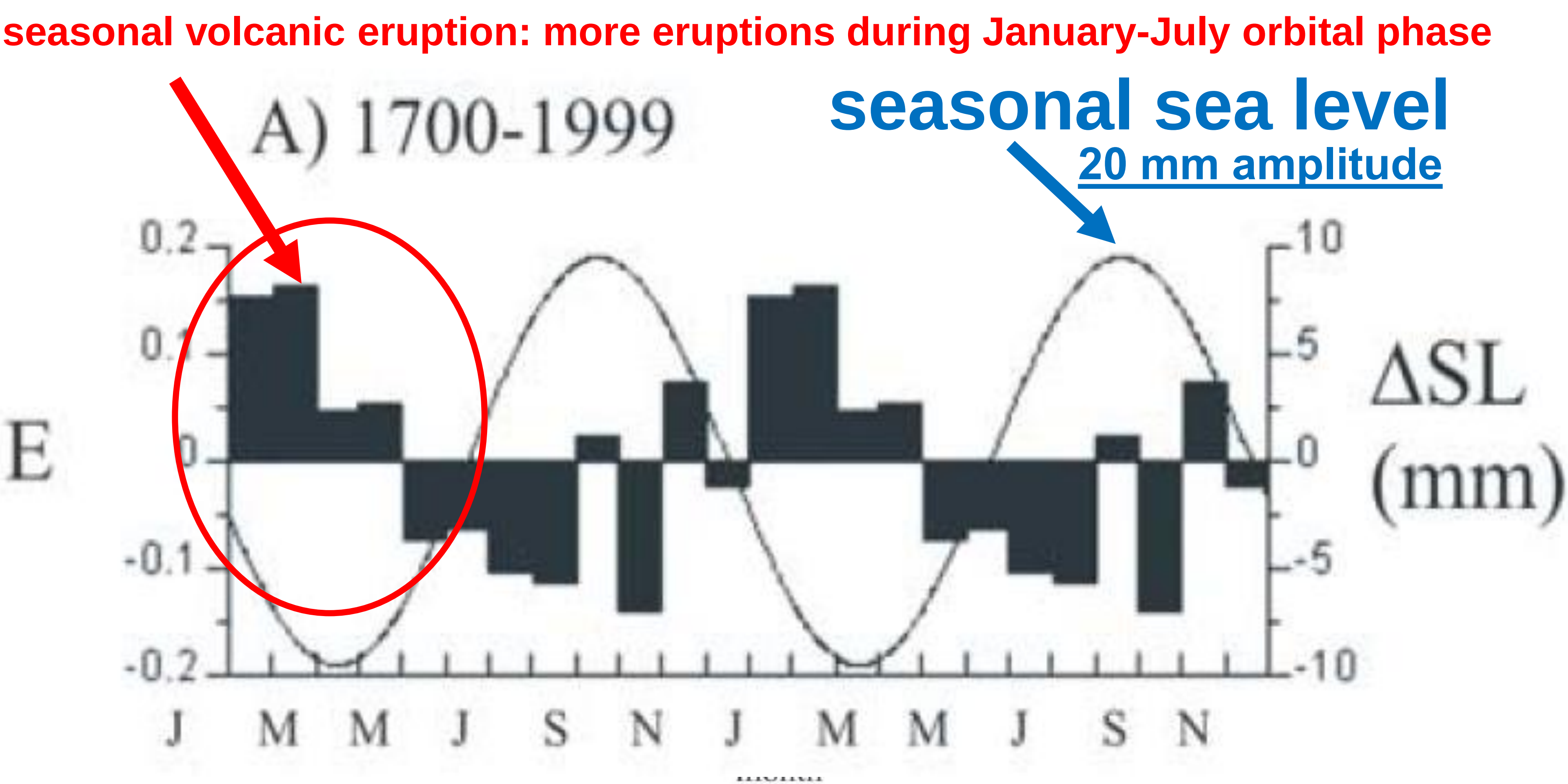
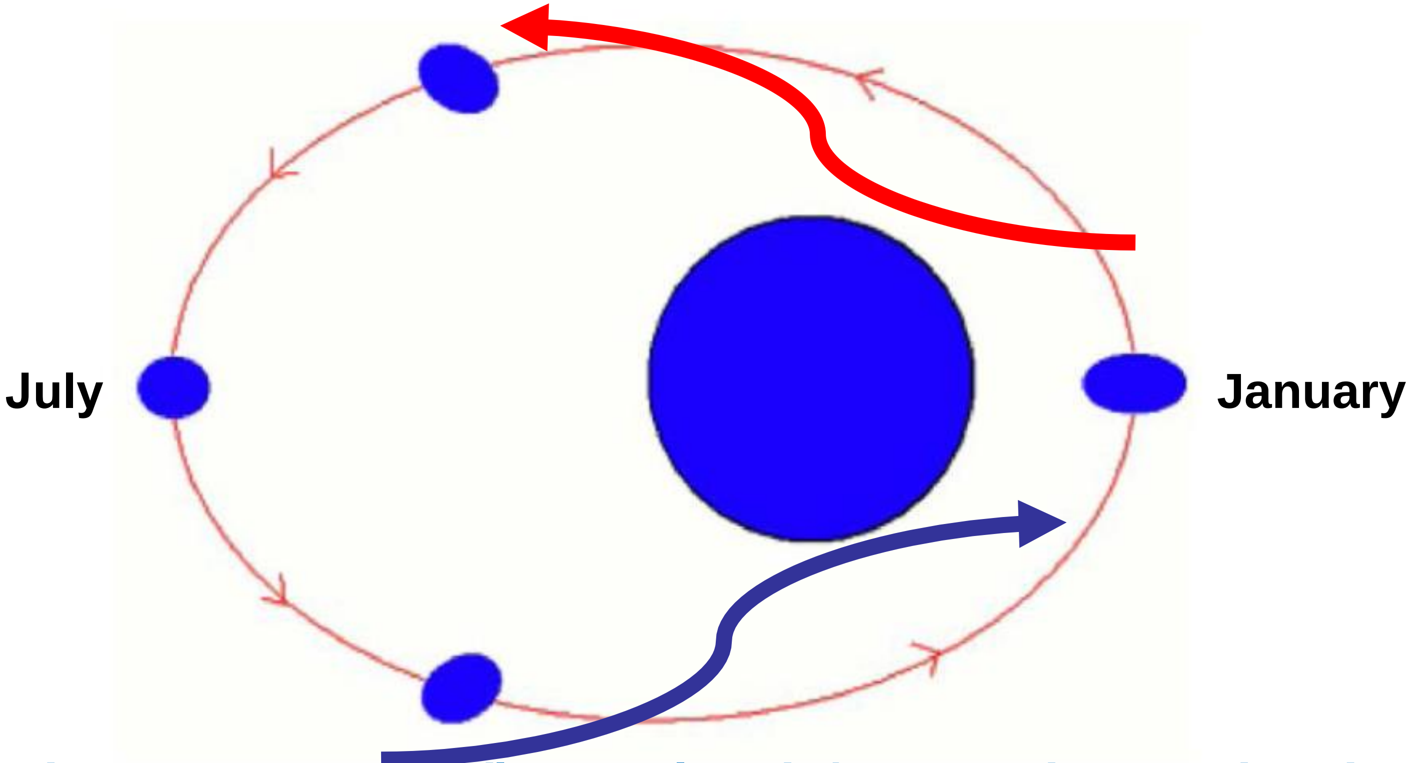


Figure 3. Monthly anomalies E_i of worldwide volcanic eruption rate during period (a) 1700–1999, (b) 1700–1899 only, and (c) 1900–1999 only. Anomalies represent the number of eruptions in a given month above or below the average monthly value m and normalized by m (see section 2). The solid lines indicate the annual cycle in global sea level observed with satellite altimetry [*Minster et al.*, 1999] (see Table 2). Note that the horizontal axes span 24 months to aid in the visualization of annual patterns.

Evidence for tidal/sea level triggering of volcanic/magmatic eruptions

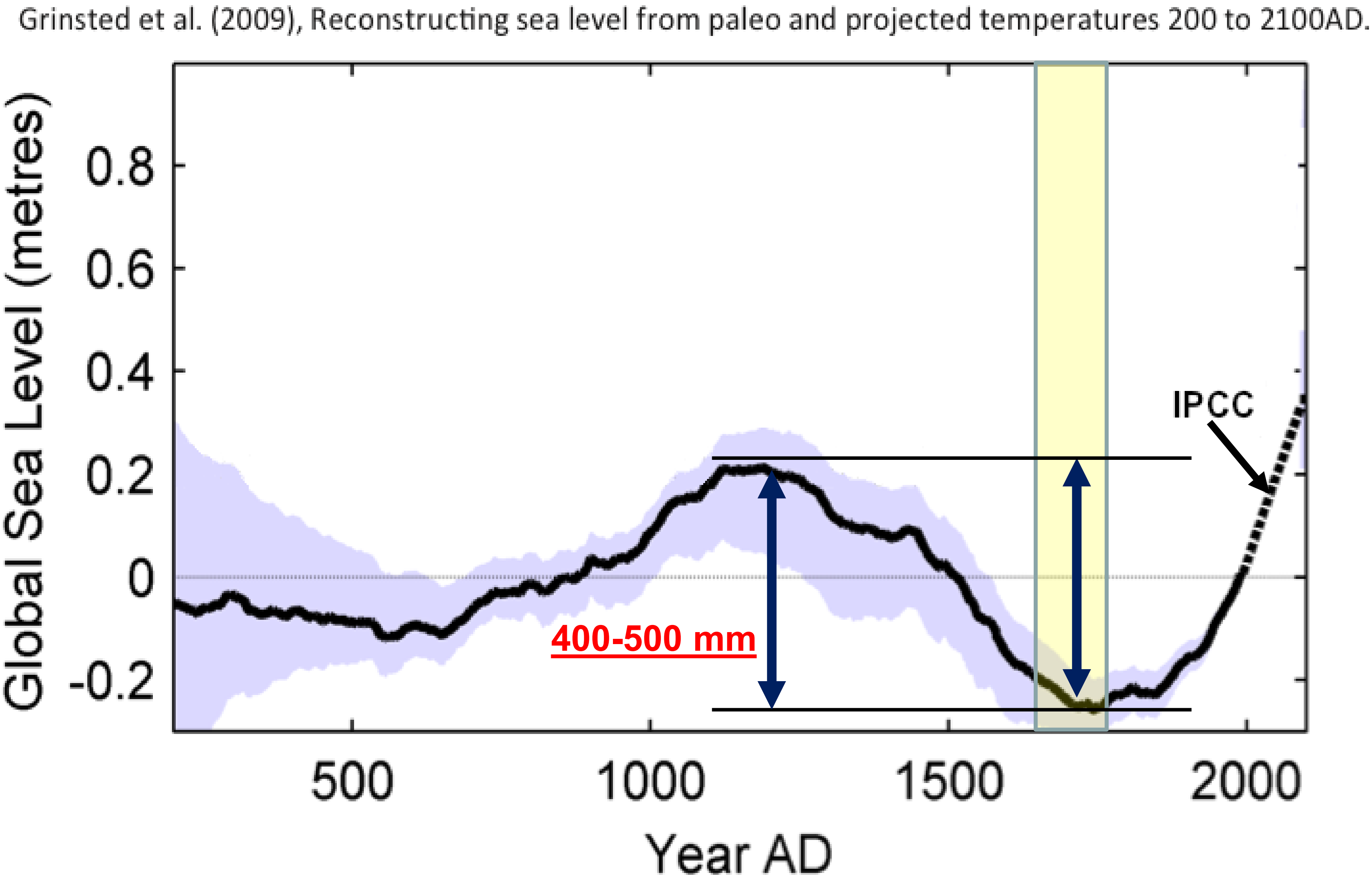
Towards maximum relaxation of stresses (more volcanic/magmatic eruptions)



Towards maximum squeezing (less volcanic/magmatic eruptions)

Figure S4. From response to reviewer:
Figure illustrates deformation of an orbiting body associated with orbital eccentricity.
Adapted from: http://large.stanford.edu/courses/2007/ph210/pavlichin2/
Early January is the to the right and early July is to the left (greatly exaggerated). In January the squeezing is maximized, but the impact of this on the stress field will vary as Earth rotates on its own axis. As Earth moves further away from the sun, there will be a relaxing of the squeezing stresses, and it appears that this is the most likely time for seafloor eruptions to occur.

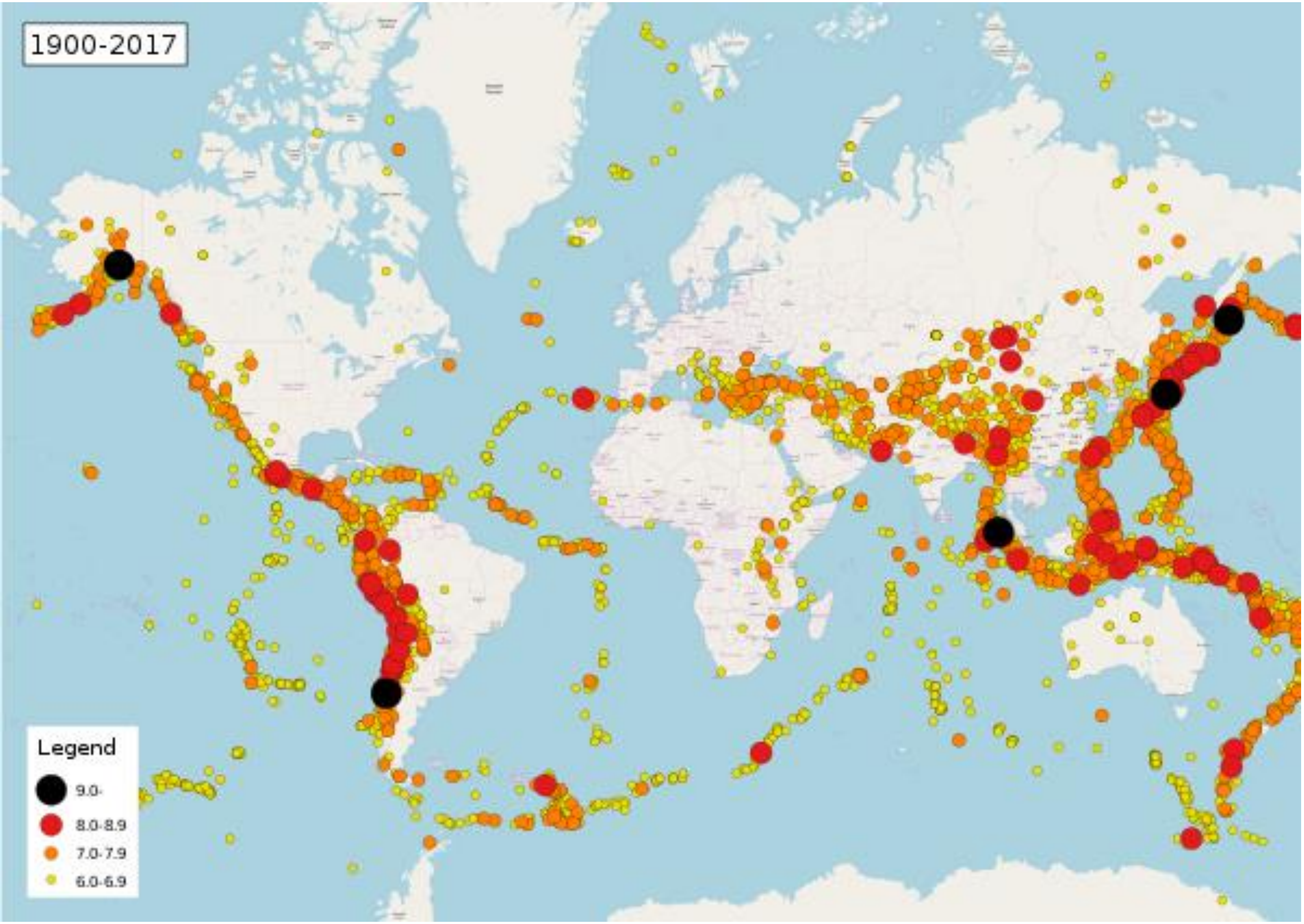
Implication of substantial global sea level lowering during the Maunder Minimum



Grinsted et al. (2010) Climate Dynamics, 34, 461-472

What about earthquakes?
Any evidence for
orbital-seasonal modulation
or signals on earthquake
activity?

A discussion of solar, climatic and tectonic/magmatic relations



https://en.wikipedia.org/wiki/Lists_of_earthquakes

A discussion of solar, climatic and tectonic/magmatic relations

21 major earthquake events in the 17th century

Date	Time‡	Place	Lat	Long	Fatalities	Mag.		Comments	Sources
24 November 1604	12:30 local time	Arica, Chile *see* 1604 Arica earthquake	-18.500	-70.400	?	8.5	M_I		[63]
3 February 1605	20:00 local time	Shikoku, Honshu, Japan *see* 1605 Keichō earthquake	33.5	138.5	thousands	7.9	M_s		[64]
13 July 1605	[illegible]	Qiongshan, [illegible]ainan, [illegible] *see* 1[illegible] Guangdon[illegible] earthquake[illegible]	19.9	11[illegible]	[illegible]00	[illegible]	[illegible]	[illegible]	[illegible]
25 October 1622	[illegible]	[illegible]ingxia, C[illegible] *see* 1622 North Guyuan earthquake	36.5	106.3	12,000	7.0	M_s		[66]
1 August 1629		Banda Sea, Indonesia *see* 1629 Banda Sea earthquake	-4.6	129.9	0	8.2-8.8	M_w	[illegible]	[67]
13 September 1692	11:00	Salta Province, Argentina *see* 1692 Salta earthquake	−25.40	−64.80	~13	7.0		The small village of Talavera del Esteco was completely destroyed.	[73]
7 June 1692	11:43 local time	Port Royal, Jamaica *see* 1692 Jamaica earthquake	17.9[illegible]	[illegible]8	[illegible]000+	7 [illegible]	[illegible]	[illegible]	[illegible][75]
11 January 1693		Catania Province, Sicily *see* 1693 Sicily earthquake	[illegible]	[illegible]	60,000	7.5			
5 September 1694	11:40	Irpinia, Italy *see* 1694 Irpinia–Basilicata earthquake	40.88	15.35	6,000	6.9	M_w		[76]
18 May 1695	12:00	Shanxi, Qing dynasty *see* 1695 Linfen earthquake	36.0	111.5	52,600–176,365	7.8	M_w		[77]
5 January 1699		Batavia, Dutch East Indies (now Jakarta, Indonesia) *see* 1699 Java earthquake	6.078	105.913	128	7.4–8.0	M_w		

Date	Time‡	Place	Lat	Long	Fatalities	Mag.		Comments	Sources
27 March 1638		Calabria, Kingdom of Sicily (present-day Italy) *see* 1638 Calabrian earthquakes	38.64	15.78	9,581–30,000	7.1		A sequence of four earthquakes.	[68]
27 March 1638	night	Tabriz, Iran *see* 1641 Tabri[illegible] ea[illegible]uake	37.9	46.1	12,613–30,000	6.8	M_s		
[illegible] Febr[illegible]	1[illegible] lo[illegible] ti[illegible]	Qu[illegible]c, Ca[illegible]a se[illegible]63 Cha[illegible]x earthquake	47.6	70.[illegible]	[illegible]	7.3	[illegible]	L[illegible]slides[illegible]e th[illegible]ma[illegible]ature[illegible]	[69]
6 April 1[illegible]67		Dubrovnik, Croatia *see* 1667 Dubrovnik earthquak[illegible]	42.3	18.1	3,000	7.2			[70]
[illegible]mb[illegible] 1667		Shamakhi, Azerbaijan *see* 1667 Shamakhi earthquake	4[illegible]	4[illegible]	80,000	6.9	M_s		[43]
25 July 16[illegible]		Shandong, China *see* 1668 [illegible]ando[illegible] [illegible]hqu[illegible]	35.3	[illegible].6	42,578	8.5		Largest earthquake in East China.	[71]
17 August 1668		Anatolia[illegible] [illegible]rkey *see* 1668 North Anatolia earthquake	40	36	8,000	8		Larg[illegible] earthquake in Turkey.	USGS
17 February 1674	19:30	Ambon, Dutch East Indies (now Indonesia) *see* 1674 Ambon earthquake and megatsunami	3.75	127.75	2,347	6.8		Major tsunami up to 100 meters high. First and largest ever documented tsunami in Indonesia.	
20 October 1687	11:30	Lima, Peru *see* 1687 Peru earthquake	−15.2	−75.9	5,000	8.2			[21]
5 June 1688		Province of Benevento, Italy *see* 1688 Sannio earthquake	41.3	14.6	est. 10,000	7		Completely destroyed Cerreto Sannita and Guardia Sanframondi, heavily damaged Benevento.	[72]

Geophysical Research Letters

RESEARCH LETTER

10.1002/2015GL065088

Key Points:
- Large deep-focus earthquakes have exhibited strong and unexpected seasonality
- The seasonality appears strongest in the northwest Pacific and South American subduction zones
- We make a testable prediction of seasonality in future large deep earthquakes

Supporting Information:
- Figures S1–S4 and Table S1

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Z. Zhan,
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Possible seasonality in large deep-focus earthquakes

Zhongwen Zhan[1,2] **and Peter M. Shearer**[1]

[1]Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California, USA, [2]Now at Seismological Laboratory, California Institute of Technology, Pasadena, California, USA

Abstract Large deep-focus earthquakes (magnitude > 7.0, depth > 500 km) have exhibited strong seasonality in their occurrence times since the beginning of global earthquake catalogs. Of 60 such events from 1900 to the present, 42 have occurred in the middle half of each year. The seasonality appears strongest in the northwest Pacific subduction zones and weakest in the Tonga region. Taken at face value, the surplus of northern hemisphere summer events is statistically significant, but due to the ex post facto hypothesis testing, the absence of seasonality in smaller deep earthquakes, and the lack of a known physical triggering mechanism, we cannot rule out that the observed seasonality is just random chance. However, we can make a testable prediction of seasonality in future large deep-focus earthquakes, which, given likely earthquake occurrence rates, should be verified or falsified within a few decades. If confirmed, deep earthquake seasonality would challenge our current understanding of deep earthquakes.

Large (M>7) and Deep-depth (> 500 km) Earthquakes: Evidence for seasonal modulation

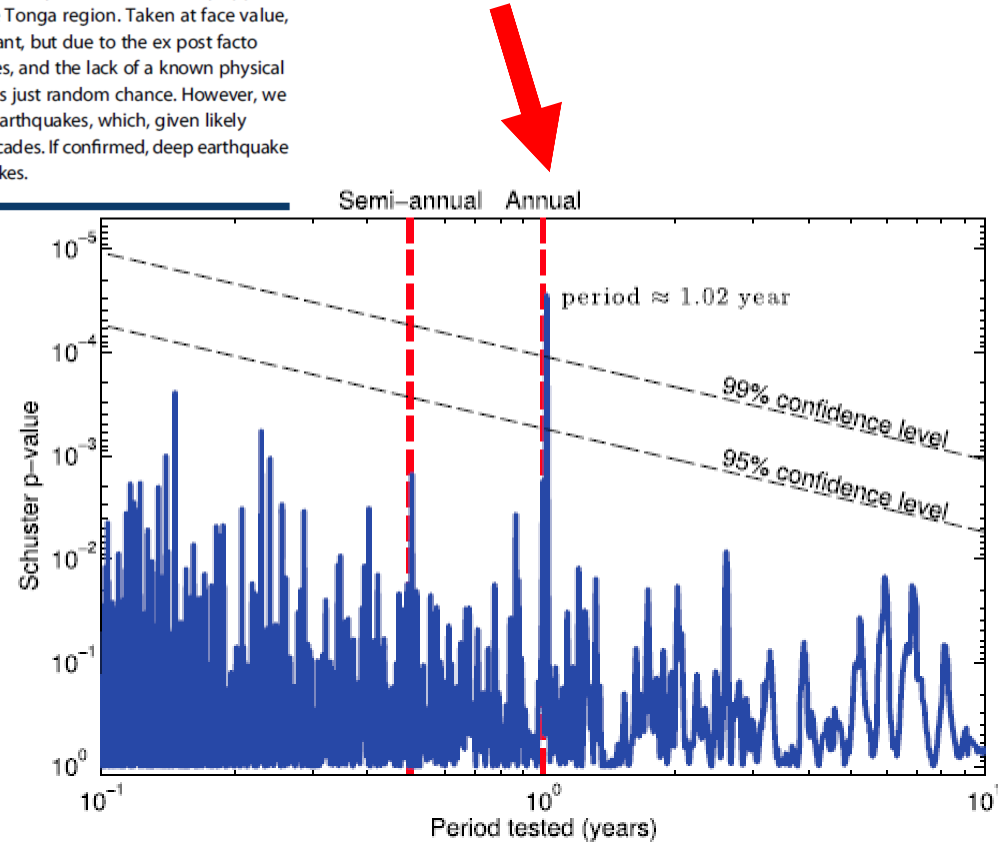


Figure 2. Schuster spectrum of large ($M_W \geq 7.0$) deep-focus (depth > 500 km) earthquakes. We compute p values for periods sampled densely from 0.1 year to 10 years. The 95% and 99% confidence levels as a function of period are plotted as the thin dashed lines. The only significant peak coincides with the annual period (the right thick dashed line).

Evidence of Snow Load and Seasonal Variation of inland Large Earthquakes around NE Japan

Large Earthquakes (M>7) that are dependent on snow loading and unloading stresses

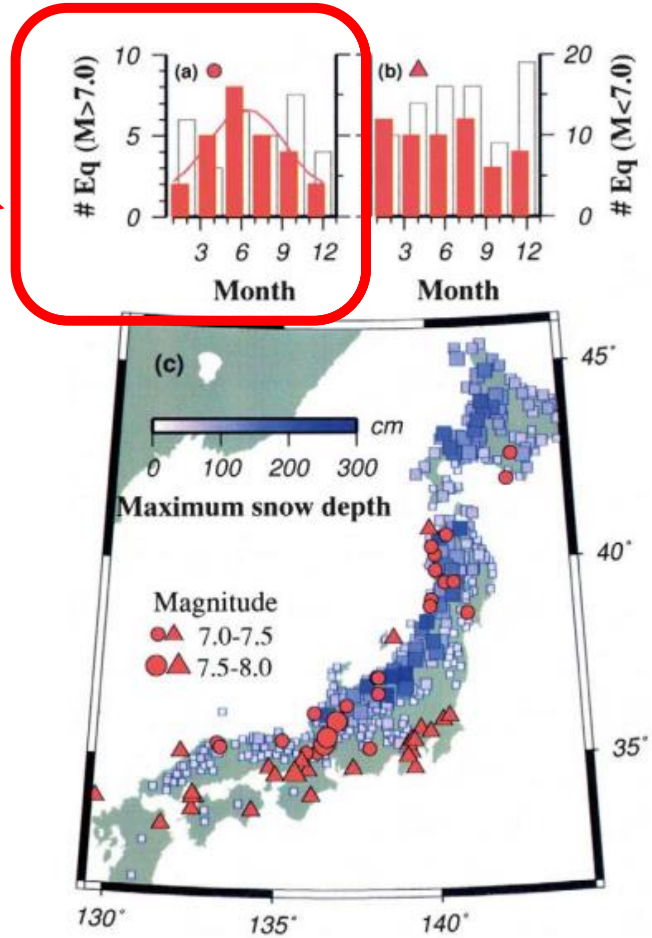


Fig. 4. Histograms showing number of earthquakes occurred in 2-month intervals, within (a) and outside (b) the snowy region. Red and white histograms show $M \geq 7.0$ (axis/label to the left) and $7.0 > M \geq 6.0$ (axis/label to the right) earthquakes, respectively. In (c) blue squares show maximum snow depths in a winter at AMeDAS stations (only points with snows deeper than 20.0 cm are shown). Epicenters of $M \geq 7.0$ earthquakes are shown in (c) as circles (snowy region) and triangles (outside). Red curve in (a) is the best-fit probability density function of the earthquake occurrence based on the two-component (stationary and annual components) model [7].

Heki (2003) Earth and Planetary Science Letters, 207, 159-164

Evidence of Seasonality of Seismicity in the Himalaya of Nepal

GEOPHYSICAL RESEARCH LETTERS, VOL. 34, L08304, doi:10.1029/2006GL029192, 2007

Seasonal modulation of seismicity in the Himalaya of Nepal

L. Bollinger,[1] F. Perrier,[2] J.-P. Avouac,[3] S. Sapkota,[4] U. Gautam,[4] and D. R. Tiwari[4]

[1] For the period 1995–2000, the Nepal seismic network recorded 37 ± 8% fewer earthquakes in the summer than in the winter; for local magnitudes ML > 2 to ML > 4 the percentage increases from 31% to 63% respectively. We show the probability of observing this by chance is less than 1%. We find that most surface loading phenomena are either too small, or have the wrong polarity to enhance winter seismicity. We consider enhanced Coulomb failure caused by a pore-pressure increase at seismogenic depths as a possible mechanism. For this to enhance winter seismicity, however, we find that fluid diffusion following surface hydraulic loading would need to be associated with a six-month phase lag, which we consider to be possible, though unlikely. We favor instead the suppression of summer seismicity caused by stress-loading accompanying monsoon rains in the Ganges and northern India, a mechanism that is discussed in a companion article. **Citation:** Bollinger, L.,

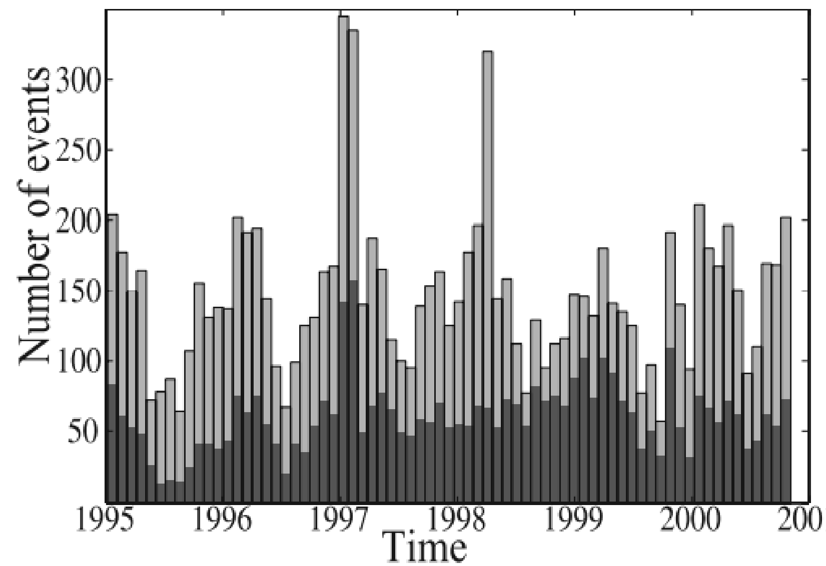
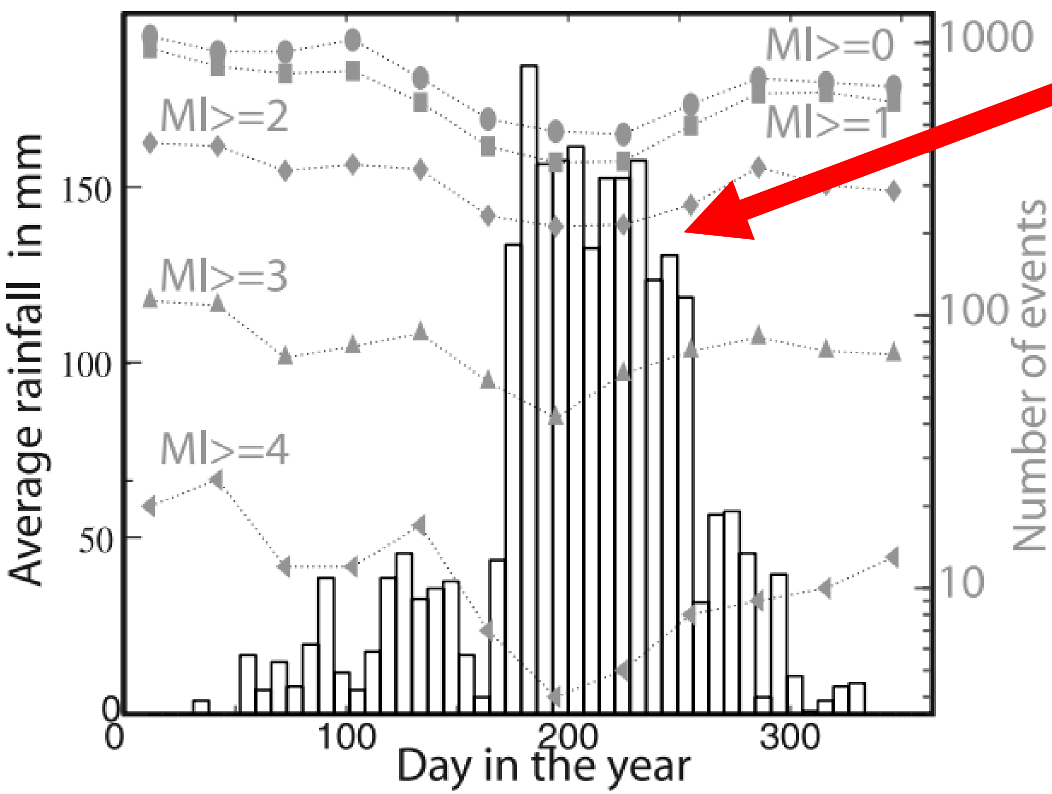


Figure 2. Variations in numbers of earthquakes each month for all magnitudes (grey) and ML > 2.5 (black) in the period 1995–2001. An annual cycle is evident with peak numbers occurring in the winter months between January and March each year.

Bollinger et al. (2007) Geophysical Research Letters, 34, 2006GL029192

Evidence of Seasonality of Rainfall + Seismicity in the Himalaya of Nepal



"Maximum precipitation corresponds to minimum earthquake activity in all magnitude bands with no discernable lag or lead"

Figure 4. Eight day averages for rainfall for 1998 (vertical bars, rainfall data from http://hydro.iis.u-tokyo.ac.jp/GAME-T/GAIN-T/routine/nepal/) compared to monthly averages for numbers of earthquakes in different magnitude ranges (symbols) averaged over the period range 1995 to 2000. Maximum precipitation corresponds to minimum earthquake activity in all magnitude bands with no discernable lag or lead.

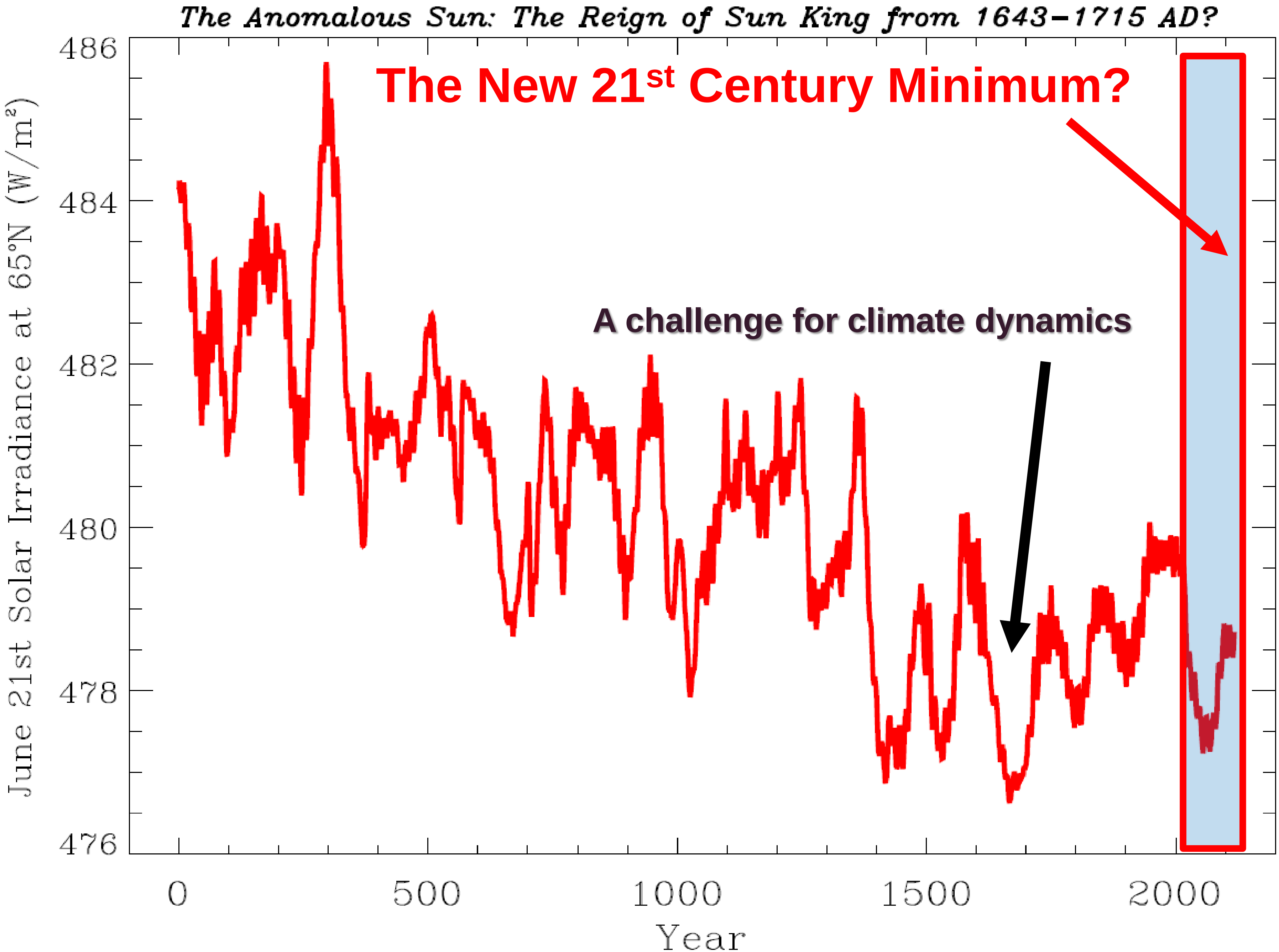
Bollinger et al. (2007) Geophysical Research Letters, 34, 2006GL029192

Three overall conclusions of this talk

1. The evidence for the solar Maunder Minimum interval of 1645-1715 is strong and robust.

2. The broadest possible scientific research agenda to understand the Maunder Minimum and Little Ice Age can be proposed in terms of the unified framework involving historical-societal-solar-orbital-meteorological-climatic-volcanic-tectonic relation.

3. The overall cold with extreme hydrologic conditions (leading to all the dramatic social-political turmoils and crises) during the 17th century of the Little Ice Age is confirmed.



Roldolfo G. Cionco and Willie Soon (2017-2022)

Global Societal Crises of the 17th Century: Perspectives from Research on Sun-Earth Relations

Willie Soon[1] (willie@ceres-science.com)

(with thanks to Victor Velasco Herrera, Gustavo Cionco and Douglas Hoyt)

DDP, Tucson: July 7-9, 2023

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[1]All Views Expressed Are Strictly My Own and Should Be Yours Too