

Data-led Study on the Sun-Earth Variability and its Relationship to Socio- Economic Activity in 18th-19th Centuries including the Dalton Minimum

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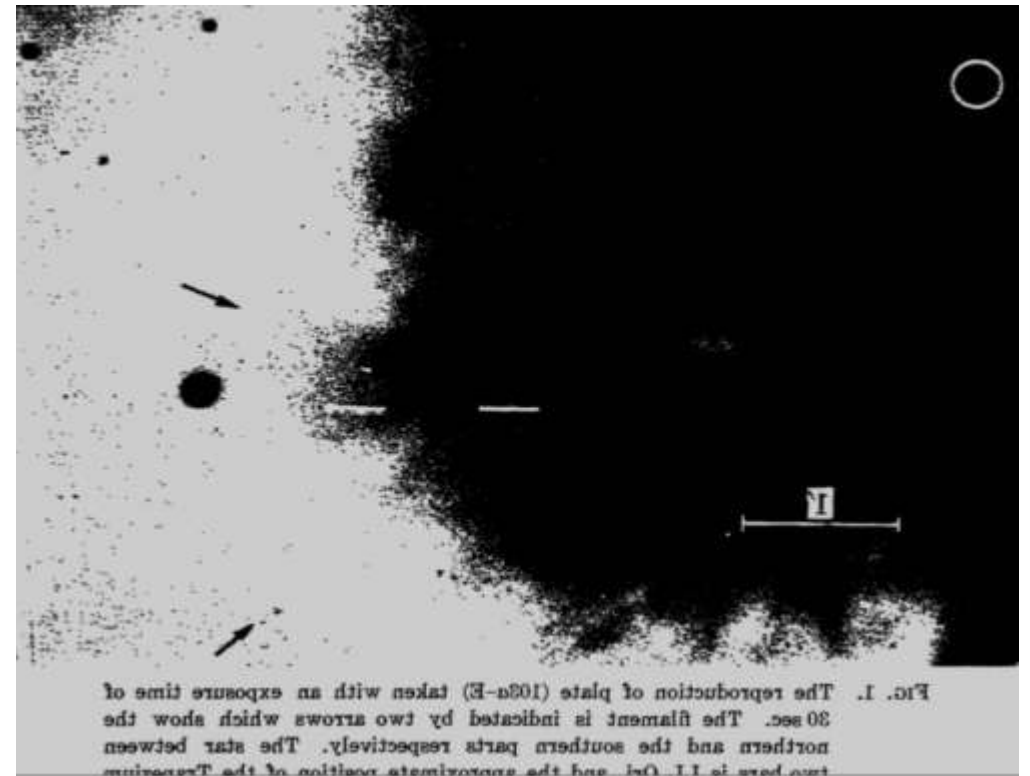
WDC for Cosmic Rays, Nagoya University



Interaction between the stellar wind of a T-Tau type young star (LL Ori) with the expanding plasma of the Orion Nebula (M41)



Ohtani, H., Watanabe, T., Oka, S. (1967), "A Fine Structure of New Class in the Orion Nebula", Publ. Astron. Soc. Japan, **19**, 274.



WDS 2020: Global Collaboration on Data beyond Disciplines (tentative)

**Tokyo, Japan
3-4 days in Nov. 2020 (TBD)**

Promoting bodies (tentative)

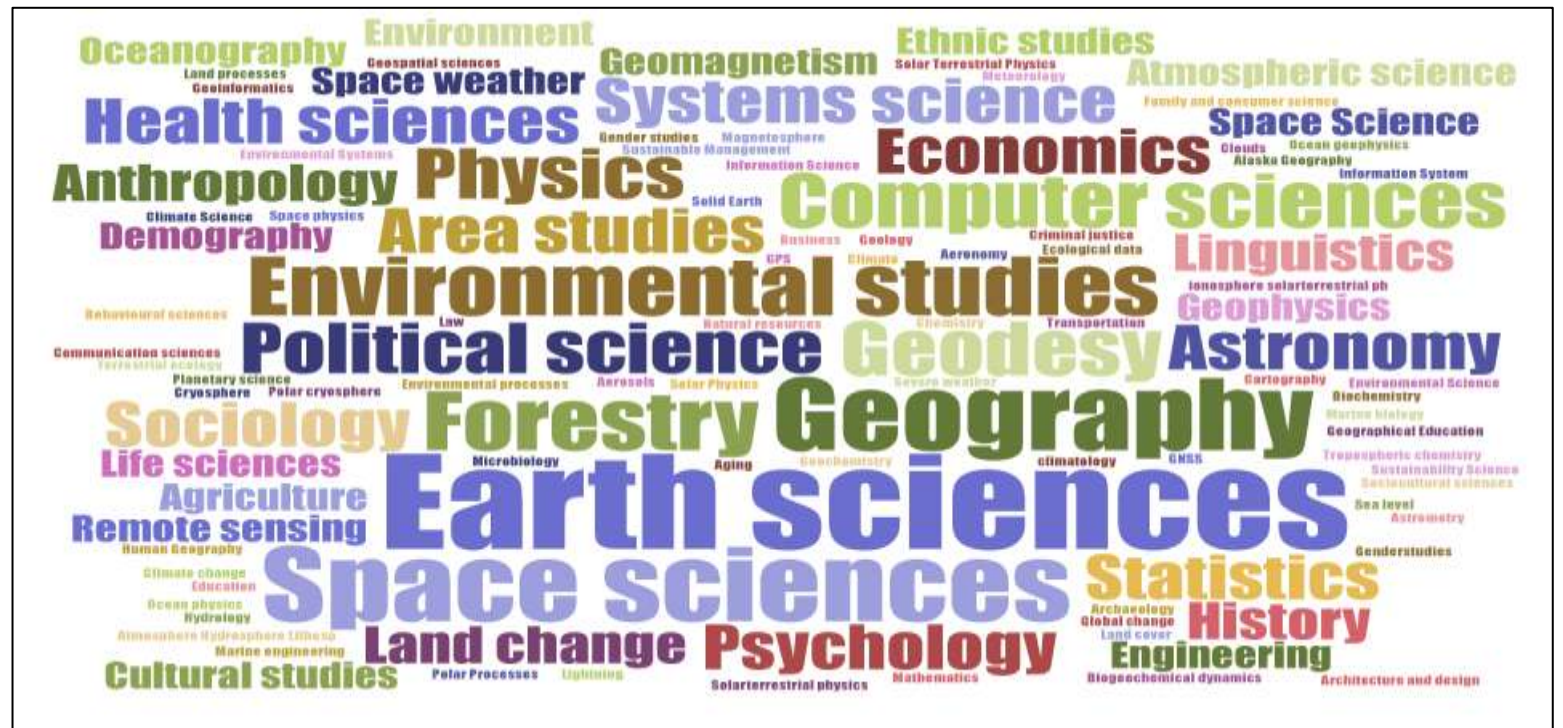
- World Data System (WDS)
- Science Council of Japan
- National Institute of Information and Communications Technology (NICT)
- Research Organization of Information and Systems (ROIS)

Agenda (provisional)

- Promotion of new multidisciplinary data-driven sciences
- Role of data community in data-led policy making
- Collaboration of WDS with international data alliances and data systems
- Reinforce and unification of regional data networks
- New movements in Data Publication under the FAIR principle
- Development of new technologies for Open Science
- Involvement of young generations in data community
- Strategy of future action



WDS Now



The International Science Council (ISC) was created in 2018 as the result of a merger between the **International Council for Science (ICSU)** and the **International Social Science Council (ISSC)**.

WDS will be asked to expand its data-oriented activities to much wider disciplines including social sciences, e.g. **history and economics**.

FAIR Principle on Data in *Open Science*

Findable

Accessible

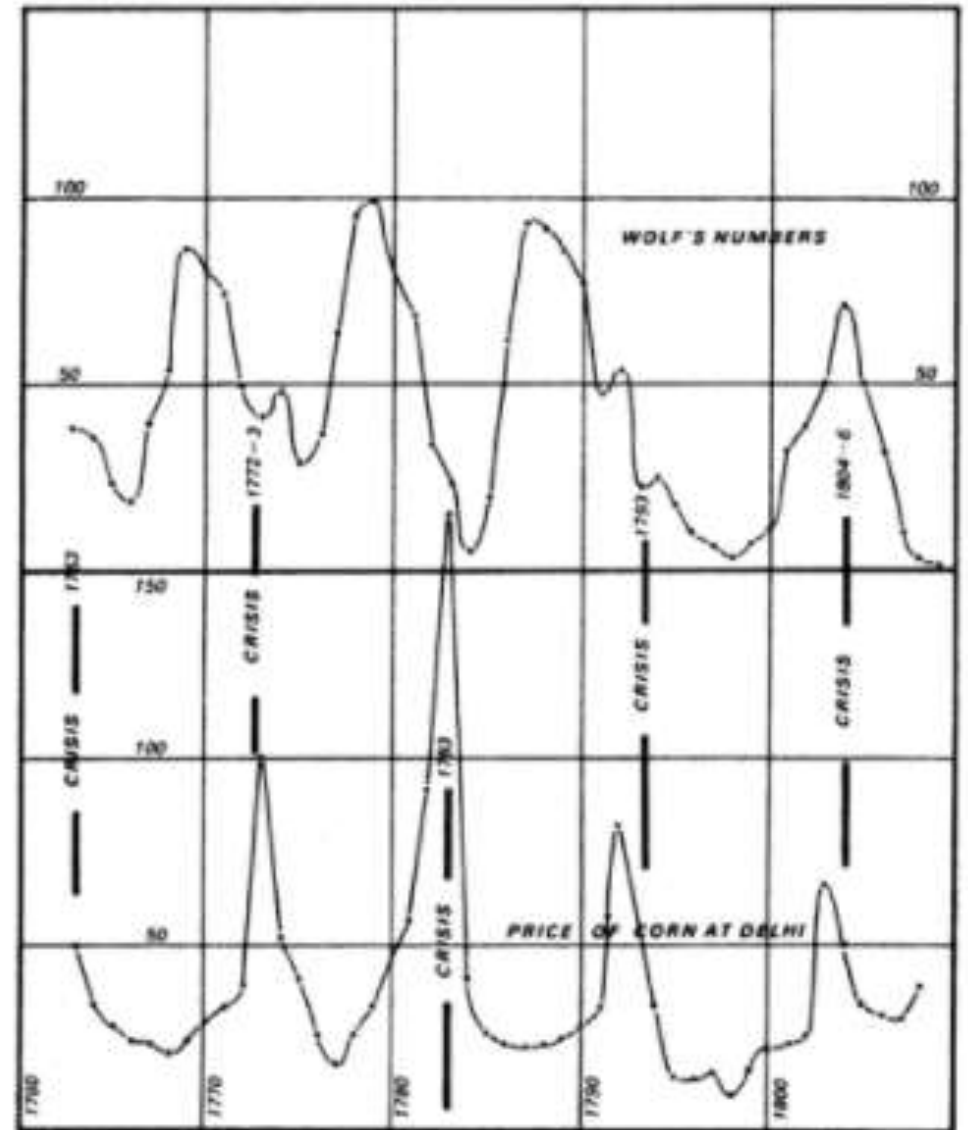
Interoperable

Reusable

William Stanley Jevons (1835 – 1882)

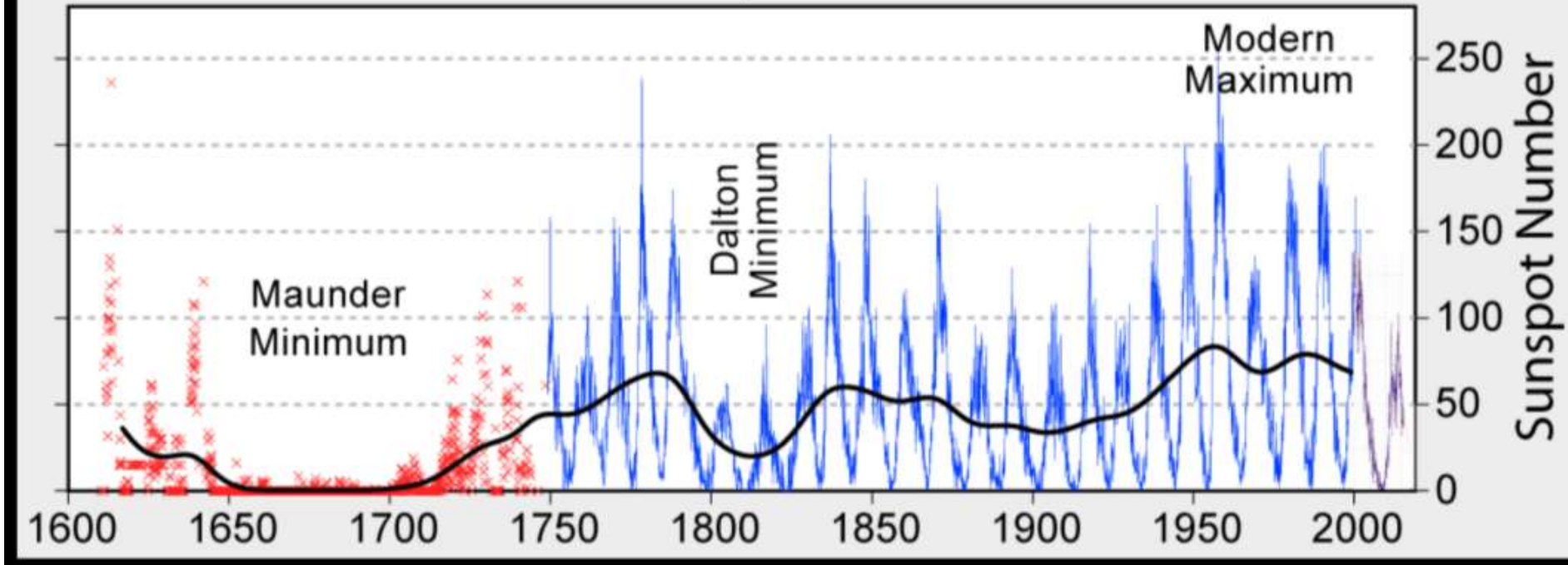
I am perfectly convinced that these decennial crises do depend upon meteorological variations of like period, which again depend, in all probability, upon **cosmical variations of which we have evidence in the frequency of sunspots, auroras, and magnetic perturbations.**

Nature, Volume 19, Issue 472, pp. 33-37 (1878)



9-8. Jevons's diagram showing fluctuations in the sunspot activity (represented by Wolf's numbers) and fluctuations in commercial activity (represented by the prices of corn at Delhi). Time is depicted on the horizontal axis. Jevons did not provide a description of exactly what is stated on the vertical axis. From "The Solar-Commercial Cycle", 1882. Reproduced in *Papers and Correspondence* 7:112. Courtesy of Palgrave/Macmillan Press.

400 Years of Sunspot Observations



| Typical Solar Cycle | Period (years) |
|-------------------------|----------------|
| Sunspot (Wolf) Cycle | ~11 |
| Magnetic (Hale) Cycle | ~22 |
| Long-term sunspot cycle | 60 - 100 |

| Buisness Cycle/Wave Name | Period (years) |
|--------------------------|----------------|
| Kitchin cycle | 3-5 |
| Juglar cycle | 7-11 |
| Kuznets swing | 15-25 |
| Kondratiev wave | 45-60 |

Chris Freeman and Francisco Louca: **As times goes by. From the Industrial Revolutions to the Information Revolution**, Oxford University Press 2001.

Capitalist development from the times of the industrial revolution to the present is divided in subsequent “Kondratiev Waves”,

| | | |
|----------------------|--------------|--|
| 1 st Wave | 1780s - 1848 | Water-powered industry |
| 2 nd Wave | 1848 - 1895 | Steam-powered industry and transportation |
| 3 rd Wave | 1895 - 1940 | Electrification of industry, transport, and the home |
| 4 th Wave | 1941 - 1971 | Motorization, civil economy, and war |
| 5 th Wave | ?? | Computerization of entire economy |

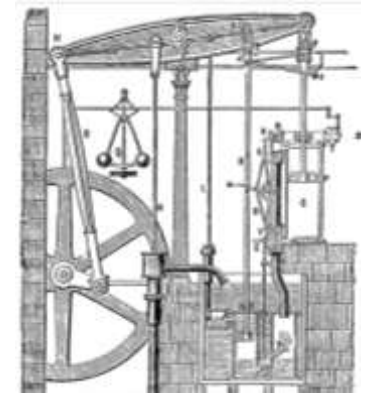
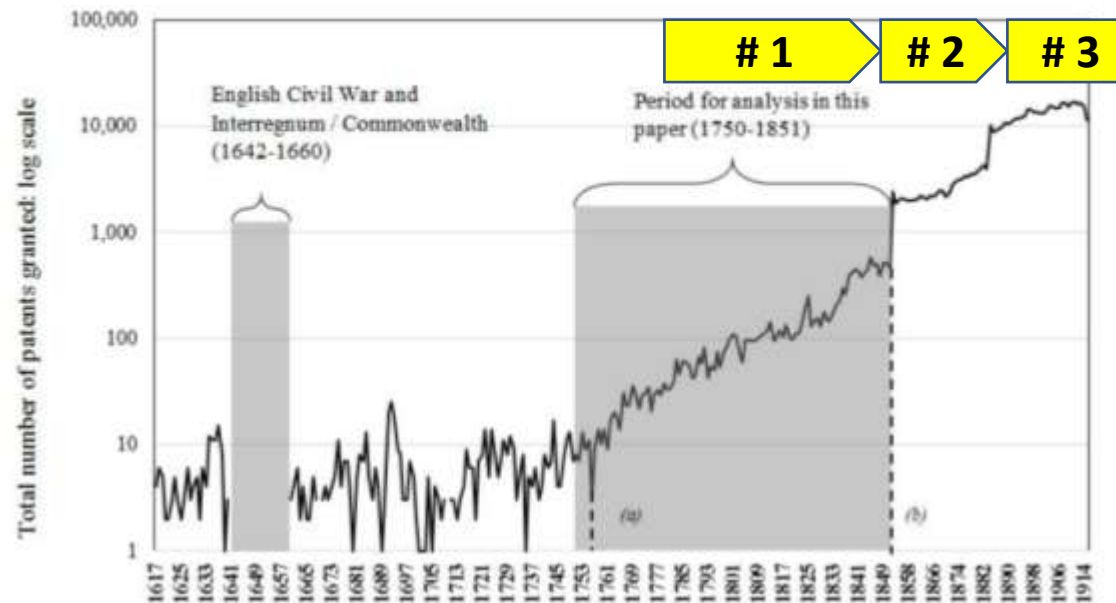


Figure 1: Total patents granted each year in England, 1617-1915



Lane, J., Economic History Working Papers No: 284, London School of Economics and Political Science, 2018.

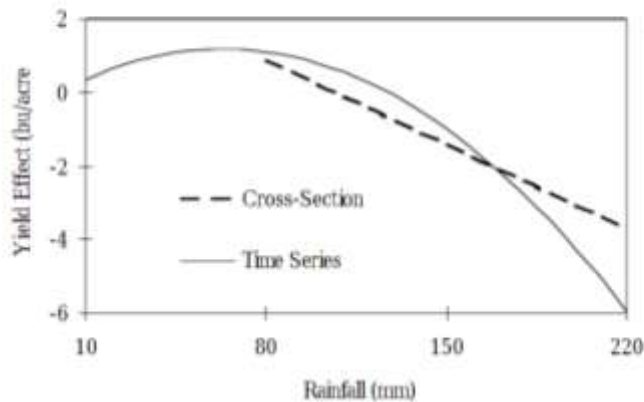
<http://eprints.lse.ac.uk/89386/1/WP284.pdf>

ESTIMATING ENGLISH WHEAT PRODUCTION IN THE INDUSTRIAL
REVOLUTION

LIAM BRUNT

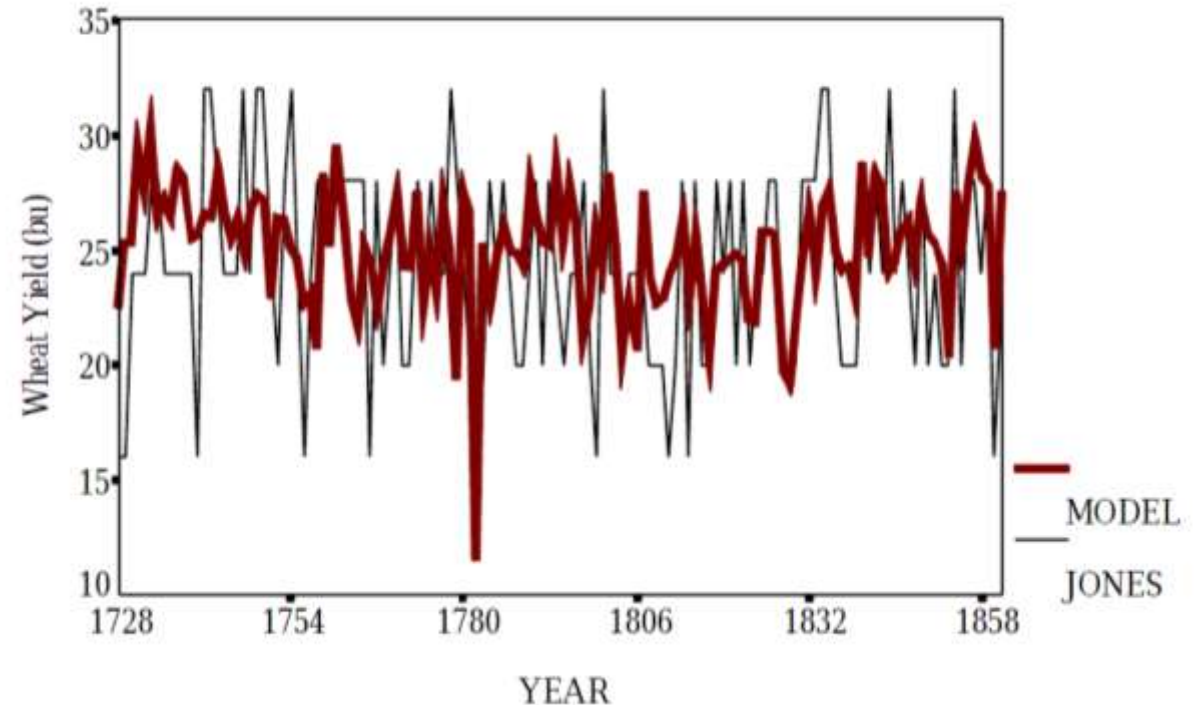
Nuffield College, University of Oxford

Figure 1. The Effect of Rainfall on Wheat Yields: a Comparison of Time and Space.



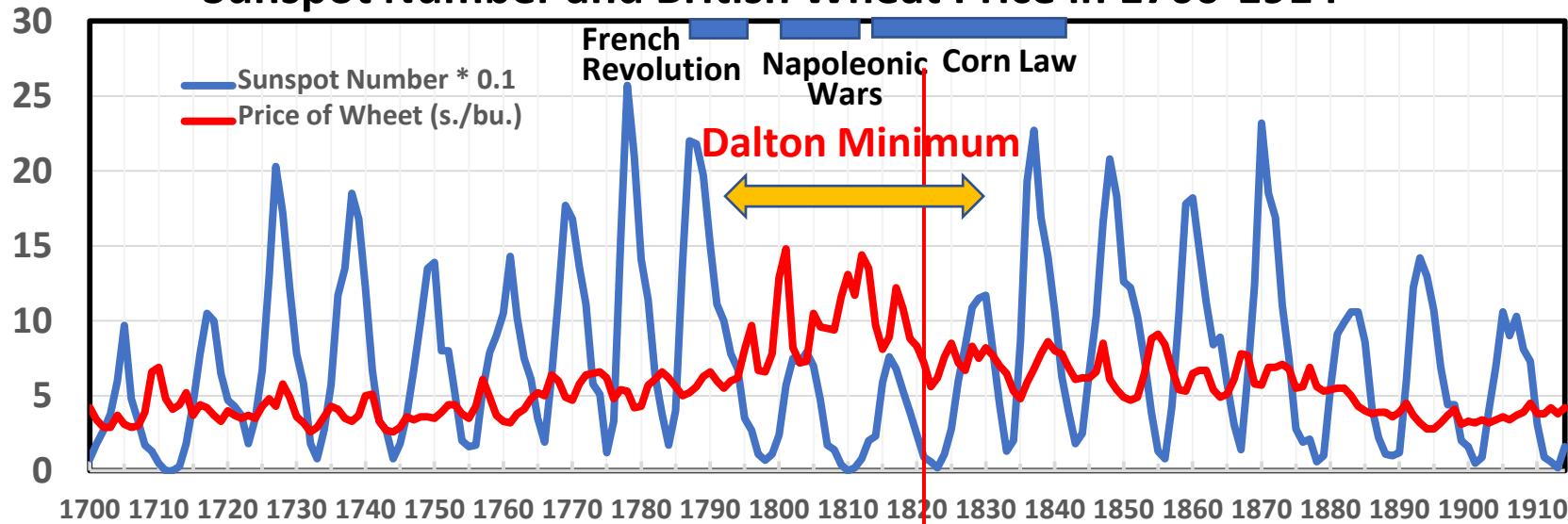
- Crop yields are very sensitive to the impact of weather
- The year on-year fluctuation of weather is much greater than the year-on-year fluctuation of other inputs (such as technology or the capital stock)

Figure 2. Weather Shocks to English Wheat Yields, 1728-1861 (bu/acre).



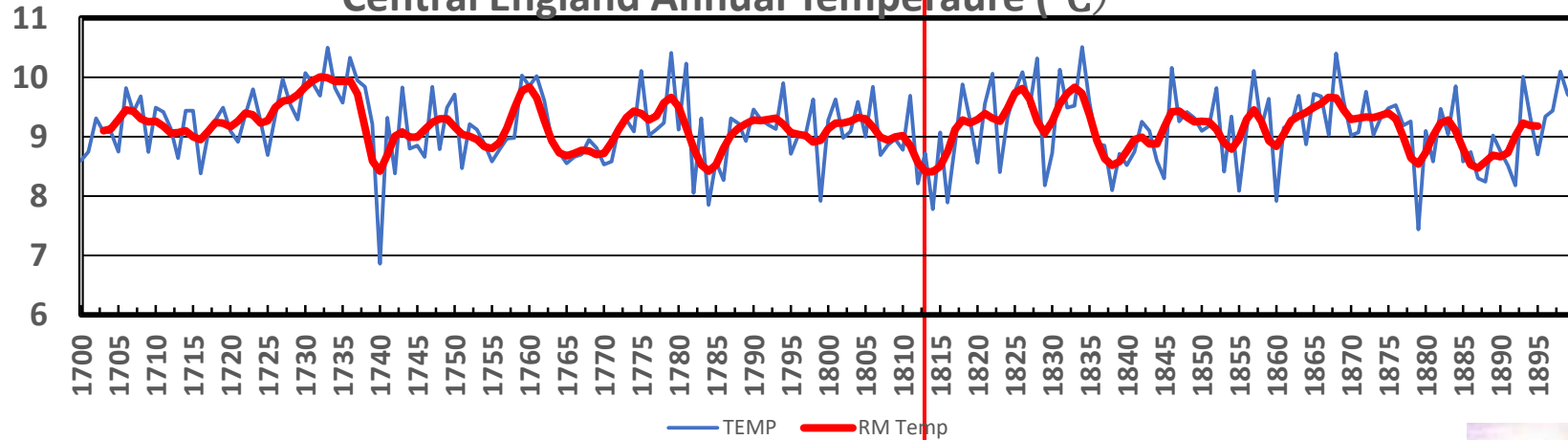


Sunspot Number and British Wheat Price in 1700-1914



All sunspot data came from SILSO.

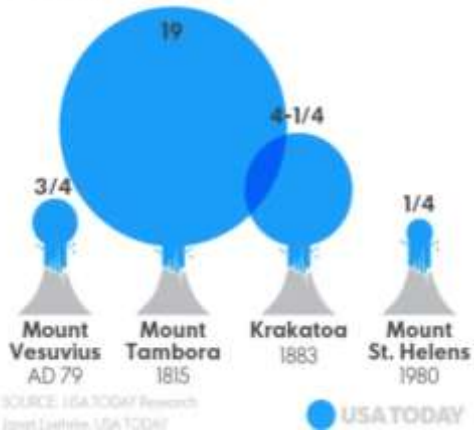
Central England Annual Temperature (°C)



VIOLENT VOLCANOES

The eruption of Mount Tambora in 1815 was the biggest in recorded human history.

Cubic miles of ejecta:



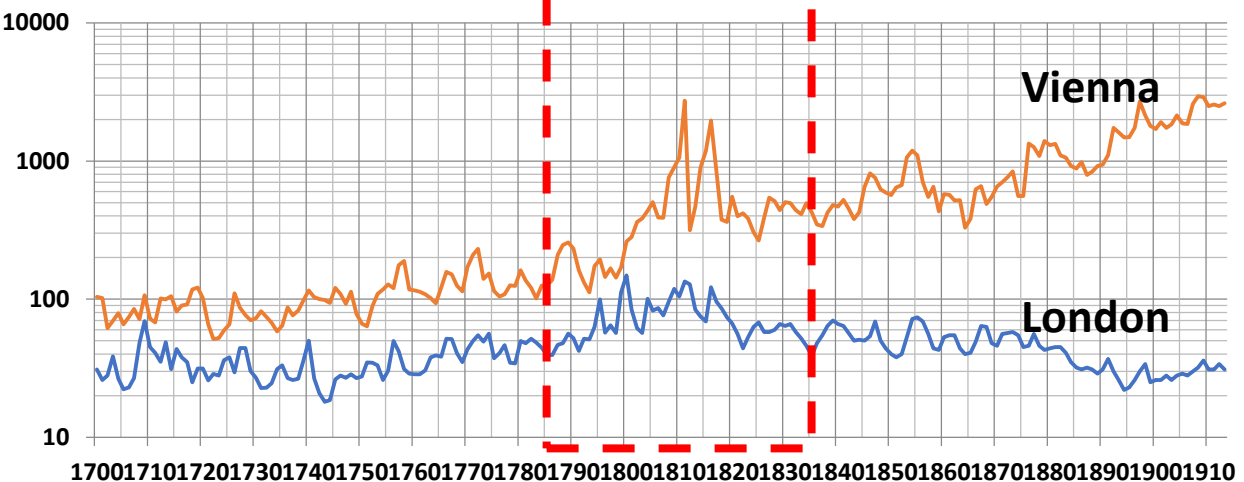
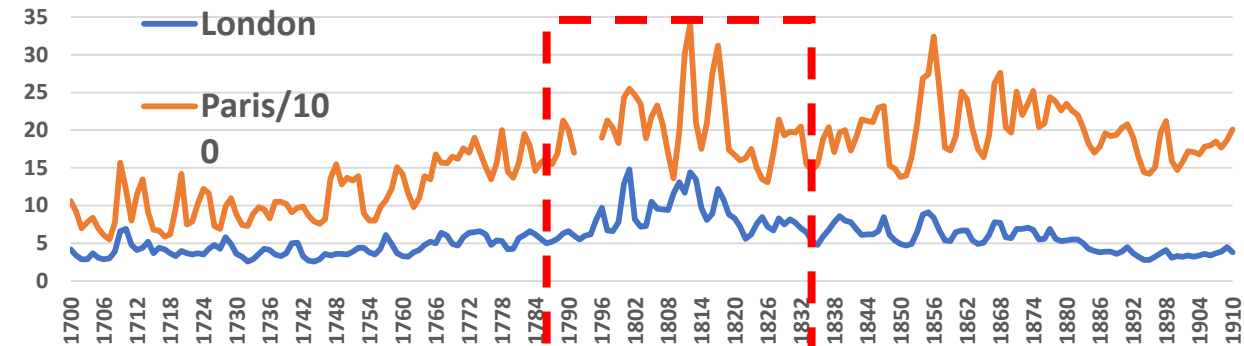
Napoleon in Russia (1812)



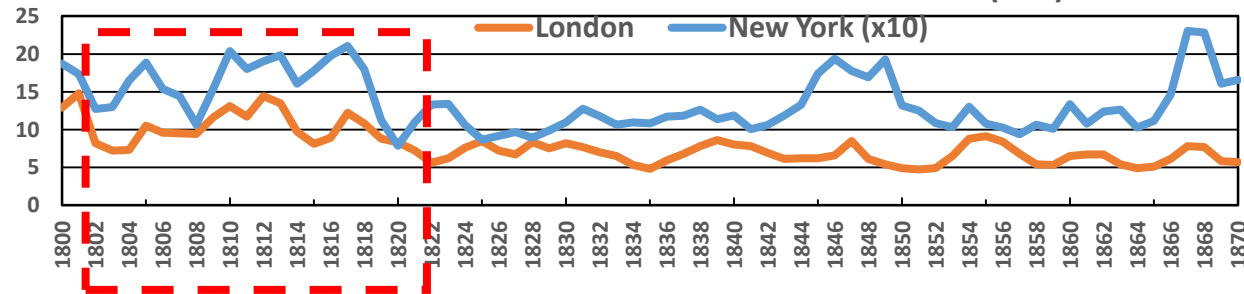
Frozen Thames (1814/15)



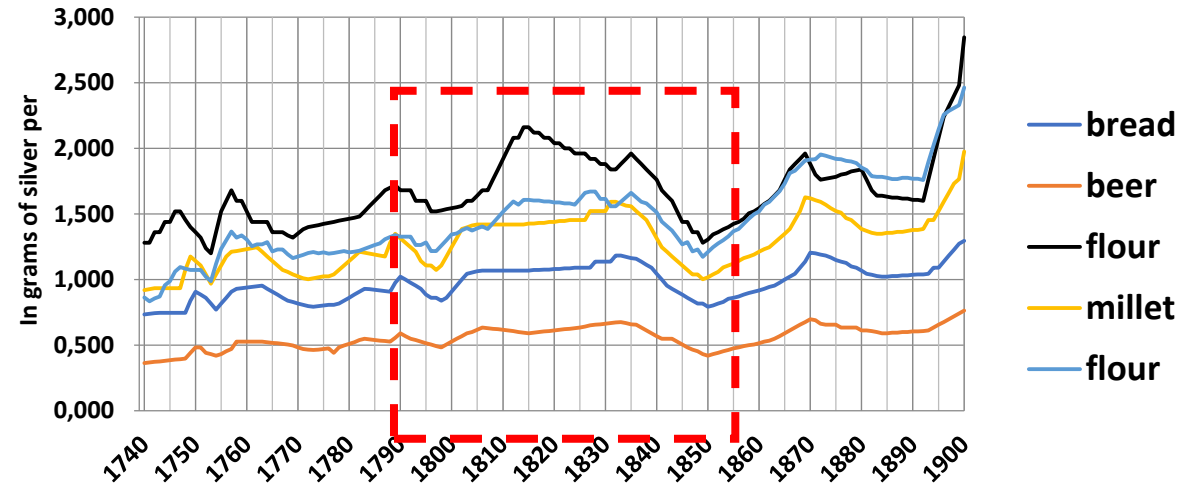
Variations of Wheat Price at London and Paris(/100)



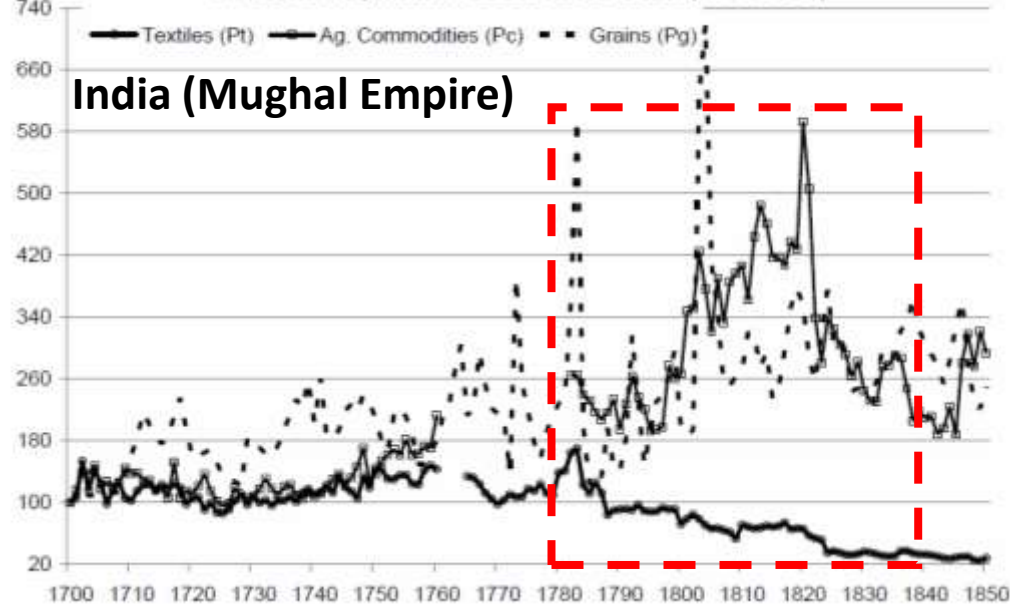
Variations of Wheat Price at London and New York (x10)



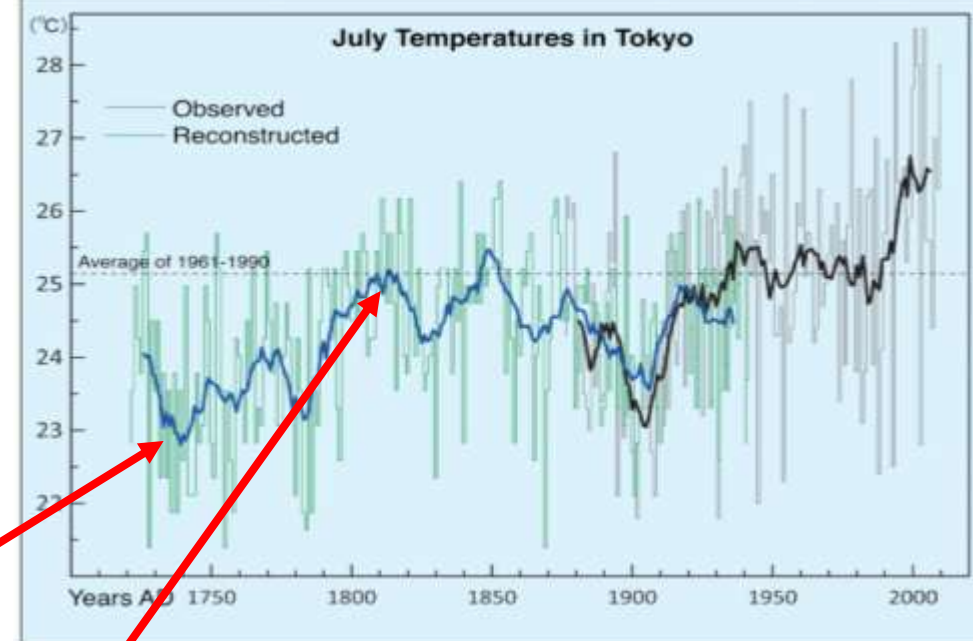
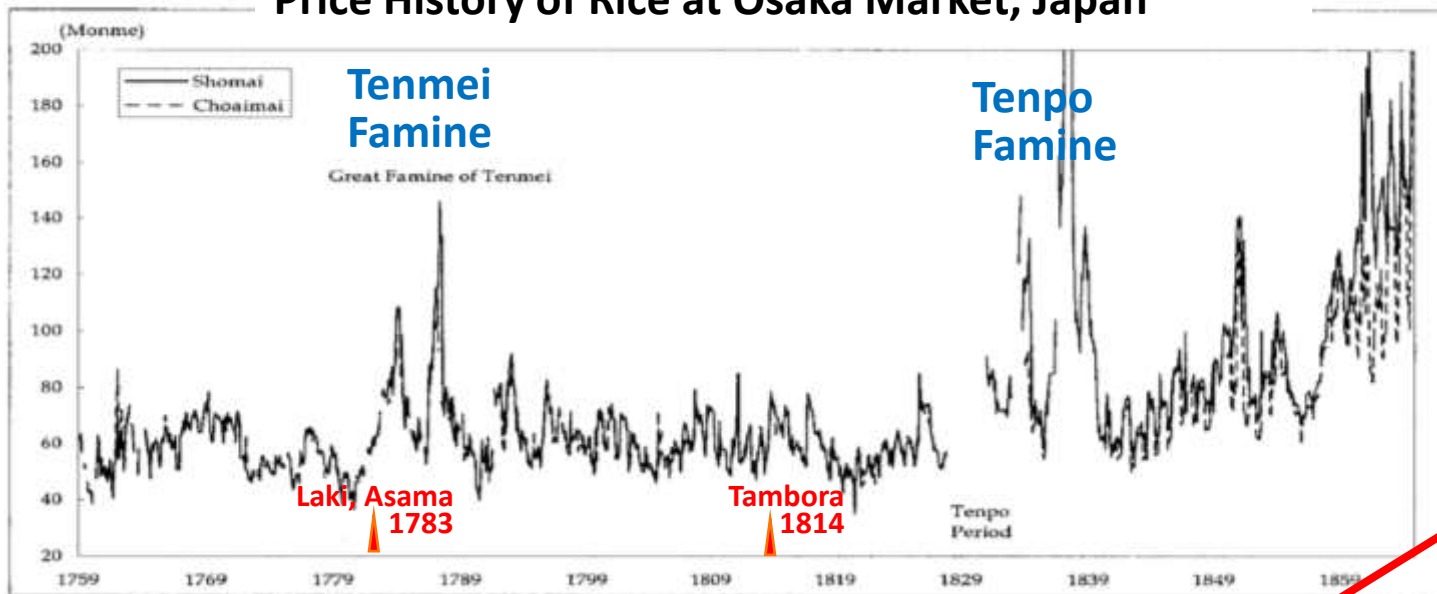
Prices at Beijing



Prices of Key Indian Goods 1700-1850 (1700=100)



Price History of Rice at Osaka Market, Japan

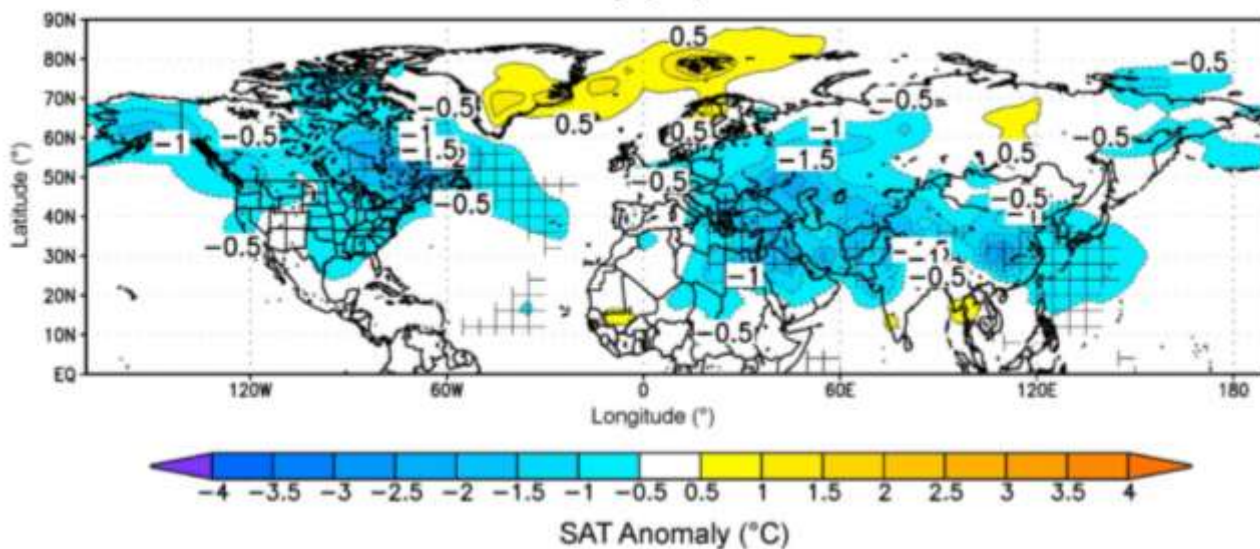


<https://jcdp.jp/reconstructed-climate-indices-jp/>

LAKI 1783

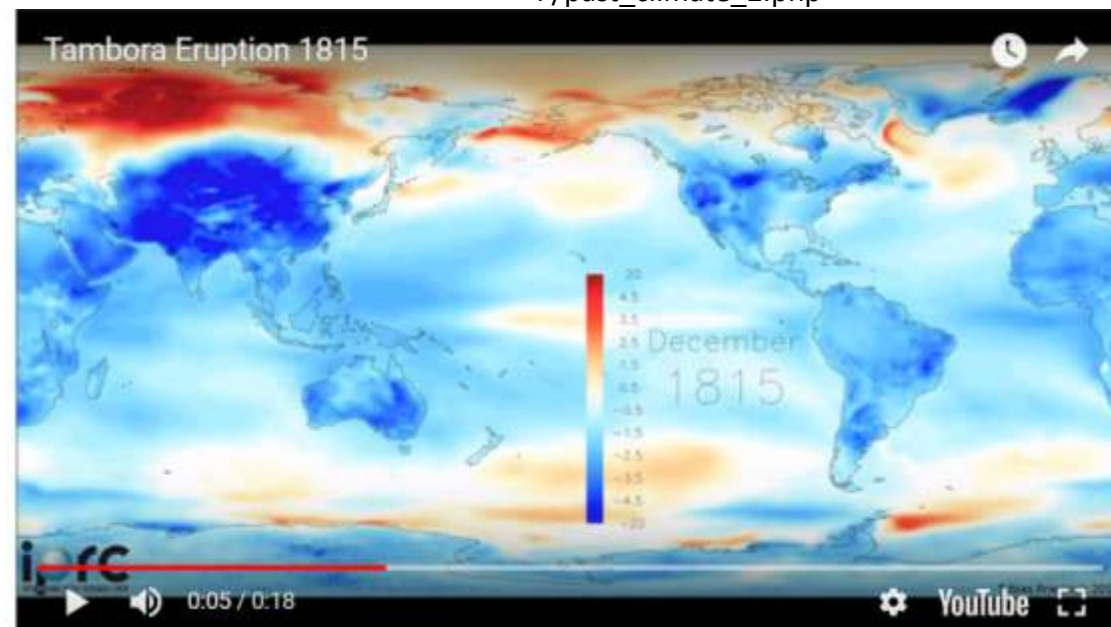
A. Schmidt et al., JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 117, D23116, doi:10.1029/2012JD018414, 2012

Laki SAT Anomaly (°C) DJF 1783–1784

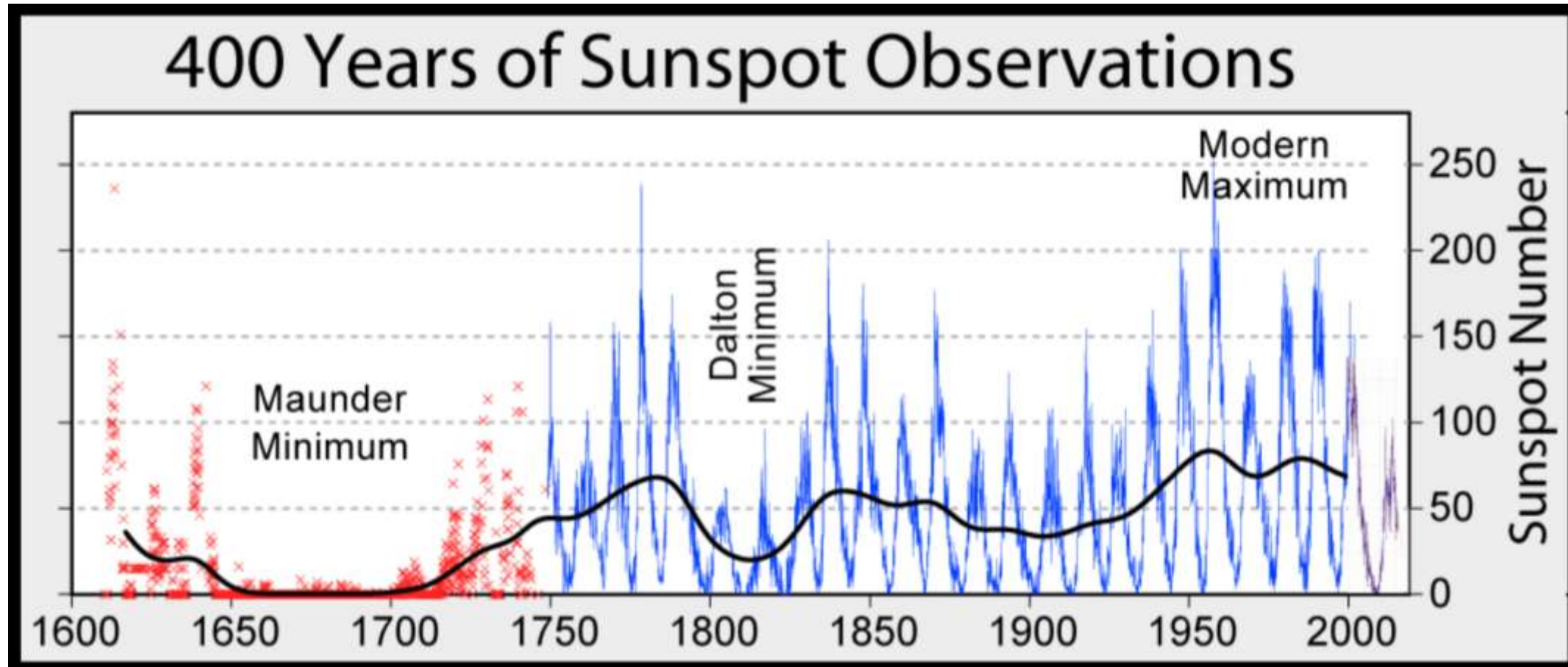


TAMBORA 1815

http://apdrc.soest.hawaii.edu/projects/SOS_MP/past_climate_2.php

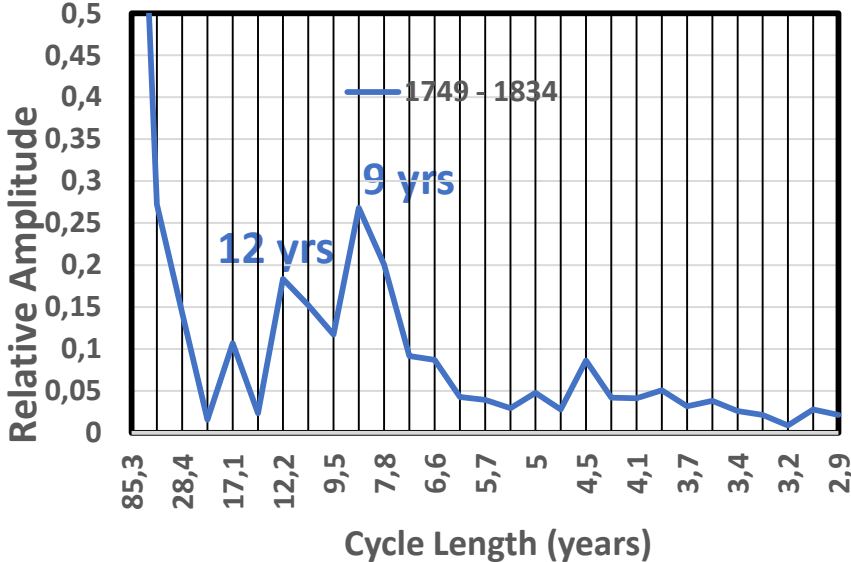


Dalton Minimum: What was peculiar?

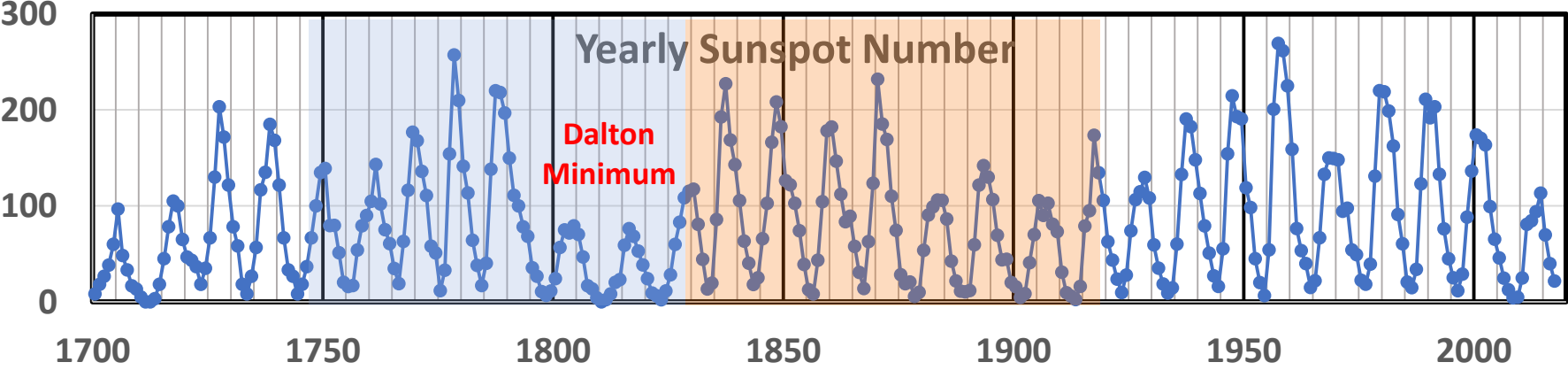
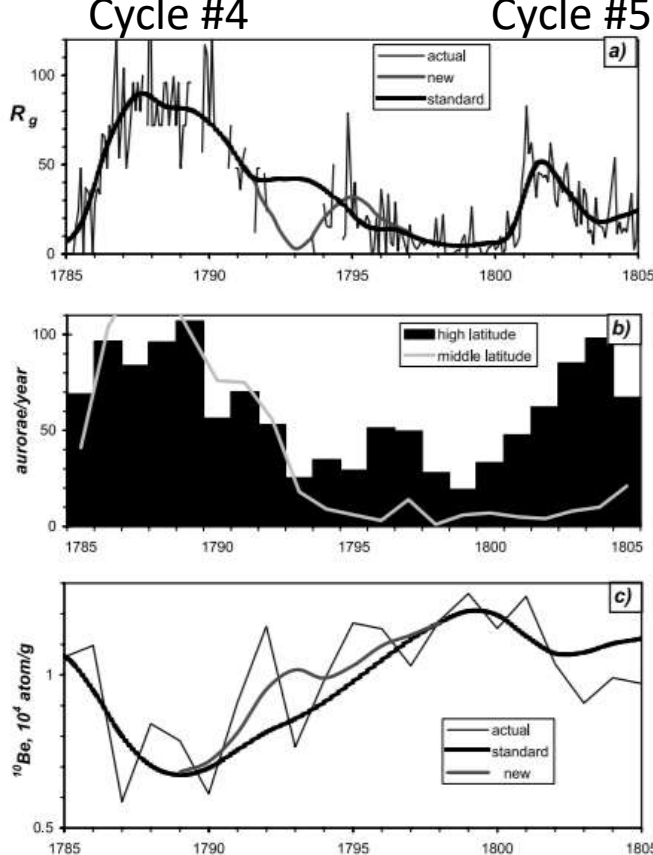
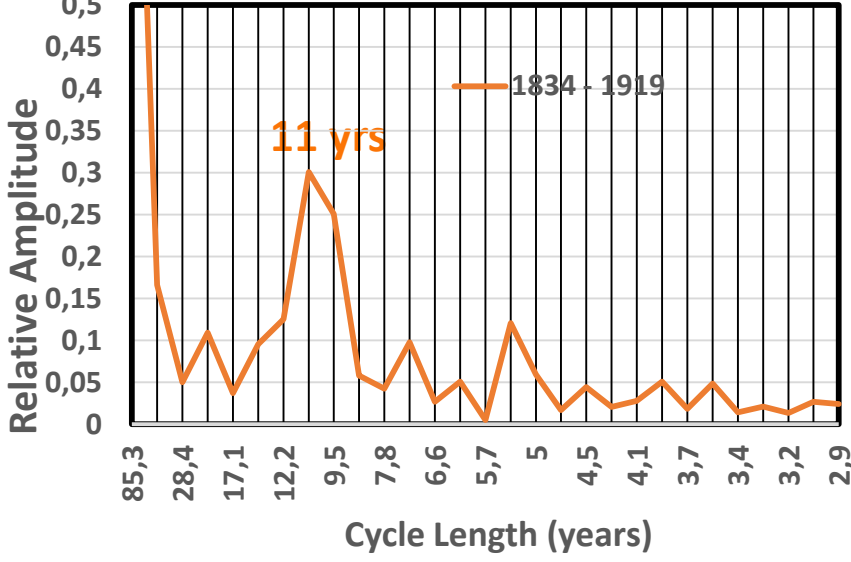


Characteristics of solar cycles were changed after the Dalton Minimum

1749-1834

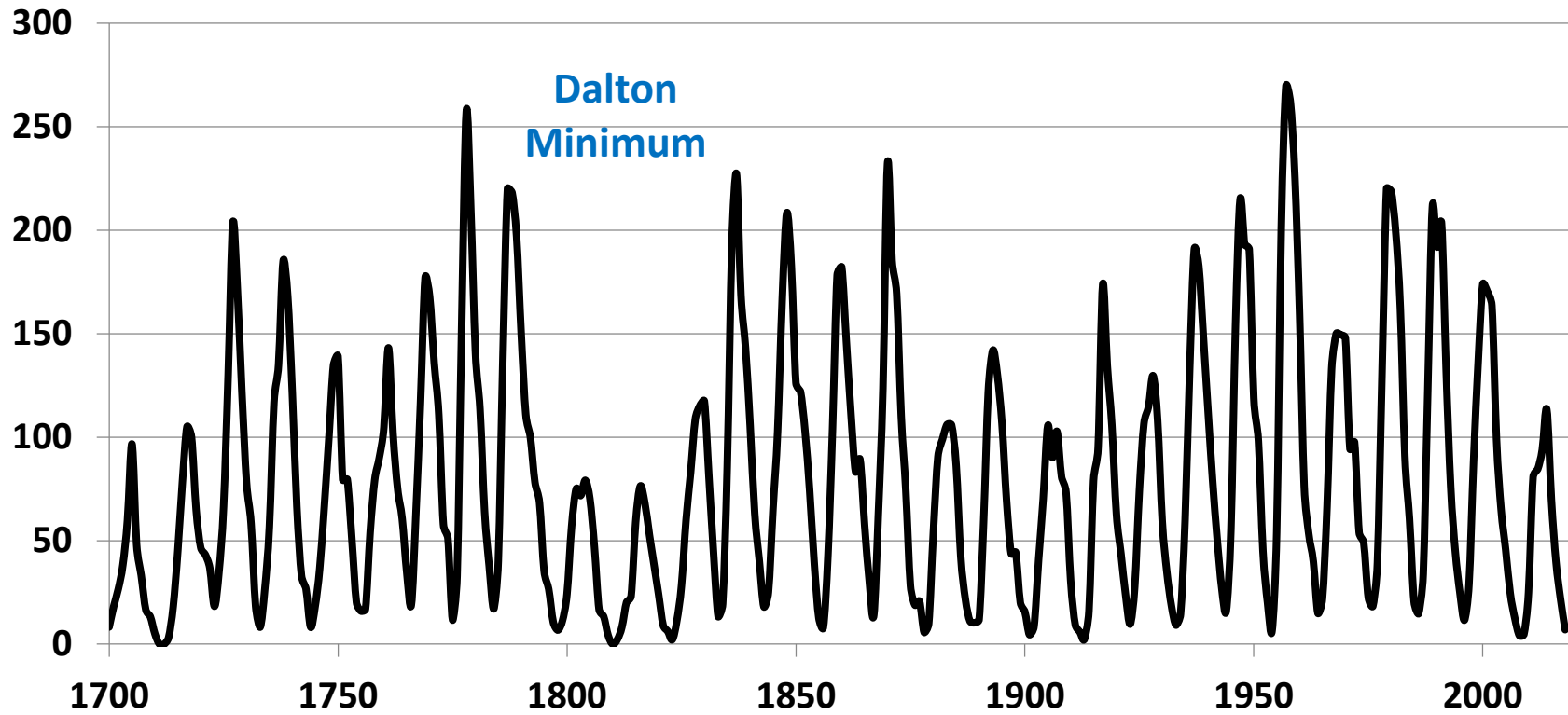


1834-1919

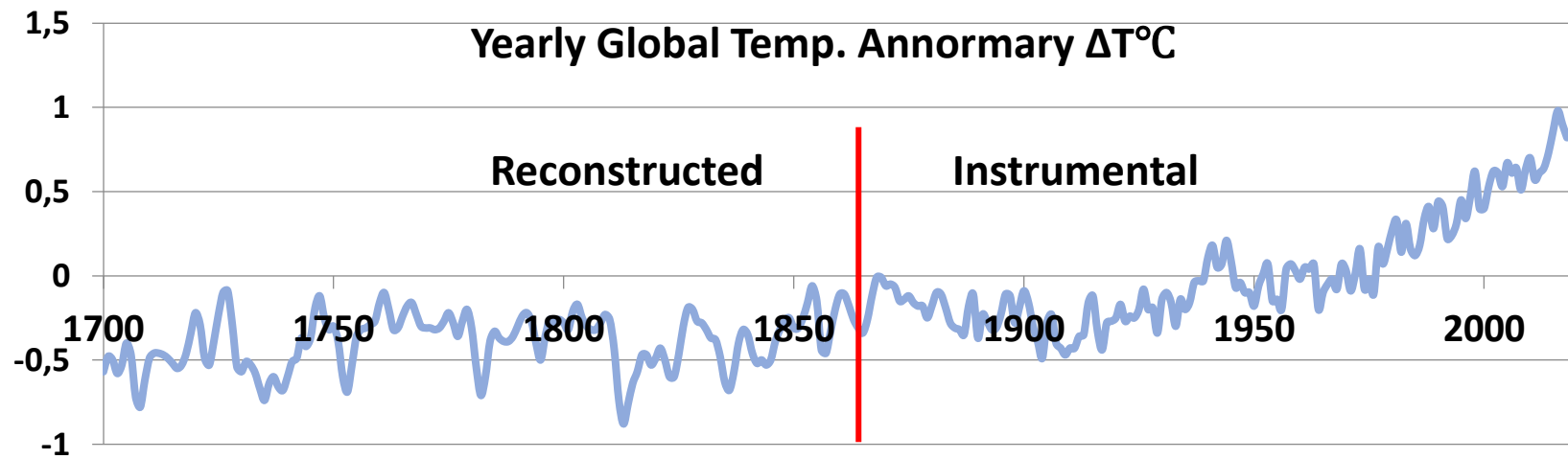


Lost sunspot cycle in the beginning of Dalton minimum: New evidence and consequences, I. G. Usoskin, et al., Geophys. Res. Lett., 29, NO. 24, 2183, 2002

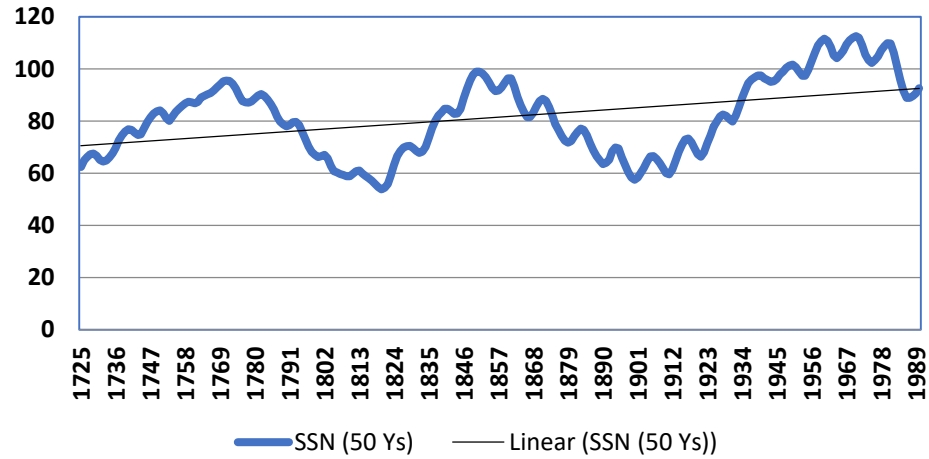
Yearly SSN (1700-2018)



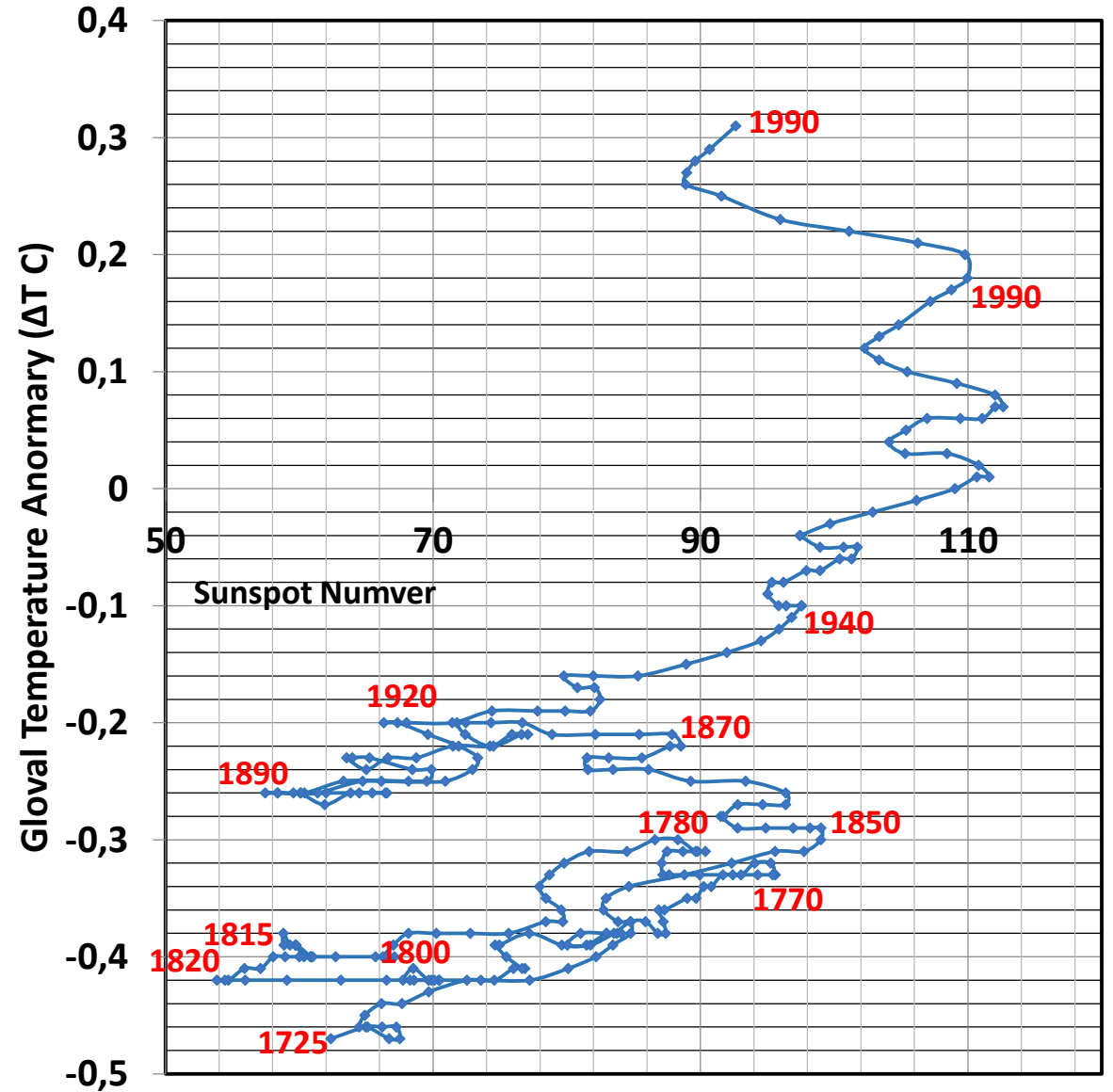
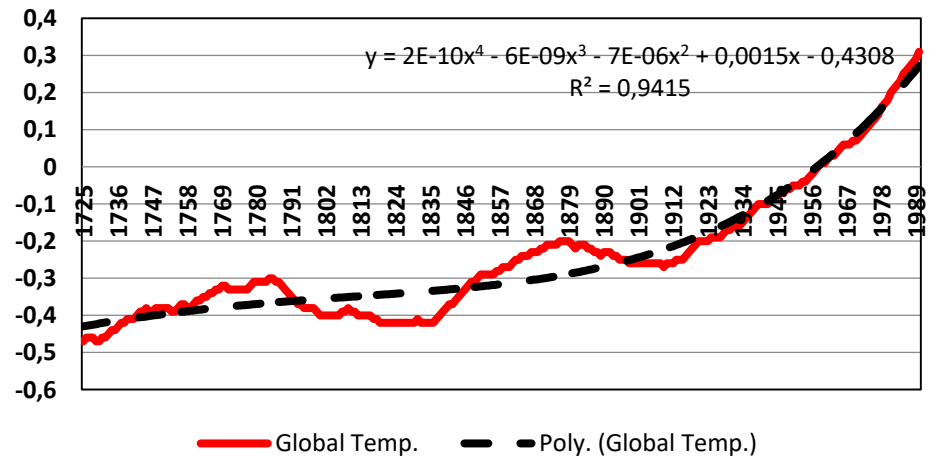
Yearly Global Temp. Annormary $\Delta T^{\circ}\text{C}$



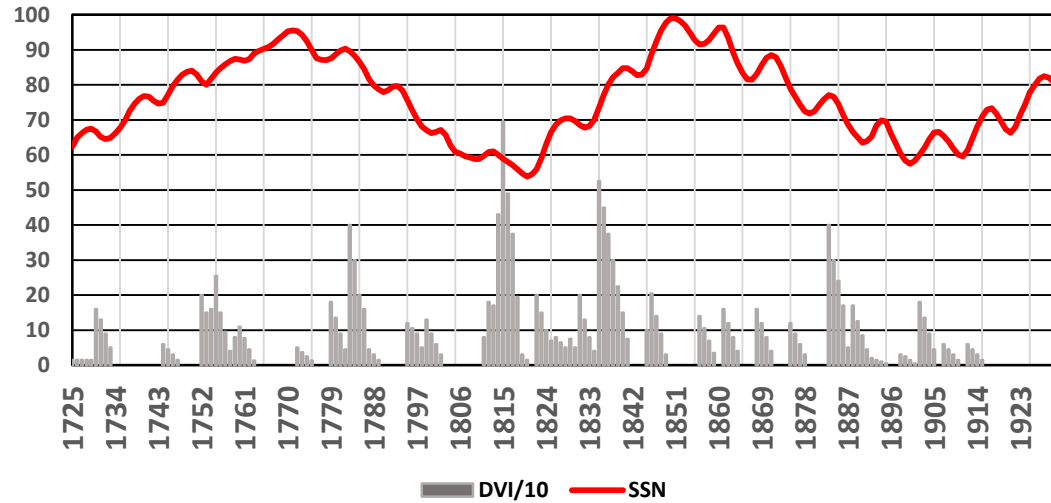
SSN (51 Yrs RM)



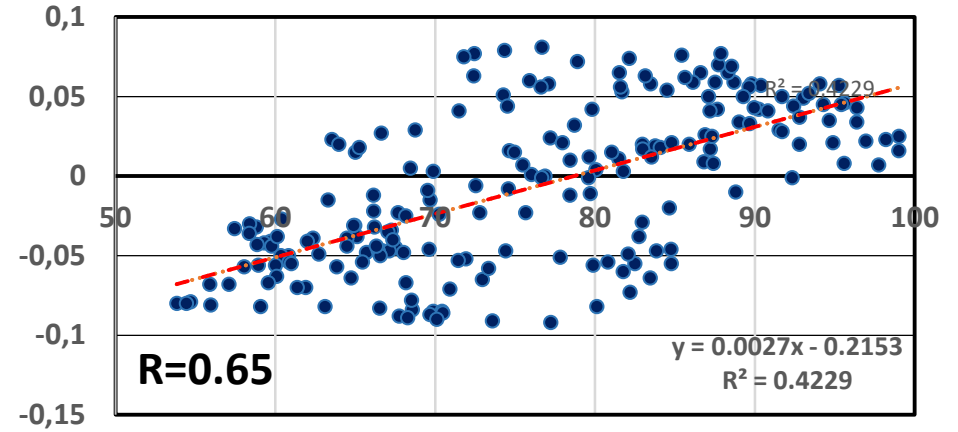
Global Temp. Annormary (51 Yrs RM)



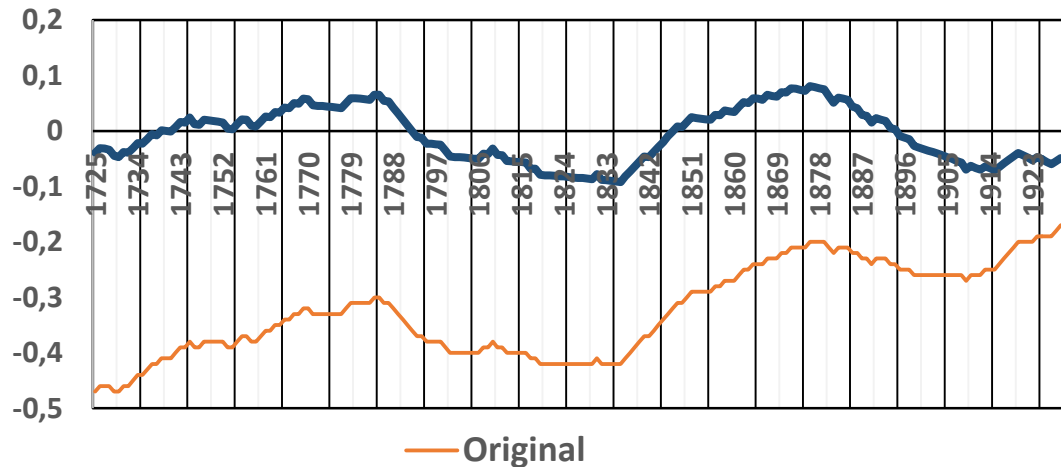
SSN (51 Yrs RM) and Dust Vail Index (DVI)/10



Trend removed Global ΔT (C) versus SSN (1725-1930)



1725-1940 Trend removed Global Temp. (51 Yrs RM)

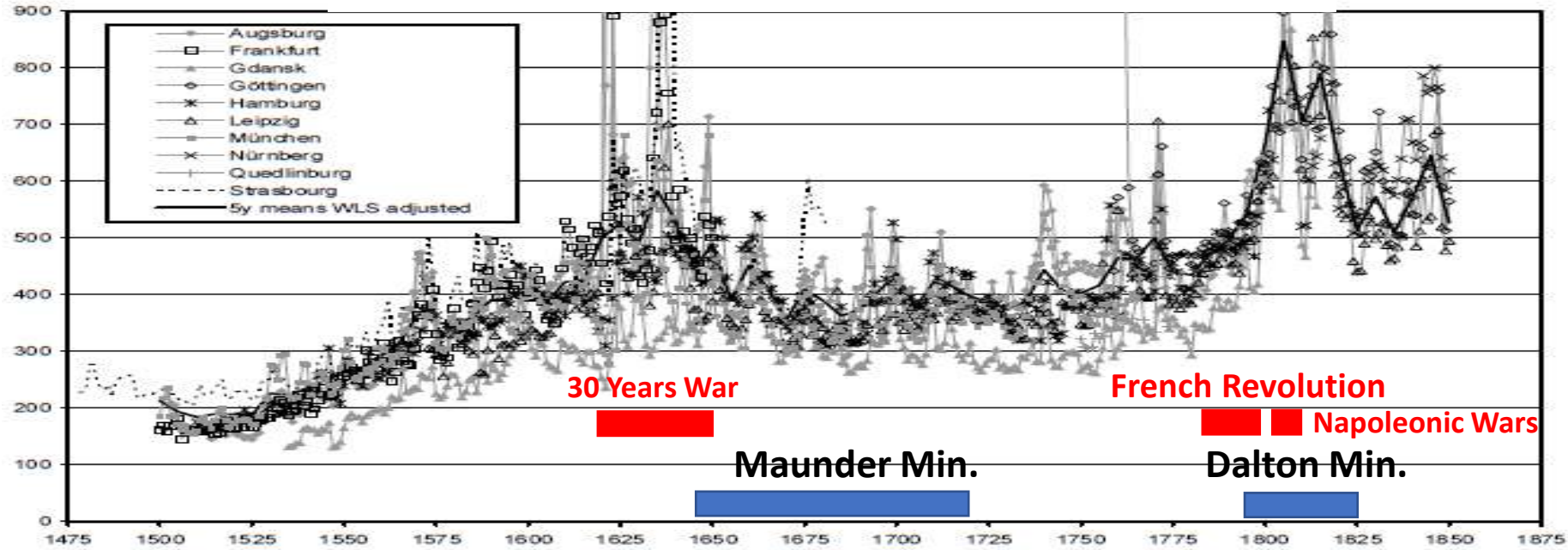


Long-term trend of the global temperature in 18th and 19th Centuries was controlled by the solar variability and the global warming.

Volcanic activities produced relatively short-term coolings.

Market Integration in Europe

Annual Consumer Prices in Germany (1500 - 1850)



Ulrich Pfister, 2010. "[Consumer prices and wages in Germany, 1500 - 1850](#)," [CQE Working Papers](#) 1510, Center for Quantitative Economics (CQE), University of Muenster.

Maunder Minimum

- Influence of the 30 Years War was enormous
- Decrease of Population
- Disintegrated Economy (Very Local)

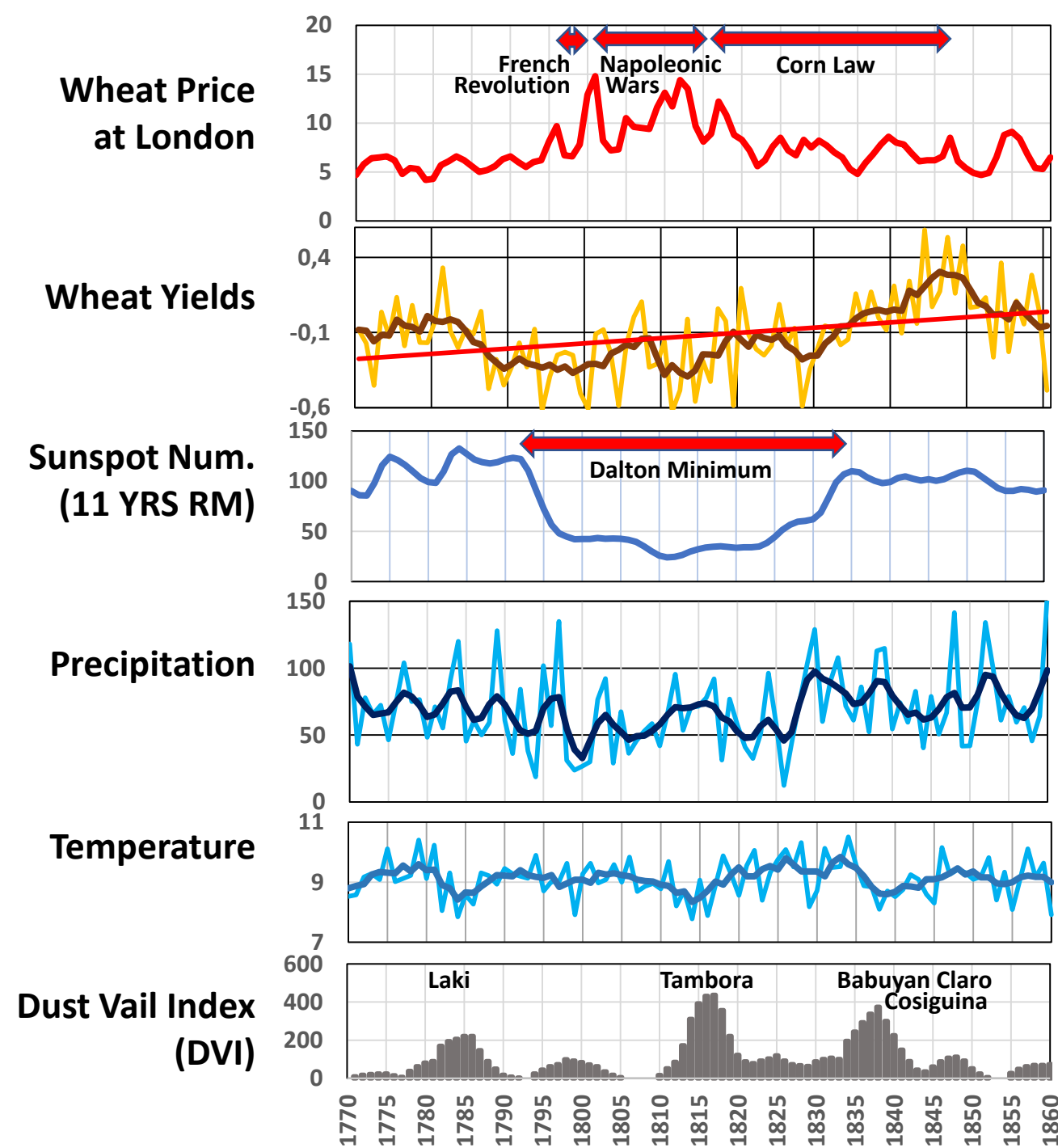
Dalton Minimum

- Influence of the Napoleonic War on economic activity was limited.
- Increasing Population
- Economic Integration in Europe

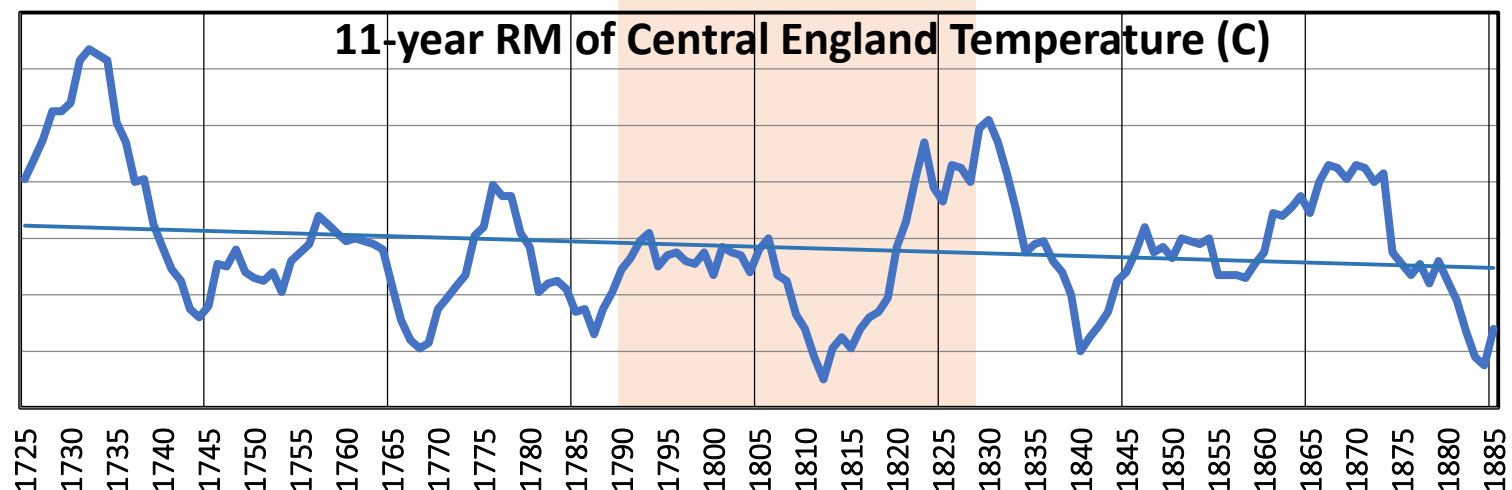
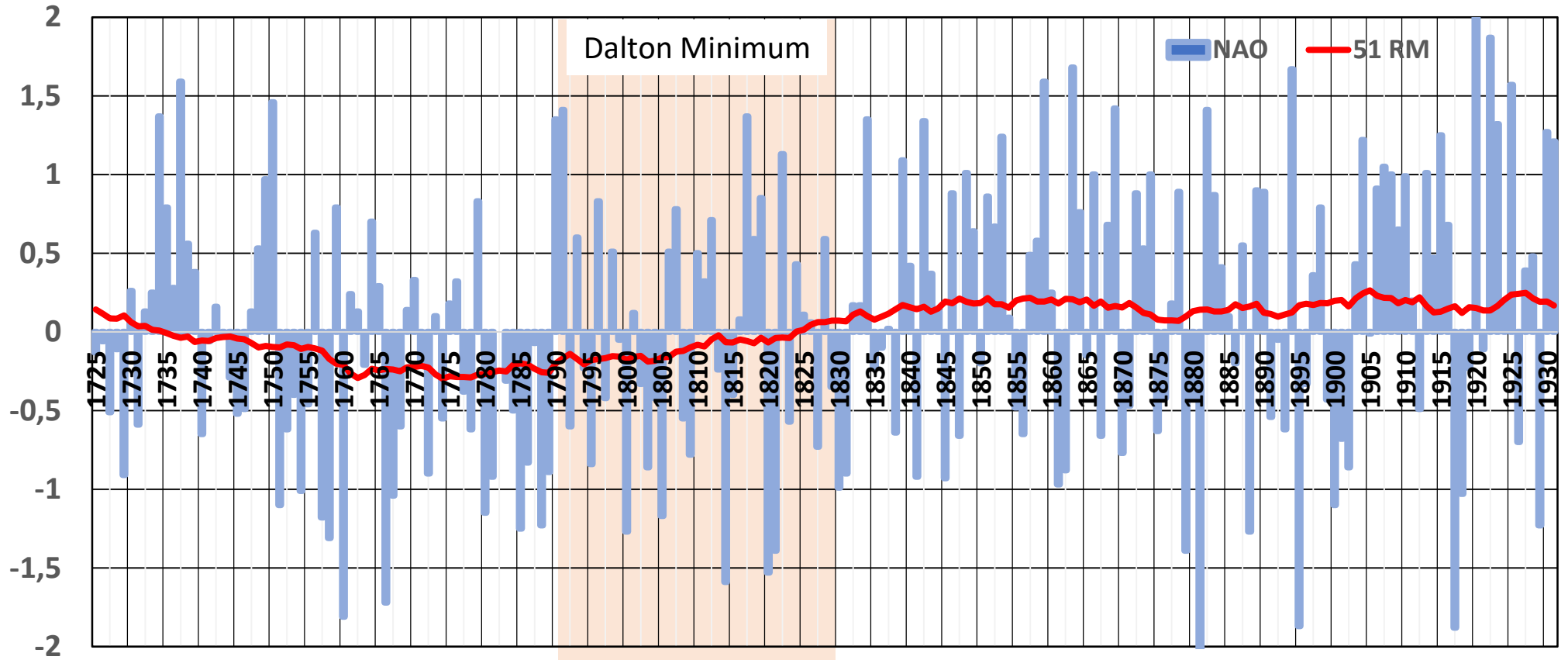
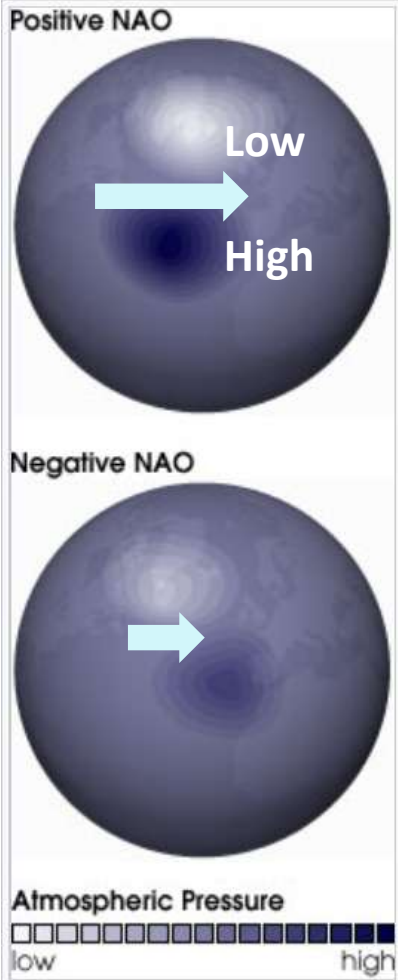
Factors controlling British wheat prices in the Dalton Minimum

1. The **low solar activity** resulted general **low surface temperature and low precipitation** in the Dalton Minimum.
2. Extensive **volcanic activities** produced years of very low temperature, particularly in 1814-1816 (Tambora).
3. Due to these weather conditions, **wheat yields** in England were **depressed 35 - 50 % in 1780-1830**. This directly raised the price because of **increasing demands**.
4. Effects of political movements in Europe (e.g. French Revolution and **Napoleonic Wars**) on general economic activity are seen also, e.g. price peaks in 1812.
5. The **Corn Law** helped to keep rather high price in 1815-1845 by weakening economic integration of Europe.

Next stage: Empirical modeling?



North Atlantic Oscillation (NAO) Indices in DJF

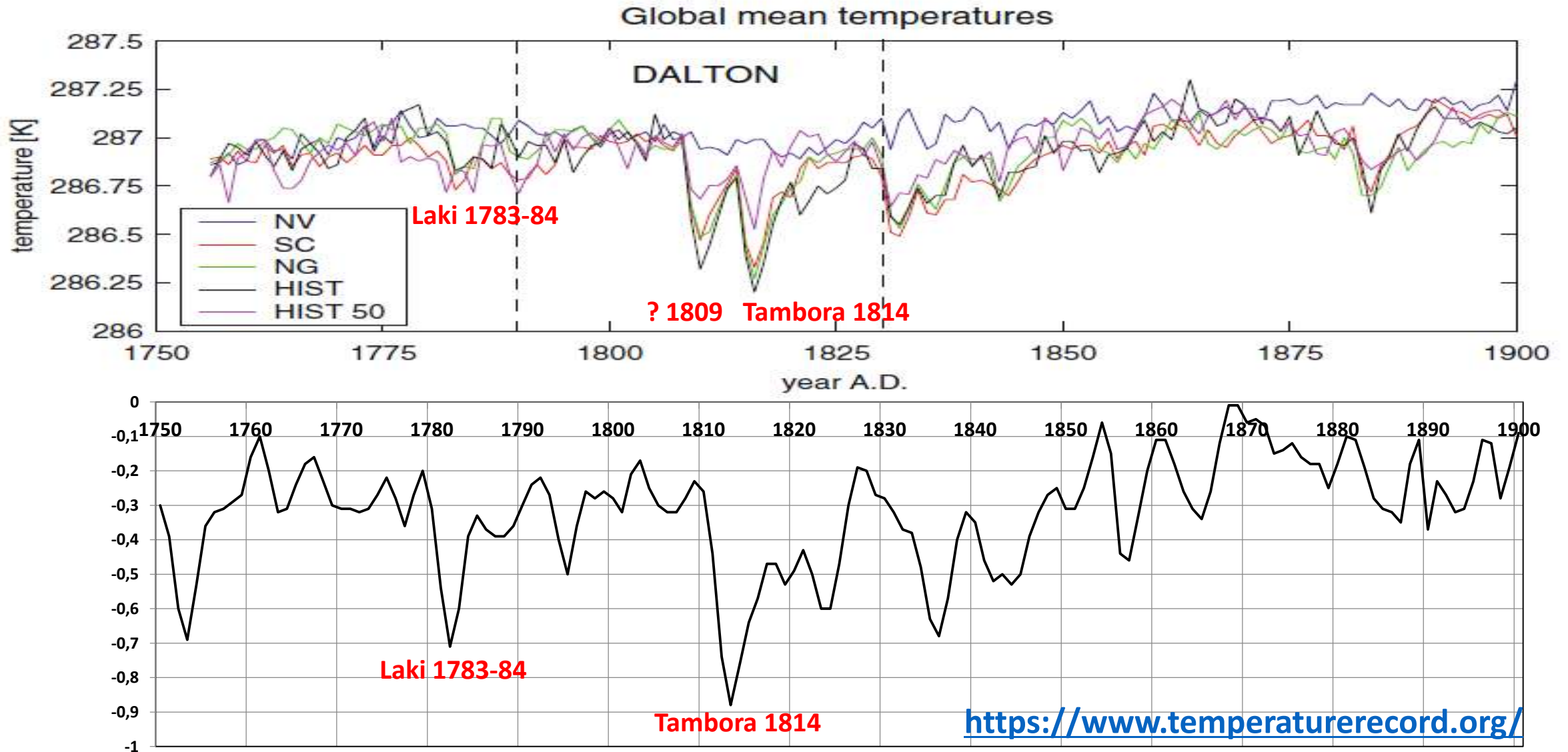


NAO > 0:
Increased westerlies.
Cool summers. Mild
and wet winters.

NAO < 0:
Westerlies are
suppressed. Cold
and dry winters.

ECHO-G Modeling

Sebastian Wagner & Eduardo Zorita, **The influence of volcanic, solar and CO₂ forcing on the temperatures in the Dalton Minimum (1790–1830): a model study**, *Climate Dynamics* (2005) DOI 10.1007/s00382-005-0029-0



Problems in usage of reconstructed data

- Works to produce reconstructed data are “research activities”, depending on hypothesis.
- Several datasets have been available for one specific parameter but evaluation is difficult to users outside of the specialty.
- Some (old and new) datasets are only available as diagrams in scientific publications. Reuse of these data is difficult.

Concluding Remarks

- ◆ **The interval of 18th – 19th Centuries is very interesting period for the multidisciplinary study through the collaboration of environmental and socio-economic scientists to find better knowledge to manage the human society under the current environmental change.**
- ◆ **Such a collaboration will be a strong motivation for multidisciplinary data provision and usage.**
- ◆ **Involving dedicated citizen scientists will be important to “excavate” long-term records particularly on social activities and proxy records of climate change.**
- ◆ **Initiative of multidisciplinary data systems, like WDS, will be important.**

Expand SCOSTEP's Interdisciplinary Activities to Social-Science Community!

