

Lecture 25: Historical Climate

Ch. 16, p. 290-308

The Earth's Climate History

1. Over the last century, the earth's surface temperature has increased by about 0.75°C (about 1.35°F).
2. Little Ice Age = Cooling during 1,400 A.D. – 1,900 A.D. (N.H. temperature was lower by 0.5°C , alpine glaciers increased; few sunspots, low solar output)
3. Medieval Climate Optimum (Warm Period) = Warming during 1,000 A.D. – 1,300 A.D. in Europe and the high-latitudes of North Atlantic (N.H. warm and dry, Nordic people or Vikings colonized Iceland & Greenland)
4. Holocene Maximum = 5,000-6,000 ybp (1°C warmer than now, warmest of the current interglacial period)
5. Younger-Dryas Event = 12,000 ybp (sudden drop in temperature and portions of N.H. reverted back to glacial conditions)
6. Last Glacial Maximum = 21,000 ybp (maximum North American continental glaciers, lower sea level exposed Bering land bridge allowing human migration from Asia to North America)
7. We are presently living in a long-term **Icehouse** climate period, which is comprised of shorter-term *glacial* (e.g., 21,000 ybp) and *interglacial* (e.g., today) periods. There were four periods of Icehouse prior to the current one.
8. For most of the earth's history, the climate was much warmer than today.

Historical Climate: The Little Ice Age

- What major climate events occurred during the last 1000 years?
- Can we see an imprint from millennial-scale and orbital-scale changes during this interval?
- What evidence indicates a cooler climate in Europe and nearby regions during the Little Ice Age?
- What might cause the little ice age?

Climate Change at Different Time Scales

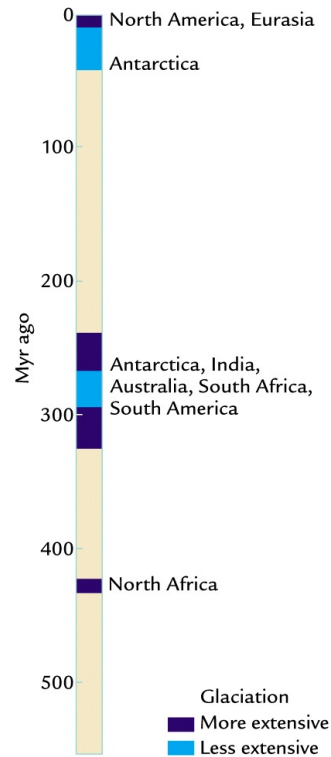
Hundreds of millions of years

Tens to hundreds of thousands of years

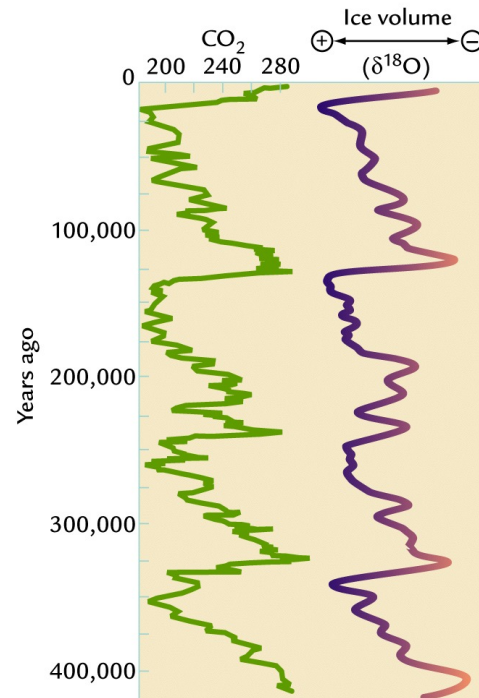
Thousands of years

Decades to hundreds of years

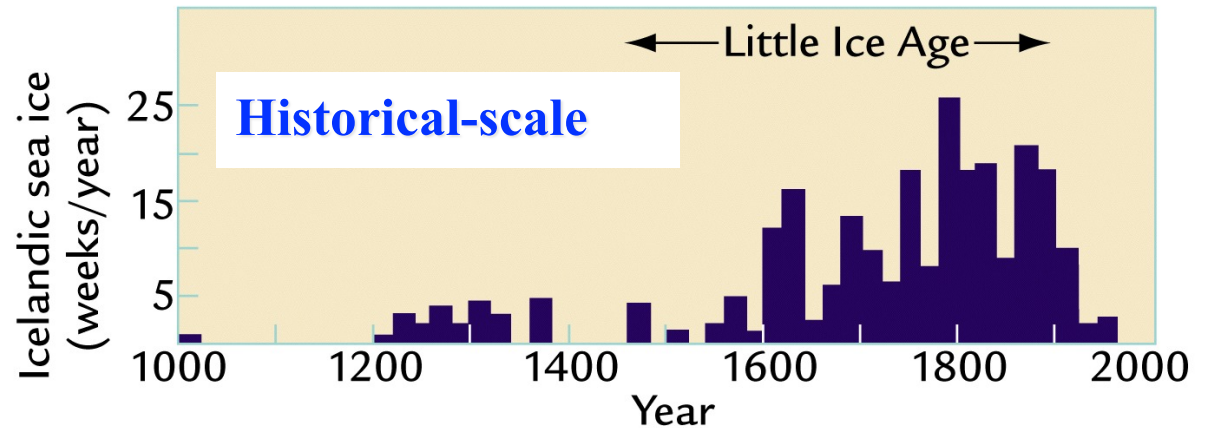
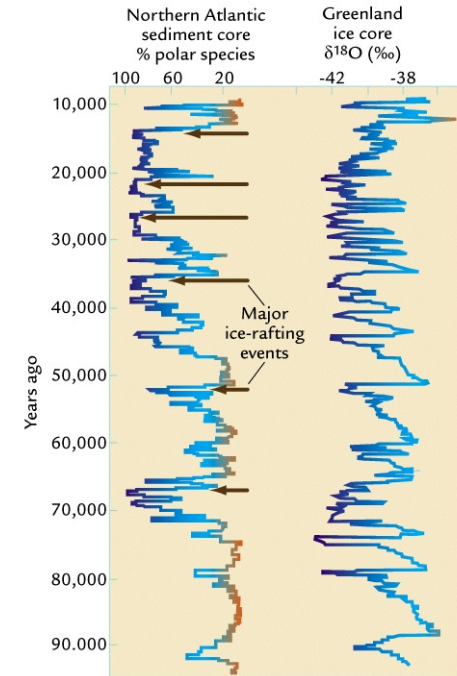
Tectonic-scale



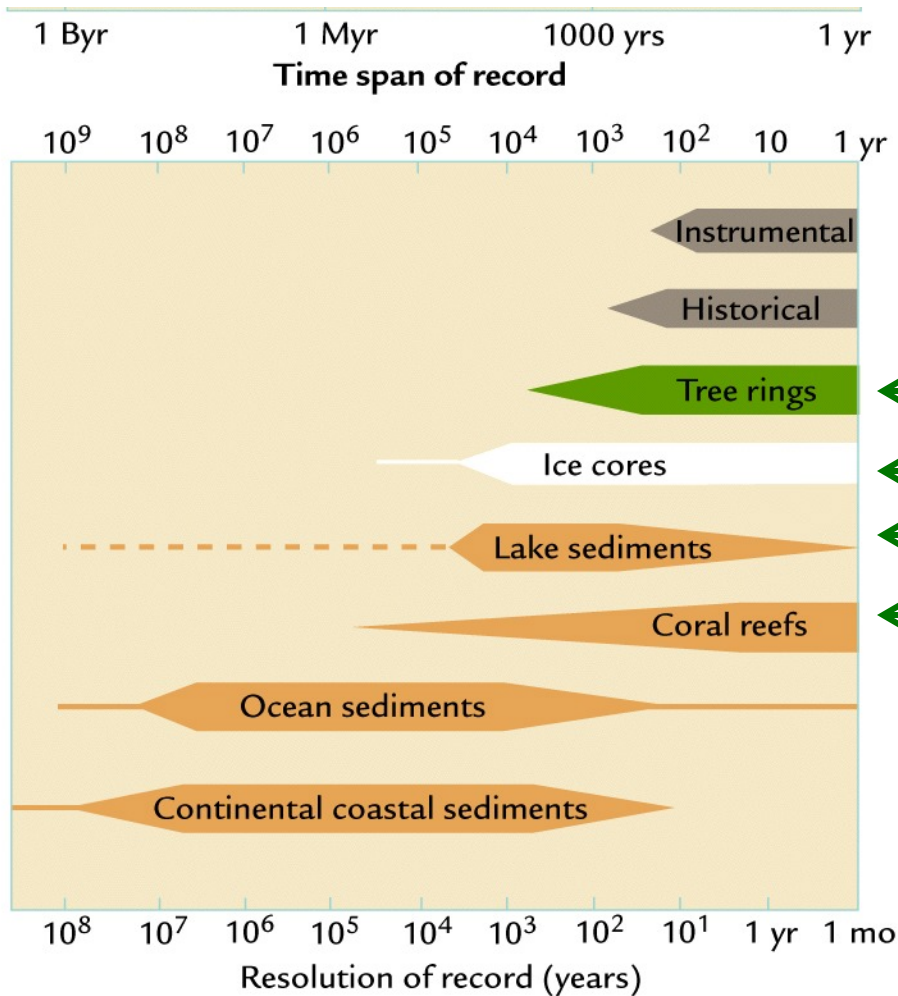
Orbital-scale (Cycles)



Millennial-scale (Oscillations)



Proxy Records of Climate



• Proxies that record **annual growth** patterns can indicate year to year variations in climate

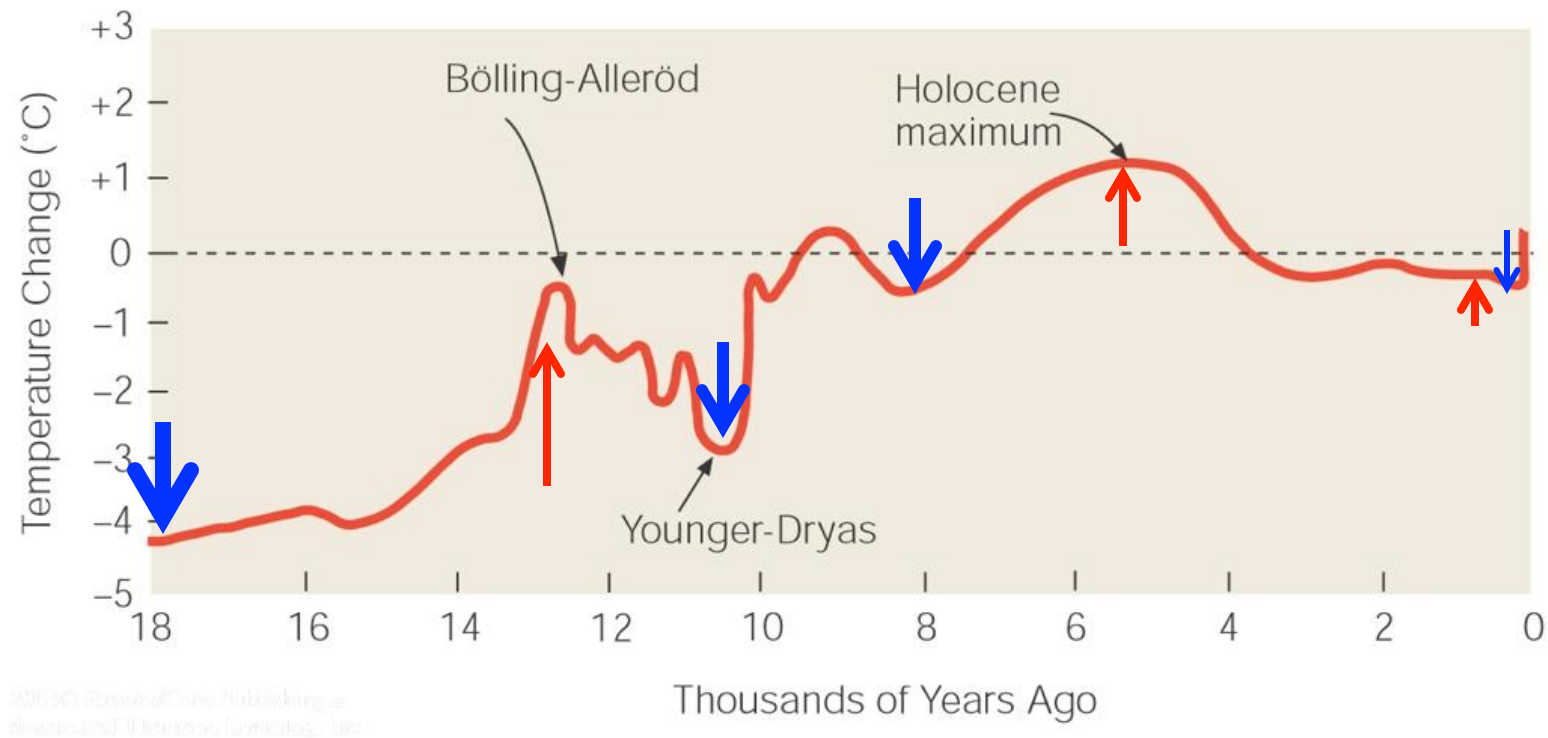
← -tree rings

← -ice cores

← -deep lake sediments

← -coral reefs

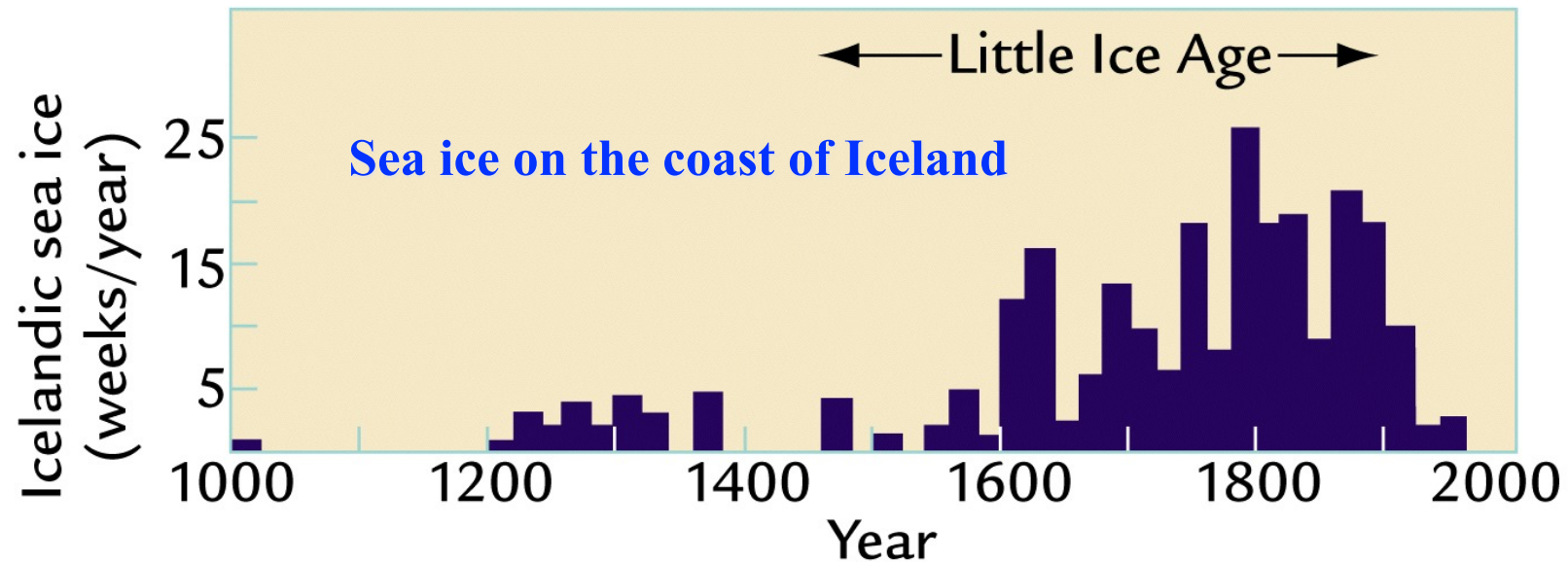
Climate Change Since the Last Glacial Maximum



Data important for estimating past climate include: **lake bottom sediment**, **ice cores**, **fossil evidence**, **written documents**, **coral isotopes**, **calcium carbonate layers in caves**, **borehole temperature**, and **dendrochronology** or **tree ring** data.

These data have helped identify several important **climate change events** in the past 18,000 years.

The Little Ice Age: Local or Global?



The cooling in Europe (1400-1900): colder winters and shorter growing seasons

Evidence Lakes, rivers, and ports in Europe froze.

The European population **seriously** affected.

Mountain glaciers in the Alps of Switzerland and Austria **advanced**.

The Little Ice Age was not a true ice age.

Major ice sheets did not develop.

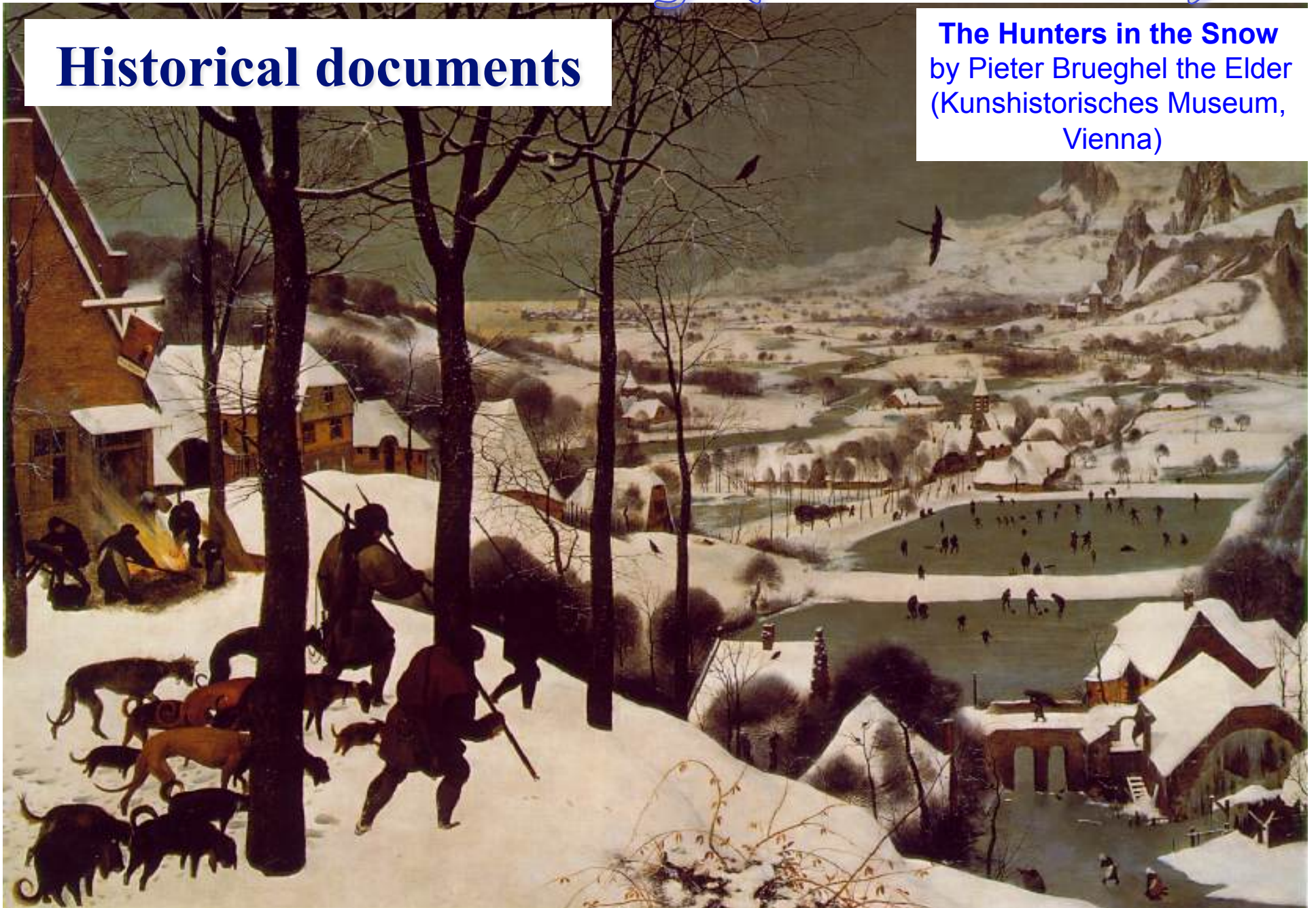
Small (<1°C) drop in global temperature.

Widely scattered land-based records, but few records from the oceans.

The Little Ice Age (~1270-1850)

Historical documents

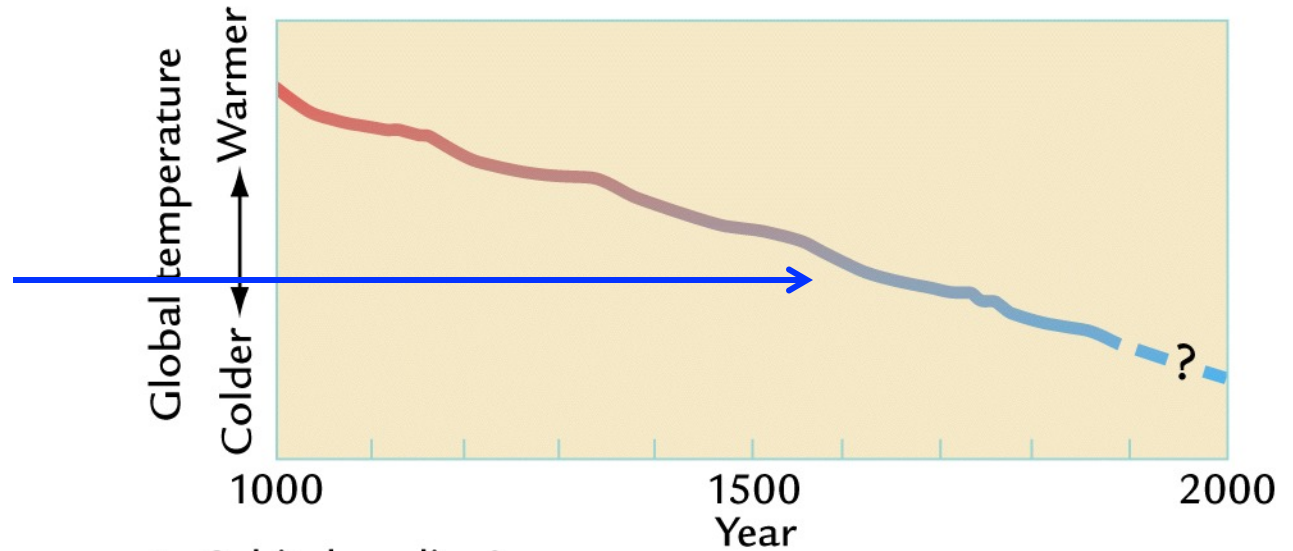
The Hunters in the Snow
by Pieter Bruegel the Elder
(Kunshistorisches Museum,
Vienna)



Two Interpretations of The Little Ice Age

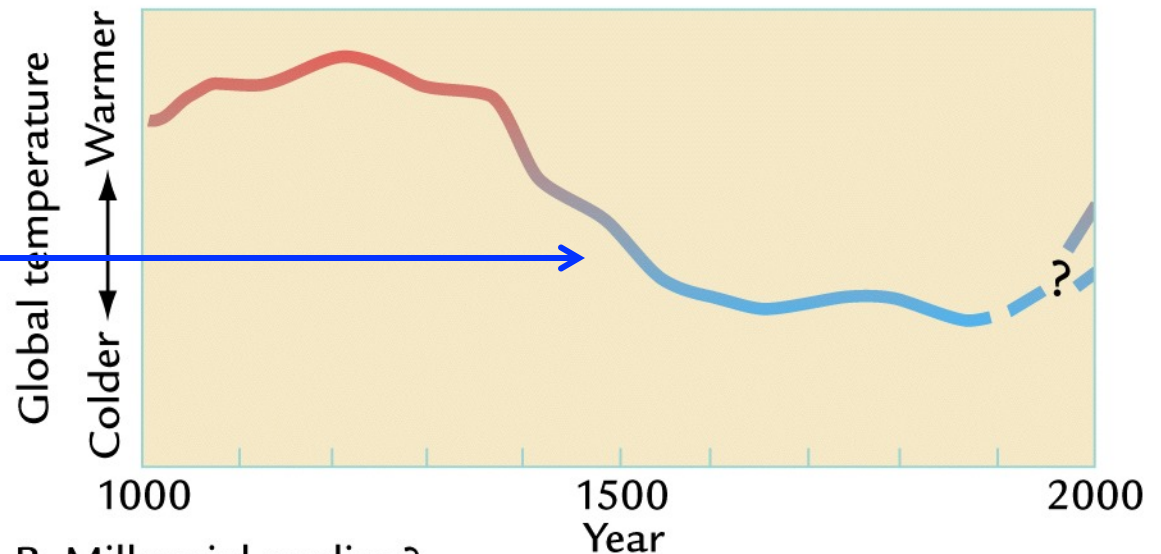
The Little Ice Age in Europe could have resulted from

A continuation of slow orbital-scale cooling



A Orbital cooling?

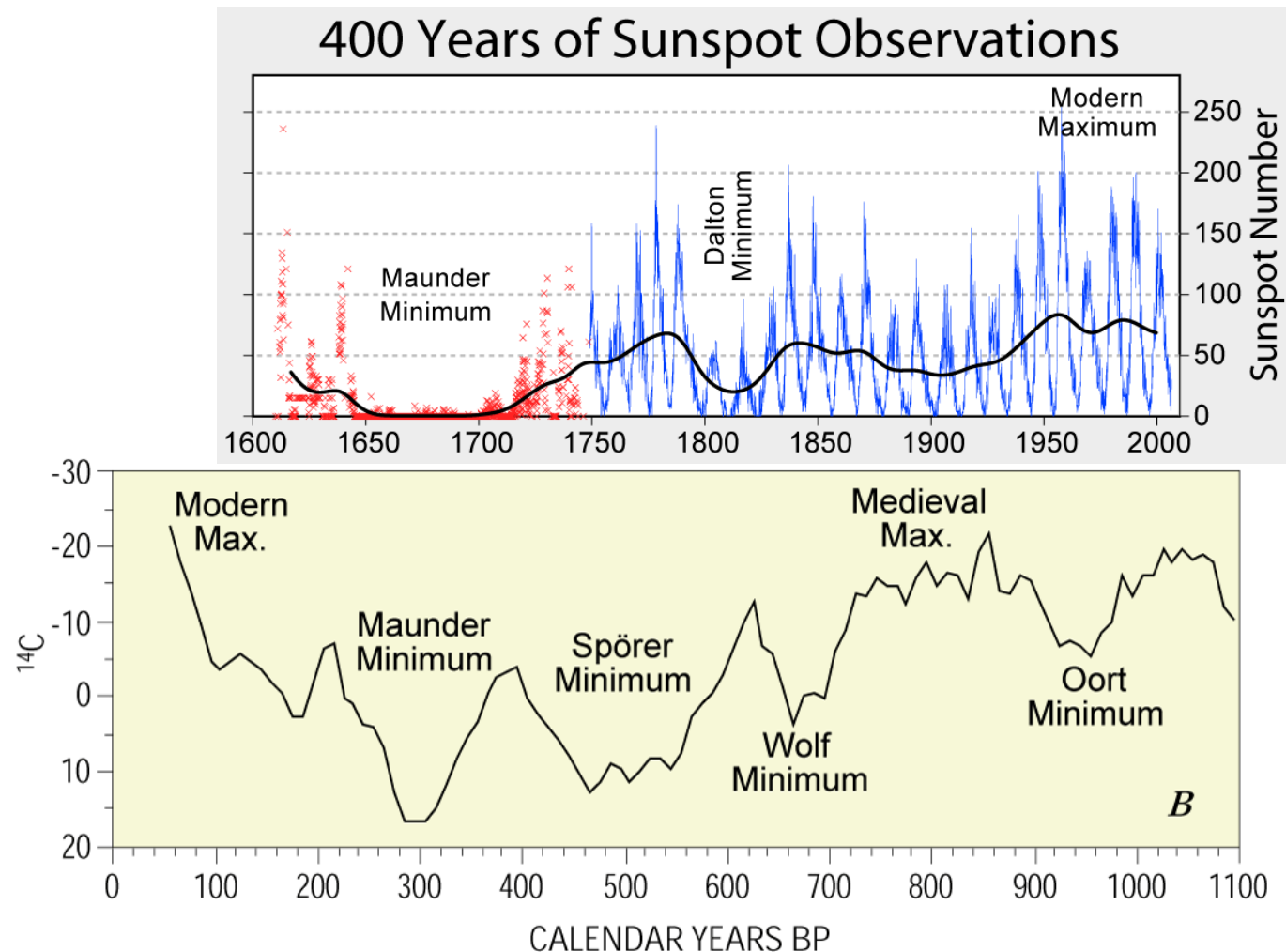
Part of a millennial-scale oscillation



B Millennial cooling?

Causes of The Little Ice Age

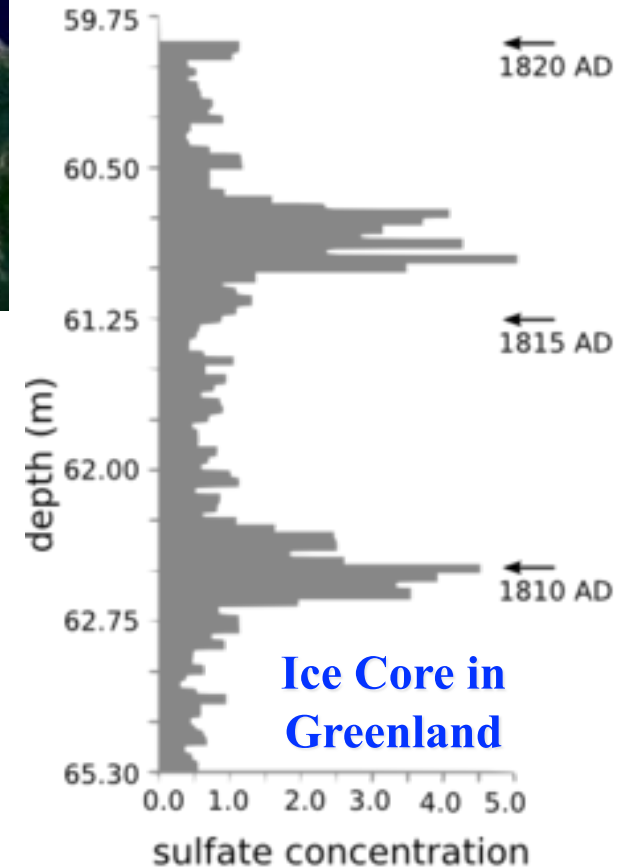
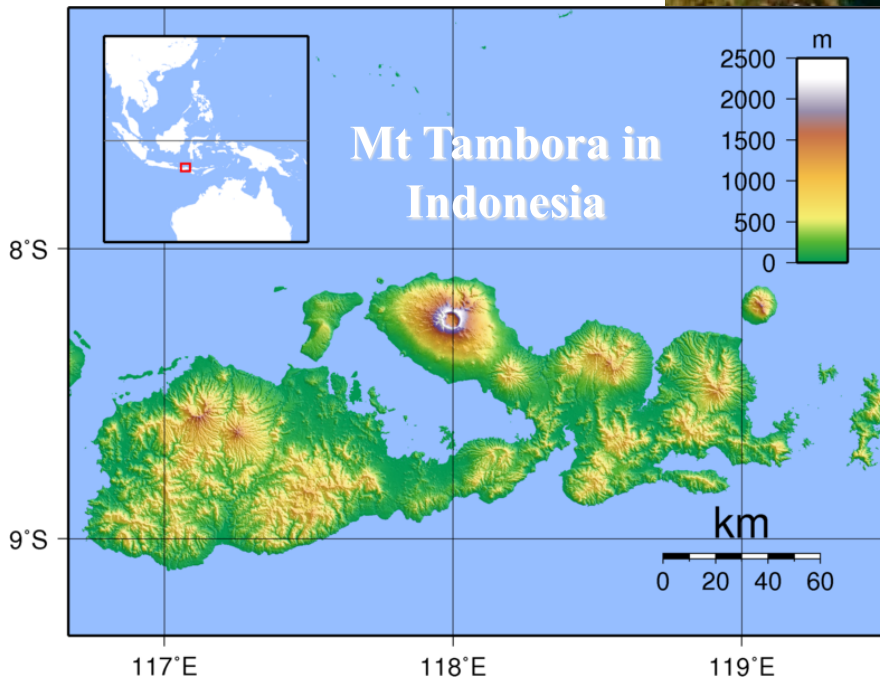
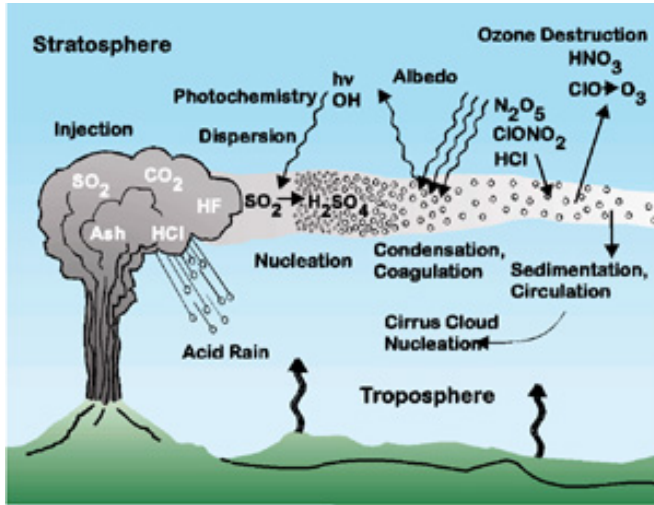
Low solar activity (1645-1715): 50 sunspots over a 30-yr period compared to normally 40,000 to 50,000 spots.



Causes of The Little Ice Age (2)

More volcanic eruptions

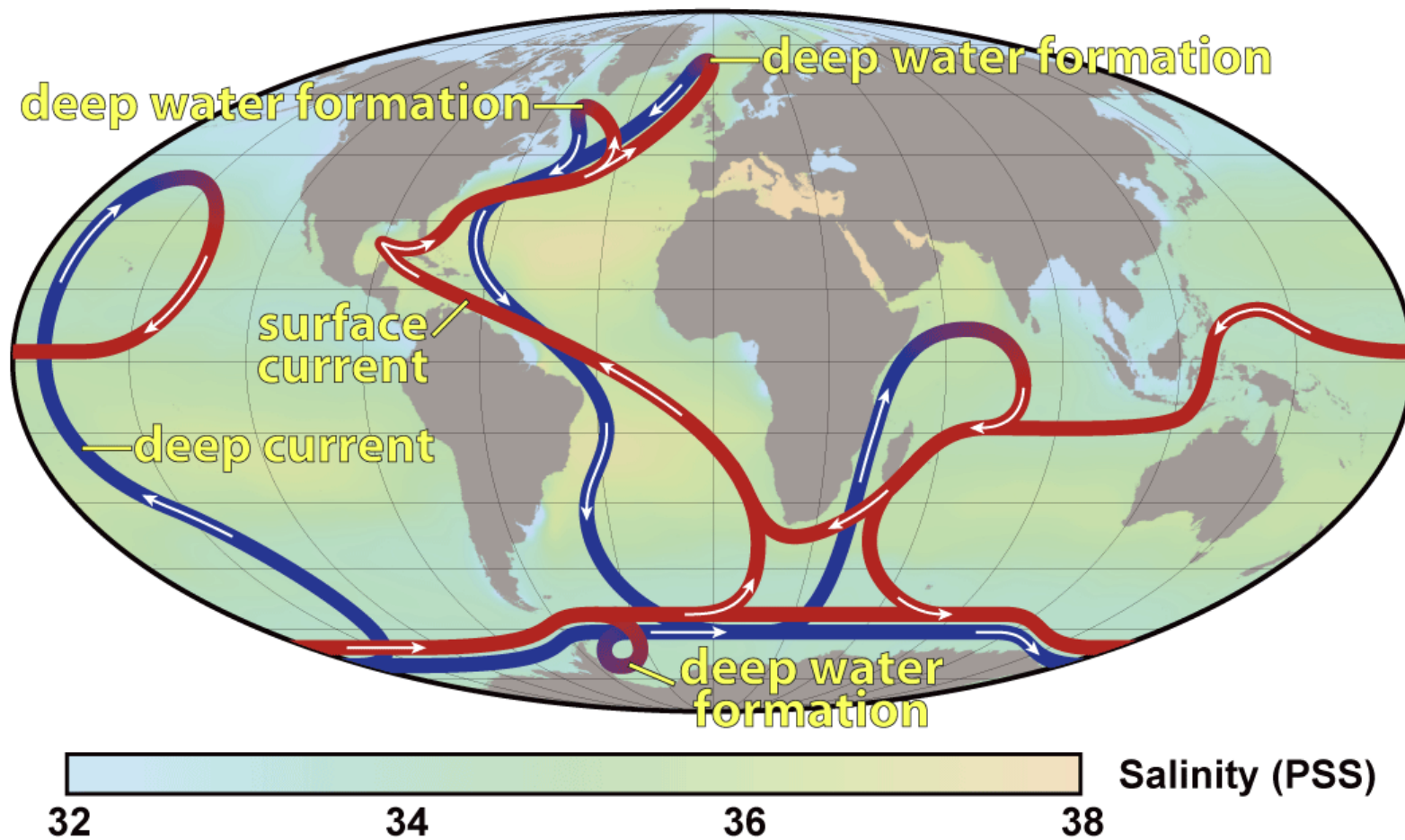
The Year without summer in 1816 caused by the 1815 eruption of Mt Tambora



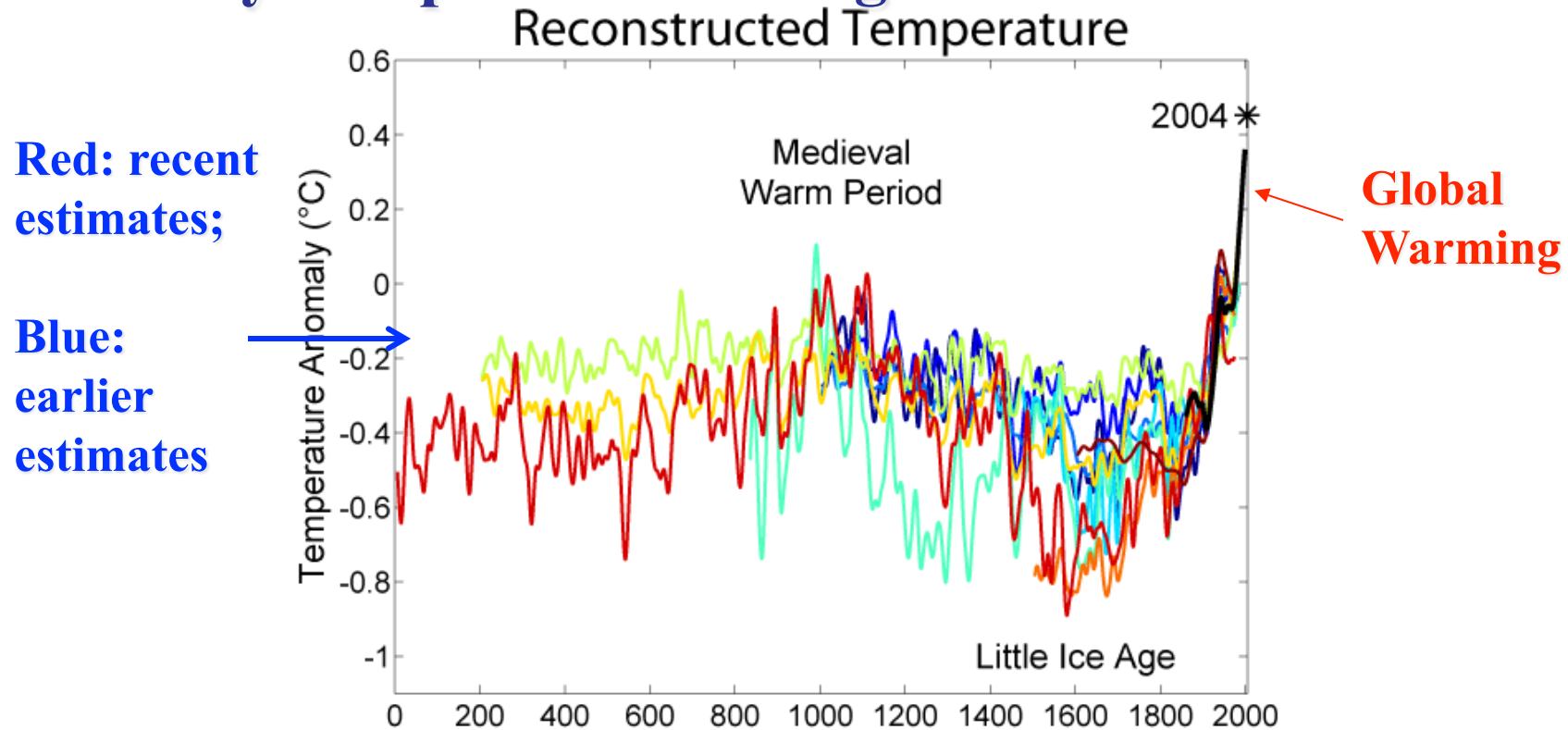
Causes of The Little Ice Age (3)

Shutdown of thermohaline circulation

Thermohaline Circulation



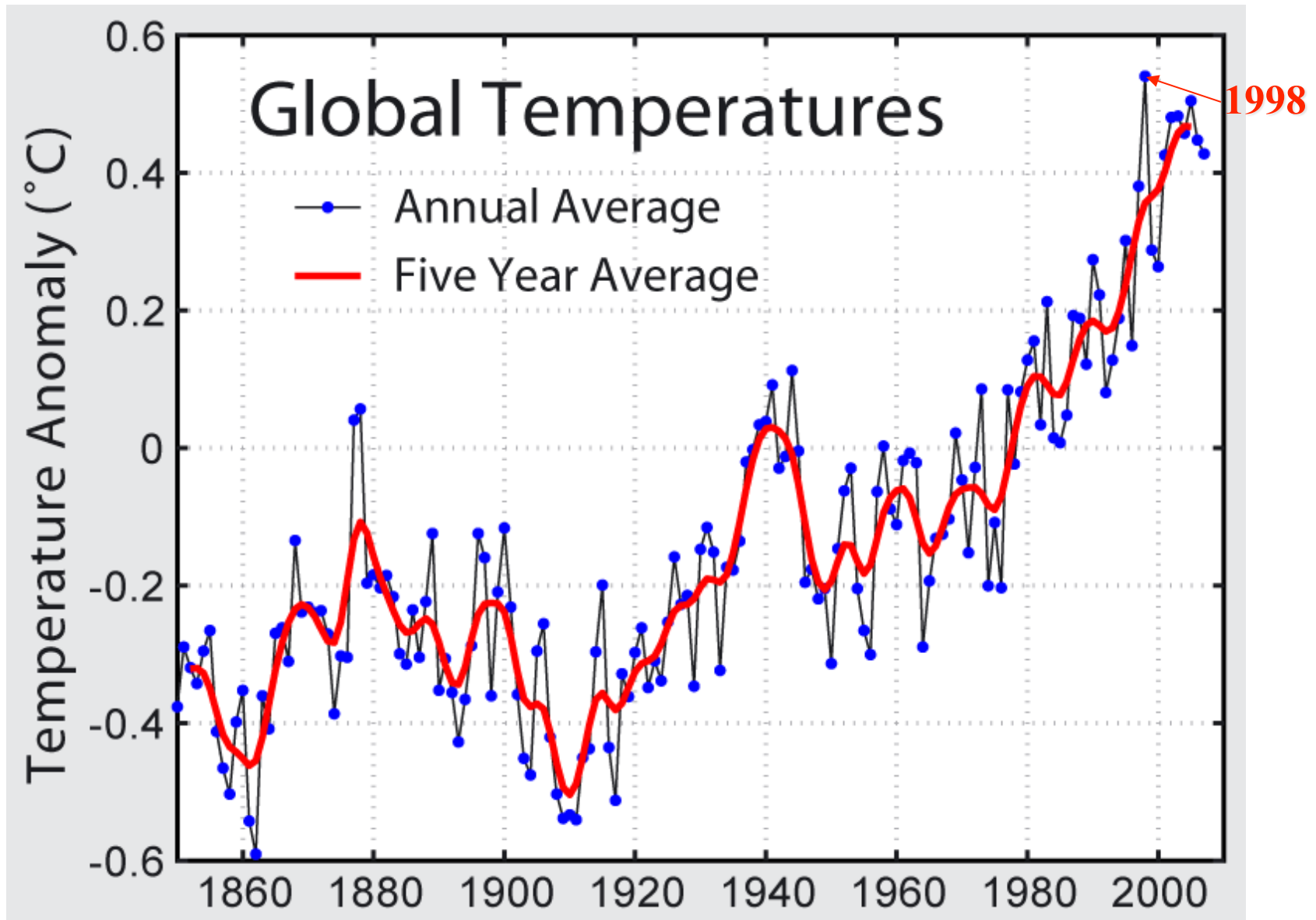
Yearly Temperature Change for the Last 2000 Years



Data from tree rings, corals, ice cores, and historical records are shown in various colors. Thermometers data in black.

About 1000 y.a., Medieval Warm Period. Certain regions were warmer than others. Warm and dry summers in England (1000-1300): vineyards flourished and wine was produced. Vikings colonized Iceland and Greenland.

Yearly Temperature Change Since 1850



Data from thermometers

Summary:

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