

MEJA



800

900

1000

1100

1200

1300

1400

1500

1600

Anno Domini





# Ijsversmaak ("Fun on the Ice")

Hendrick Avercamp, 1608



# Mediaeval Optimum

- Settlements in Iceland (825: Irish monks; ca 870: Vikings) and Greenland (986)
- Vineyards in England
- Agriculture on the summits of the Lammermuir Hills
- Woodlands cleared
- Population growth

	England	France
AD 1200:	1.4 million	6.2 million
AD 1300:	5 million	18 million

# The Great Famine 1315-1321

- “Exceedingly great rains descended from the heavens...”
- “Therefore is the anger of the Lord kindled against his people, and he hath stretched forth his hands against them, and hath smitten them” (Chronicle of Malmesbury)
- “There began a dearness of wheat...”





Triumph of Death, Camposanto (Pisa), Mid-14 century (1338?)



# The winter of 1570/1571





Triumph of Death, Jan Brueghel, 15



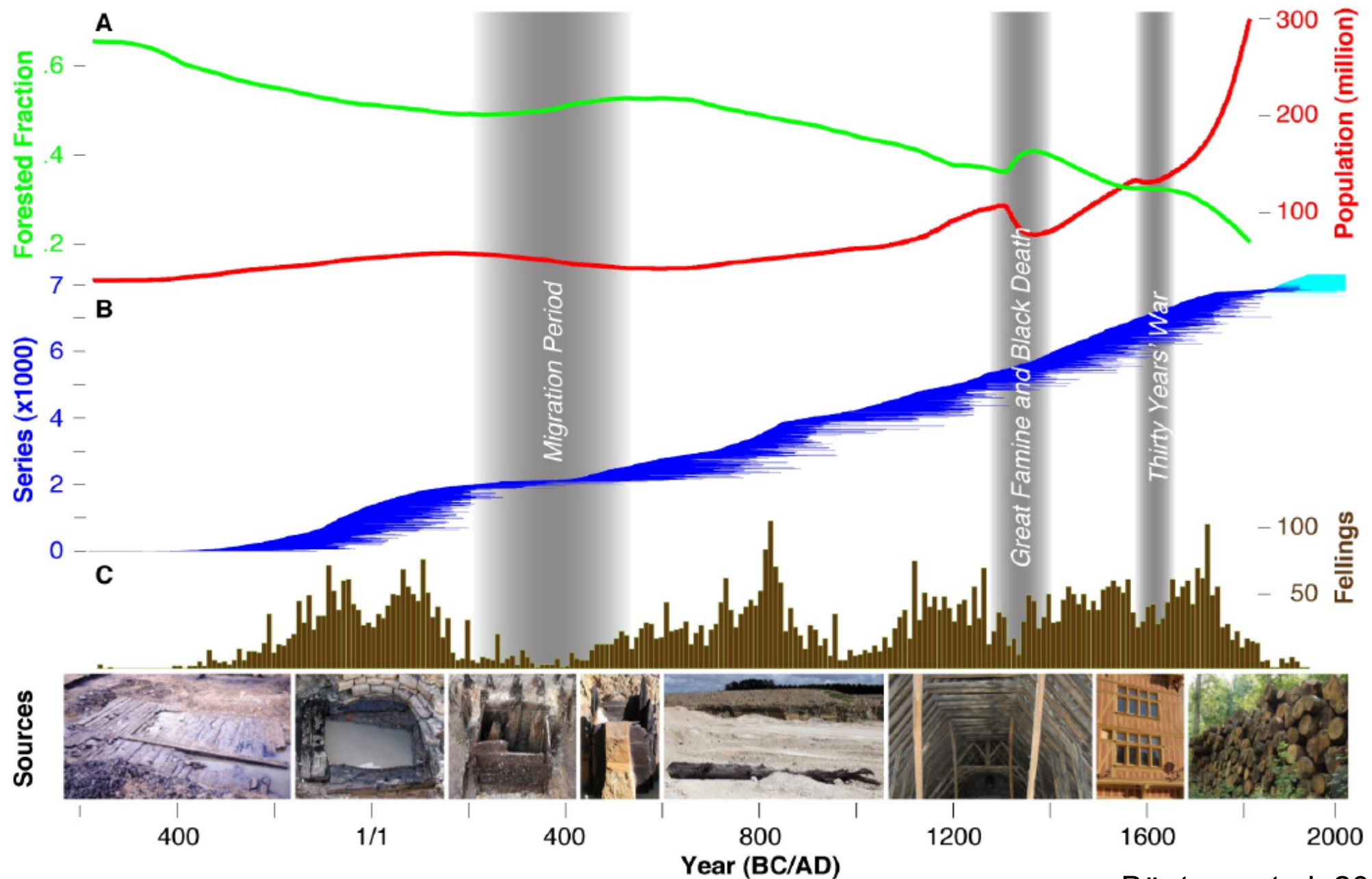


# Historical events 1300-1900

- 1315-1321: The Great Famine
- 1337-1435: Hundred Years War
- 1300+: Rise of the Hanseatic League
- 1348: Black Death
- c. 1350: Greenland W. Settlement abandoned
- 1469: Wine cultivation abandoned in England
- 1492 Columbus
- 1570/71: extremely harsh winter
- 1618-1648: Thirty Years War
- 1798-1815: Napoleonic Wars
- 1845-1849: Irish Potato Famine, emigration

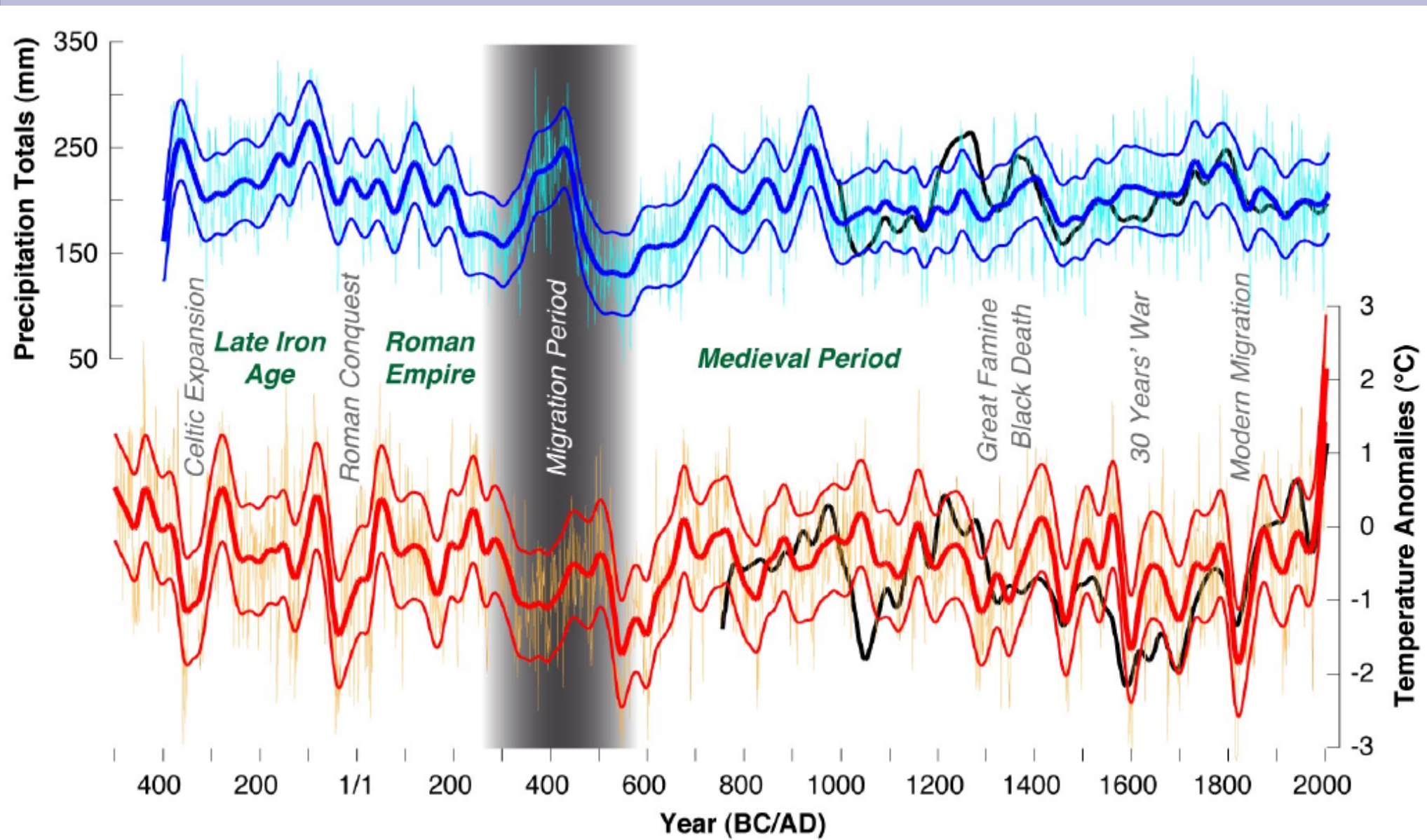


# Tree rings (Central Europe)





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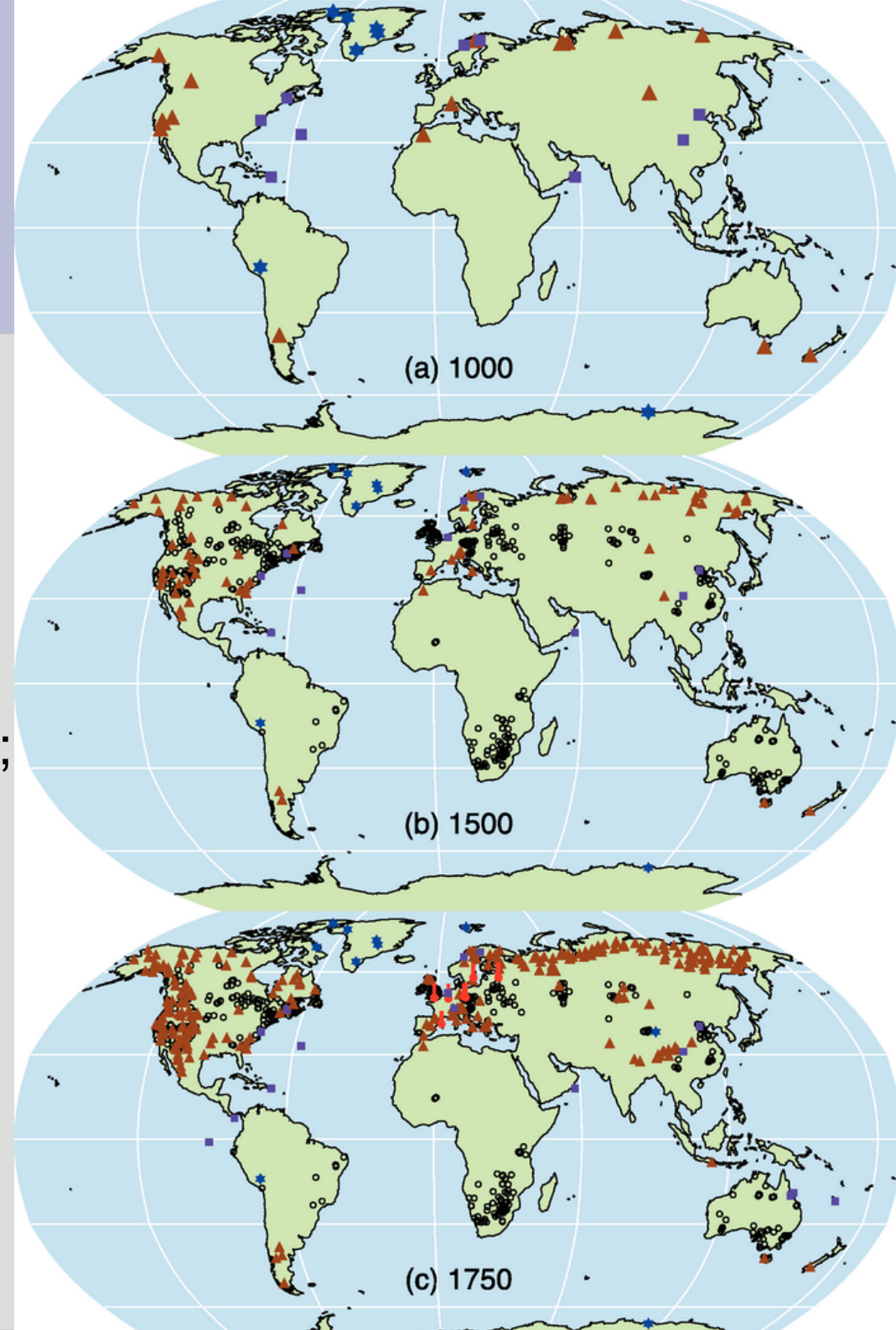


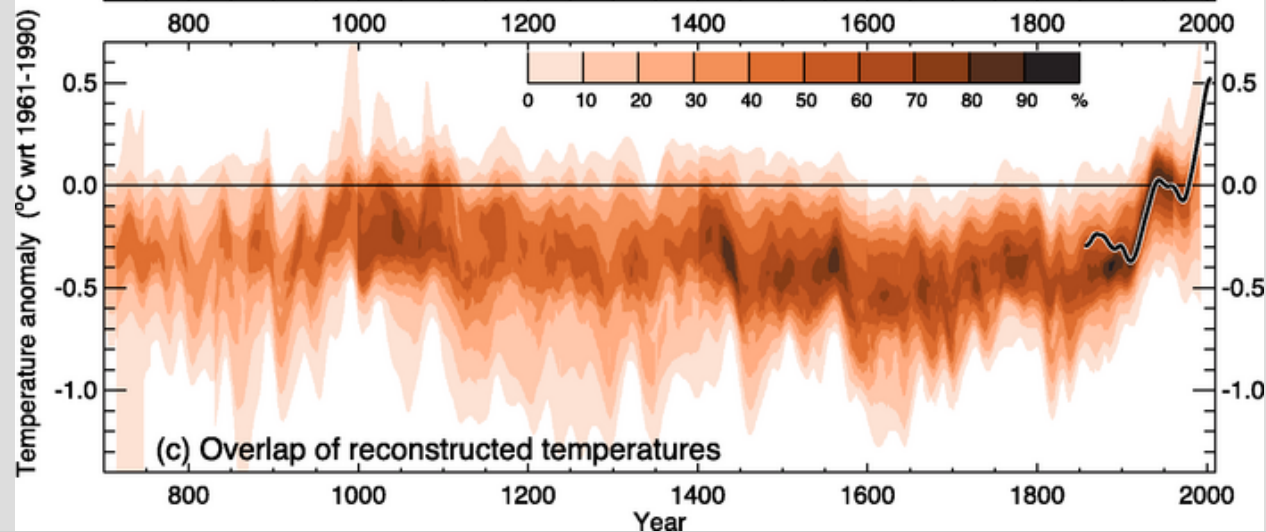
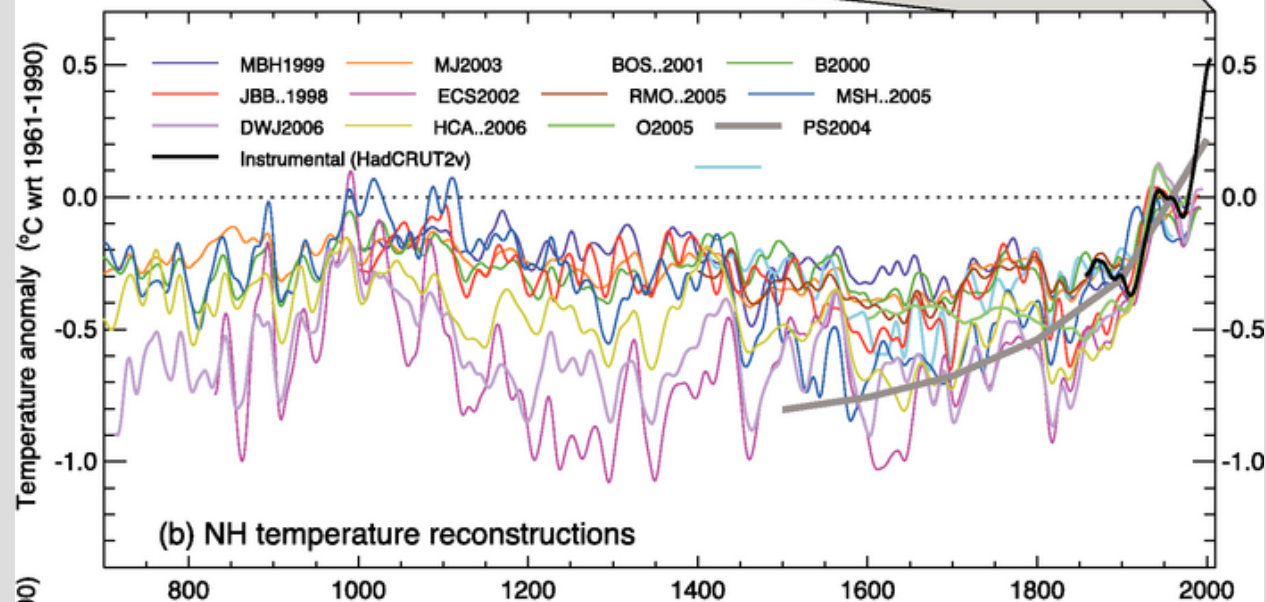
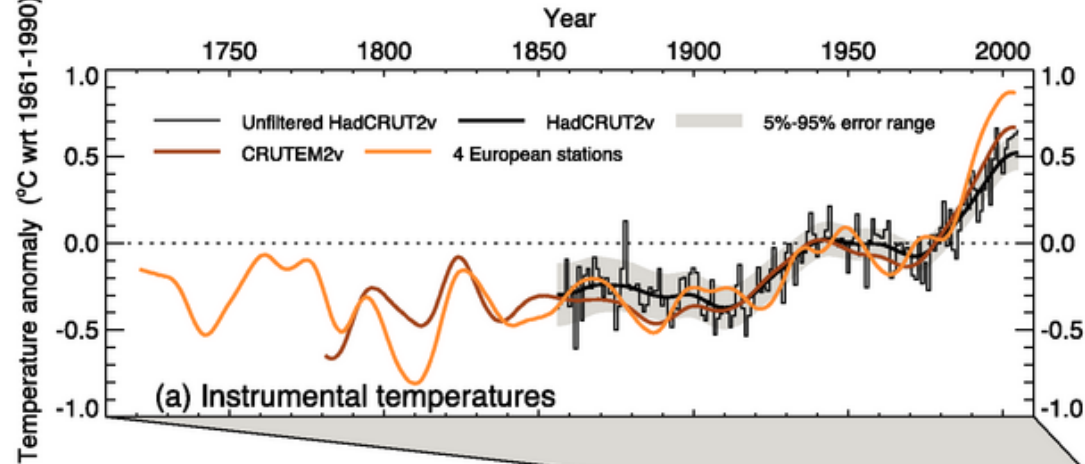


# Global Temperature

Locations of proxy records with data back to AD 1000, 1500 and 1750:

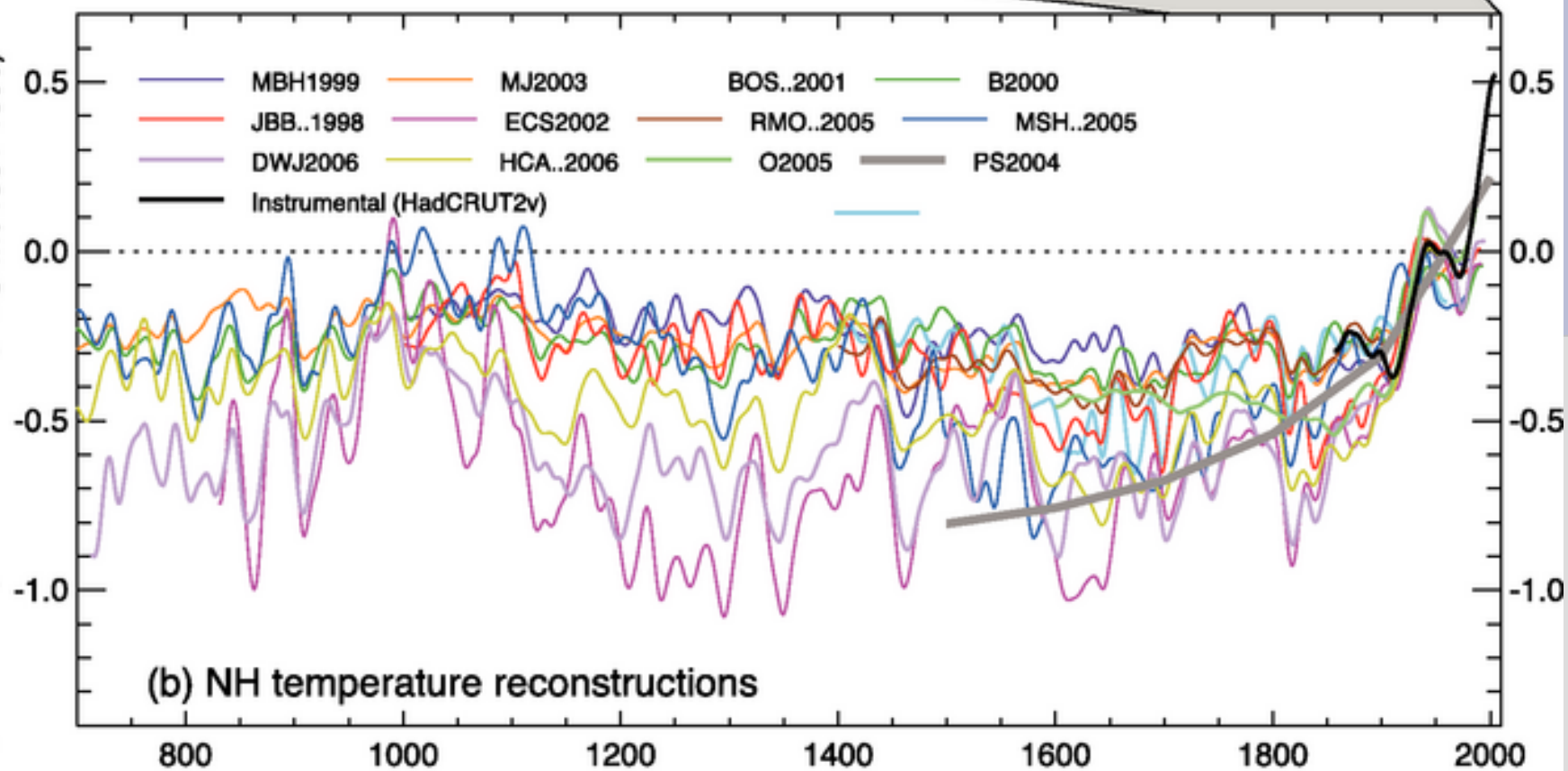
- instrumental: red thermometers;
- tree ring: brown triangles;
- borehole: black circles;
- ice core/ice borehole: blue stars;
- other including low-resolution records: purple squares



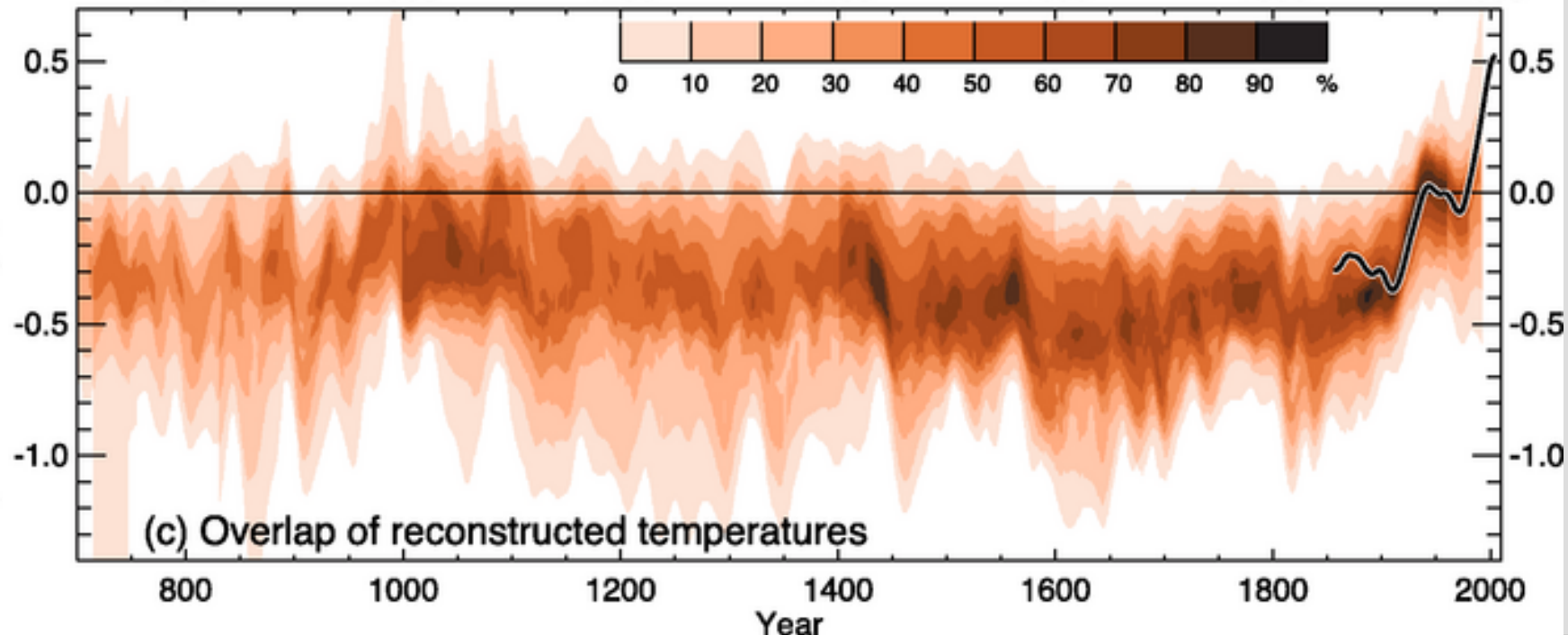




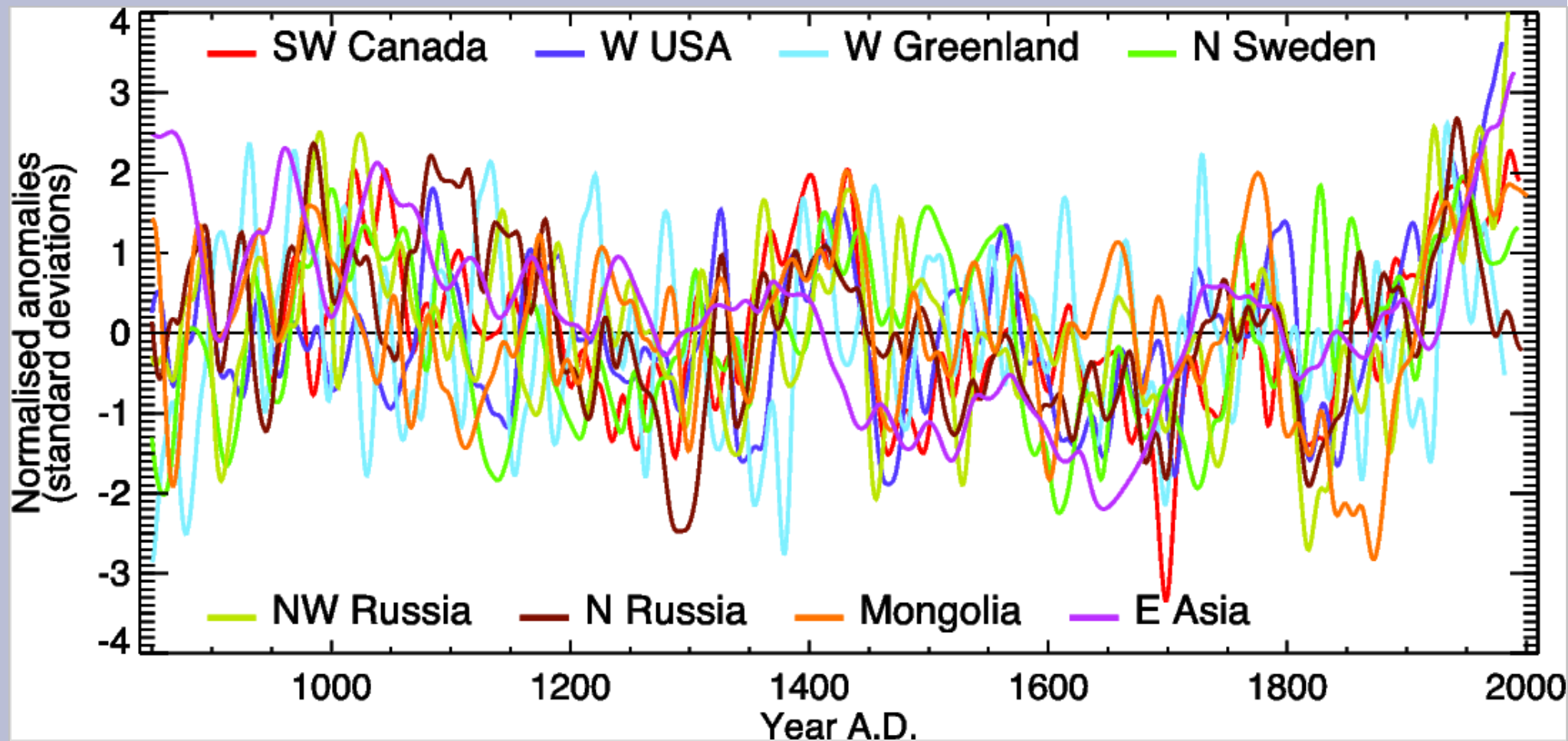
Temperature anomaly (°C wrt 1961-1990)



Temperature anomaly (°C wrt 1961-1990)

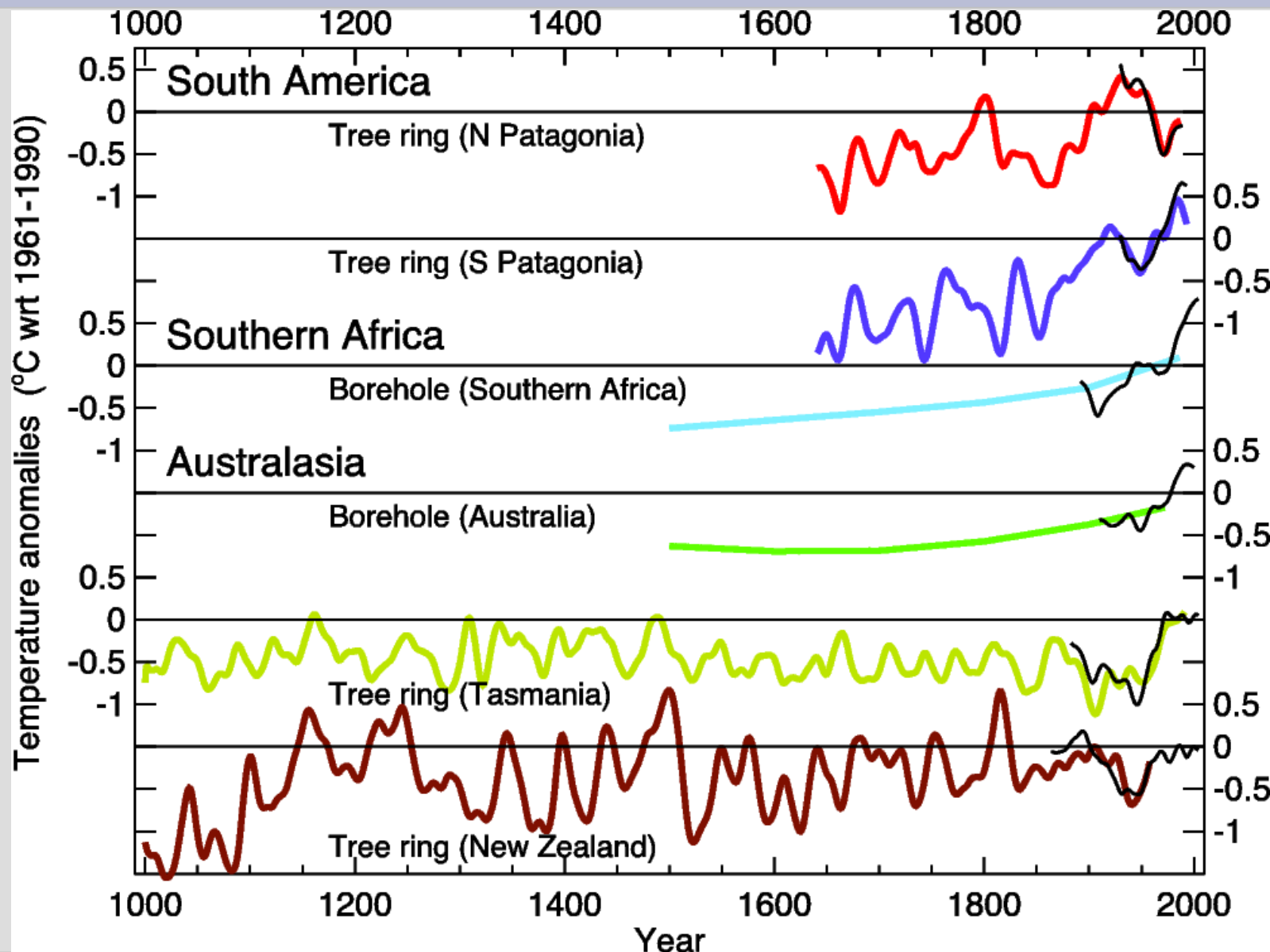


# Regional Variability





# Southern Hemisphere?

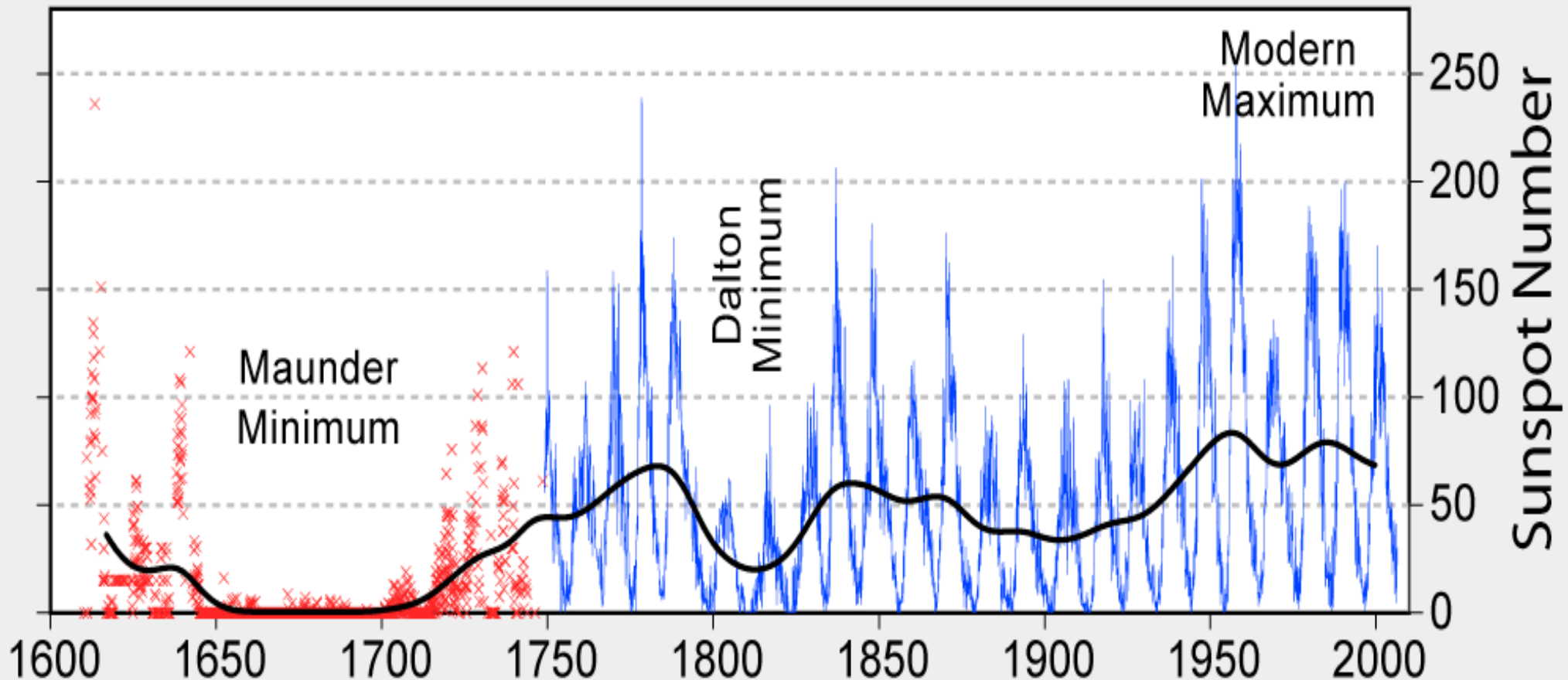


black lines:  
instrumental  
record for  
each region

IPCC 2007:  
Fig 6.12

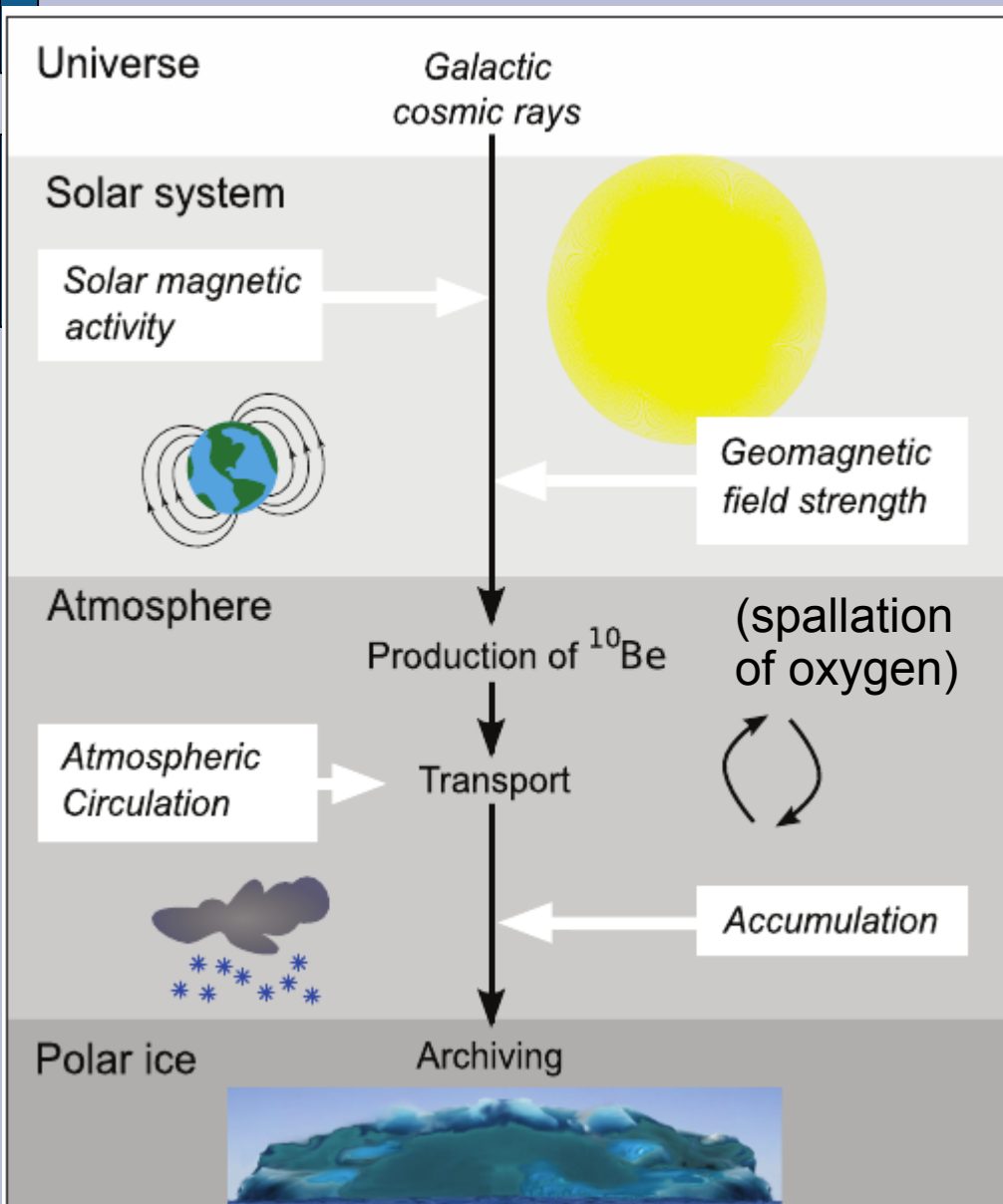
# Solar Forcing

## 400 Years of Sunspot Observations





# Solar irradiance from $^{10}\text{Be}$



Grand Solar Minima:

O: Oort

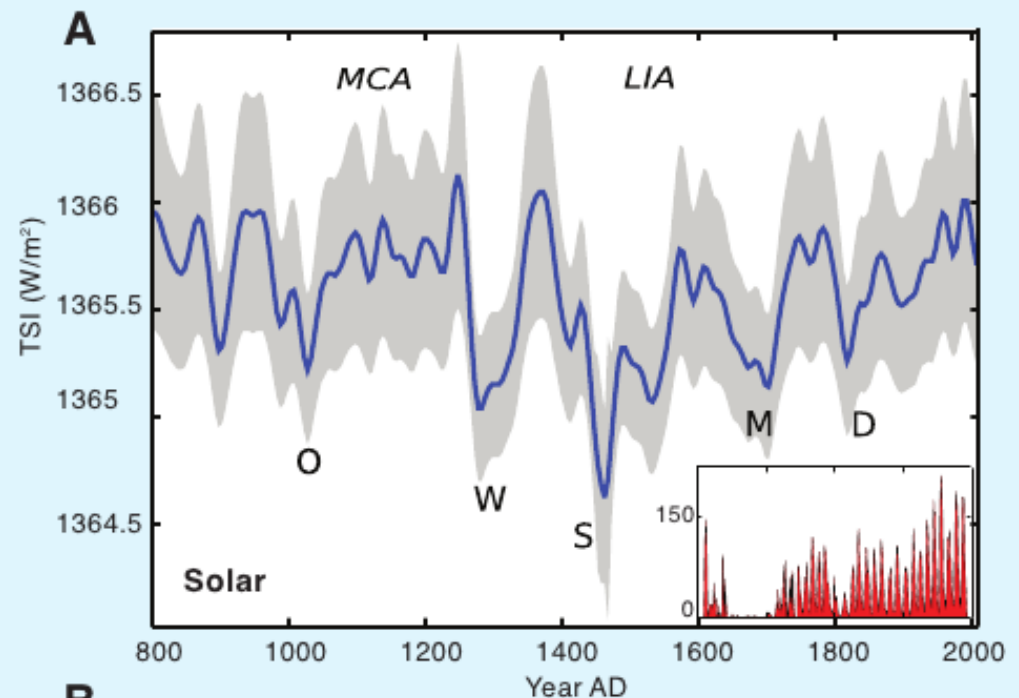
W: Wolf

S: Spörer

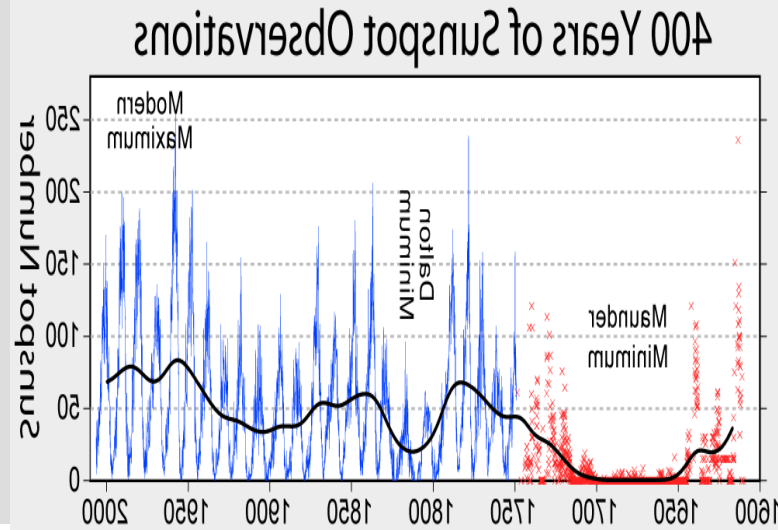
M: Maunder

MCA: Medieval Climate Anomaly

LIA: Little Ice Age



# Solar Forcing

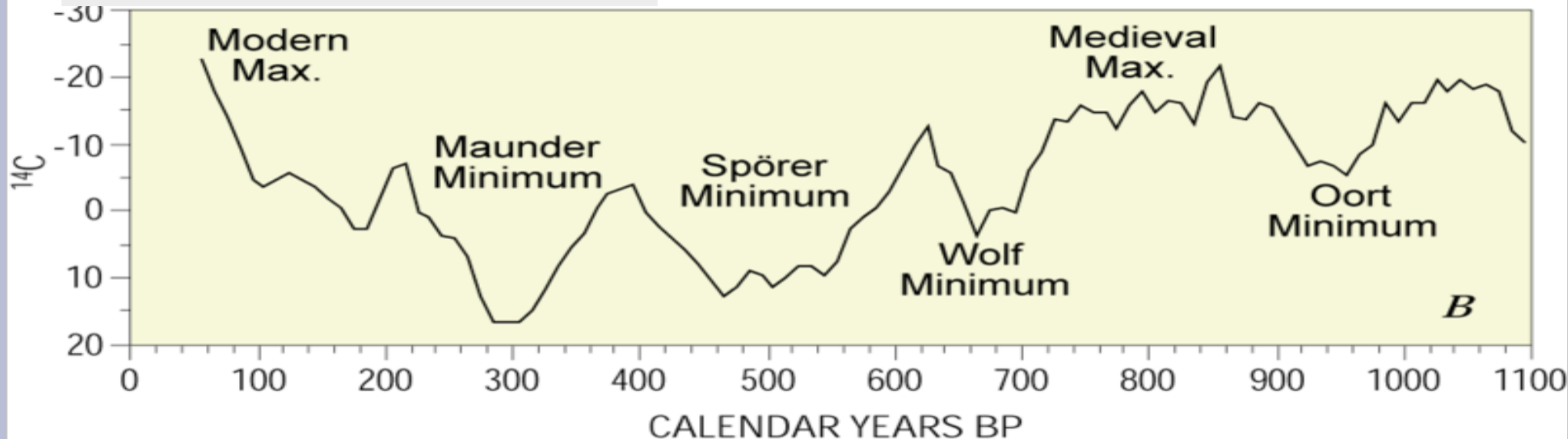


C-14 formation in Atmosphere:  
hard solar radiation hits atoms and  
produces free **neutrons (n)**

Then:



C-14 content of the atmosphere

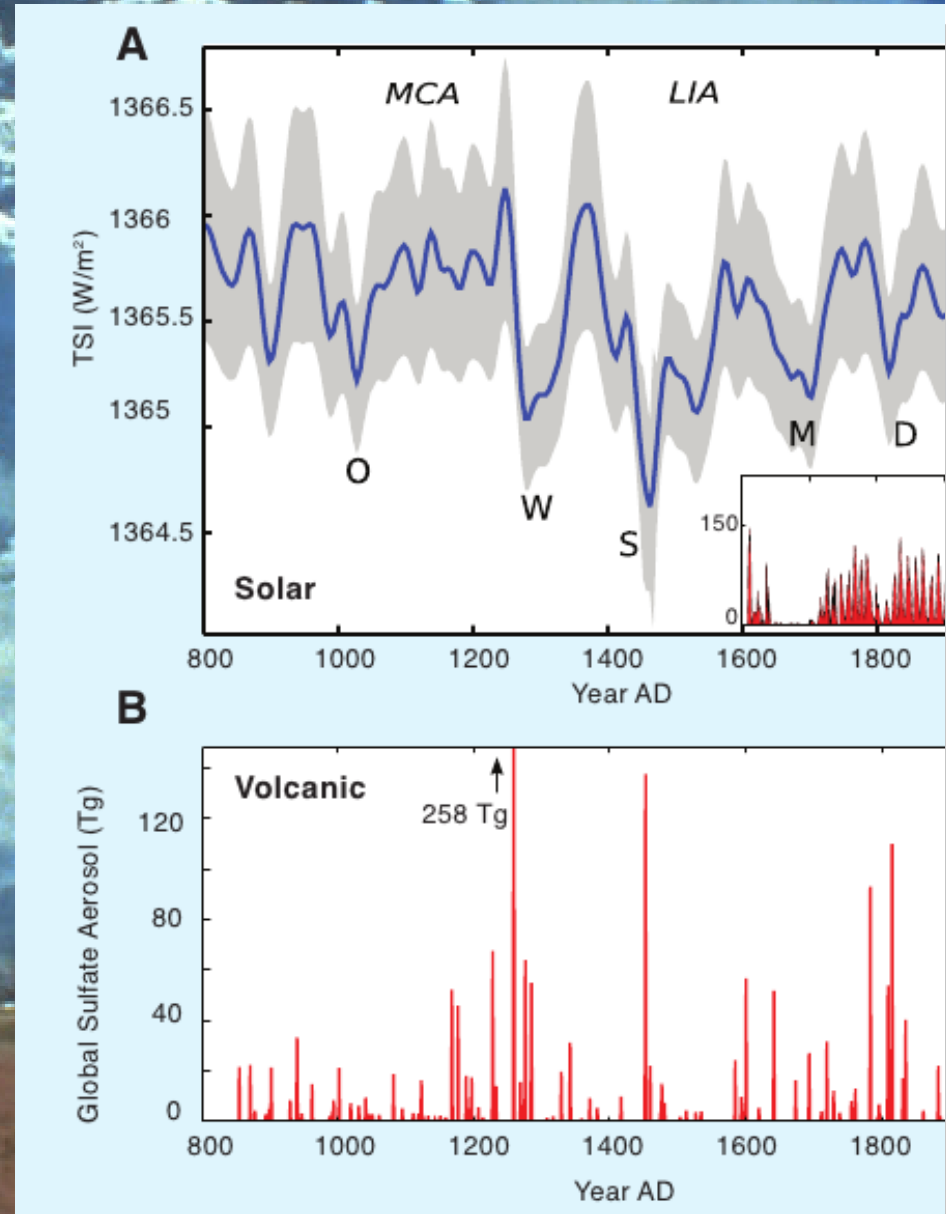




# Volcanic activity

Hansen (1996)

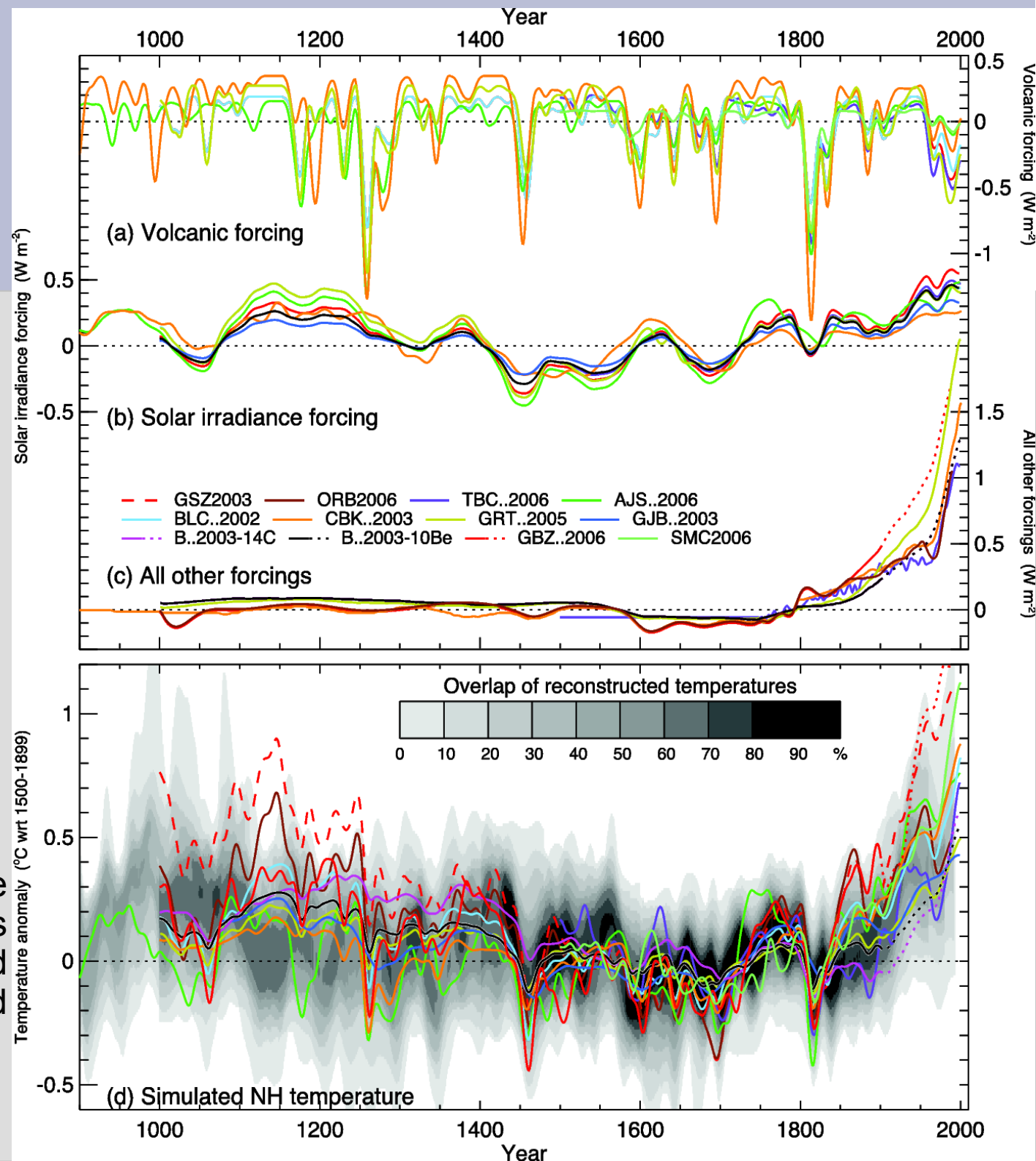
258: unknown location  
280: Quilotoa (Ecuador)  
450: Pinatubo? (Phillipines)  
600: Huaynaputina (Peru)  
783/84 Laki (Iceland)  
816: Tambora (Indonesia)  
883: Krakatoa



# Modelling

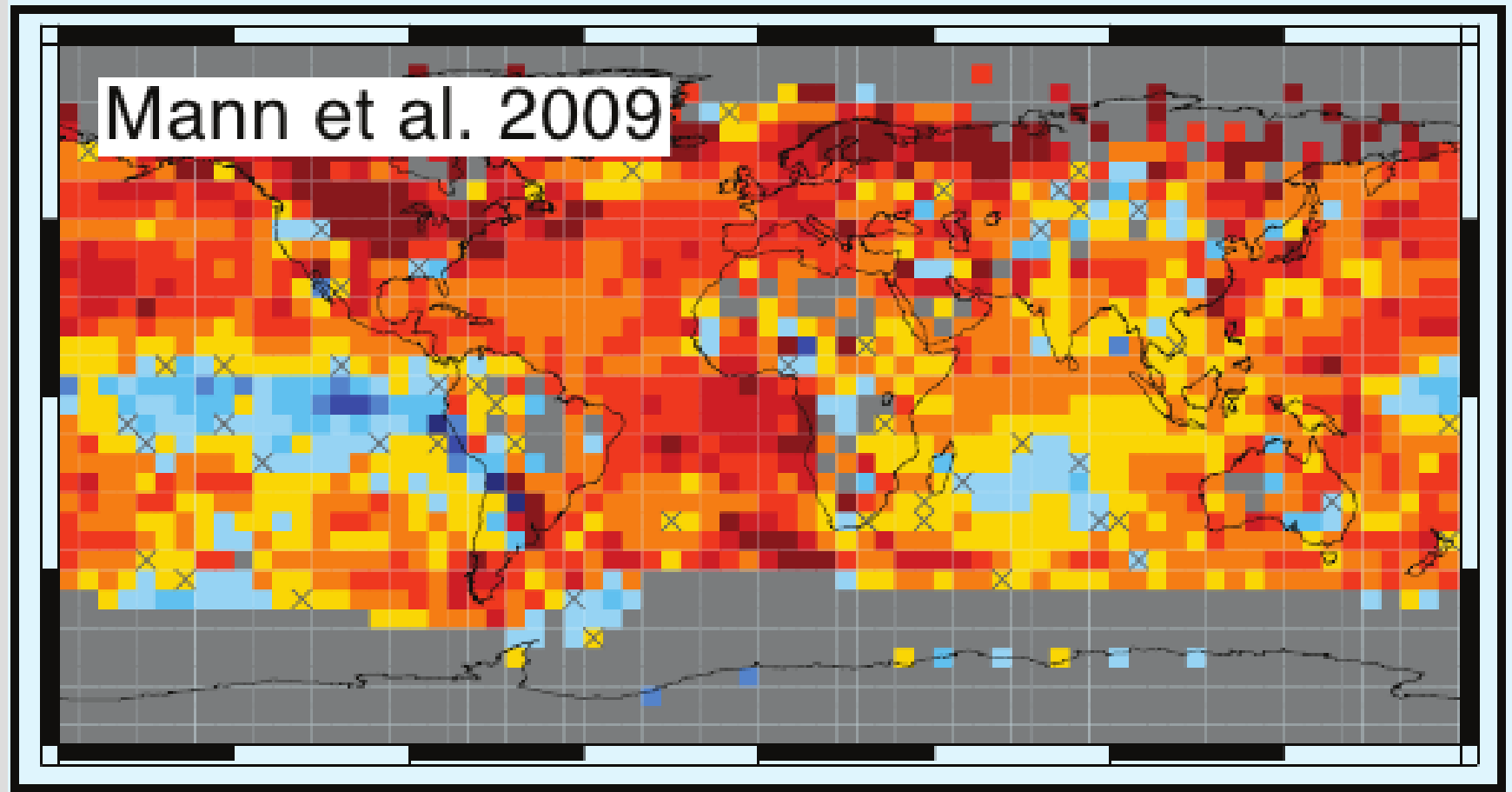
Forcings  
(W/m<sup>2</sup>)

Northern Hemisphere  
temperatures  
lines: simulated  
shading: reconstructed



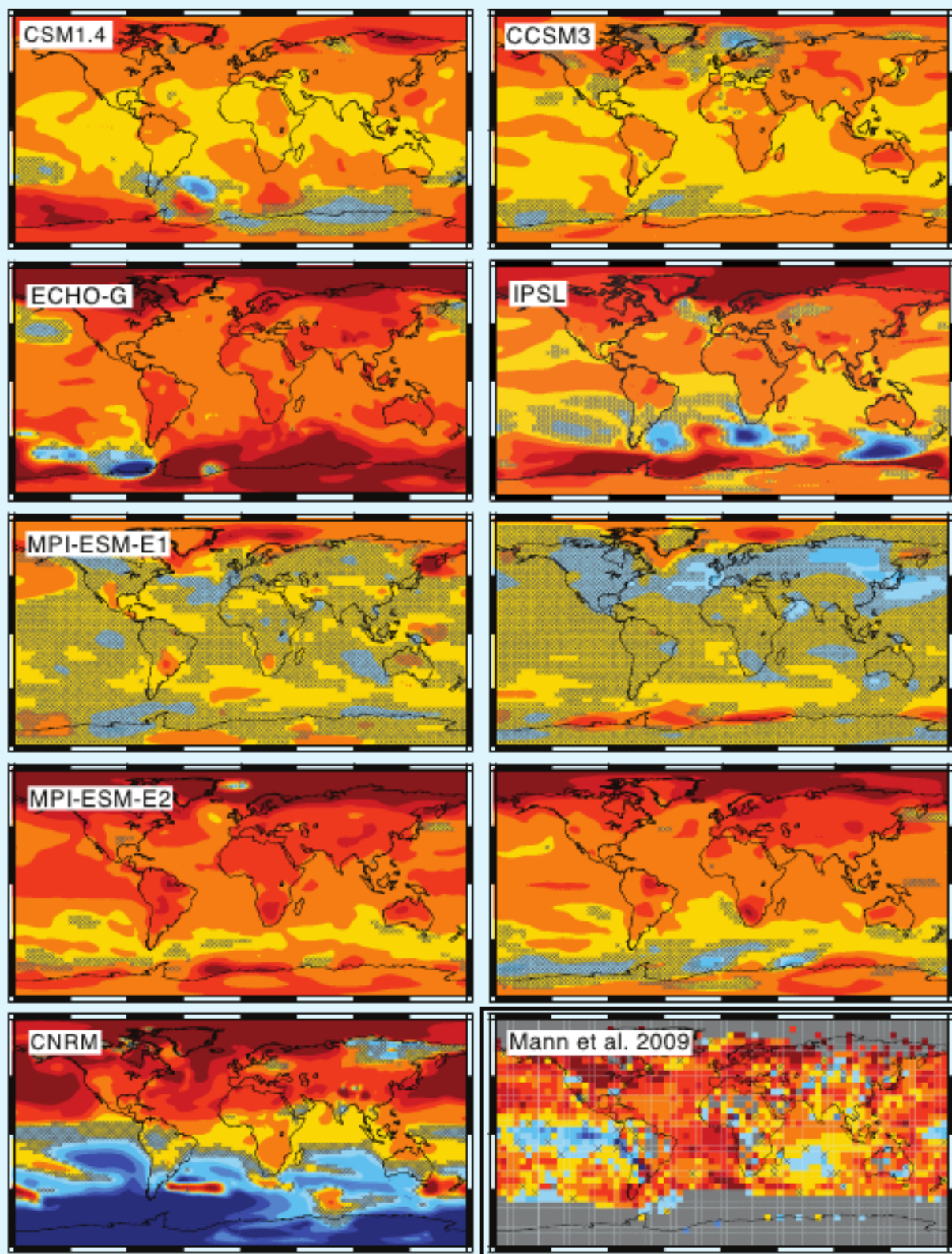


# Climate reconstruction: 950-1250 minus 1400-1700



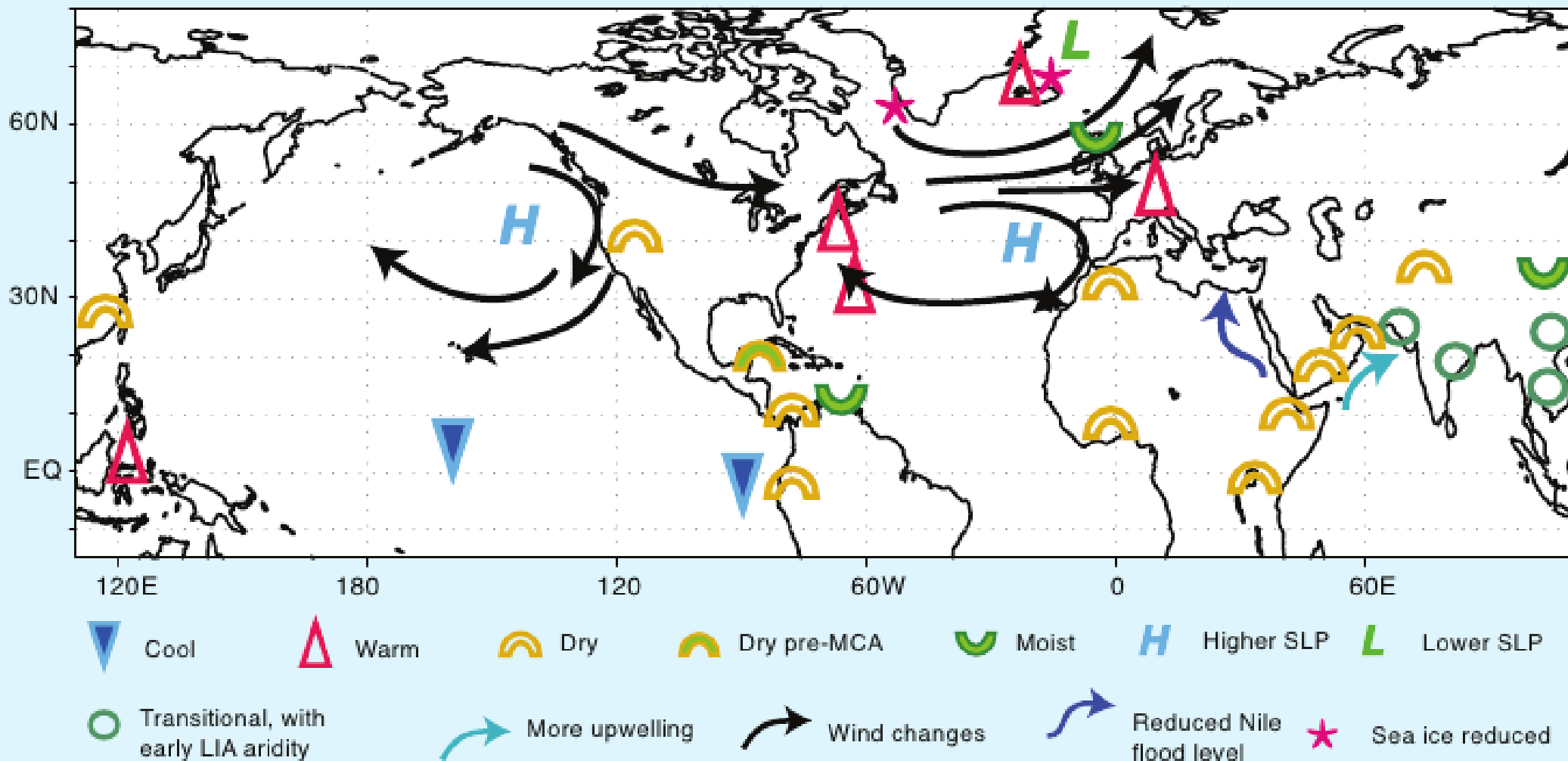
Temperature difference (K)

# Models





# Climate reorganisation? (MCA versus LIA)



# Climate and Wars in China

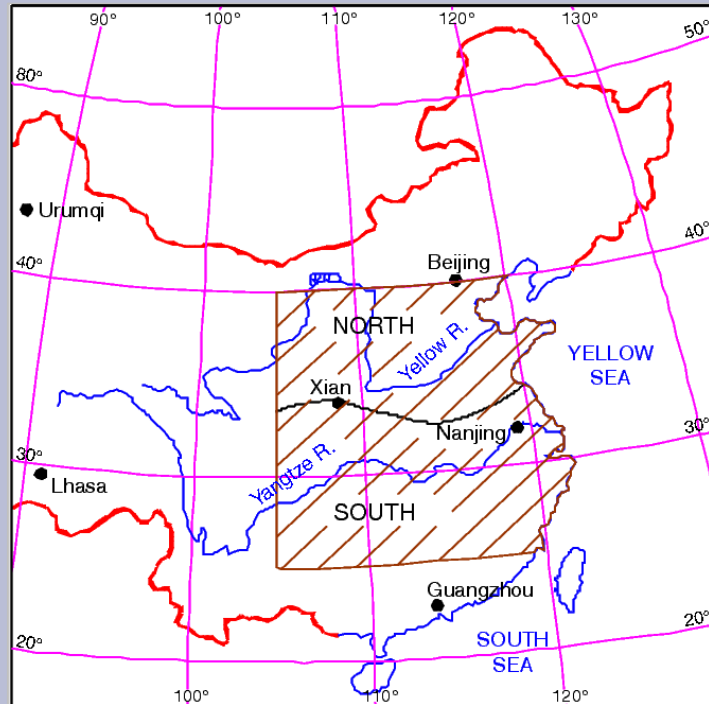
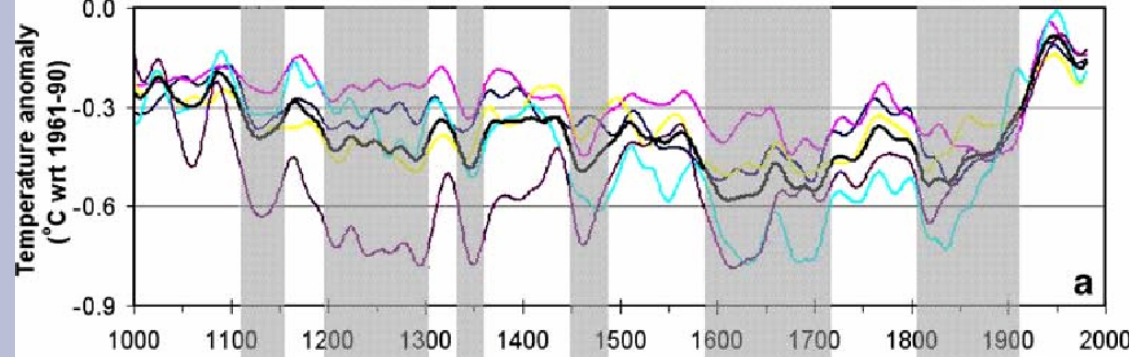
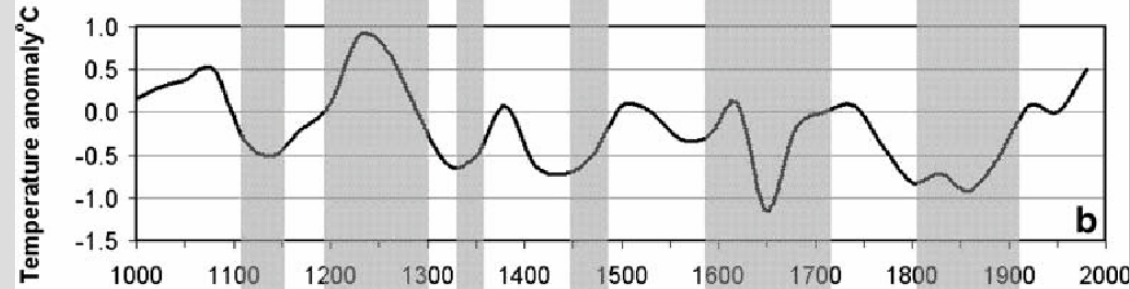


Fig. 1 Physical regionalization of eastern China.

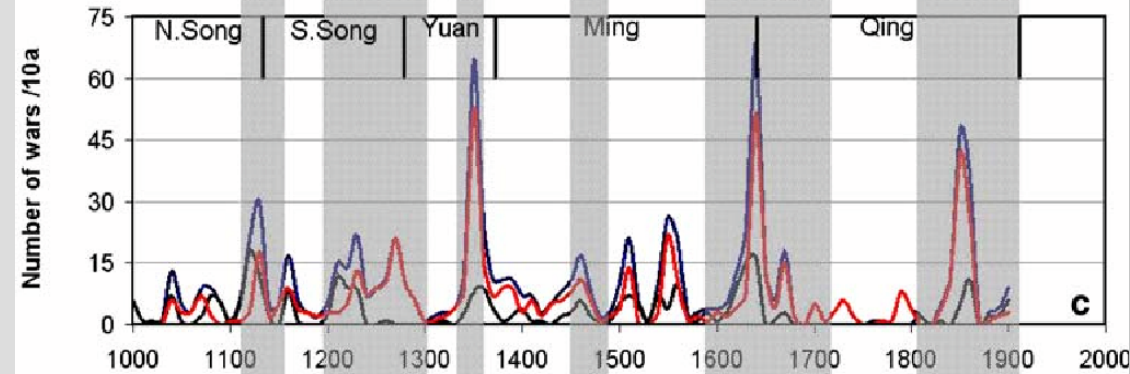
N. Hemisphere



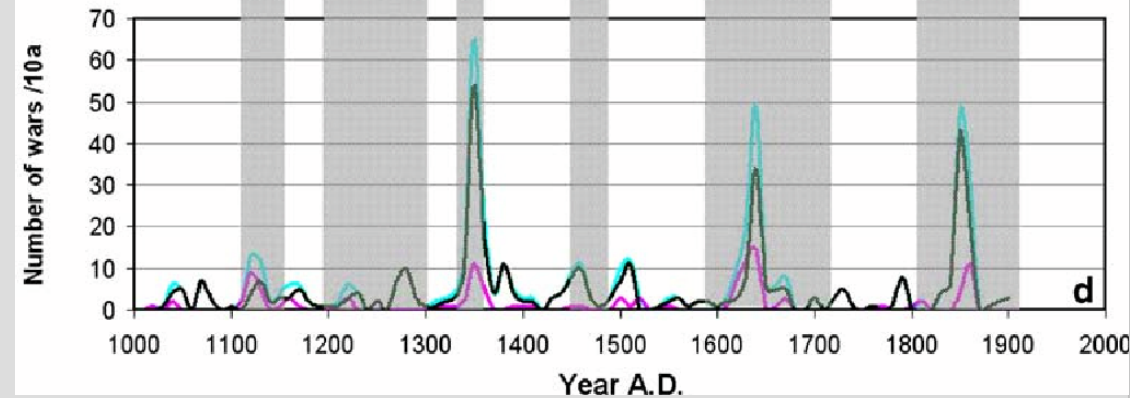
China  
Winter



Wars (N/S)



Rebellions (N/S)

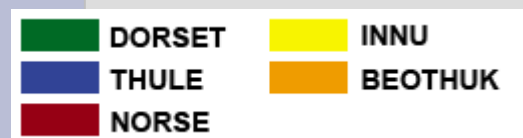




# Greenland



Brown (2000): Archaeology online feature  
<http://www.archaeology.org/online/features/greenland/>



900: Gunnbjörn Úlfsson reports land  
 982: Eiríkr inn rauði (Erik the Red) finds land  
 983: returns with ca 700 followers

1126: first bishop on Greenland

before 1350: West Settlement abandoned

1378: last bishop in Greenland dies. successor is elected but refuses to leave Norway

1406 last Norwegian trade ship reaches Greenland; contact is lost

1535 dubious reports of people on West coast

1585 John Davis searches for North West passage, no sign of Europeans in Greenland



# Archaeology

- Evidence for violence (injuries):
  - Thule?
  - Viking marauders?
- Isotope analysis:
  - seafood consumption rose from 20% to 80%
  - indicates poor agriculture results
- Trade routes to Norway lost – no iron tools
- Population was never huge, maximum ca. 5000
- Thule people (seal&whale hunting) lived ok



reconstructed Norse chapel

# A Mediaeval property developer...

That country which is called Greenland, was discovered and colonized from Iceland. Eric the Red [Eirekr enn Rauthi] was the name of the man, an inhabitant of Breidafirth, who went out thither from here, and settled at that place, which has since been called Ericsfirth [Eiriksfiorthr].



Eriksfjord

He gave a name to the country, and called it Greenland, and said that it must persuade men to go thither, if the land had a good name.

*Ari Þorgilsson,  
“Íslendingabók”, ca 1120  
(transl. Arthur Middleton  
Reeves, 1906)*

# Climate and Human History

## Stephan Matthiesen

- |             |                                      |
|-------------|--------------------------------------|
| 19/1        | 1. Climate and climate history       |
| 26/1        | 2. The Ice Age                       |
| 2/2         | 3. Farming and City States           |
| 9/2         | 4. The Roman Empire                  |
| 16/2        | 5. Tang and Maya in the 10th century |
| 23/2        | 6. Mediaeval Optimum; Little Ice Age |
| 1/3         | 7. El Niño through the ages          |
| 8/3         | 8. Miscellaneous topics              |
| <b>15/3</b> | <b>no class!</b>                     |
| 22/3        | 9. Current and future changes        |
| 29/3        | 10. Summary and re-cap               |



# Literature

- Fagan (2000): The Little Ice Age.
- Behringer (2007): Kulturgeschichte des Klimas
- PAGES (2011). Medieval Climate Anomaly. PAGES Newsletter 19(1)  
(online: <http://www.pages-igbp.org>)
- Büntgen et al. (2011). 2500 years of European climate variability and human susceptibility. Science , 331 (6017), 578-582.
- IPCC (2007): Chapter 6: Paleoclimate. IPCC WG1 (Scientific Basis) AR4 Report  
(online: <http://www.ipcc.ch/>)