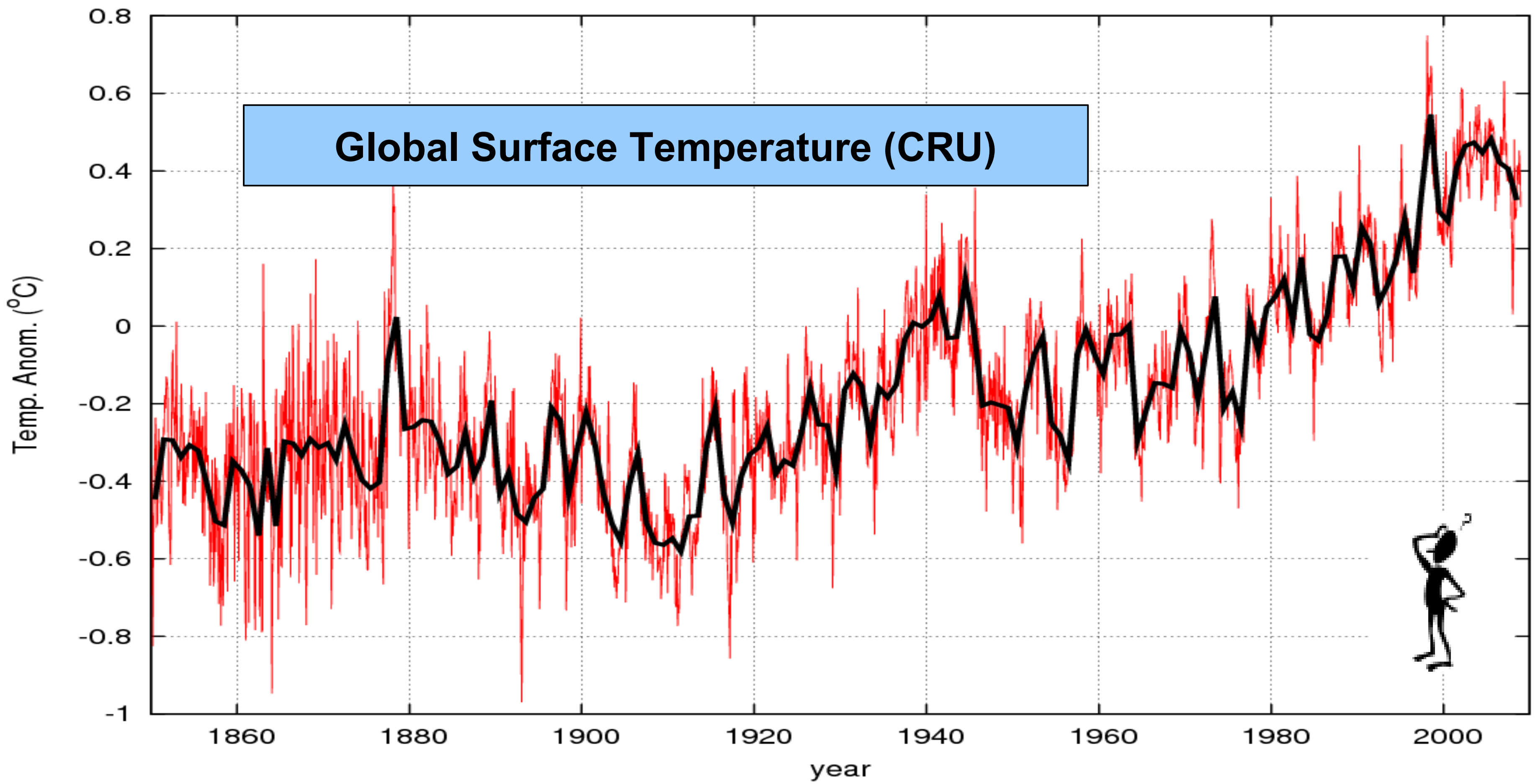
Climate oscillations and their implication for climate and sea level rise forecast.

Nicola Scafetta
Duke University

New Bern, NC
October, 7 2011



North Carolina Sea-Level Rise Assessment Report

March 2010

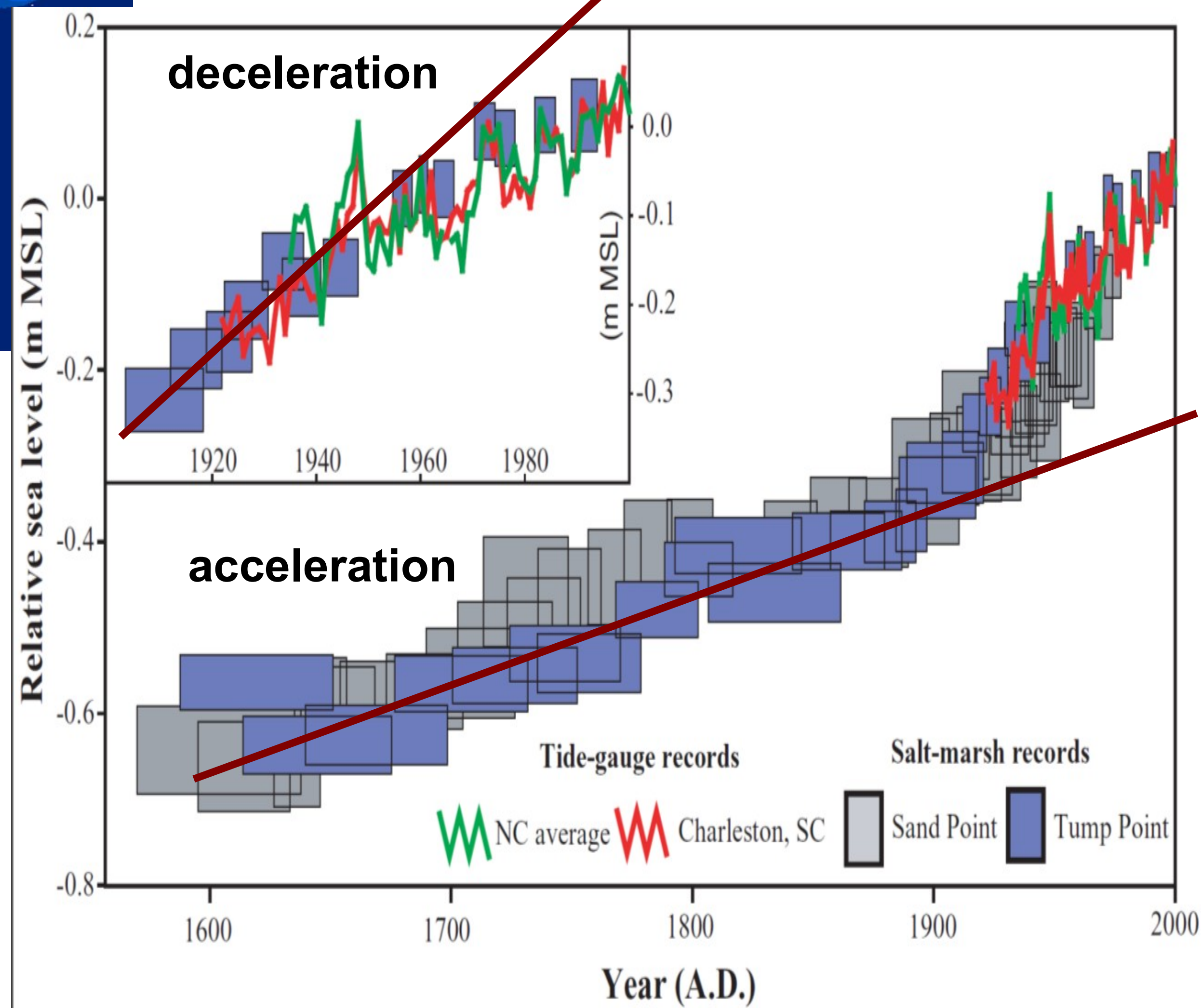
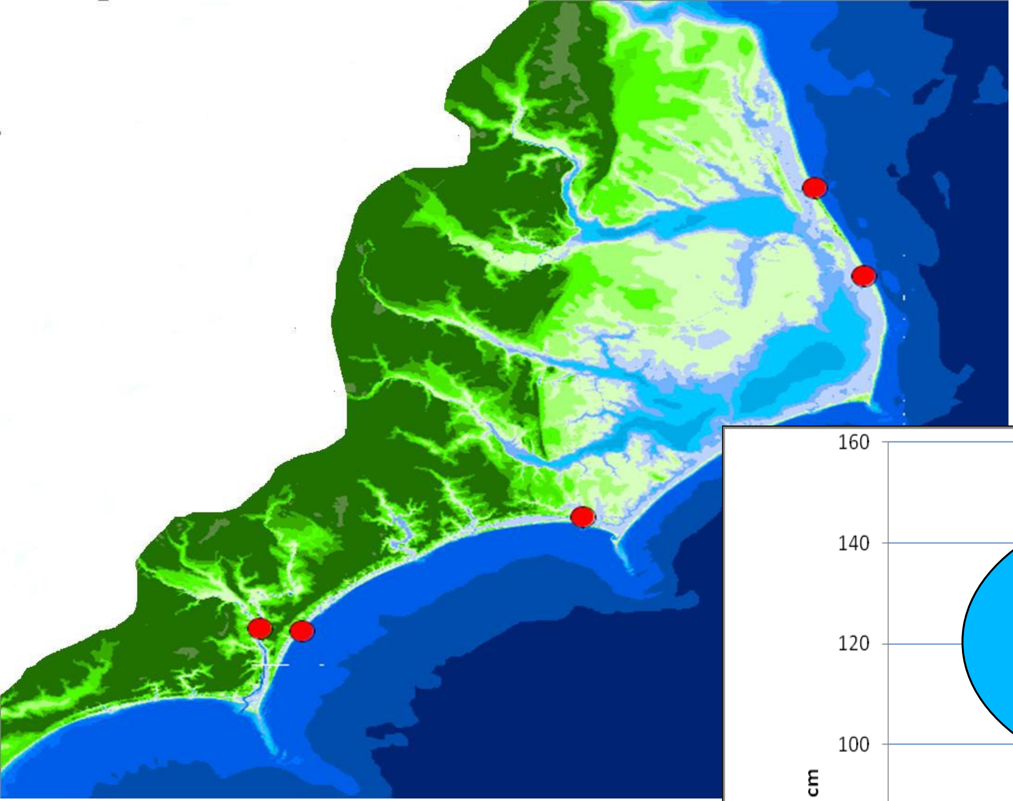


Figure 1. Reconstructions of RSL at Sand Point (grey boxes) and Tump Point (blue boxes) for the period since AD 1500. An average tide-gauge record from North Carolina (green) and the record from Charleston, South Carolina (red) are also shown. Inset: 20th century RSL reconstructed at Tump Point is compared to tide-gauge records (from Kemp et al., 2009).



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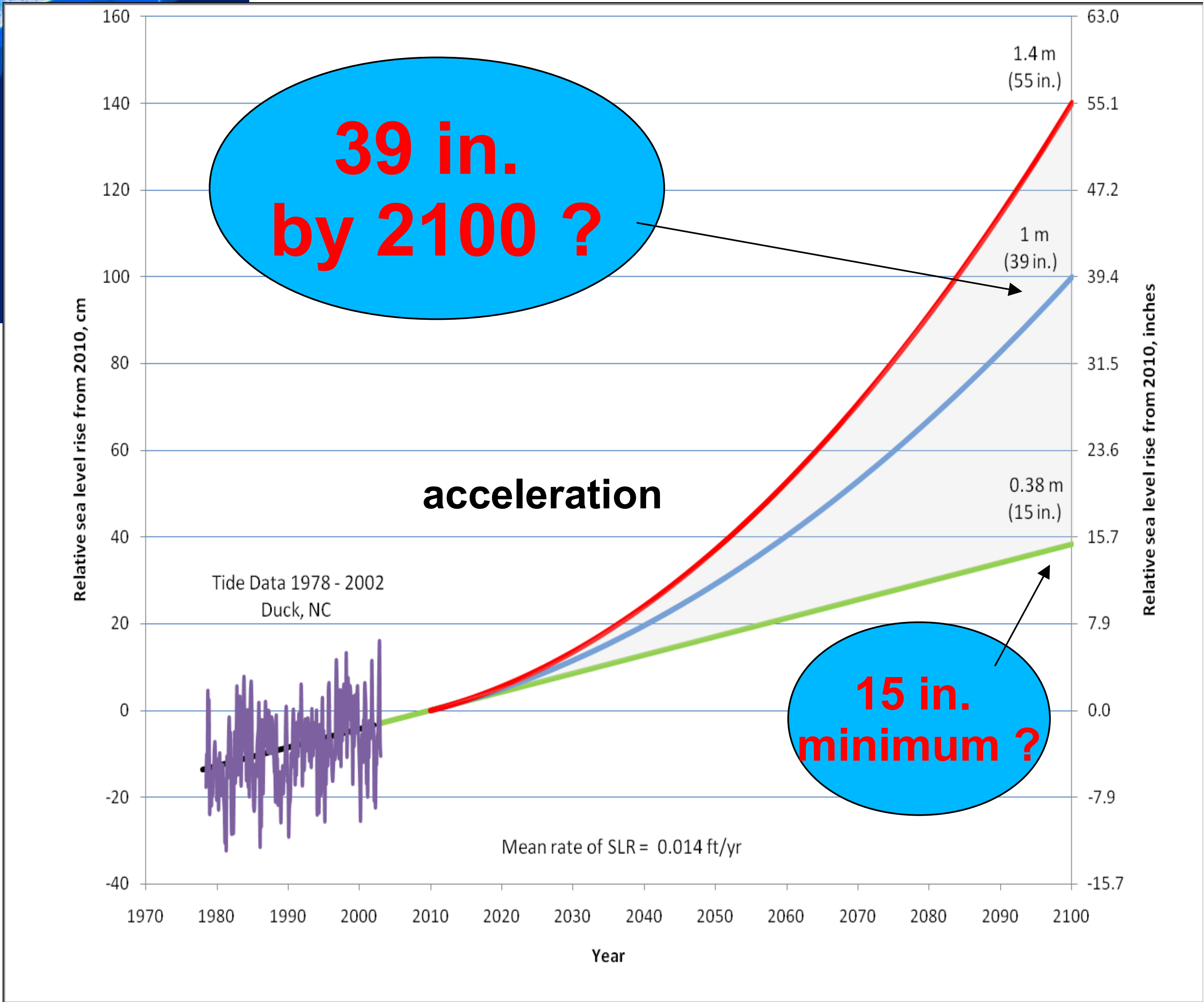
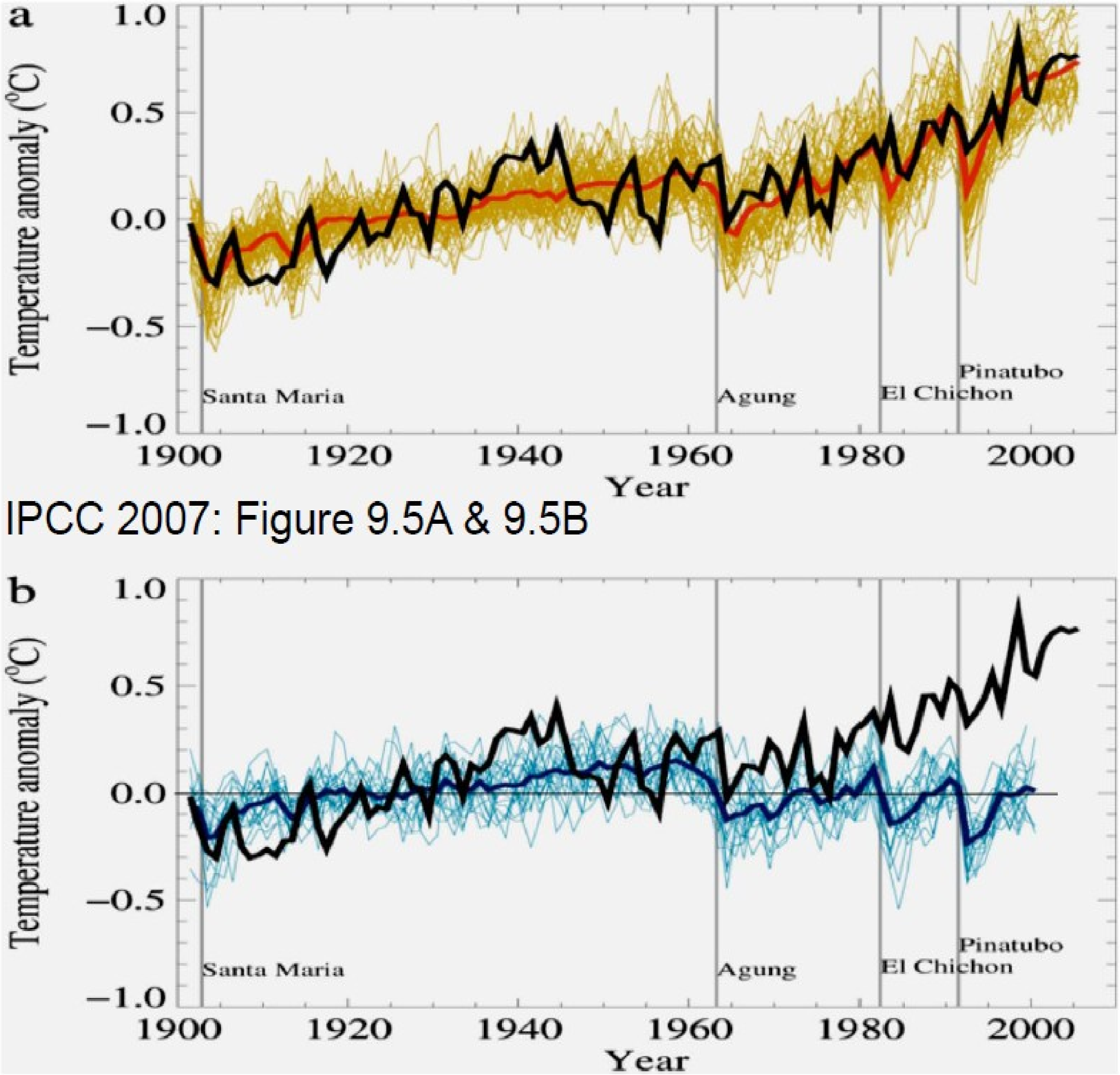


Figure 2. This chart illustrates the magnitude of SLR resulting from differing rates of acceleration. The most likely scenario for 2100 AD is a rise of 0.4 meter to 1.4 meters (15 inches to 55 inches) above present.

The IPCC's theory of Anthropogenic Global Warming

About 90% (100%) of the warming observed since 1900 (1970) is anthropogenic



IPCC 2007: Figure 9.5A & 9.5B

The red simulation is obtained with GCMs forced with both anthropogenic and natural forcing

The blue simulation is obtained with GCMs forced only with natural (solar and volcano) forcing.

Do climate models include all involved physical mechanisms?

The IPCC projections for the 21st century

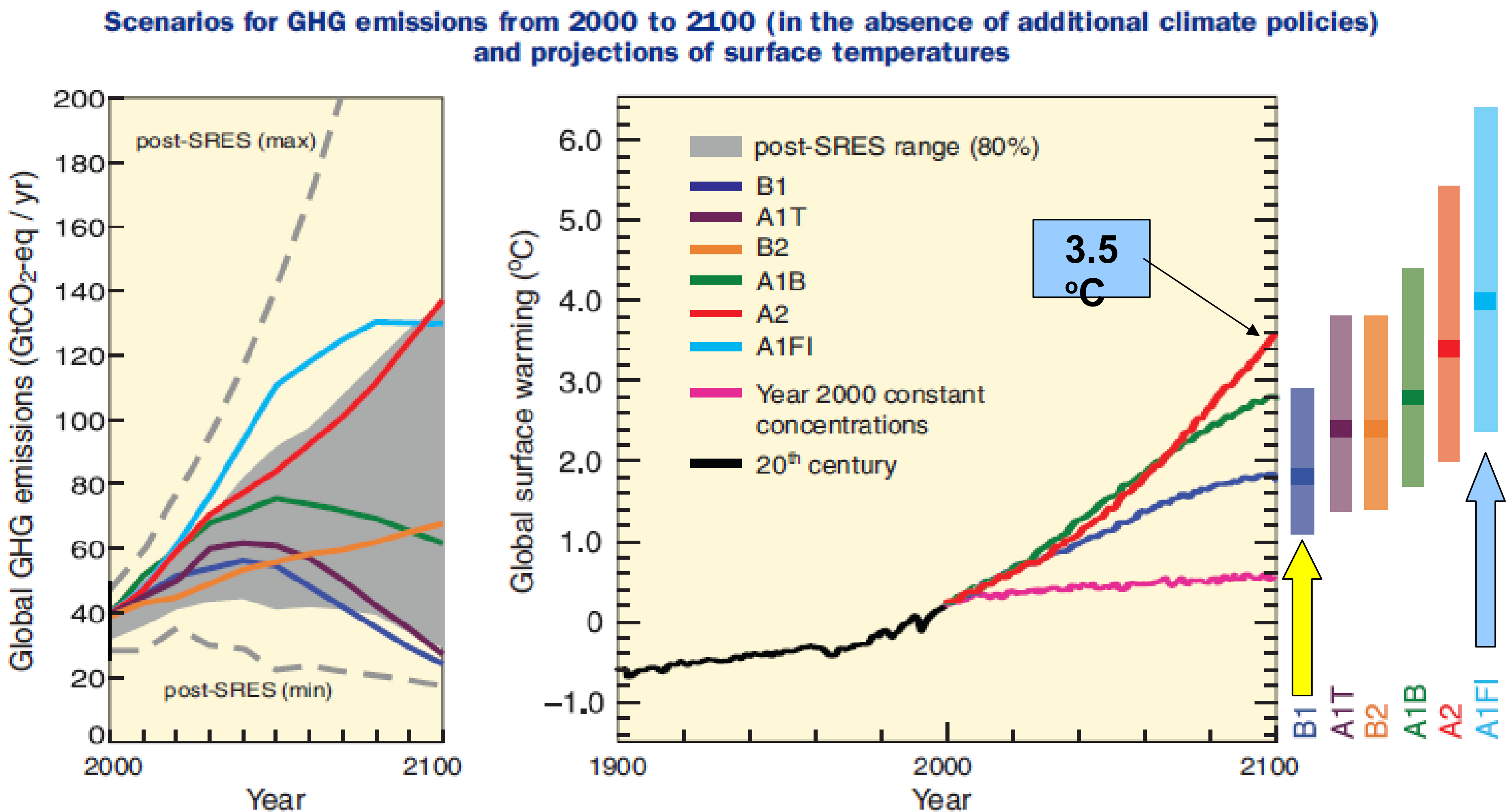


Figure SPM.5. ***Left Panel:*** *Global GHG emissions (in $GtCO_2$-eq) in the absence of climate policies: six illustrative SRES marker scenarios (coloured lines) and the 80th percentile range of recent scenarios published since SRES (post-SRES) (gray shaded area). Dashed lines show the full range of post-SRES scenarios. The emissions include CO_2, CH_4, N_2O and F-gases.* ***Right Panel:*** *Solid lines are multi-model global averages of surface warming for scenarios A2, A1B and B1, shown as continuations of the 20th-century simulations. These projections also take into account emissions of short-lived GHGs and aerosols. The pink line is not a scenario, but is for Atmosphere-Ocean General Circulation Model (AOGCM) simulations where atmospheric concentrations are held constant at year 2000 values. The bars at the right of the figure indicate the best estimate (solid line within each bar) and the likely range assessed for the six SRES marker scenarios at 2090-2099. All temperatures are relative to the period 1980-1999. {Figures 3.1 and 3.2}*

A Semi-Empirical Approach to Projecting Future Sea-Level Rise

Stefan Rahmstorf   19 JANUARY 2007   VOL 315   SCIENCE

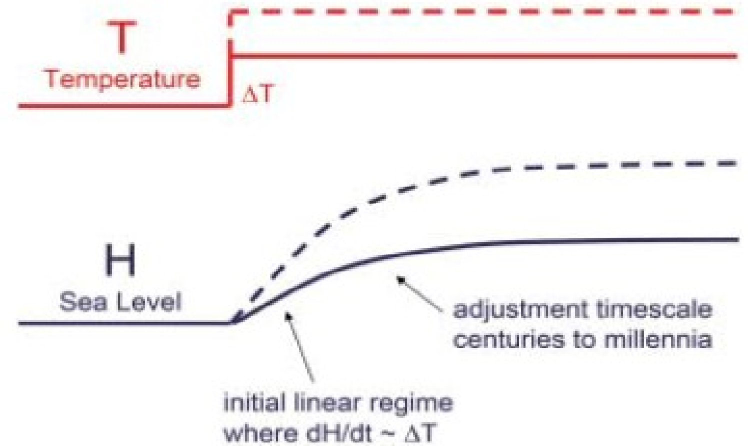


Fig. 1. Schematic of the response of sea level to a temperature change. The solid line and the dashed line indicate two examples with different amplitude of temperature change.

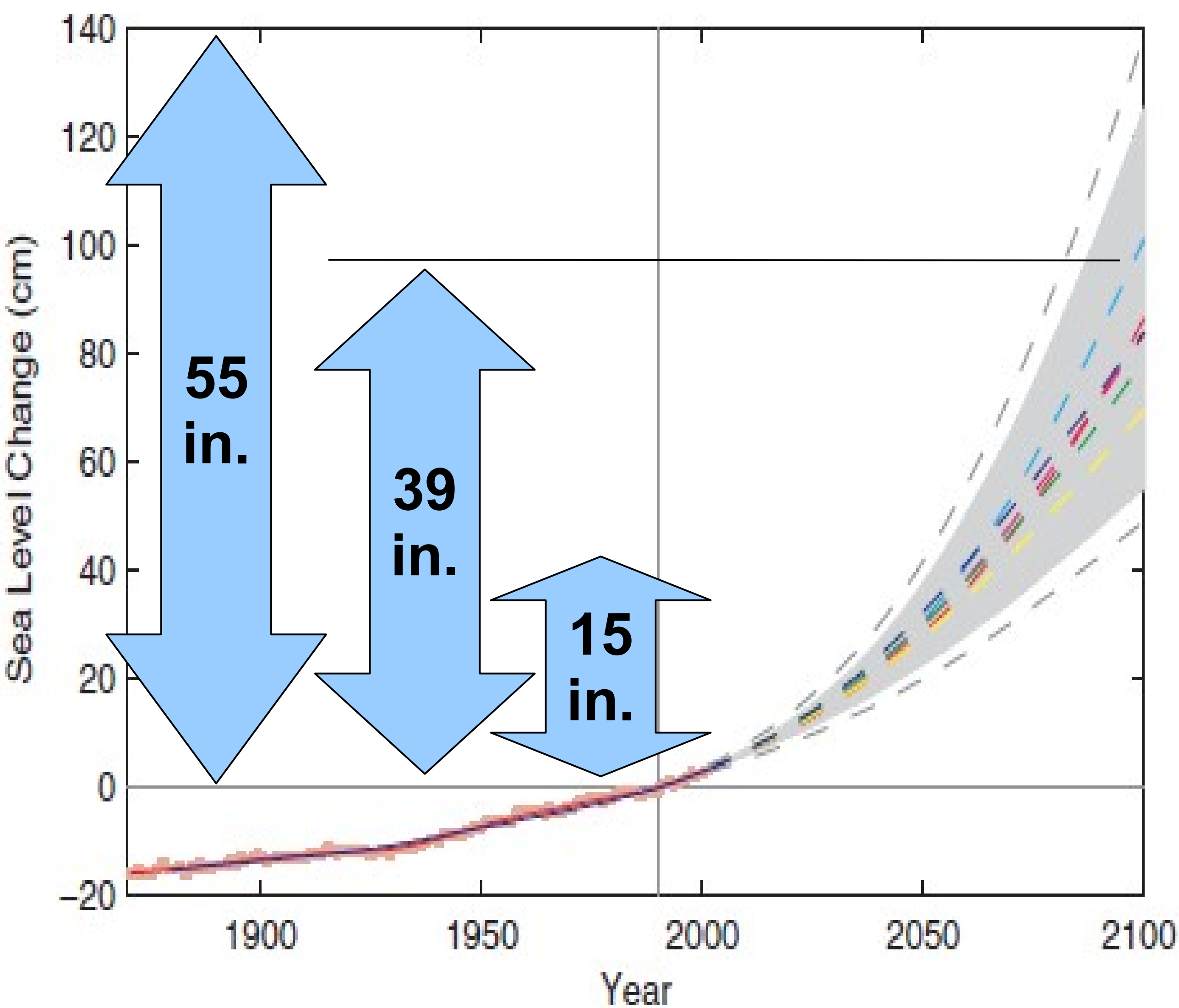
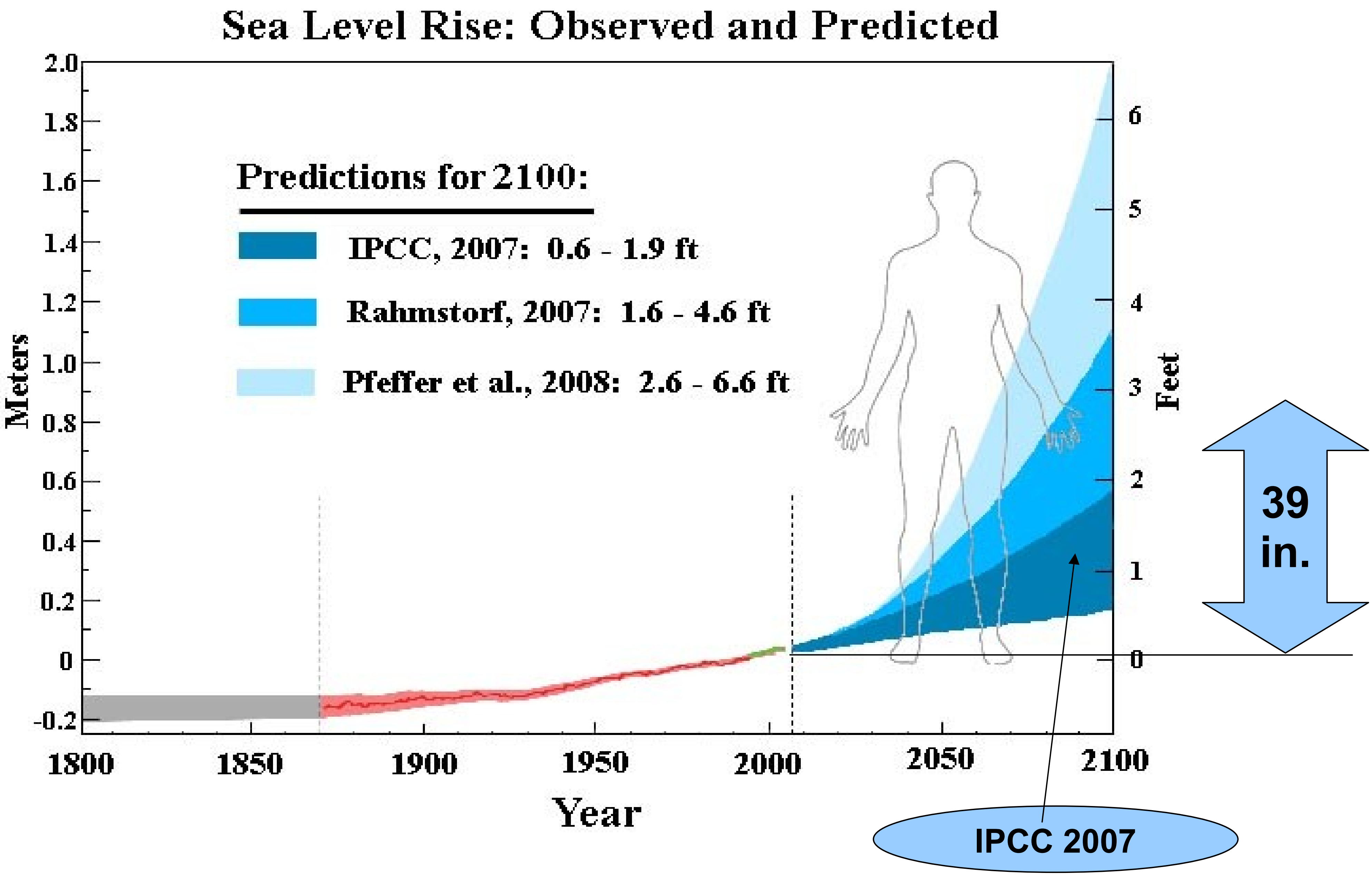


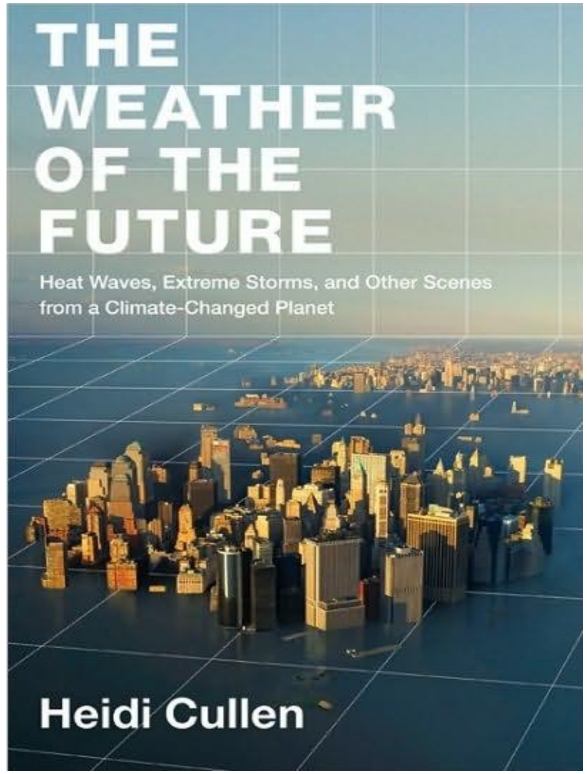
Fig. 4. Past sea level and sea-level projections from 1990 to 2100 based on global mean temperature projections of the IPCC TAR. The gray uncertainty range spans the range of temperature rise of 1.4° to 5.8° C, having been combined with the best statistical fit shown in Fig. 2. The dashed gray lines show the added uncertainty due to the statistical error of the fit of Fig. 2. Colored dashed lines are the individual scenarios as shown in (*1*); the light blue line is the A1FI scenario, and the yellow line is the B1 scenario.

Different Ranges of SLR Projections

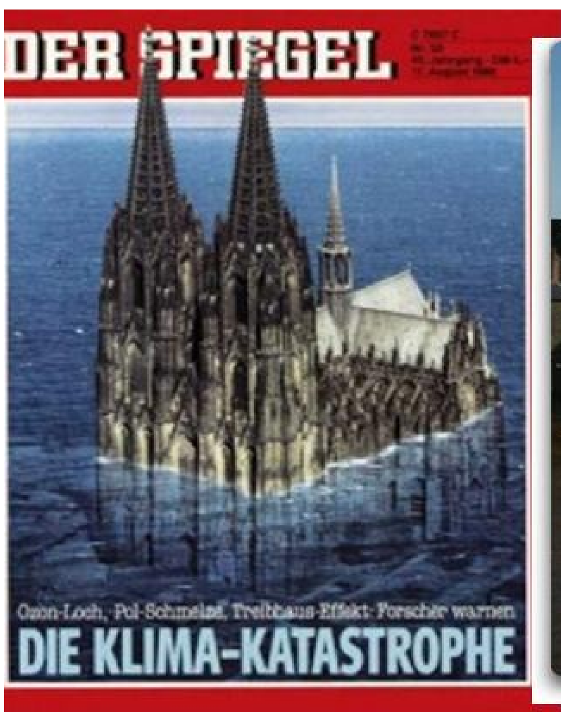


Sea Level Rise in the media.

Nonsense!!



Armageddon by 2100: NYC above, London below



Flooded cities forecast by 2100: Cologne, Germany (left), UK (right)

Can we trust the IPCC projections?

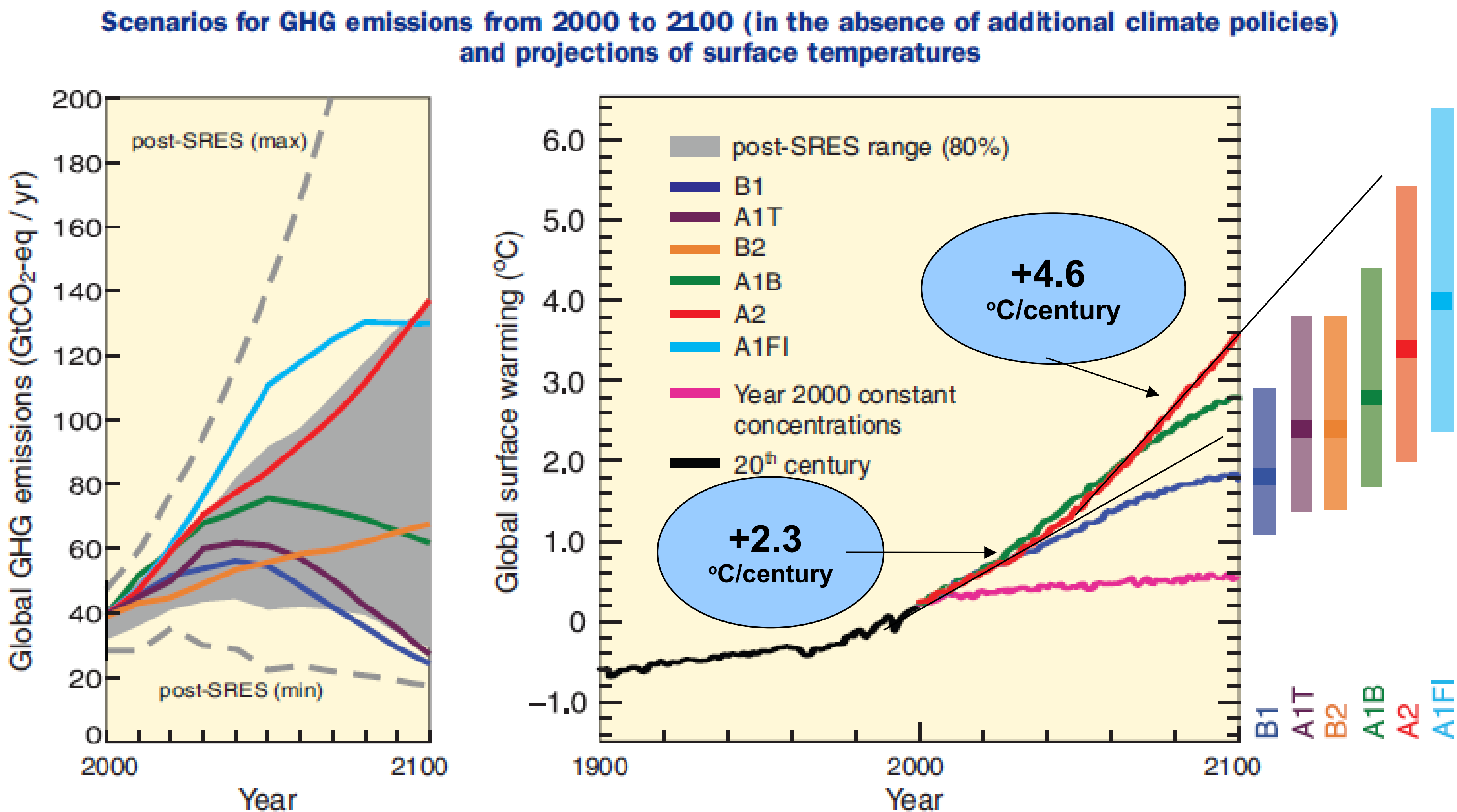
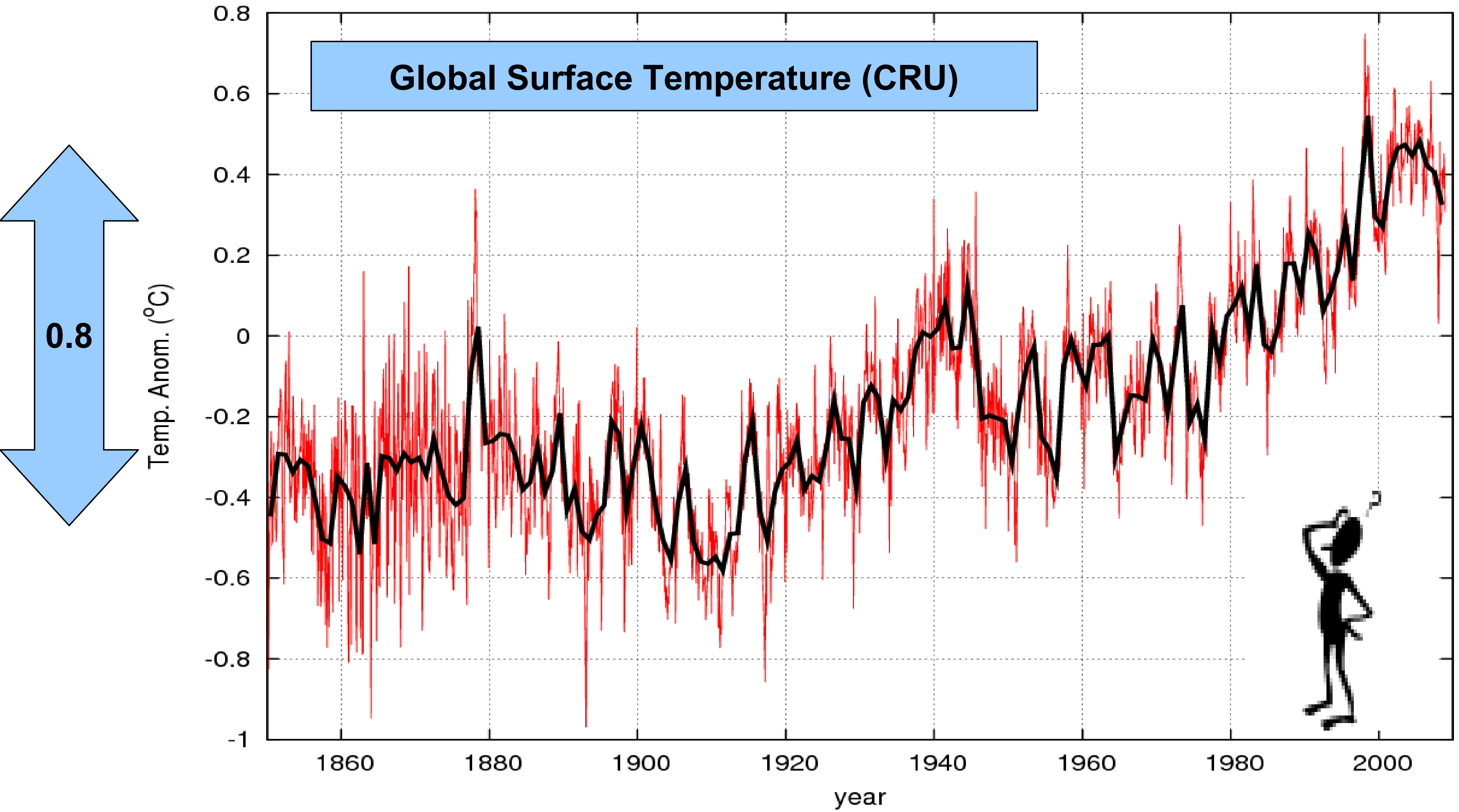
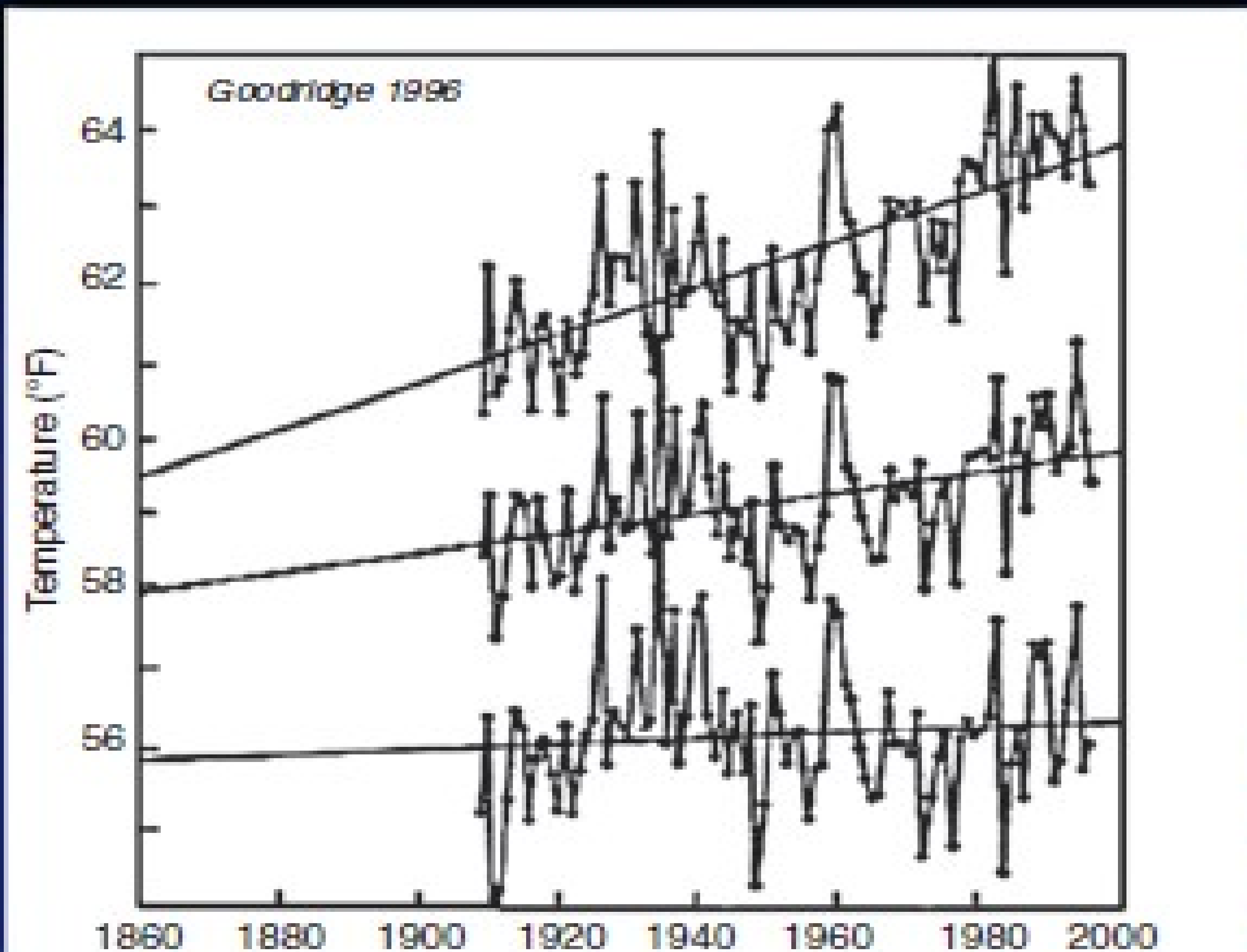


Figure SPM.5. ***Left Panel:*** *Global GHG emissions (in $GtCO_2$-eq) in the absence of climate policies: six illustrative SRES marker scenarios (coloured lines) and the 80th percentile range of recent scenarios published since SRES (post-SRES) (gray shaded area). Dashed lines show the full range of post-SRES scenarios. The emissions include CO_2, CH_4, N_2O and F-gases.* ***Right Panel:*** *Solid lines are multi-model global averages of surface warming for scenarios A2, A1B and B1, shown as continuations of the 20th-century simulations. These projections also take into account emissions of short-lived GHGs and aerosols. The pink line is not a scenario, but is for Atmosphere-Ocean General Circulation Model (AOGCM) simulations where atmospheric concentrations are held constant at year 2000 values. The bars at the right of the figure indicate the best estimate (solid line within each bar) and the likely range assessed for the six SRES marker scenarios at 2090-2099. All temperatures are relative to the period 1980-1999. {Figures 3.1 and 3.2}*

Can we trust the 0.8 °C global warming?



Urban Heat Island Effect



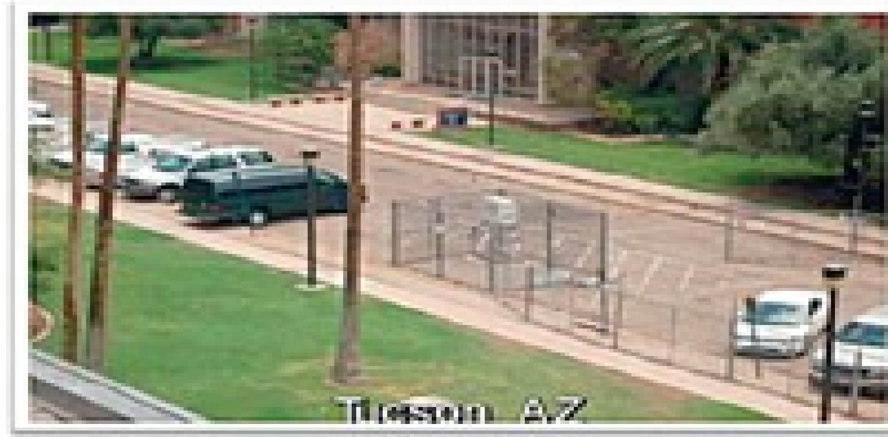
Counties in CA with >1 million Population +4F

Counties in CA with between 100,000 and 1 million Population +1F

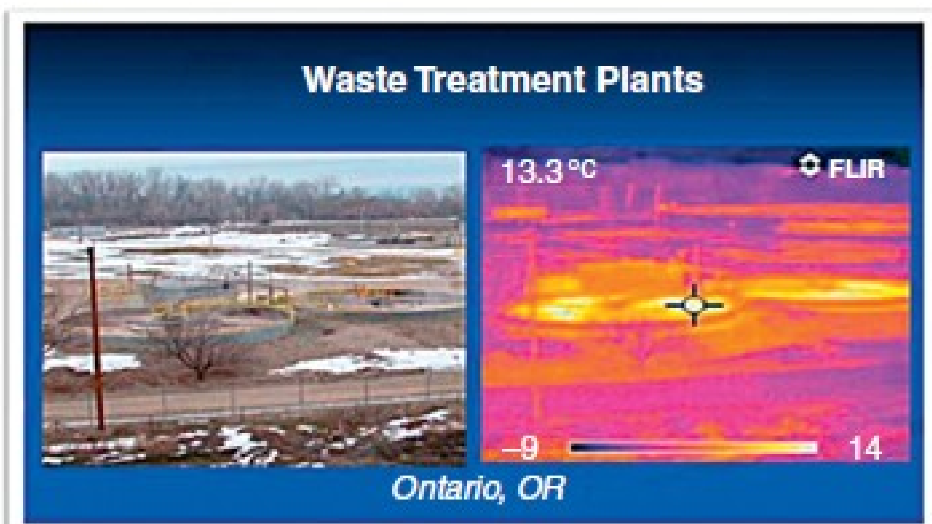
Counties in CA with less than 100,000 Population 0F

FIGURE 16 Jim Goodrich analysis of warming in California counties by population 1910–1995.

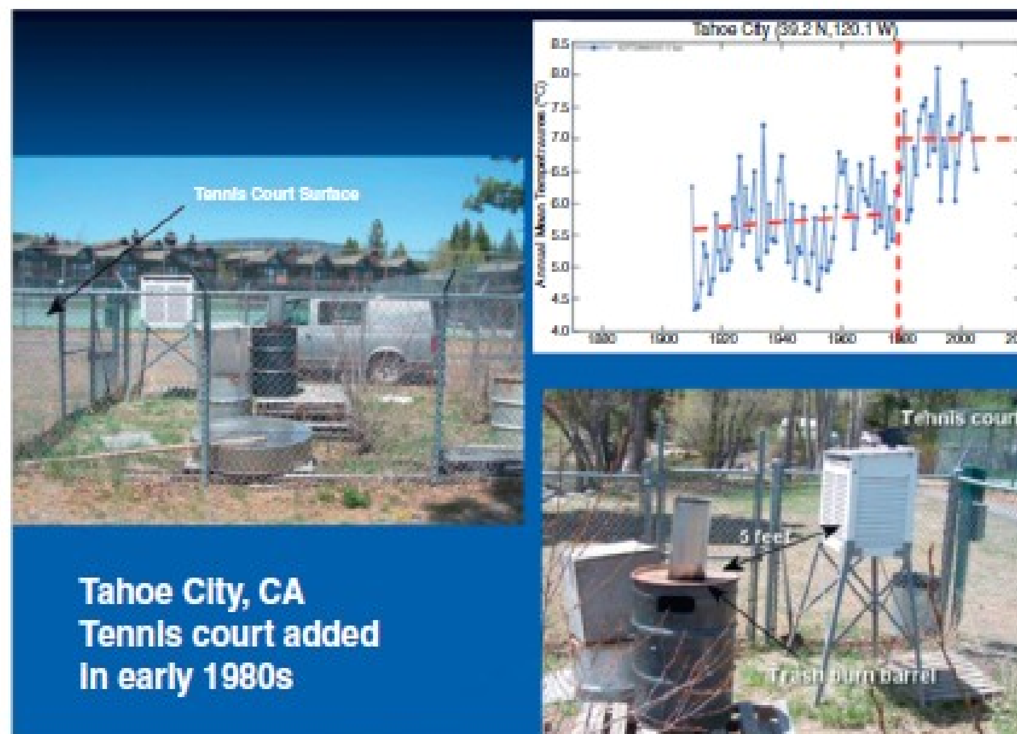
USHCN weather station at Hopkinsville, KY (Pielke et al., 2006). The station is sited too close to a building, too close to a large area of tarmac, and directly above a barbecue.



USHCN station at Tucson, AZ, in a parking lot on pavement. (Photo by Warren Meyer, courtesy of surfacestations.org.)



Numerous sensors are located at waste treatment plants. An infrared image of the scene shows the output of heat from the waste treatment beds right next to the sensor. (Photos by Anthony Watts, surfacestations.org.)



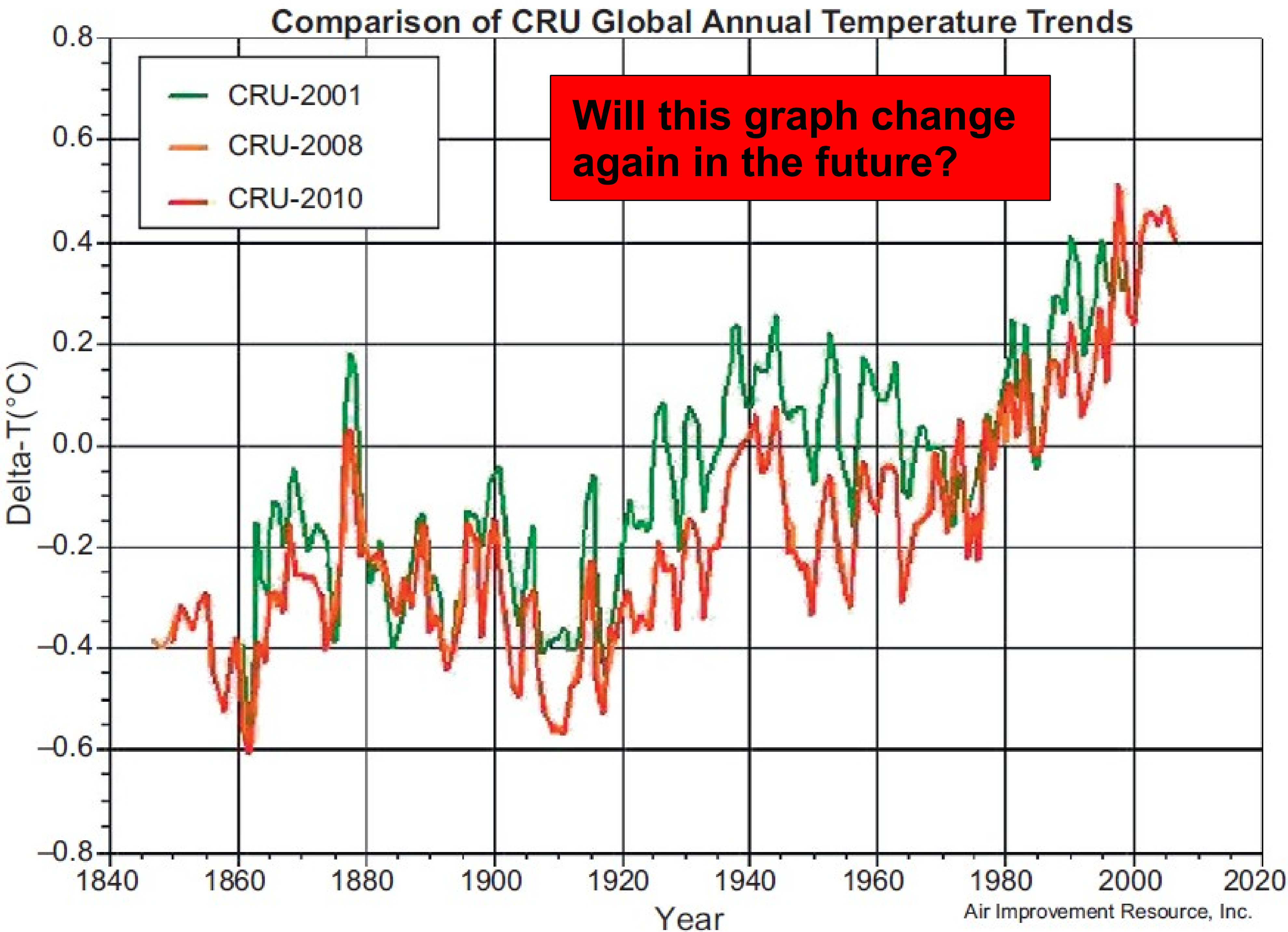
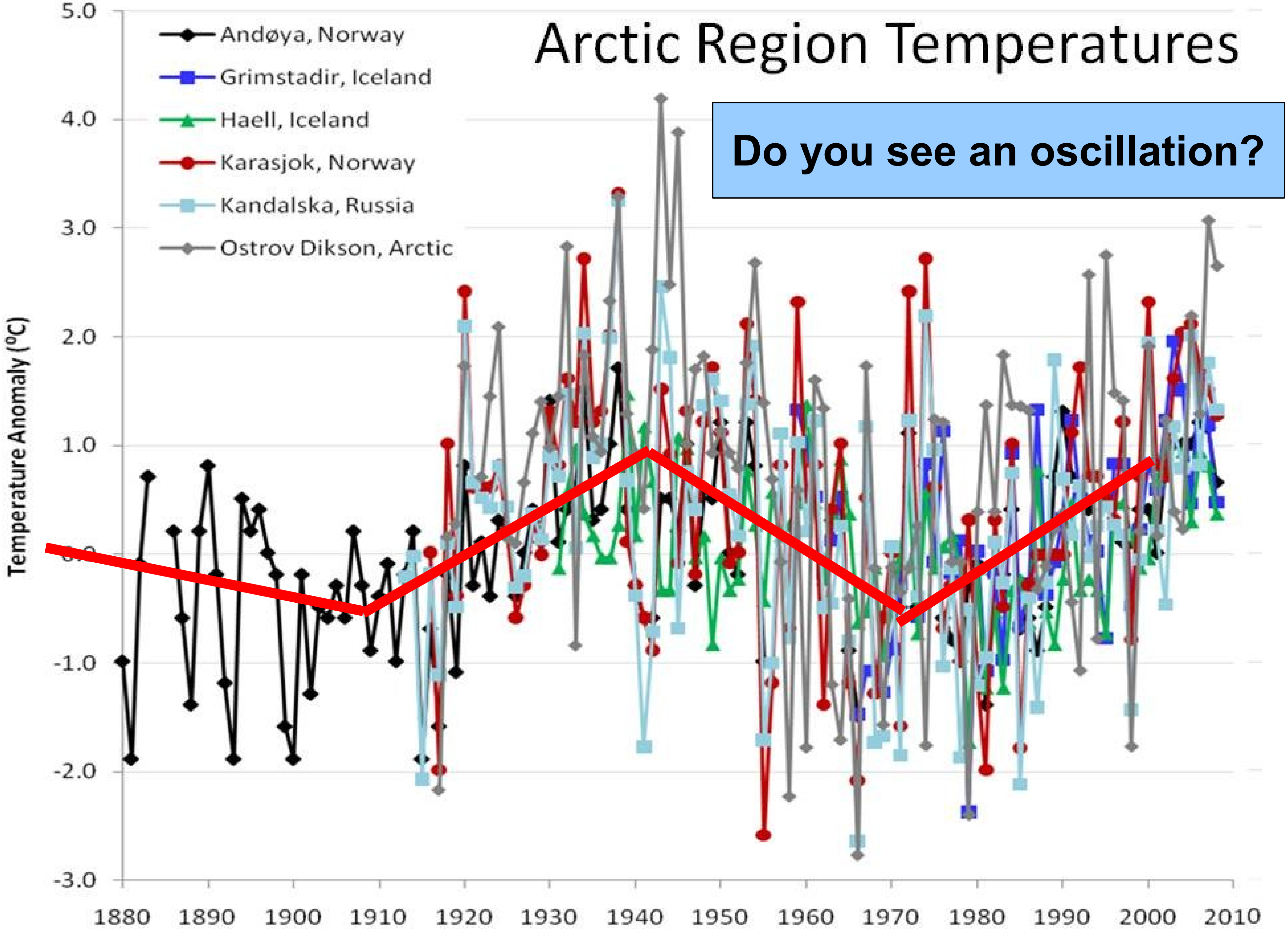
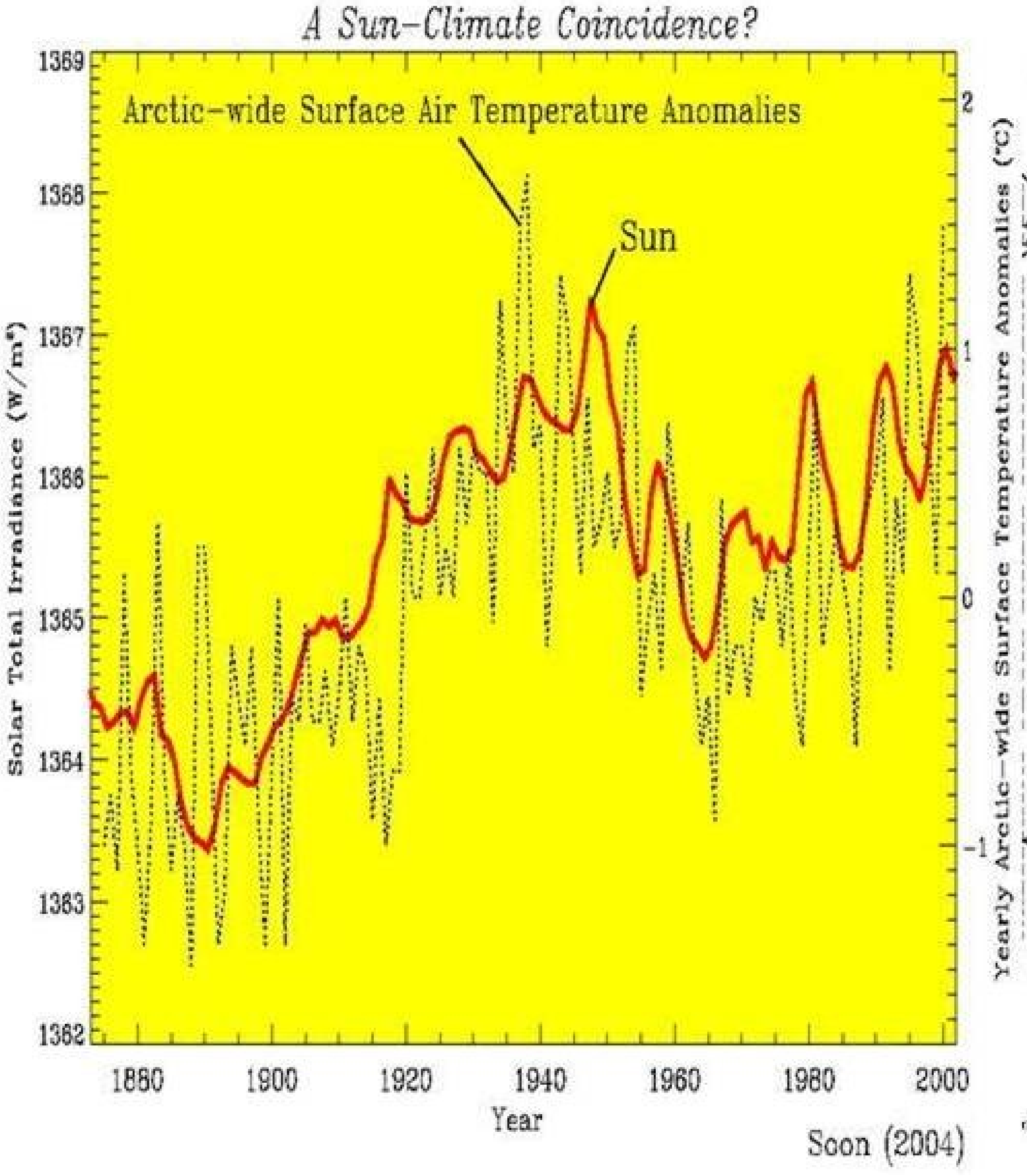


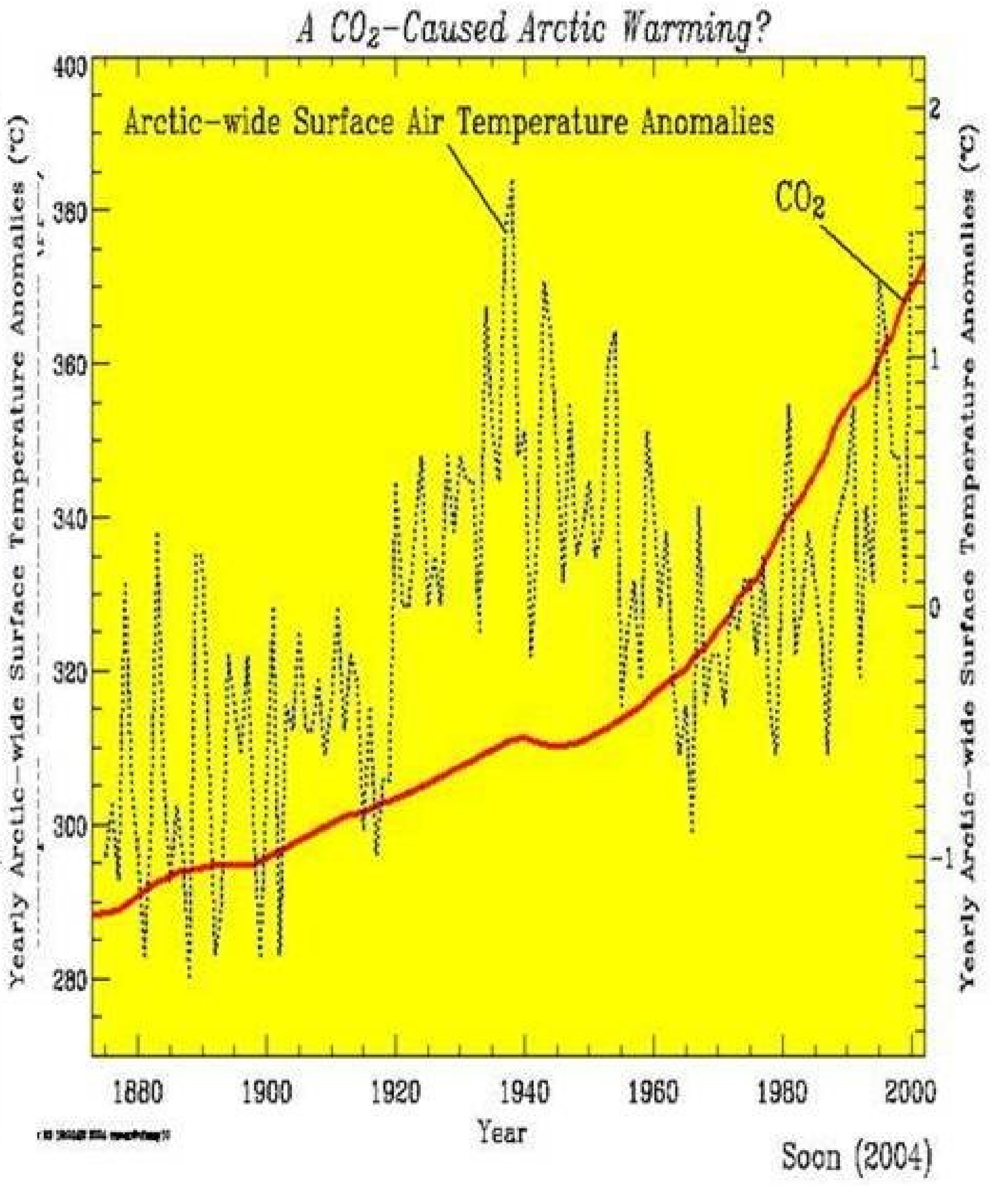
FIGURE 40 Comparing Hadley CRU 2001 vs. 2008 and 2010 annual mean temperatures.



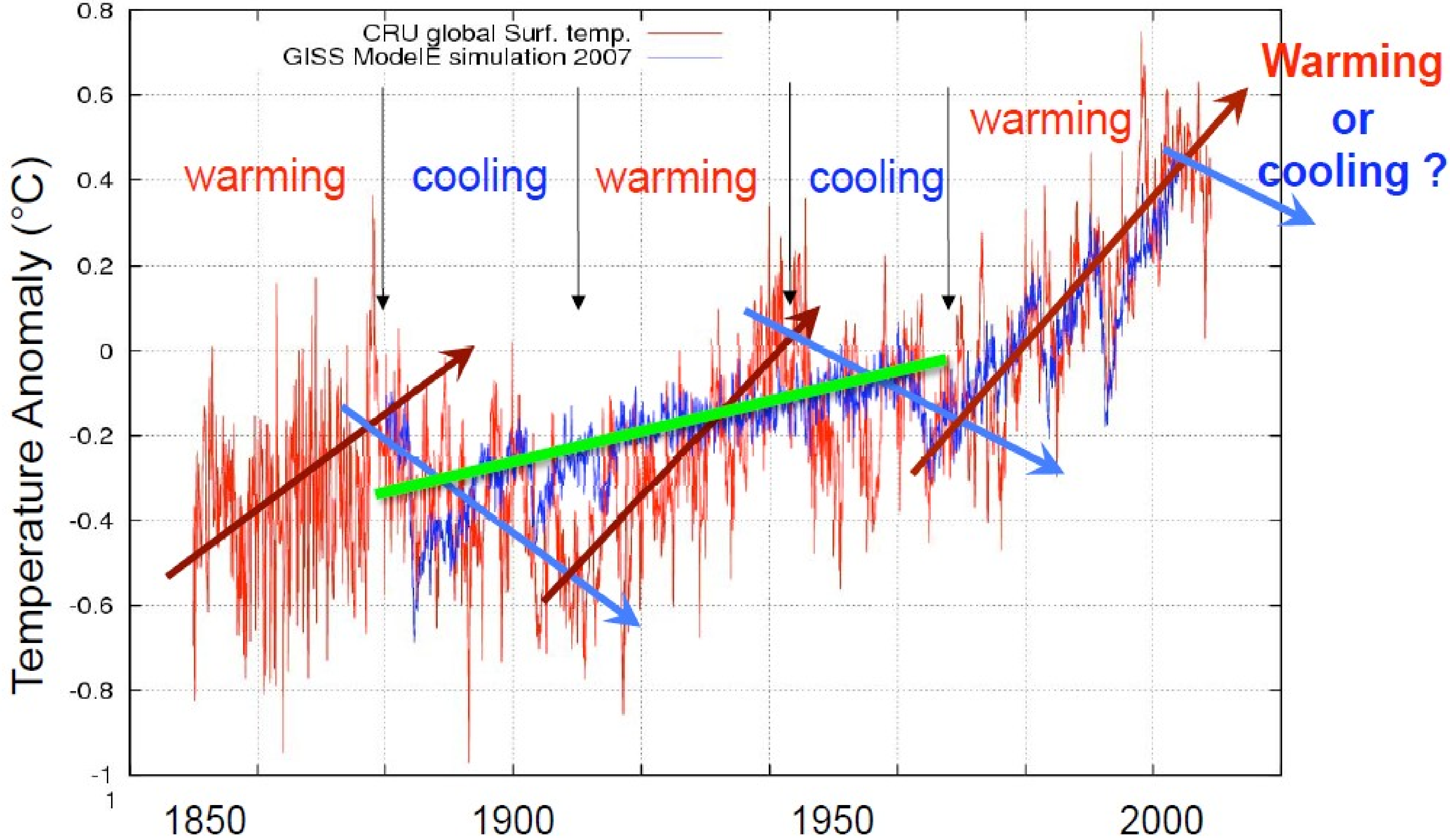
Arctic Region Temperatures
Do you see an oscillation?
Andøya, Norway
Grimstadir, Iceland
Haell, Iceland
Karasjok, Norway
Kandalska, Russia
Ostrov Dikson, Arctic
Temperature Anomaly (ºC)
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

The Sun is more likely the dominant driver of the recorded Arctic temperature variations



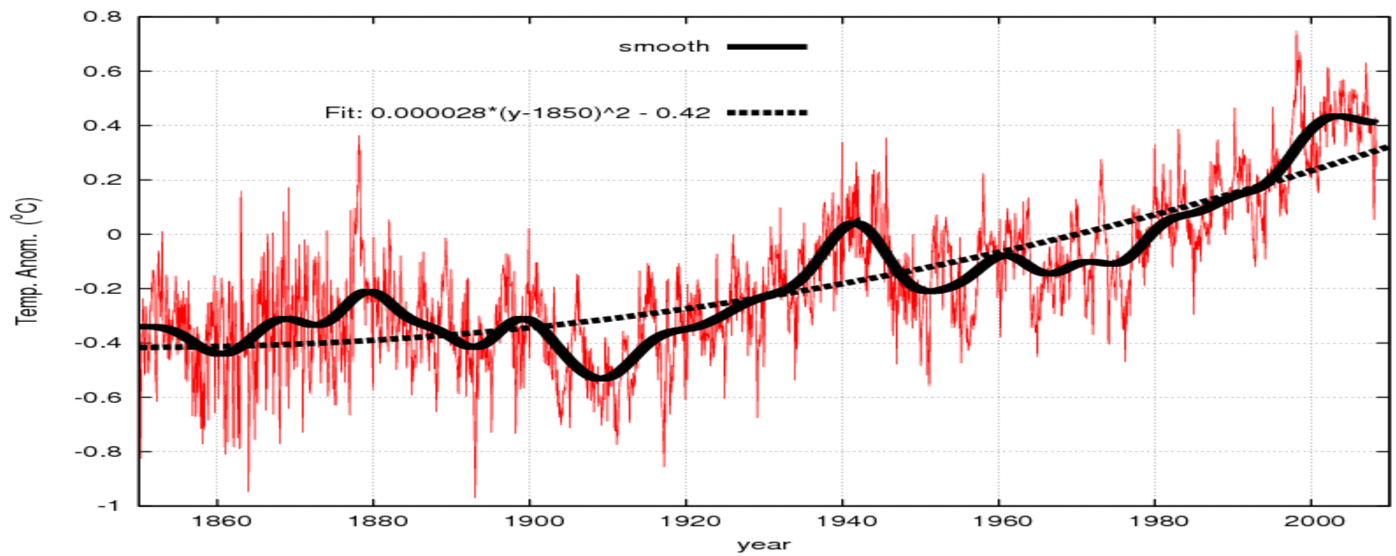


Comparison between the CRU global surface temperature and GCM simulation: models need improvement

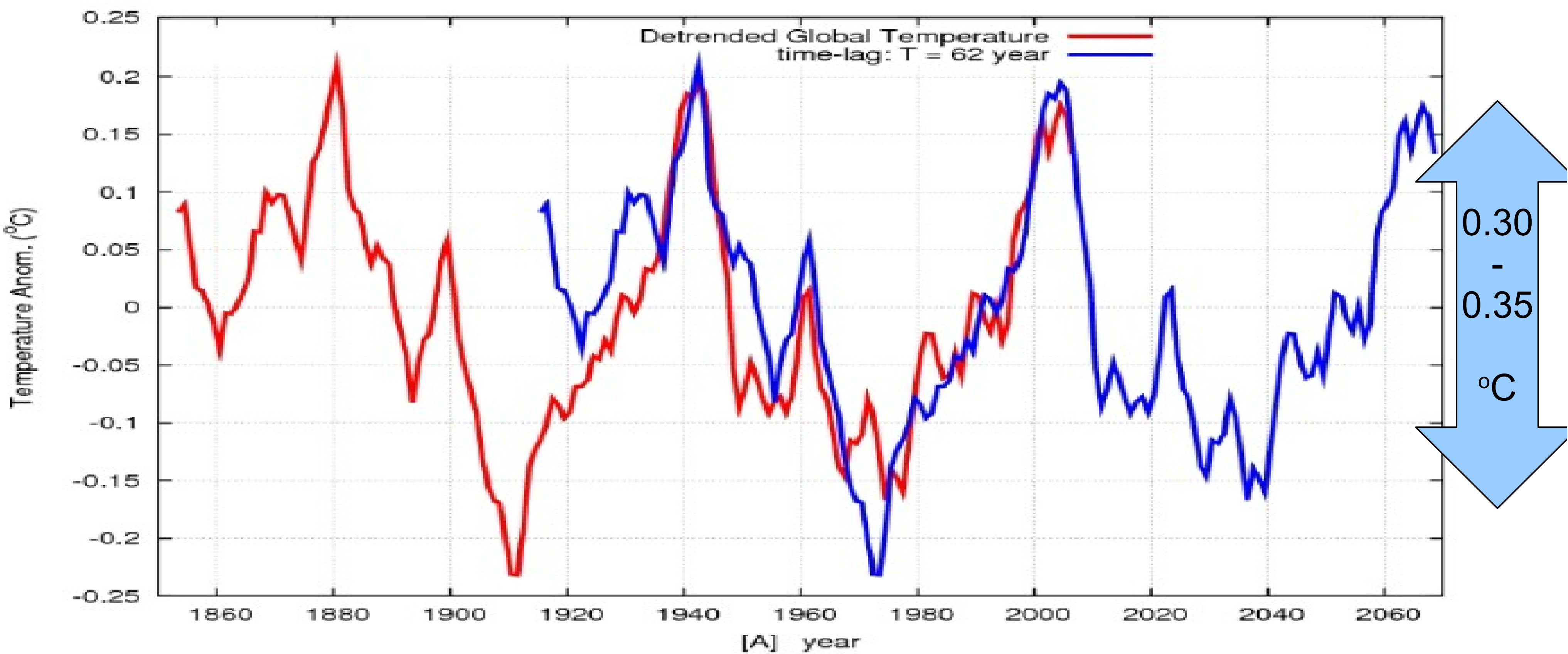


The observed temperature is swinging with warming and cooling periods. The model GISS model E (blue) well reproduces the 1970s to 2000 observed warming. However, it fails with the observed climate variability before 1960. The model output suggests a 1880-1960 flat, linear trend (**green**).

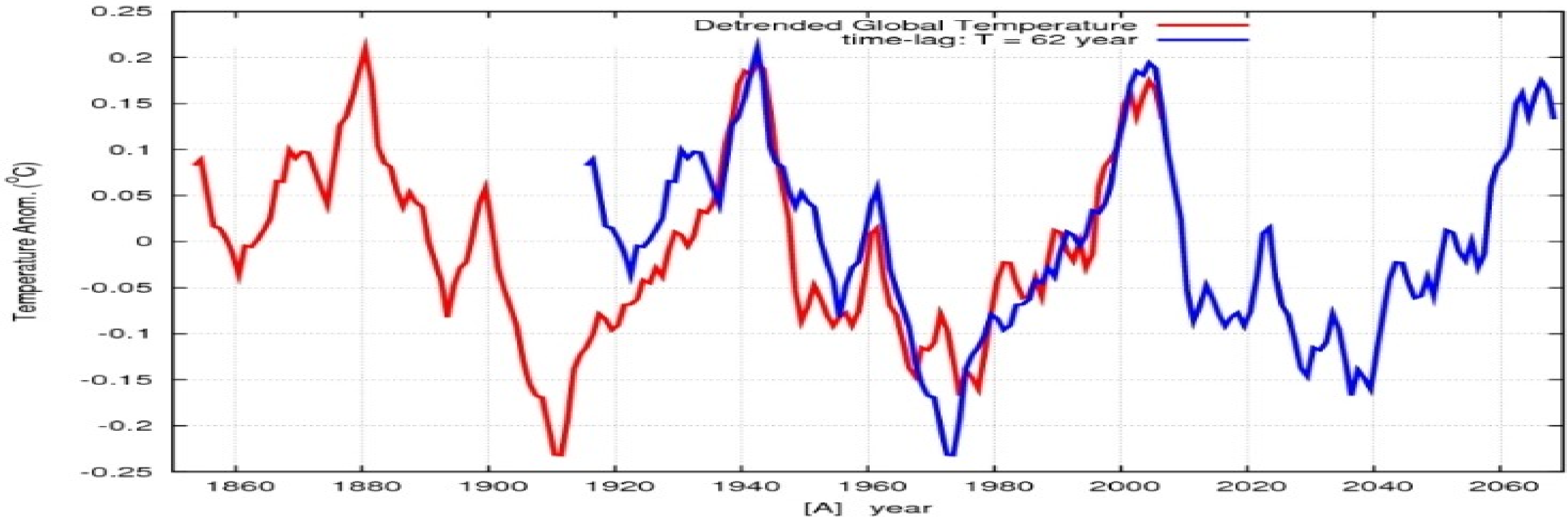
Hansen et al. "Climate simulations for 1880–2003 with GISS Model E," Clim Dyn (2007) 29:661–696

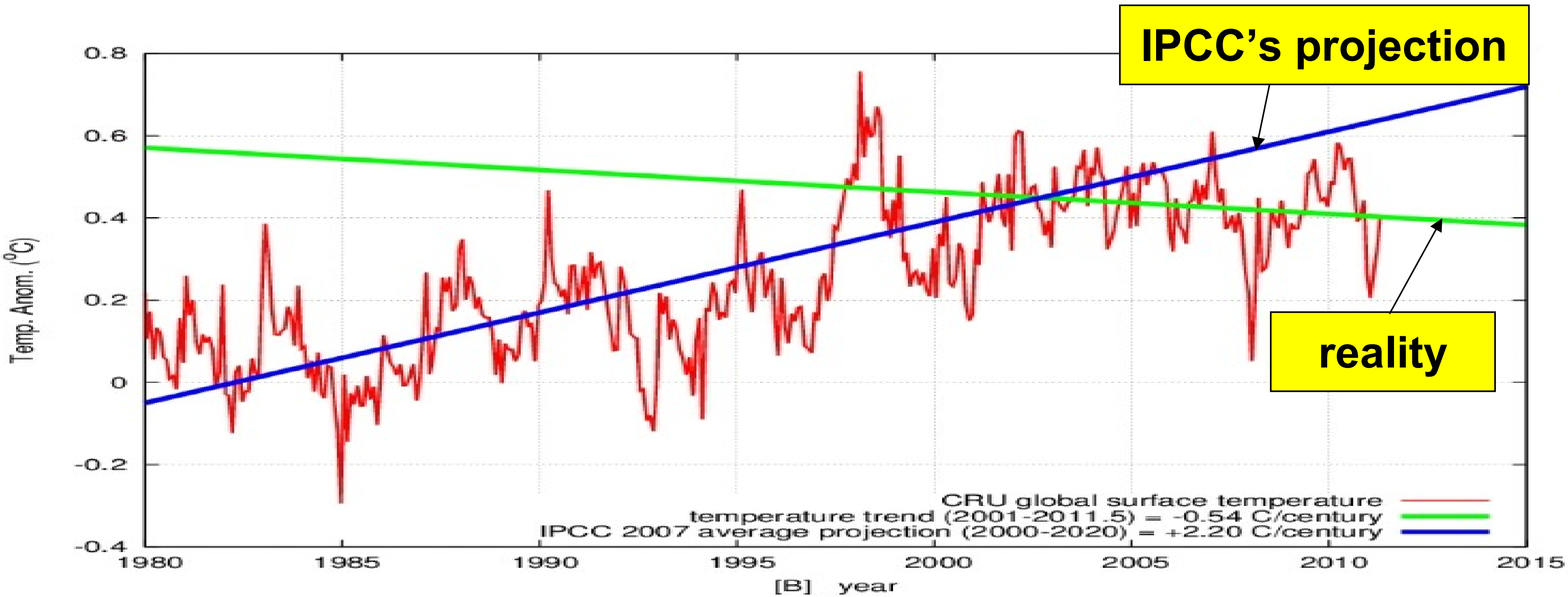


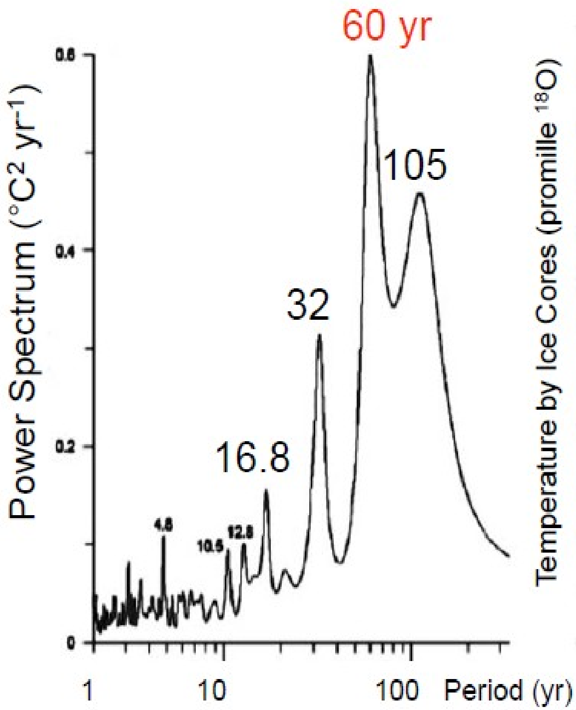
~60 year oscillations in the CRU global temperature

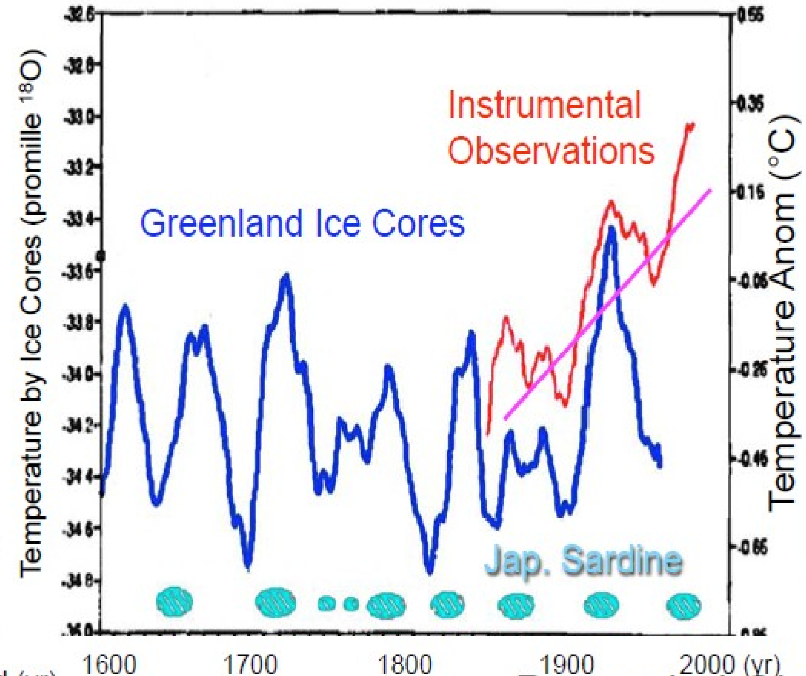


A ~60-year cycle in the temperature is evident





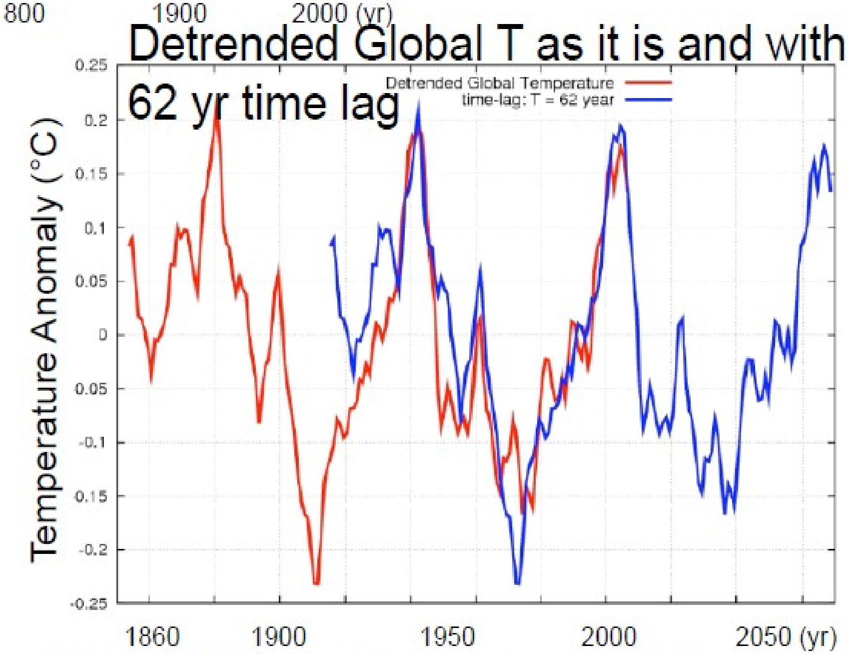




~60 year oscillations in climate records

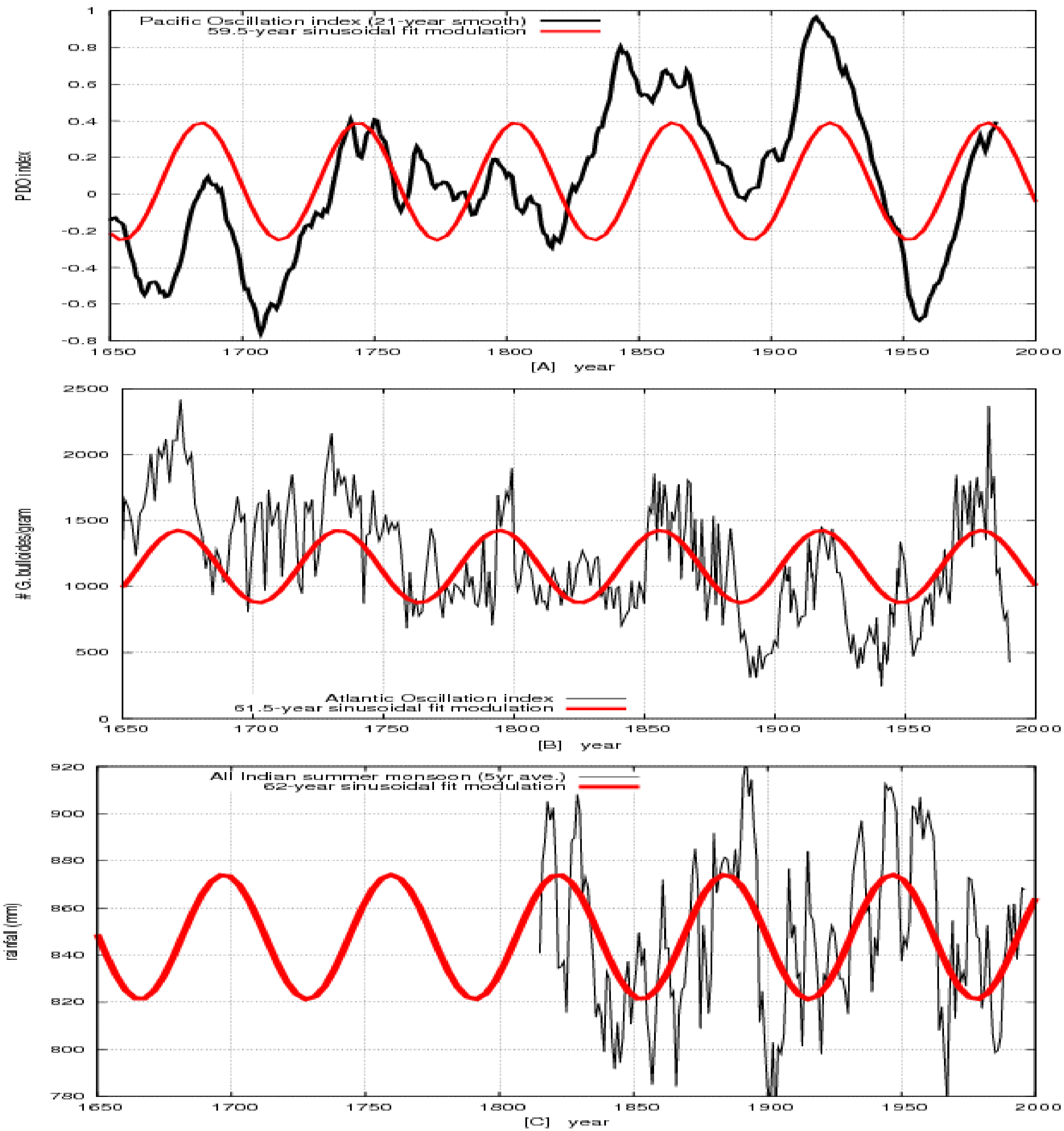
Table I. Predominant periods of climatic fluctuations within the range of 20–100 years according

Time series	Series length, years	Predominant peak, y
Ice core samples	1420 (552–1973)	54
Arctic pine tree	1480 (500–1980)	60
California bristlecone pine tree	1500 (479–1979)	76
California bristlecone pine tree	8000 (–6000–1979)	55.4
Sardine (sediment core samples)	1730 (270–1970)	57 and 76
Anchovy (sediment core samples)	1730 (270–1970)	57
Global dT	140 (1861–2001)	55



Klyashtorin, L.B., V. Borisov, and A. Lyubushin (2009), Cyclic changes of climate and major commercial stocks of the Barents Sea, *Mar. Biol. Res.* **5**, 4-17.

A ~60-year cycle in multi-secular records

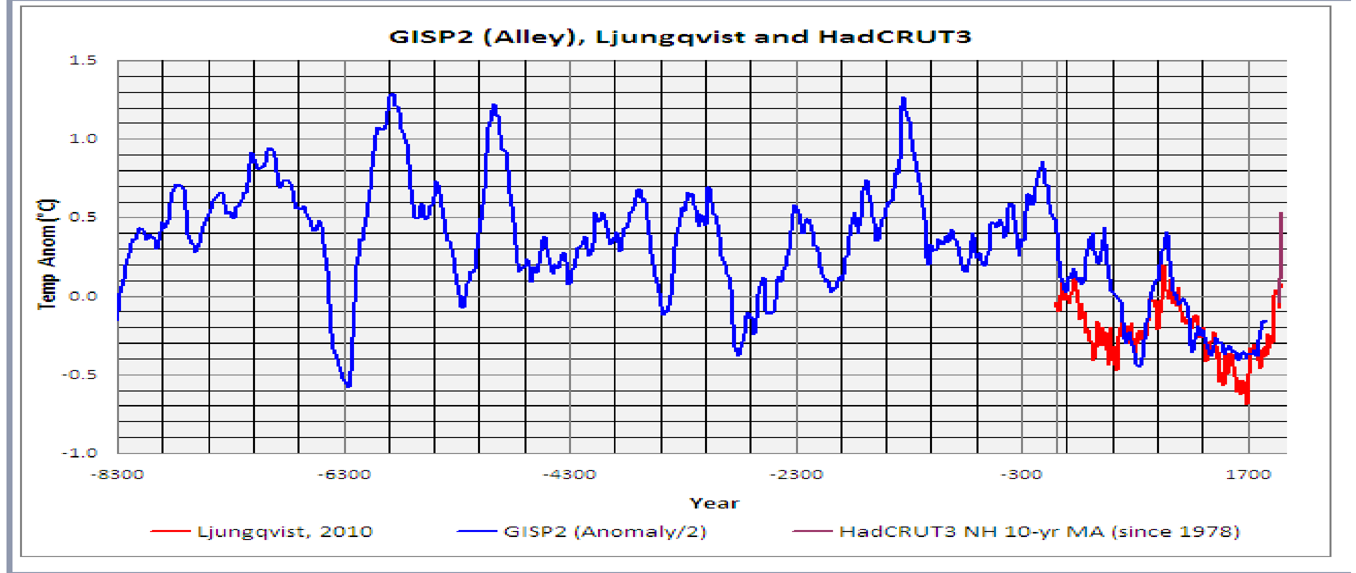


[A] Twenty-year moving average of the tree-ring chronologies from Pinus Flexilis in California and Albertain: this record is used as a proxy for reconstructing the Pacific Decadal Oscillation [MacDonald and Case, 2005].

[B] Record of G. bulloides abundance variations (1-mm intervals) from 1650 to 1990 A.D. [Black et al., 1999]; this is a proxy for the Atlantic variability since 1650.

[C] Five-year running average of the Indian summer monsoon rainfall for the last 181 years [Agnihotri and Dutta, 2003].

A ~60-year cycle in Multi-millennial records



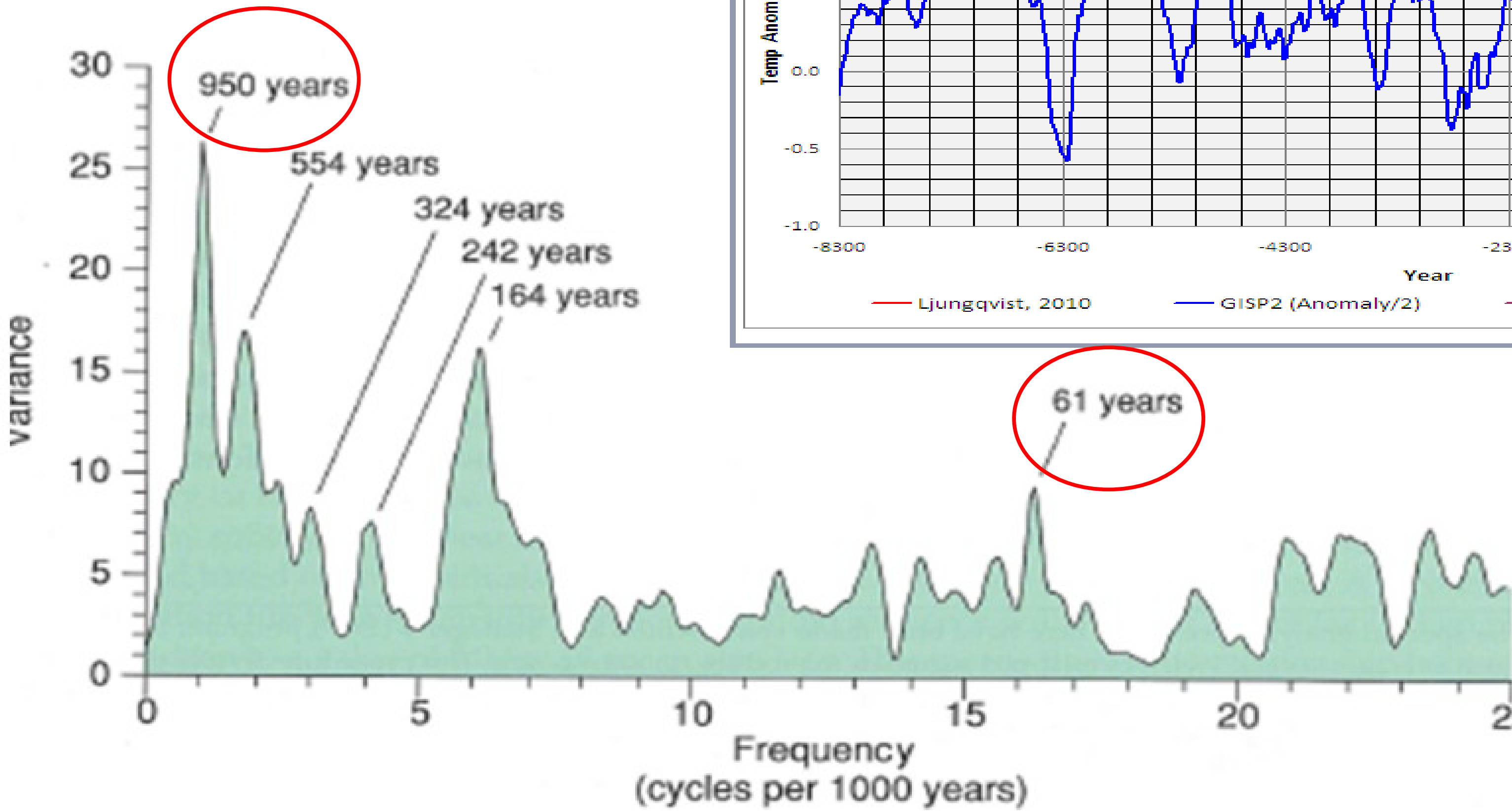


Figure 7 Power spectrum of 2-m average record of δ^{18}O ratios measured on the Holocene portion of the GISP2 ice core. Wavelengths, in years, of dominant peaks are labeled.

GISP2 Holocene Power Spectrum (Fixed Depth Intervals)

Davis, J.C. and G.C. Bohling. *The Search for Patterns in Ice-Core Temperature Curves*, 2001 in L.C. Gerhard, W.E. Harrison and B.M. Hanson, eds., *Geological Perspectives of Global Climate Change*, p. 213-229.

Recent global sea level acceleration started over 200 years ago?

S. Jevrejeva,[1] J. C. Moore,[2,3] A. Grinsted,[2] and P. L. Woodworth[1]

GEOPHYSICAL RESEARCH LETTERS, VOL. 35, L08715,
doi:10.1029/2008GL033611, 2008

Sea level rose by 6 cm during the 19th century and 19 cm in the 20th century.

Superimposed on the long-term acceleration are quasiperiodic fluctuations <u>with a period of about 60 years.</u>

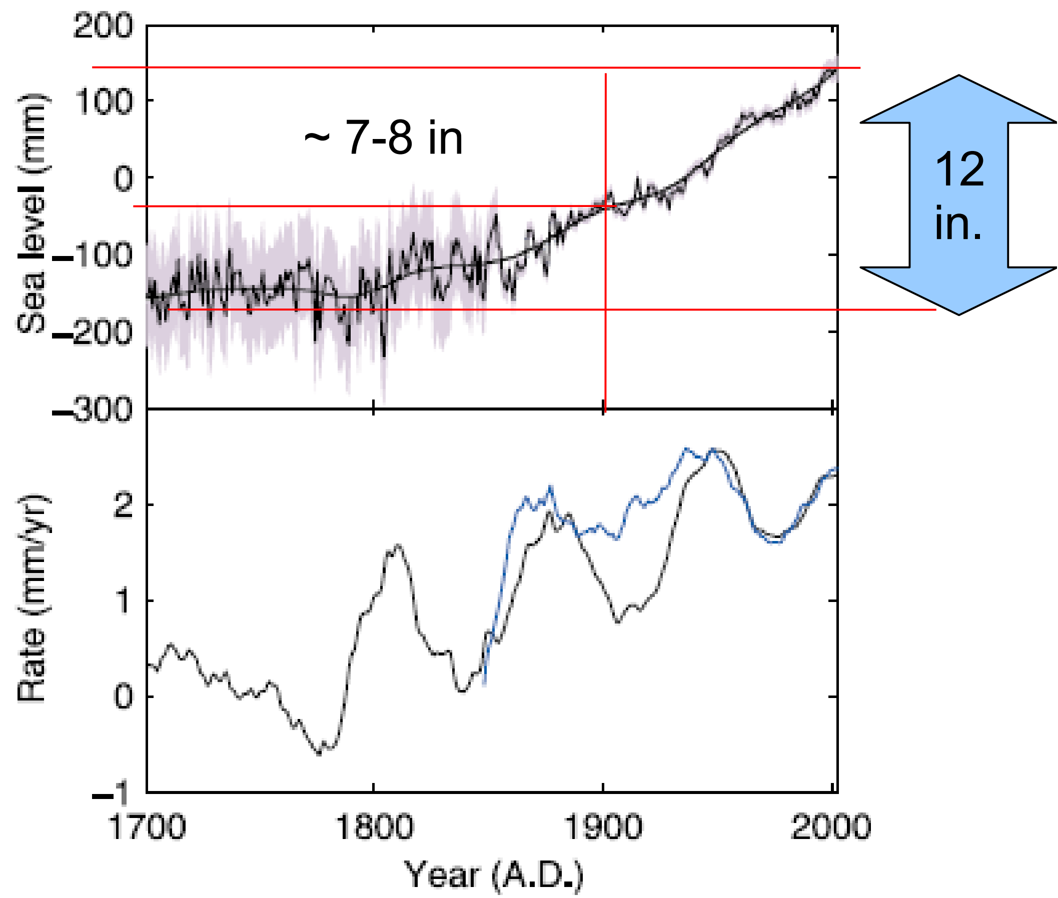


Figure 3. (top) Time series of yearly global sea level and time variable trend detected by method based on MC-SSA with 30year windows, grey shading represents (top) the standard errors. (bottom) The evolution of the rate of the trend (black line) since 1700. Blue line corresponds to the rate of North East Atlantic regional sea level rise since 1850.

Can we trust the IPCC projections?

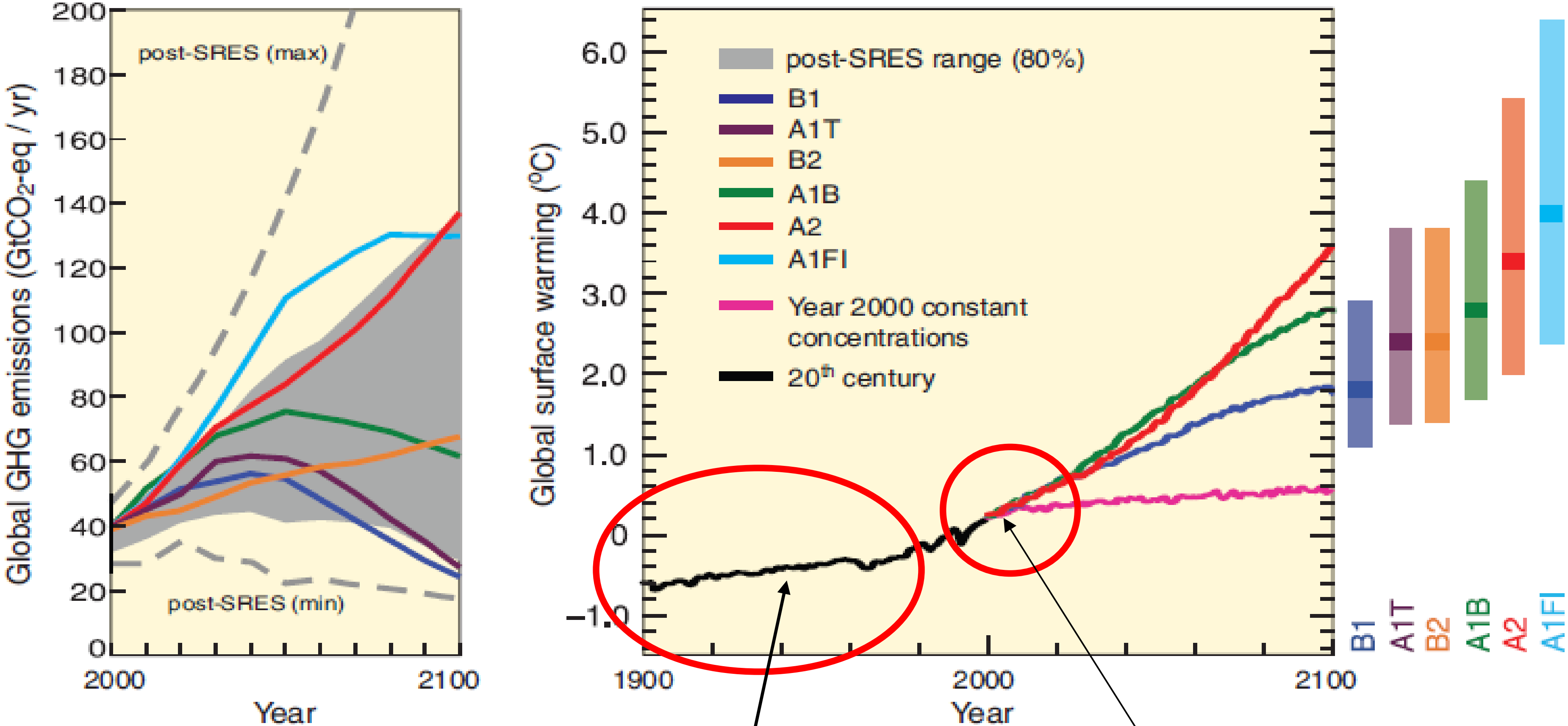


Figure SPM.5. **Left Panel:** Global GHG emissions (in $GtCO_2$-eq) in the absence of climate policies: six illustrative SRES marker scenarios (coloured lines) and the 80th percentile range of recent scenarios published since SRES (post-SRES) (gray shaded area). Dashed lines show the full range of post-SRES scenarios. The emissions include CO_2, CH_4, N_2O and F-gases. **Right Panel:** Solid lines are multi-model global averages of surface warming for scenarios A2, A1B and B1, shown as continuations of the 20th-century simulations. These projections also take into account emissions of short-lived GHGs and aerosols. The pink line is not a scenario, but is for Atmosphere-Ocean General Circulation Model (AOGCM) simulations where atmospheric concentrations are held constant at year 2000 values. The bars at the right of the figure indicate the best estimate (solid line within each bar) and the likely range assessed for the six SRES marker scenarios at 2090-2099. All temperatures are relative to the period 1980-1999. {Figures

Failure to reproduce the 60-year climate variability before 1960

Failure to reproduce the cooling after 2002

Climate Change Attribution Using Empirical Decomposition of Climatic Data

Craig Loehle[1] and Nicola Scafetta*

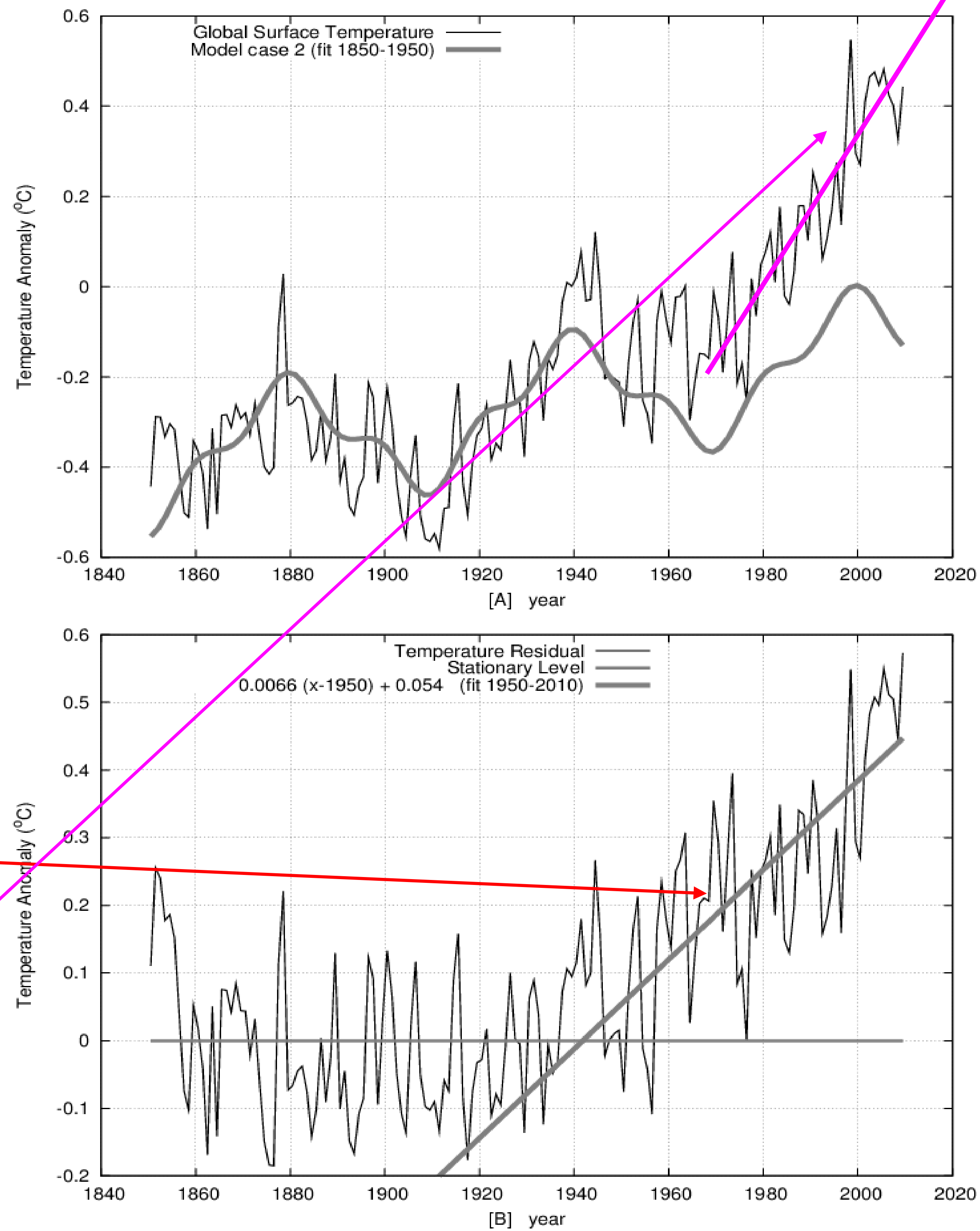
The Open Atmospheric Science Journal 5, **74-86 (2011).**

The real "net" anthropogenic warming is estimated to be about

0.66 °C/century

not the IPCC

2.3 °C/century



~ Let Us Reason A Little Bit ~

The IPCC claims that 100% of the warming observed since 1970 has been induced by human activity.

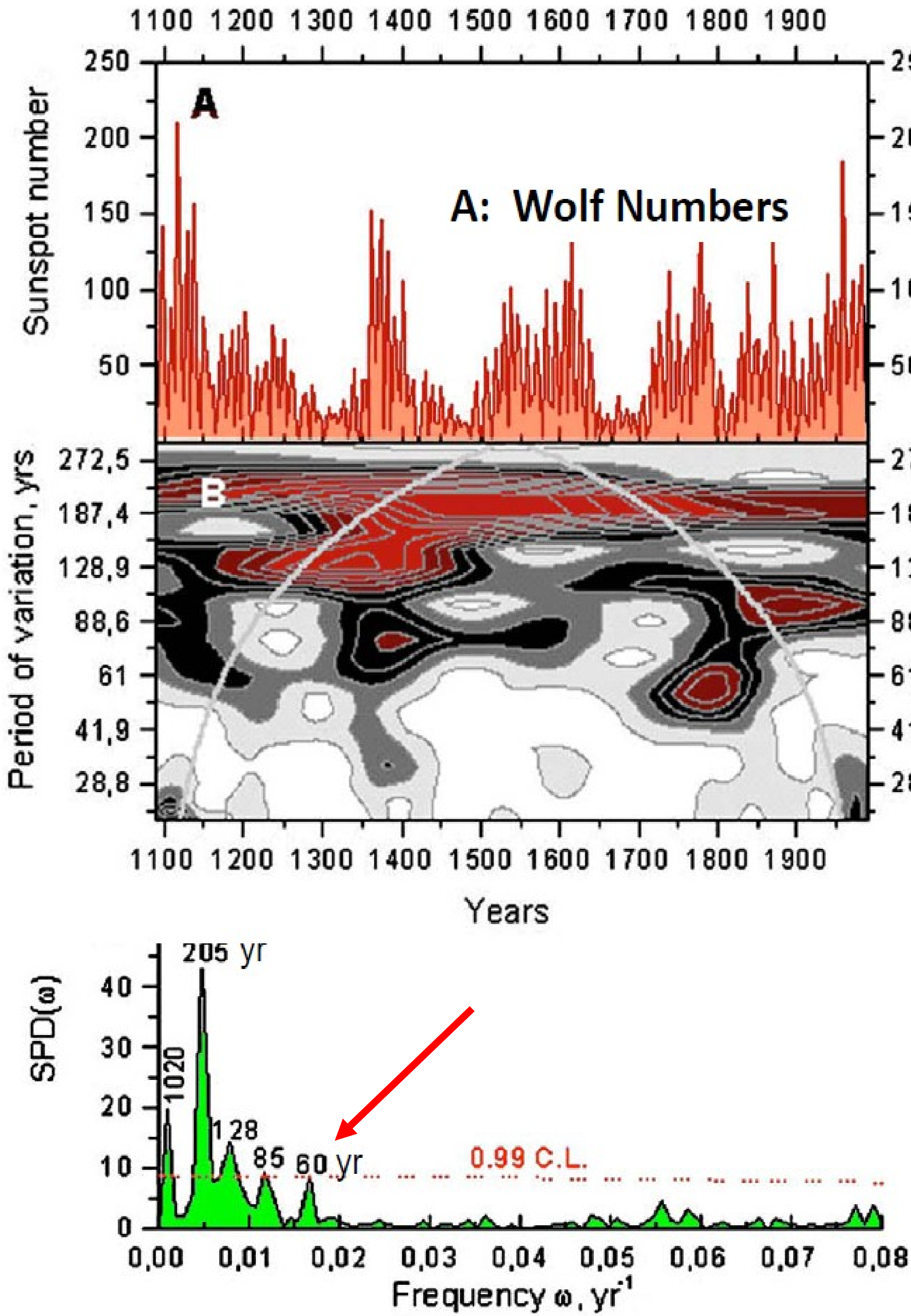
HOWEVER

If the climate is characterized by a ~60-year natural cycle as large as 0.30-0.35 ^{o}C, given the fact that this cycle was in its warm phase from 1970 to 2000, then about 60-70%% of the 0.5 ^{o}C warming observed since 1970 has been natural induced.

Consequently the IPCC models are wrong and they have overestimate the anthropogenic effect on climate by at least about three-four times.

RIGHT?

Solar Cycles



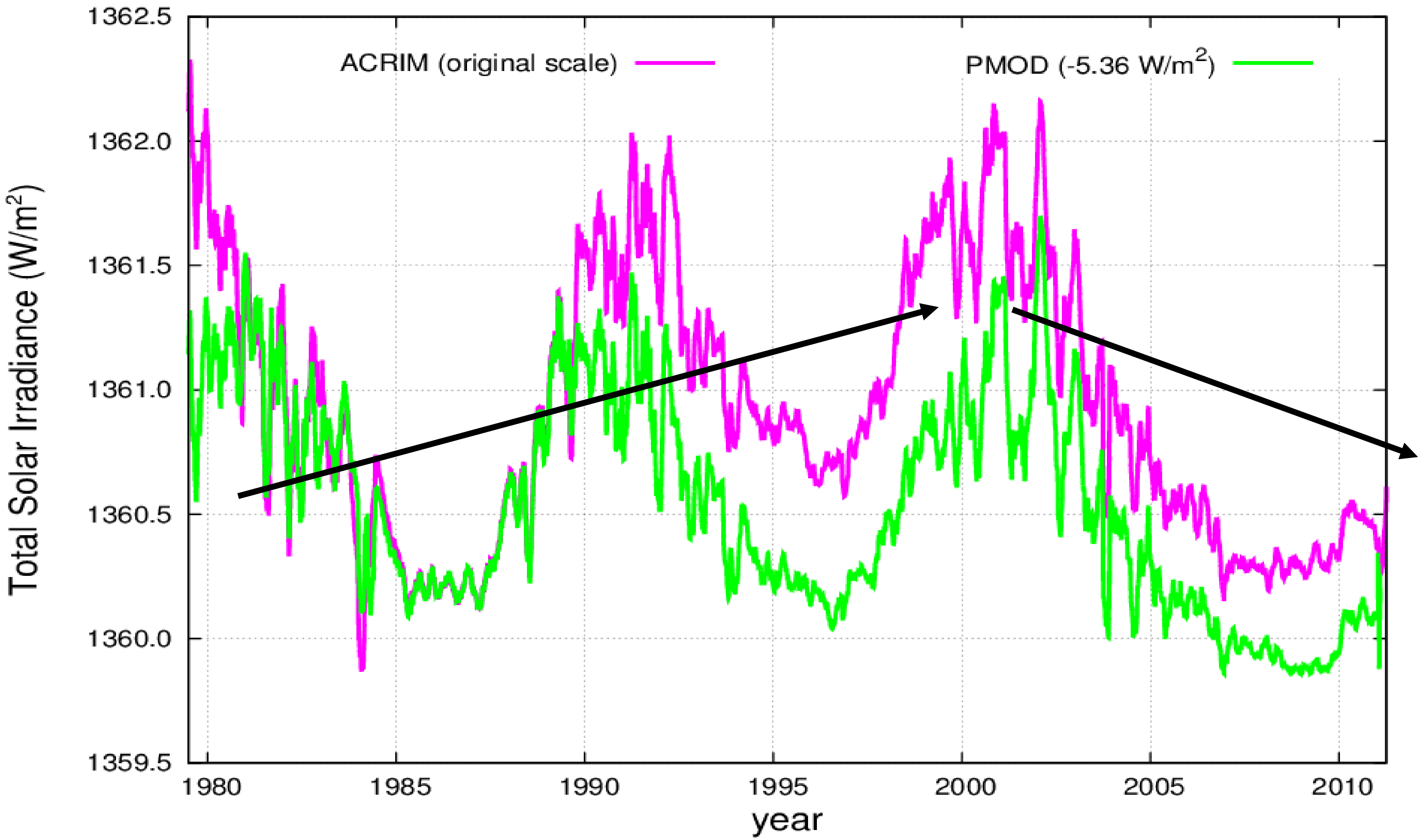
Wolf Numbers reconstructed by Nagovitsyn (1997) using data by Schove (1979).
After 1700 AD direct Zürich data.

Local wavelet (Morlet basis) **spectrum of Wolf Numbers** reconstructed by Nagovitsyn. White domains – local wavelet power <0.2; black domains – local wavelet power >1.0 (0.99 c.l.).

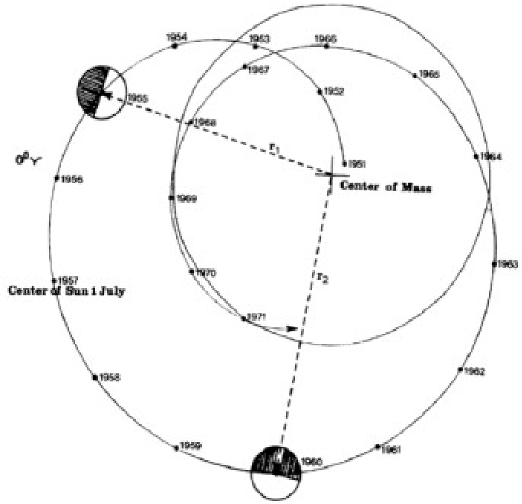
Fourier Spectrum Density of Wolf Numbers reconstructed by Nagovitsyn. Dotted line: 0.99 c.l. (red noise factor 0.3).
Significant cycles at 60, 85, 128, 205 yr.

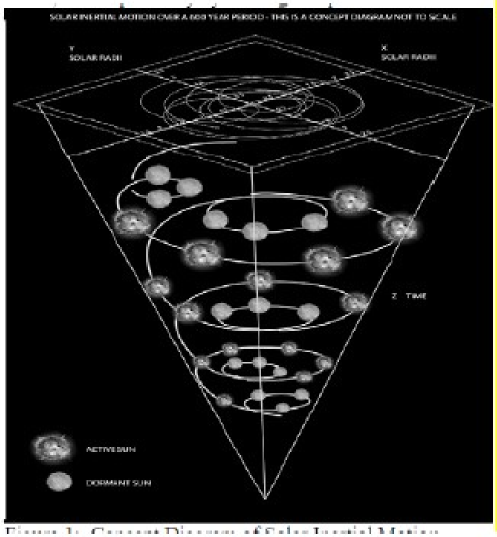
Ogurtsov et al., Solar Physics, 2002

ACRIM Total Solar Irradiance (TSI) Composite may show part of a solar 60-year cycle modulation

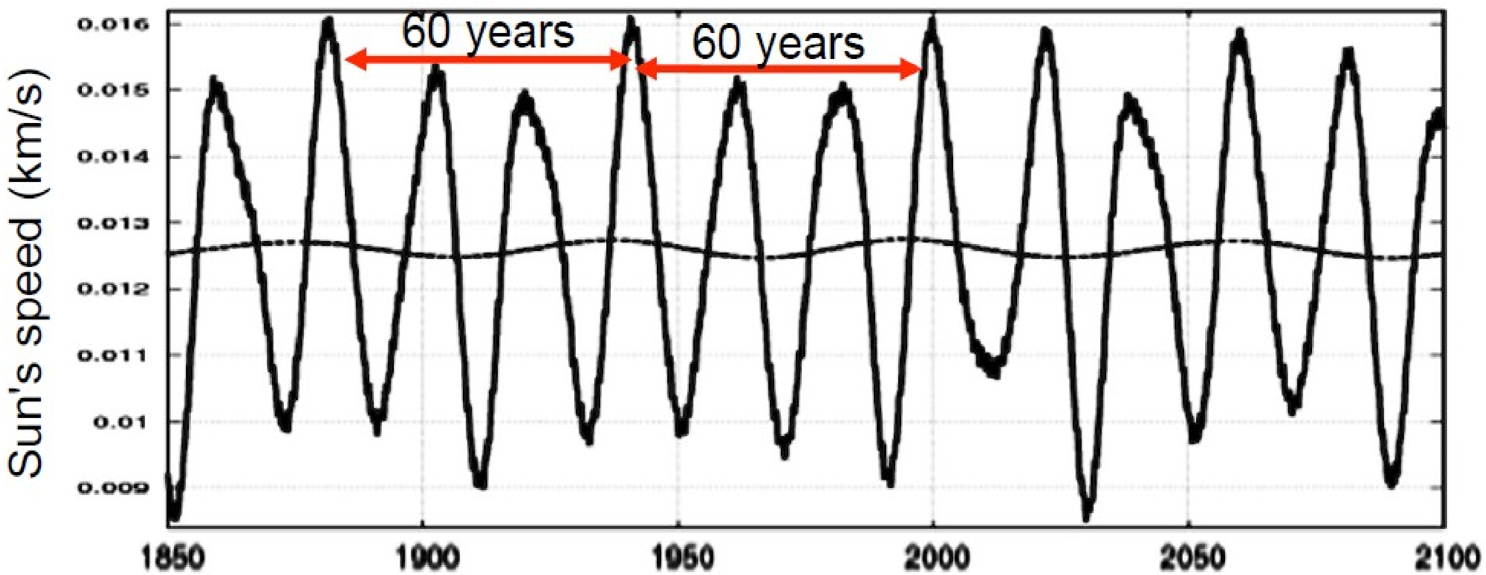


Major cycles in the Solar system



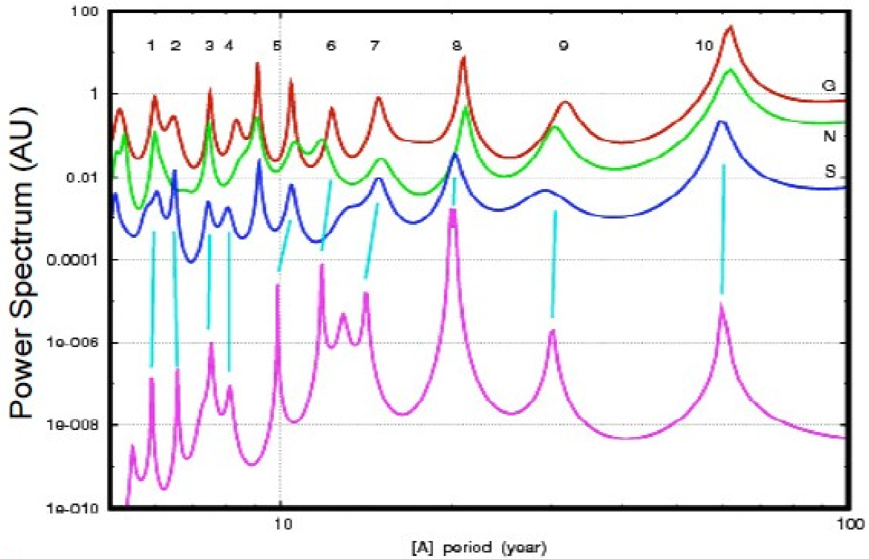


Schwabe sunspot: 11 yr
Jupiter: 11.85 yr
Lunar Nodal Precession: 18.6 yr
Sun orbit around the Center of Mass: 19.9 yr
Hale magnetic sunspot: 22 yr
Saturn: 29.4 yr
Saturn and Jupiter (Synodic): 60 yr
Uranus: 84 yr

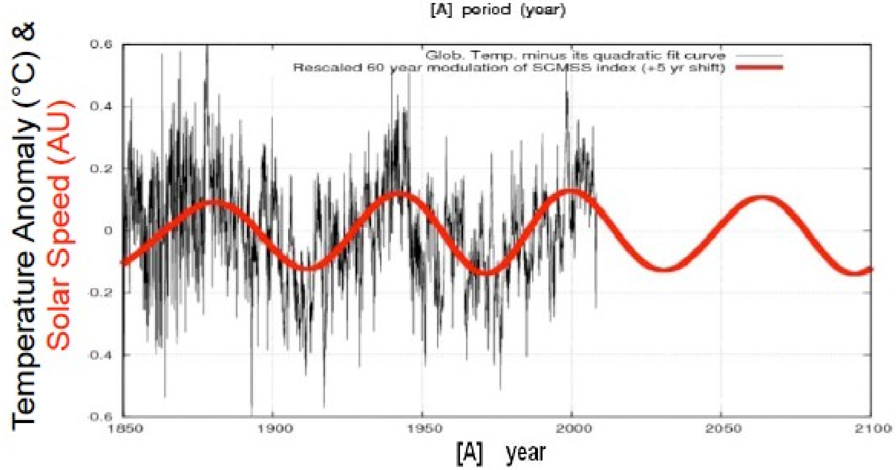


Scafetta, N. (2010b), Empirical evidence for a celestial origin of the climate oscillations and its implications. *J. of Atmospheric and Solar-Terrestrial Physics* **72**, 951–970.

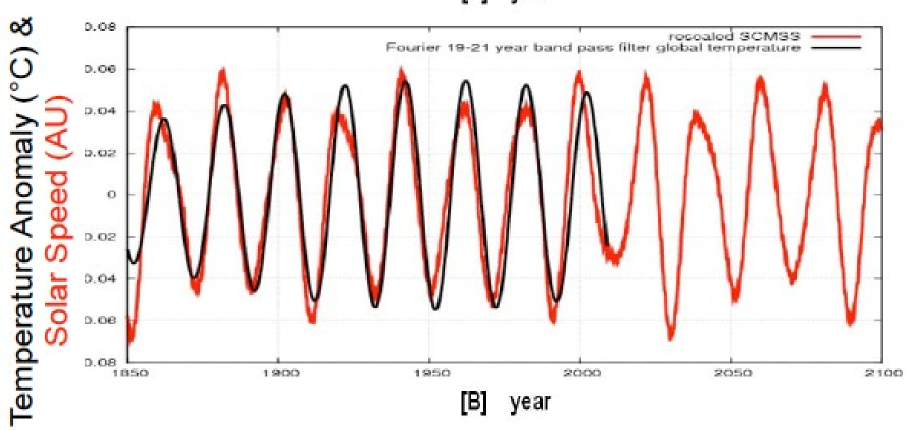
Comparison between the 20 & 60 yr Jupiter/Saturn conjunction cycles and Solar Speed and the CRU global surface temperature series



Power spectra of the **CRU temperatures** (**Global**, **Northern Hemisphere** & **Southern Hemisphere**) and the **Solar Speed** relative to CMSS.

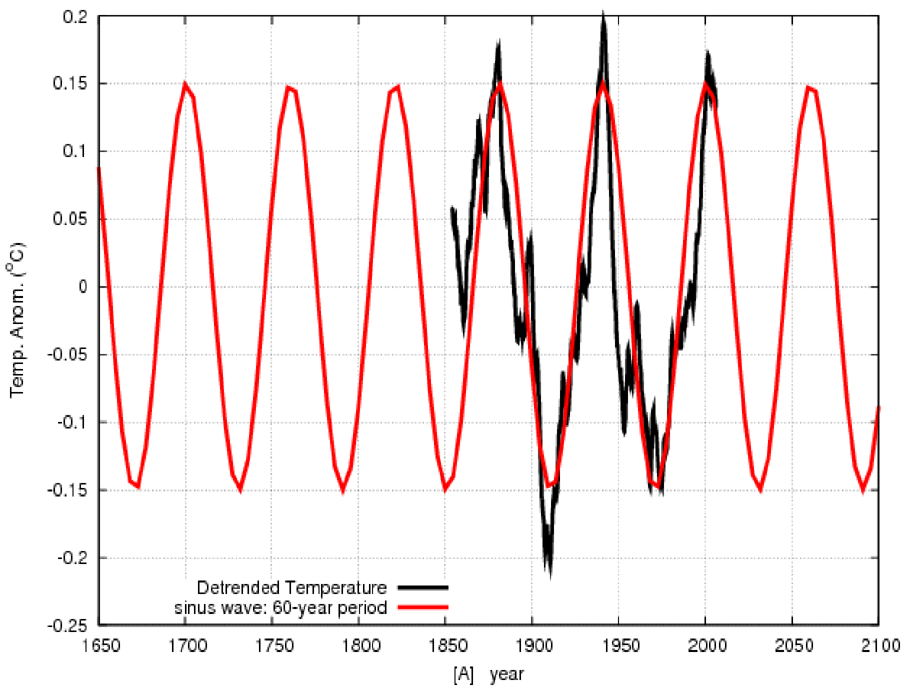


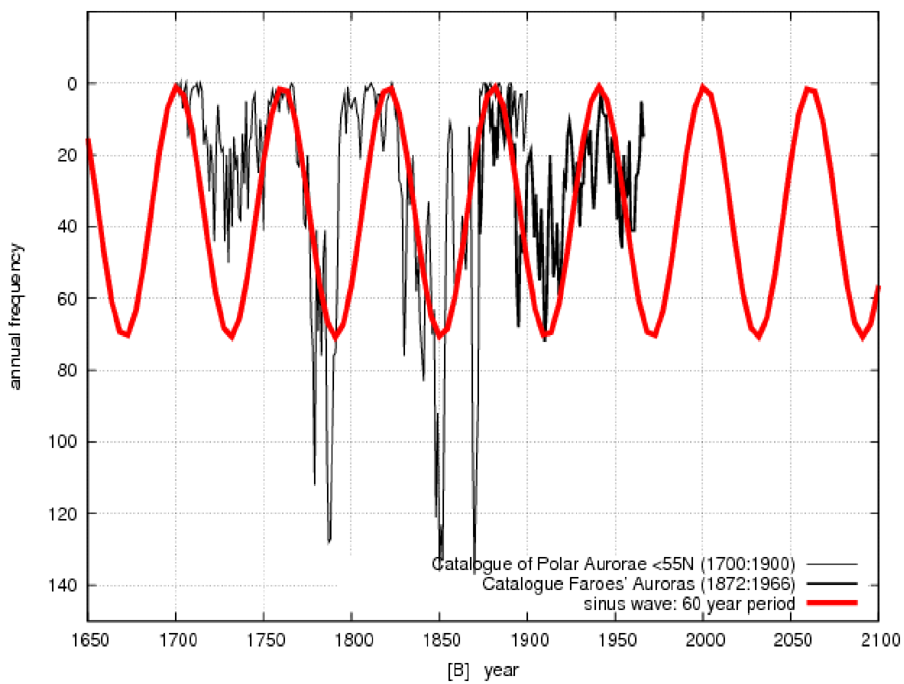
Global Surface Temperature (black) detrended of its quadratic fit plotted with the rescaled 60-year modulation of the **Solar Speed** of the CMSS.

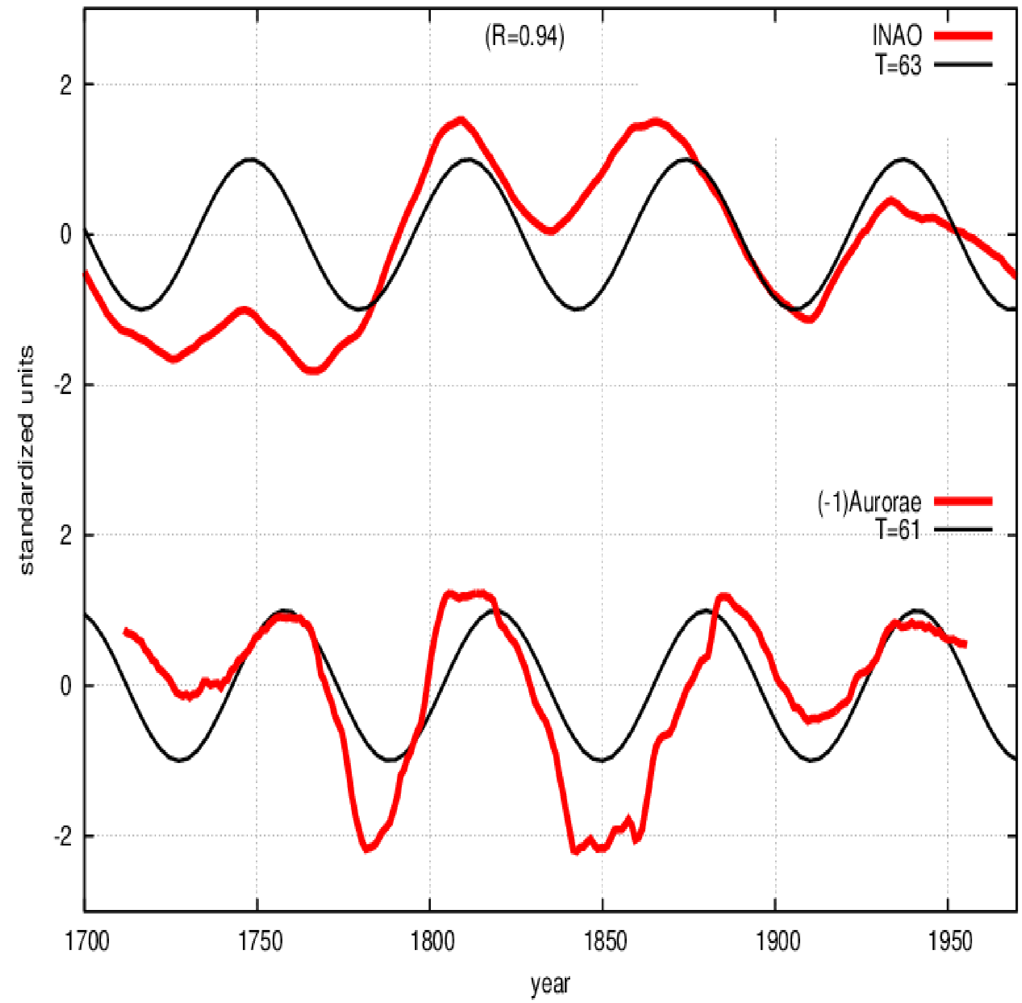


The 20-year oscillation of the **Temperature** (black) plotted against the rescaled **Solar Speed** of the CMSS (red). No lag-time is applied.

Mazzarella and Scafetta, "Evidences for a quasi 60-year North Atlantic Oscillation since 1700 and its meaning for global climate change," Theor. Appl. Climatol., DOI 10.1007/s00704-011-0499-4 (2011).



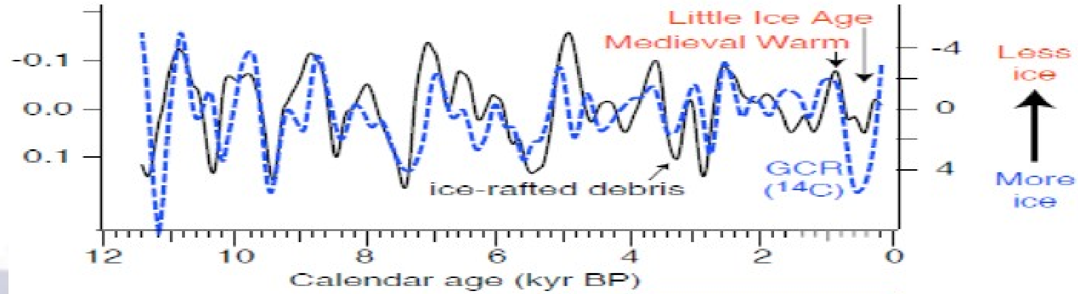




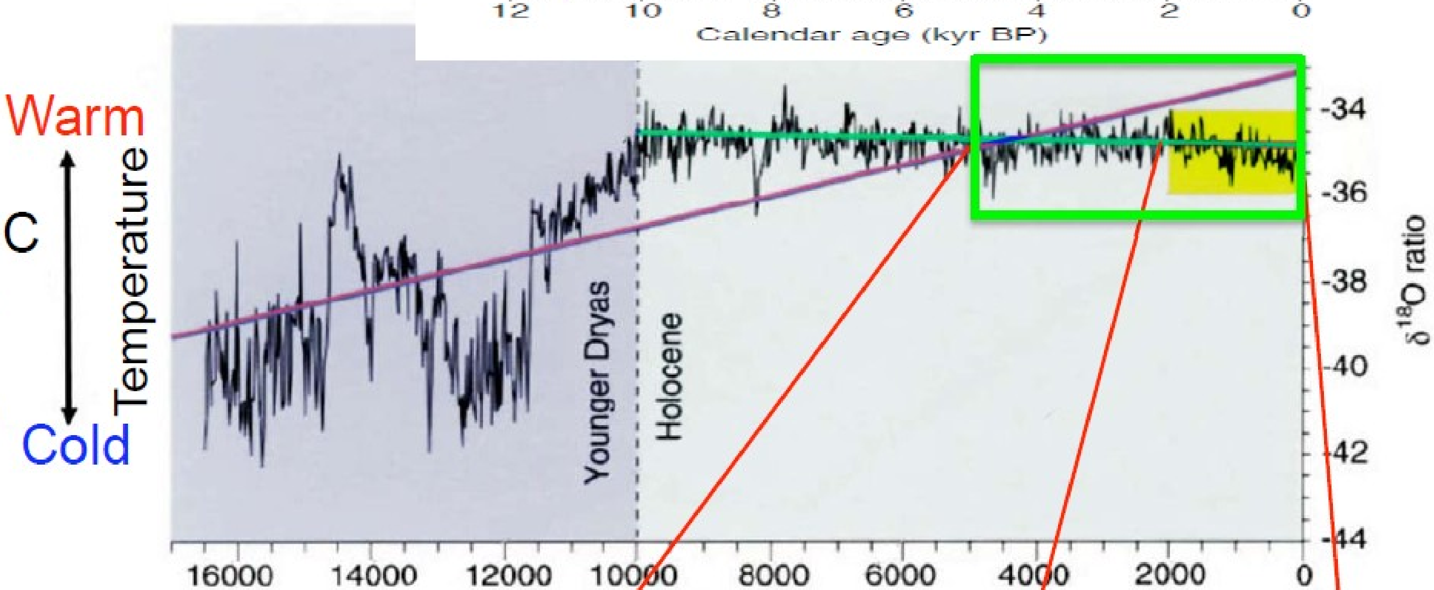
Aurora Borealis have a 60-year cycle

Kerr, Science 2001

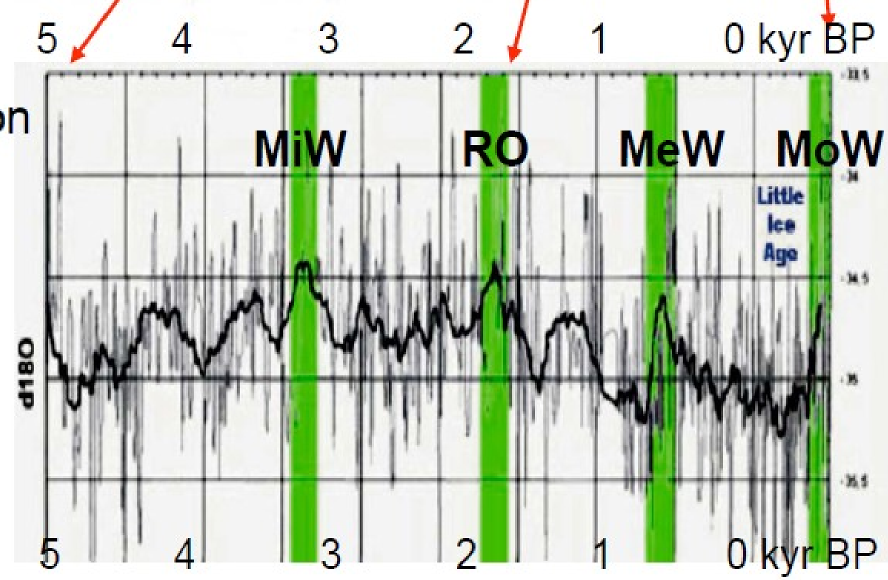
^{14}C Reconstructed Solar activity
~1000 year oscillations



^{18}O Holocene
Temp
reconstruction

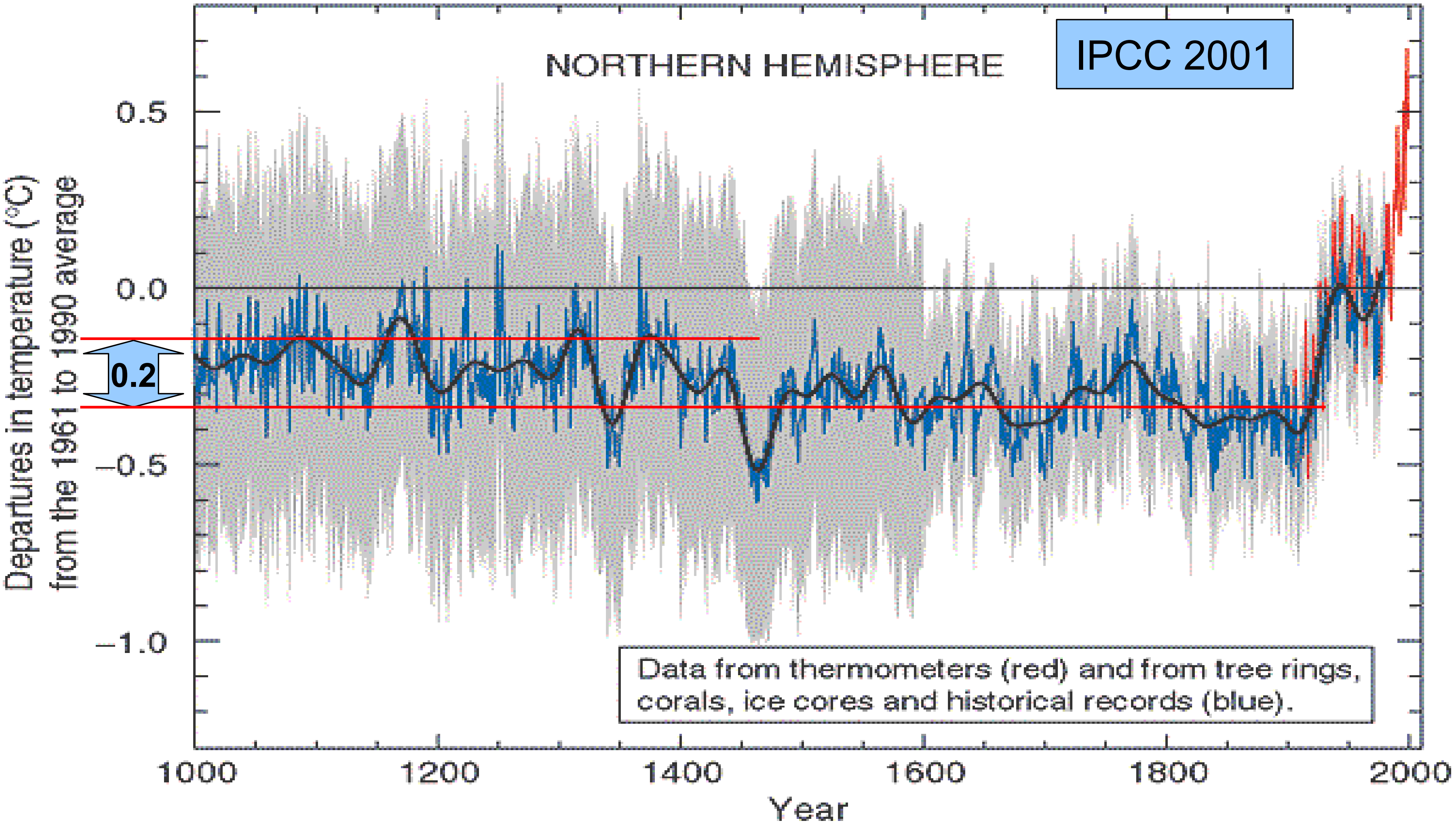


^{18}O Holocene Temperature reconstruction
~1000 year oscillations

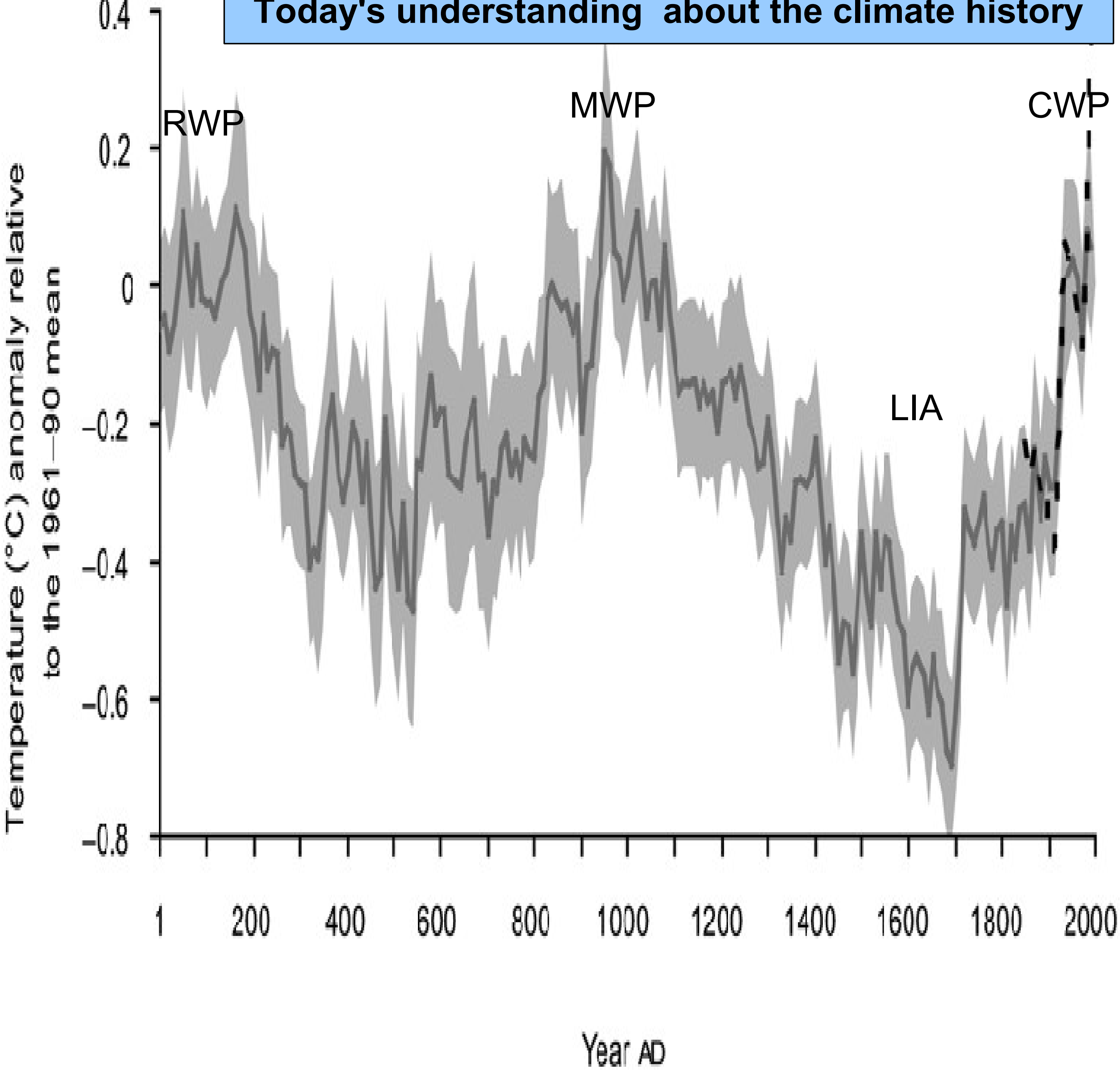


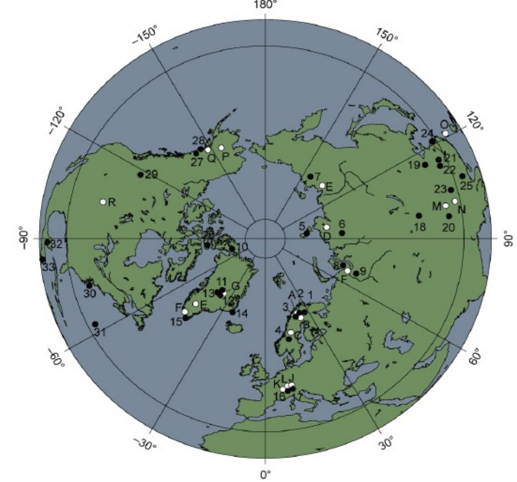
MiW = Minoan Warm Period,
RO = Roman Optimum,
MeW = Medieval Warm Period,
MoW = Modern Warm Period.

The “Hockey Stick” temperature (Mann, Bradley, Hughes 1998).
This record surprised the scientific community because the pre-industrial climate (<1900) varies 5-10 times **less** than what was previously expected!



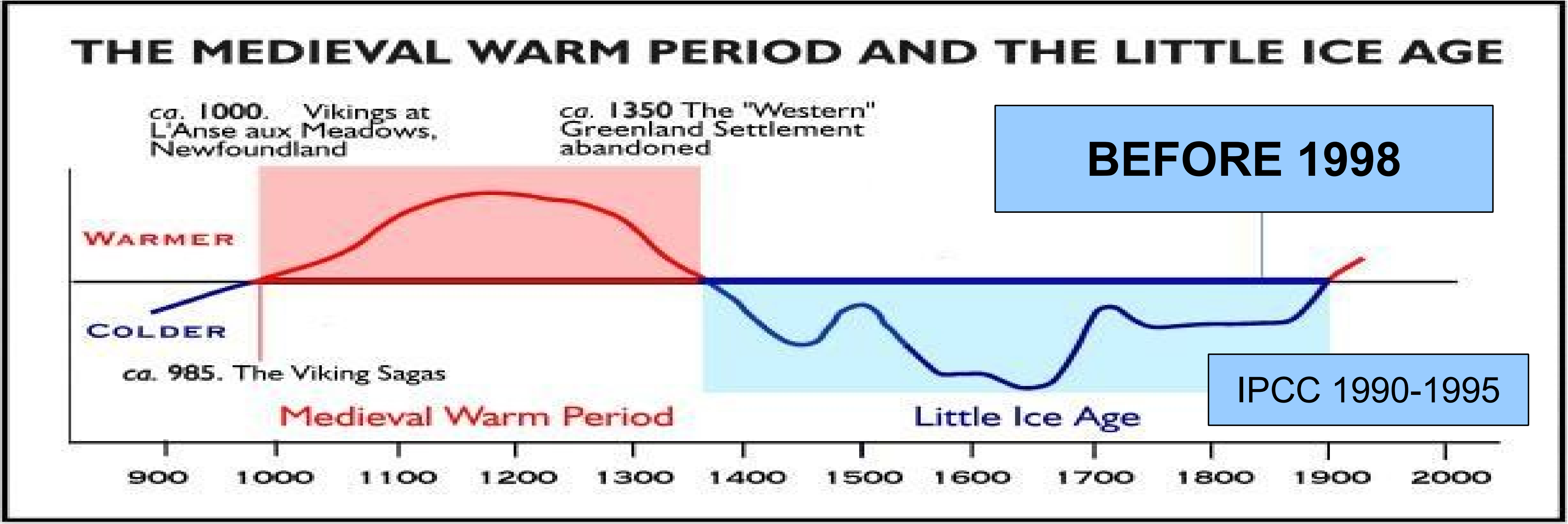
After the Hockey Stick:
Today's understanding about the climate history





Since 2004 several new global paleoclimate temperature reconstructions were proposed. They show a large pre-industrial variability, which better agrees with known history.

Example: Moberg 2005, Ljungqvist 2010


THE MEDIEVAL WARM PERIOD AND THE LITTLE ICE AGE
ca. 1000. Vikings at L'Anse aux Meadows, Newfoundland
ca. 1350 The "Western" Greenland Settlement abandoned
BEFORE 1998
WARMER
COLDER
ca. 985. The Viking Sagas
Medieval Warm Period
Little Ice Age
IPCC 1990-1995
900
1000
1100
1200
1300
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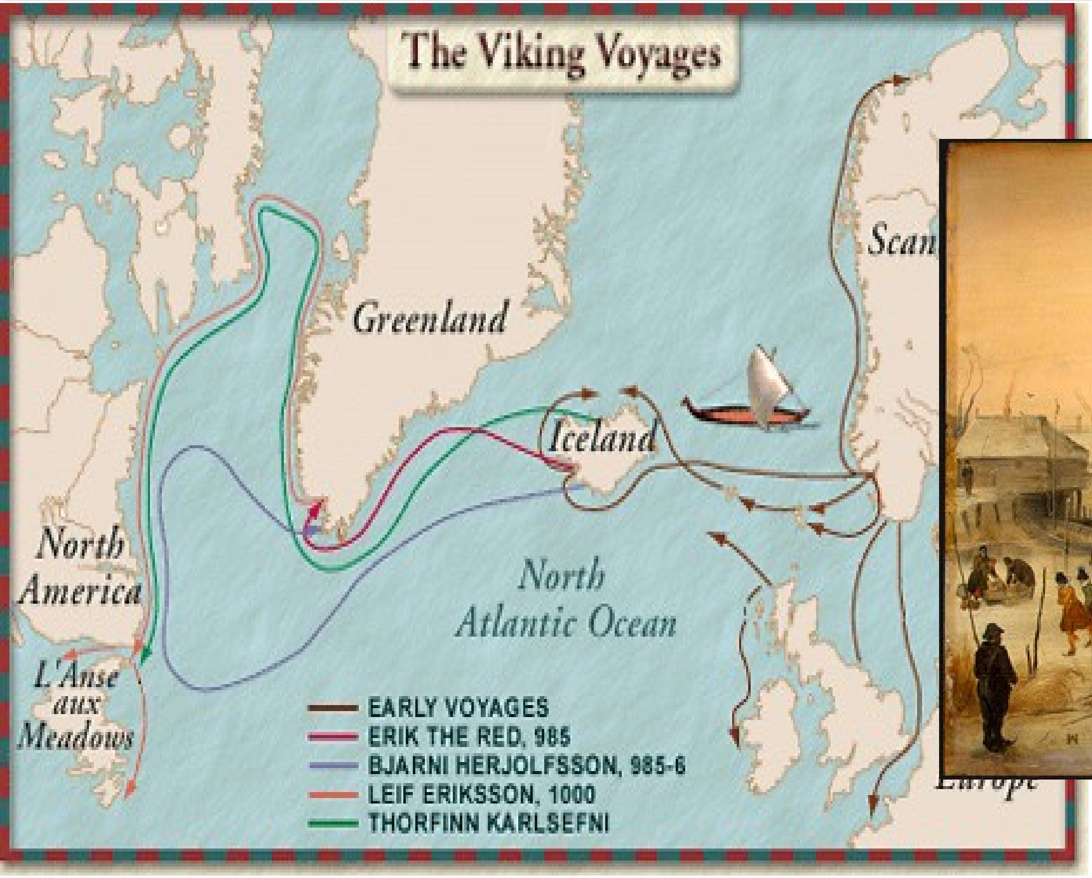
1500
1600
1700
1800
1900
2000


The Viking Voyages
Greenland
Iceland
North America
L'Anse aux Meadows
North Atlantic Ocean
EARLY VOYAGES
ERIK THE RED, 985
BJARNI HERJOLFSSON, 985-6
LEIF ERIKSSON, 1000
THORFINN KARLSEFNI

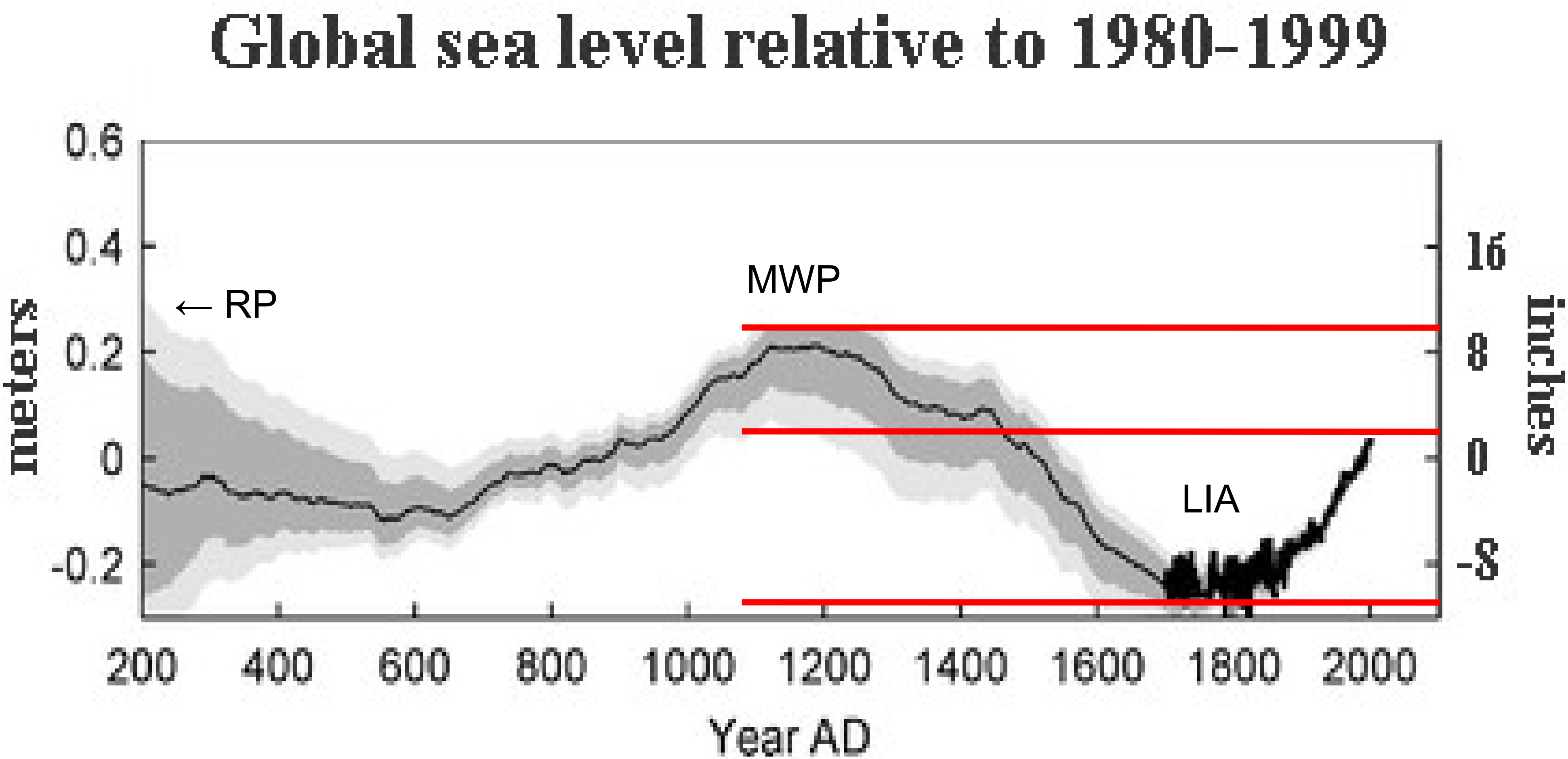
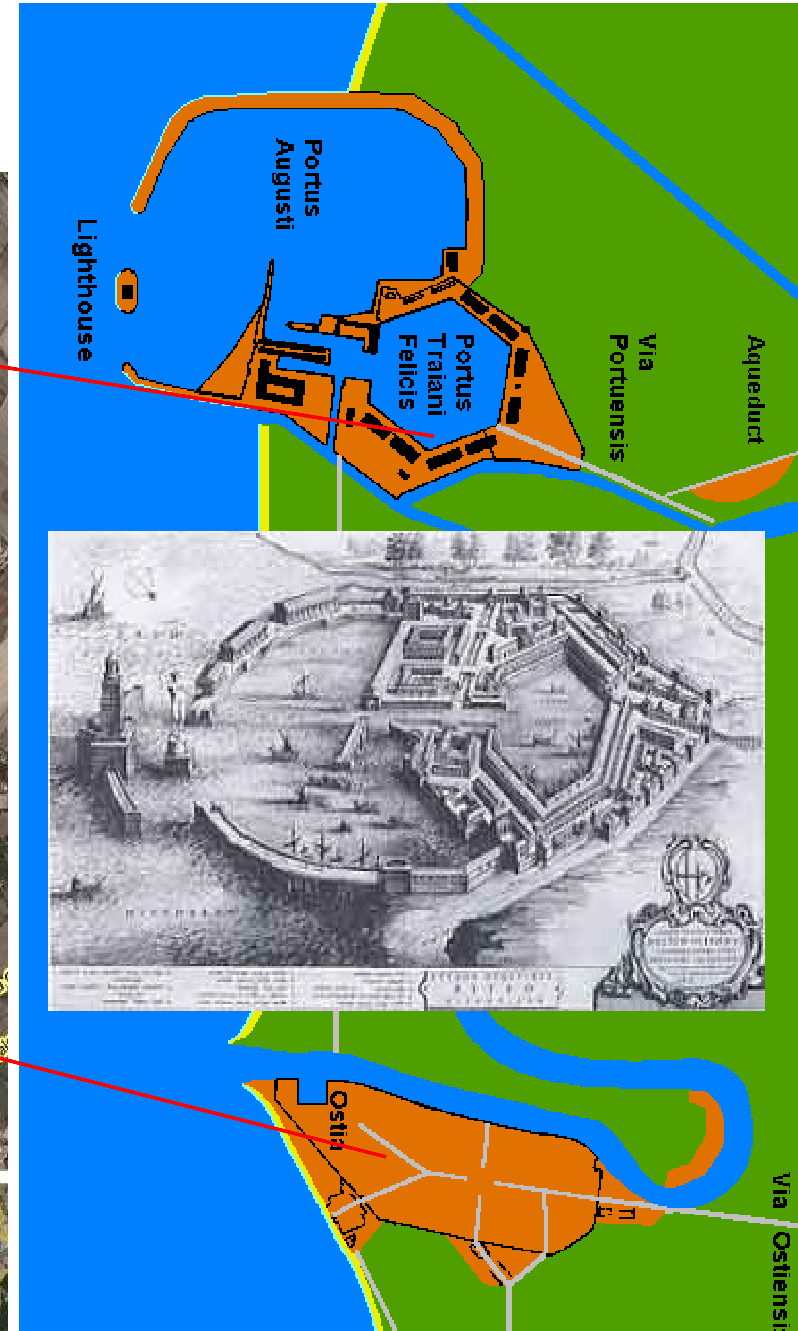


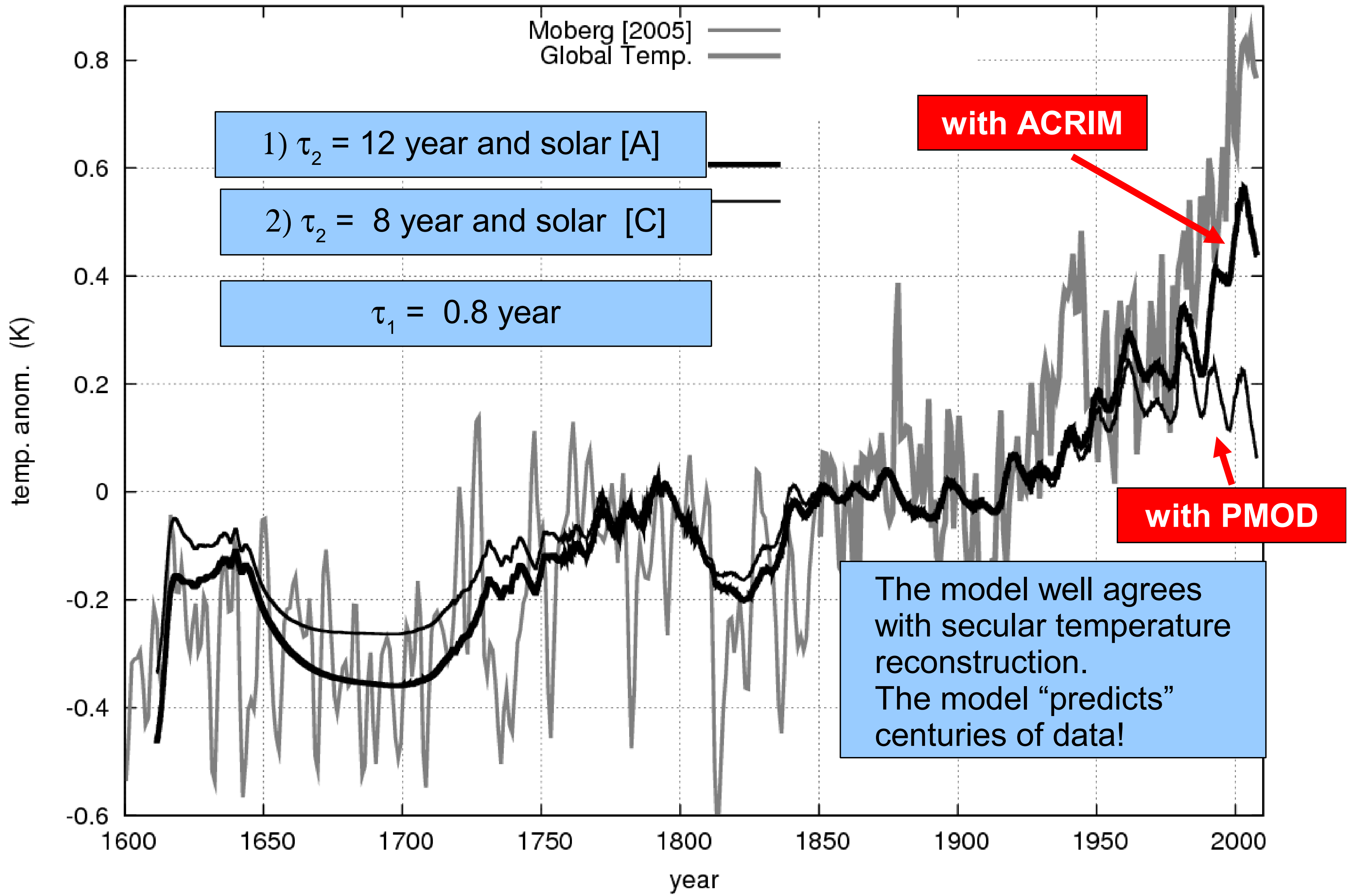
Figure 1. Global sea level from 200 A.D. to 2000, as reconstructed from proxy records of sea level by Moberg *et al.* 2005. The thick black line is reconstructed sea level using tide gauges (Jevrejeva, 2006). The lightest gray shading shows the 5 - 95% uncertainty in the estimates, and the medium gray shading denotes the one standard deviation error estimate. The highest global sea level of the past 110,000 years likely occurred during the Medieval Warm Period of 1100 - 1200 A.D., when warm conditions similar to today's climate caused the sea level to rise 5 - 8" (12 - 21 cm) higher than present. Image credit: Grinsted, A., J.C. Moore, and S. Jevrejeva, 2009, "Reconstructing sea level from paleo and projected temperatures 200 to 2100 AD", Climate Dynamics, DOI 10.1007/s00382-008-0507-2, 06 January 2009.

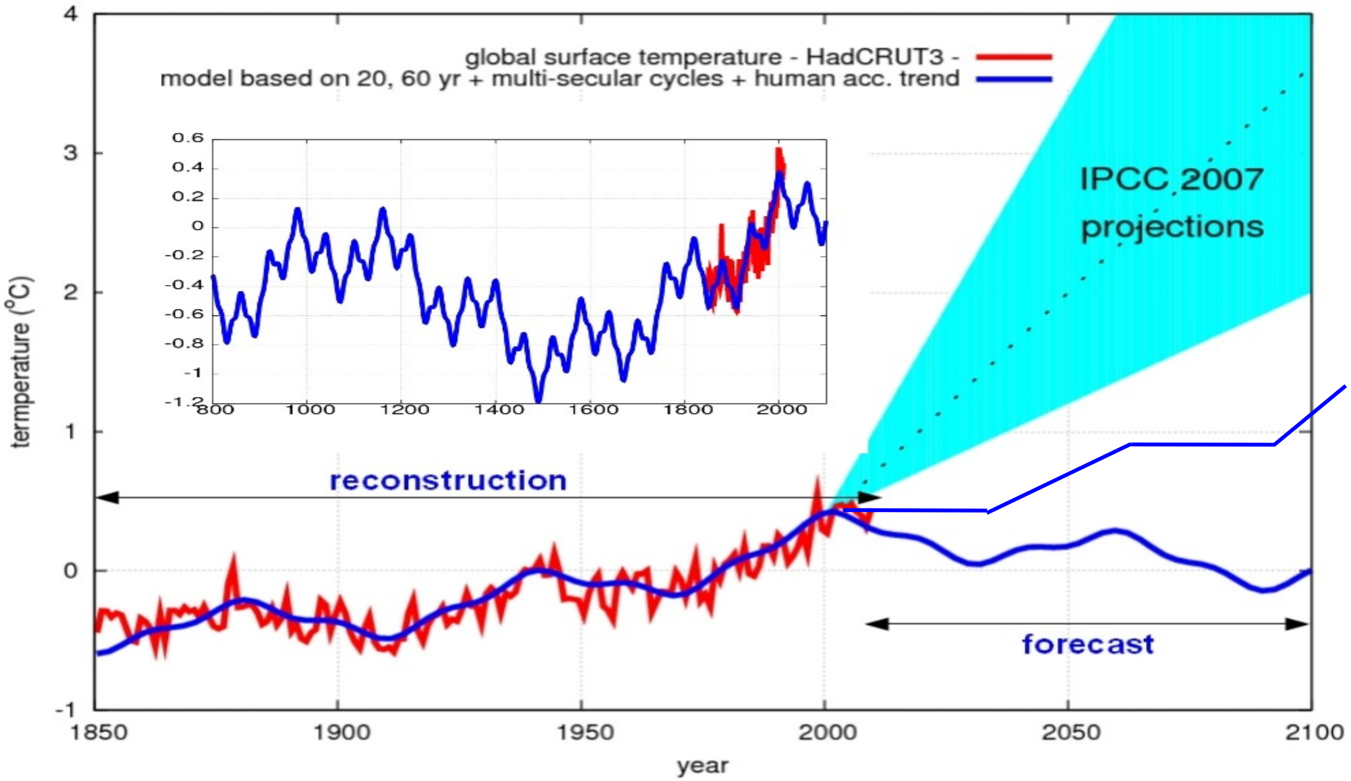
During the Roman Period the sea level was likely higher than today

OSTIA HARBOUR CITY OF ANCIENT ROME



N. Scafetta, "Empirical analysis of the solar contribution to global mean air surface temperature change," Journal of Atmospheric and Solar-Terrestrial Physics 71 1916–1923 (2009).





Global Temperature reconstruction and forecast based on the solar system oscillations

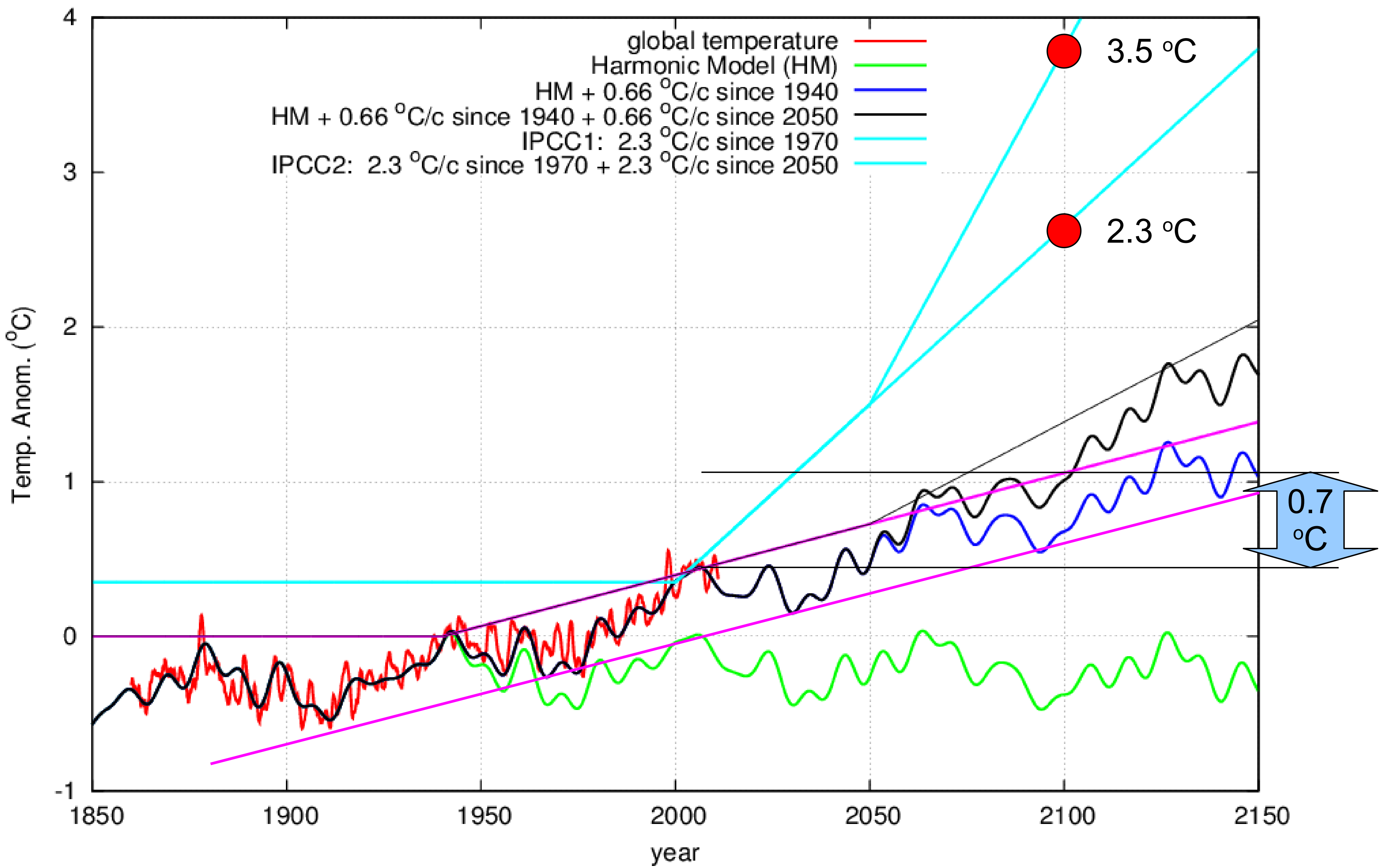
A harmonic model based on the 20- 30- and 60-year oscillations of the Speed of the Sun relative to the Center of Mass of the Solar System (CMSS) **explains the multi-decadal temperature oscillations.**

The **increasing trend** may be due to: (1) Anthropogenic GreenHouse Gases (GHGs) e.g.CO_2 and CH_4. **A smaller GHGs contribution (compared with IPCC) is suggested**. (2) poorly corrected urban heat island. (3) Quasi-millennial solar cycle.

Next future? **GC might remain stationary until 2030-2040** because the astronomical forcing induces a cooling phase that may (partially) oppose GHGs adverse effects.

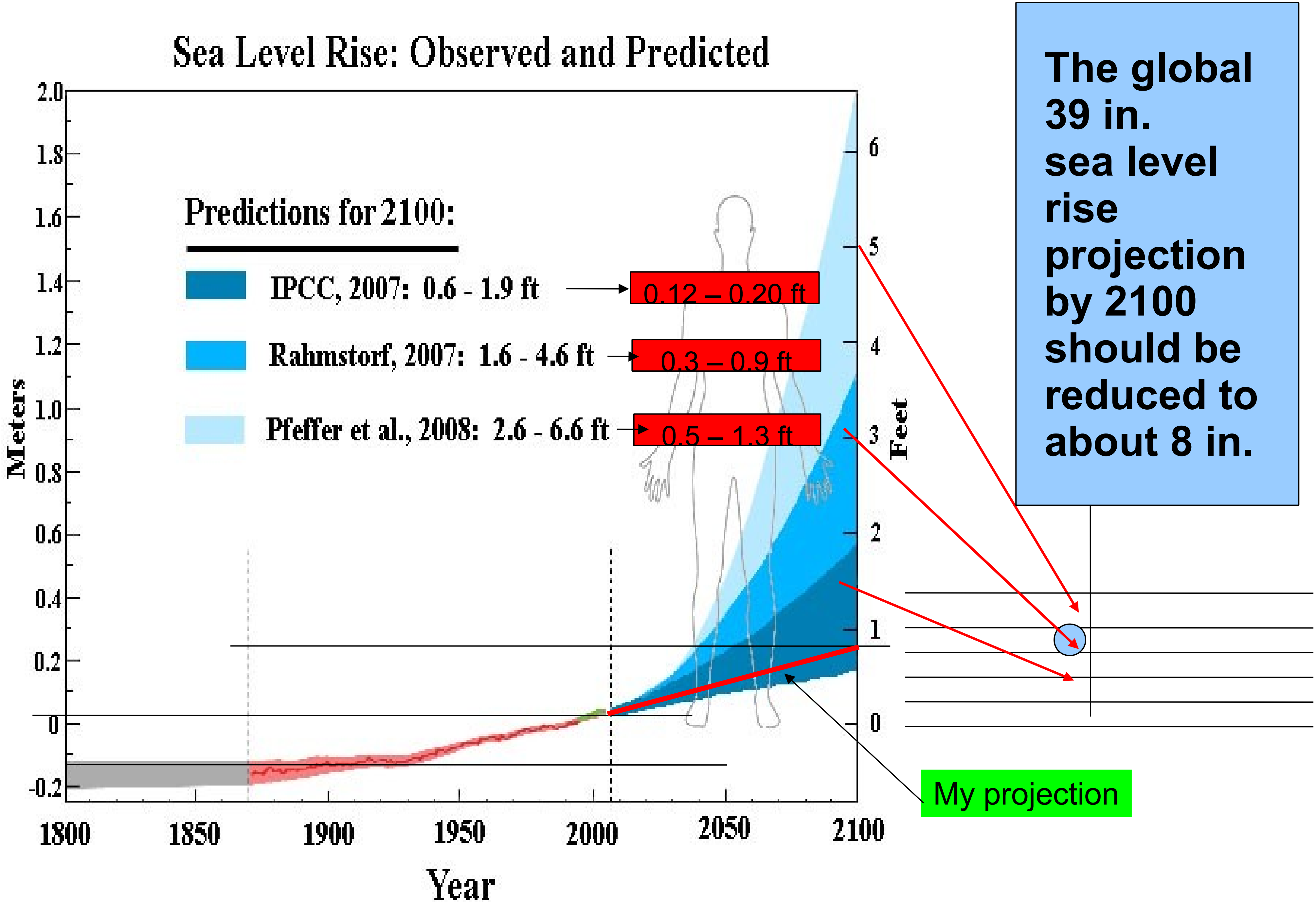
Scafetta, 21010

Global temperature forecast based on ~9, ~10.5, ~20, ~60 and ~950 years + anthropogenic warming trends



The harmonic model predicts a warming five times lower than the IPCC likely scenario

Corrected Ranges of SLR Projections



Corrected Ranges of SLR Projections in North Carolina

Table 1. MSL trends for N.C. water-level stations in mm/year (adapted from Zervas, 2004).

Station Number	Station Name	Mean Sea-Level Trend mm/yr	Mean Sea-Level Trend inches/century	Period of Data
8651370	Duck	4.27 ± 0.74	16.8 ± 2.9	1978-2002
8652587	Oregon Inlet Marina	2.55 ± 1.21	10.1 ± 4.8	1977-1980, 1994-2002
8654400	Cape Hatteras	3.46 ± 0.75	13.6 ± 3	1978-2002
8656483	Beaufort	3.20 ± 0.54	12.6 ± 2.2	1973-2002
8656590	Atlantic Beach	2.48 ± 1.99	9.7 ± 7.8	1977-1983, 1998-2000
8658120	Wilmington	2.12 ± 0.23	8.4 ± 0.8	1935-2002
8659084	Southport	2.04 ± 0.25	8 ± 1	1933-1954, 1976-1988
8659182	Yaupon Beach	2.92 + 0.77	11.5 ± 3	1977-1978, 1996-1997

North Carolina Sea-Level Rise Assessment Report March 2010

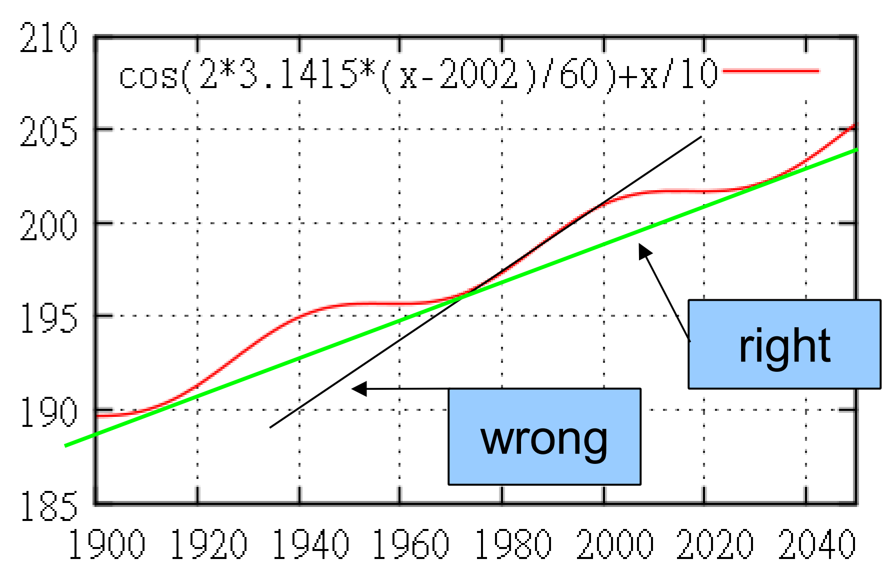
Overestimated because of the 60-year cycle that was in warming phase from 1970 to 2000

Reasonable because of the completed 60-year cycle from 1935 to 2002

The Sea Level Rise for North Carolina has been
on average 8-10 in per century since 1900.

This value is about 1.2-1.4 times larger than the world SLR average of 7-8 in since 1900.

Thus, the SLR per NC by 2100 may be between 9 in and 12 in. (upper limit)



CONCLUSIONS

1) Current climate models are severely uncertain and poorly reconstruct the temperature.

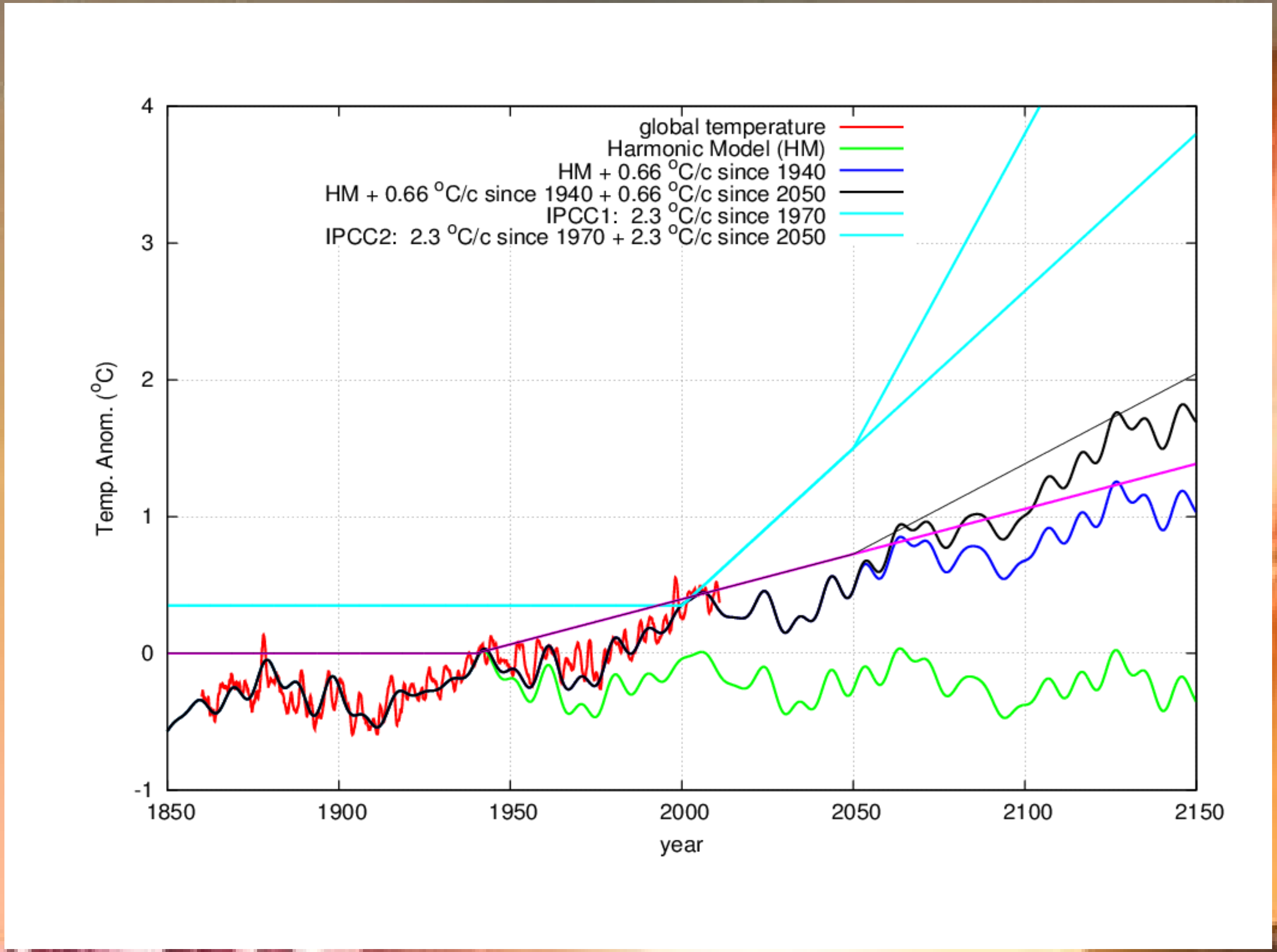
2) Climate system appears to be characterized by large natural cycles. Same of the major cycles are about:

9, 10-11, 20-22, 60, 800-1000 year.

3) These cycles can be easily interpreted as astronomical cycles because they are present in the orbits of the Moon, of the planets (Jupiter and Saturn) and in the solar dynamics (11 and 22 solar cycles).

4) The global temperature may rise by 0.7 ^{o}C by 2100 which would imply that the sea level will rise five times less than previously estimated:
The 39 in. SLR projection for NC should be reduced to 9-12 in.

Many Thanks for Your kind Attention



IPCC's huge uncertainty in the climate sensitivity to CO_2 concentration