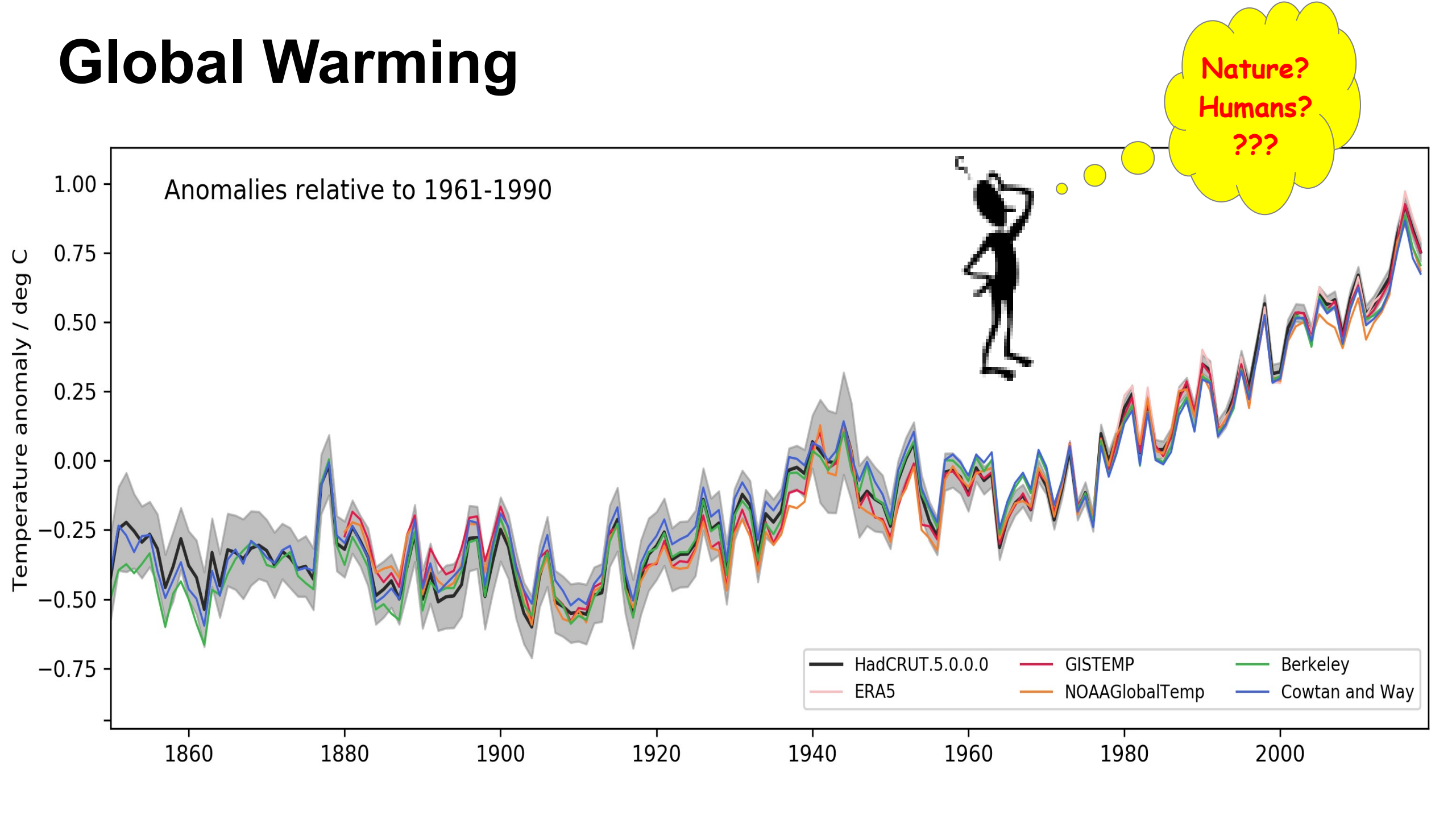
DiSTAR Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II
SCUOLA POLITECNICA E DELLE SCIENZE DI BASE

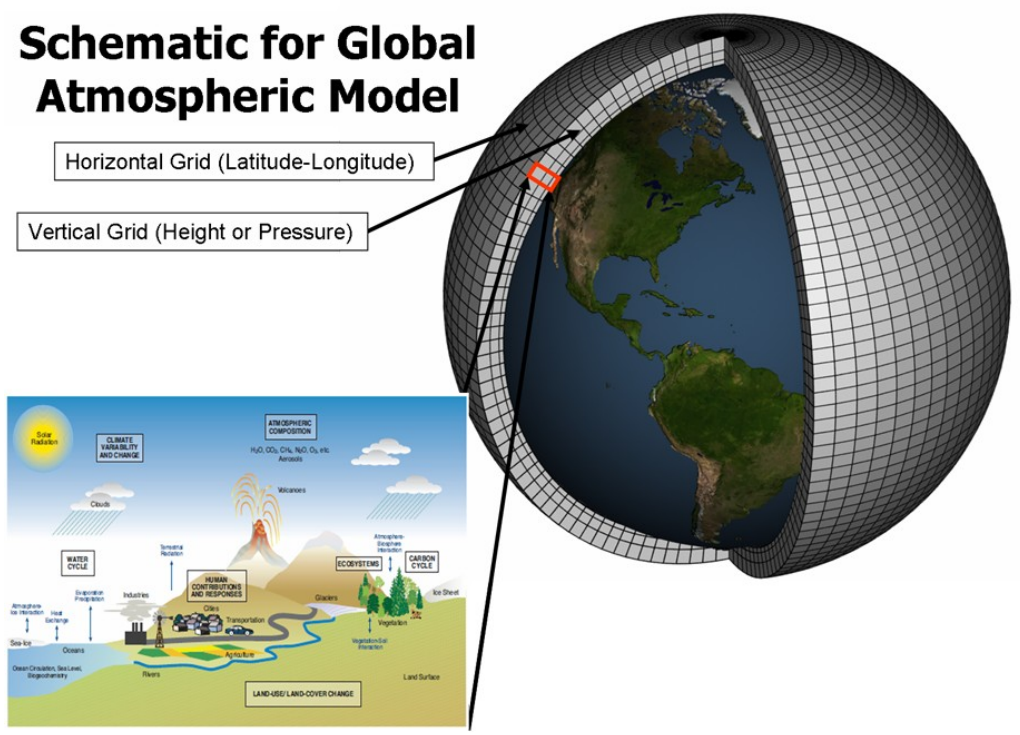
CMIP6 GCMs versus global surface temperatures

Prof. Nicola Scafetta

25 November, 2022

Global Warming



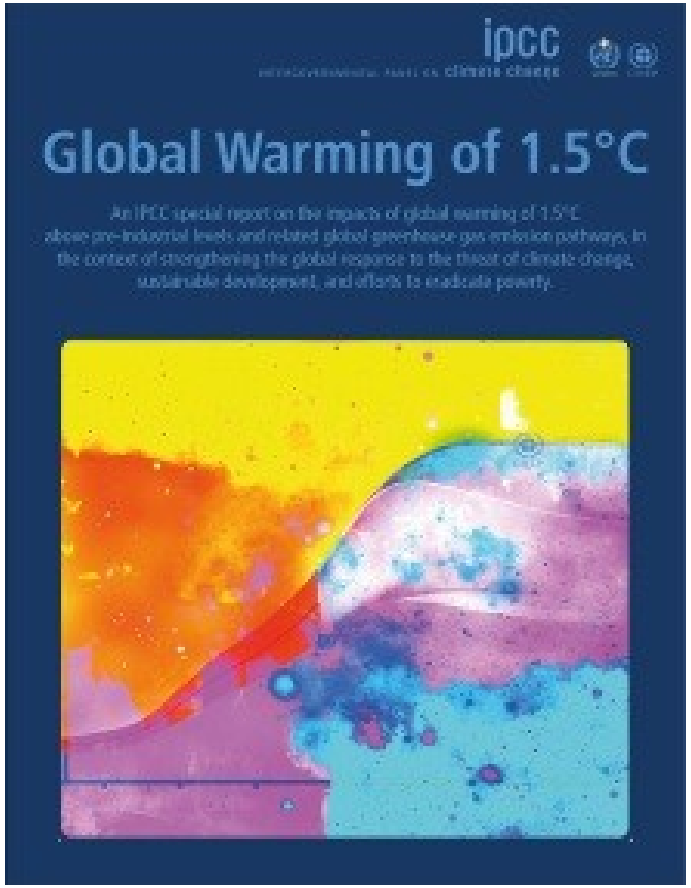


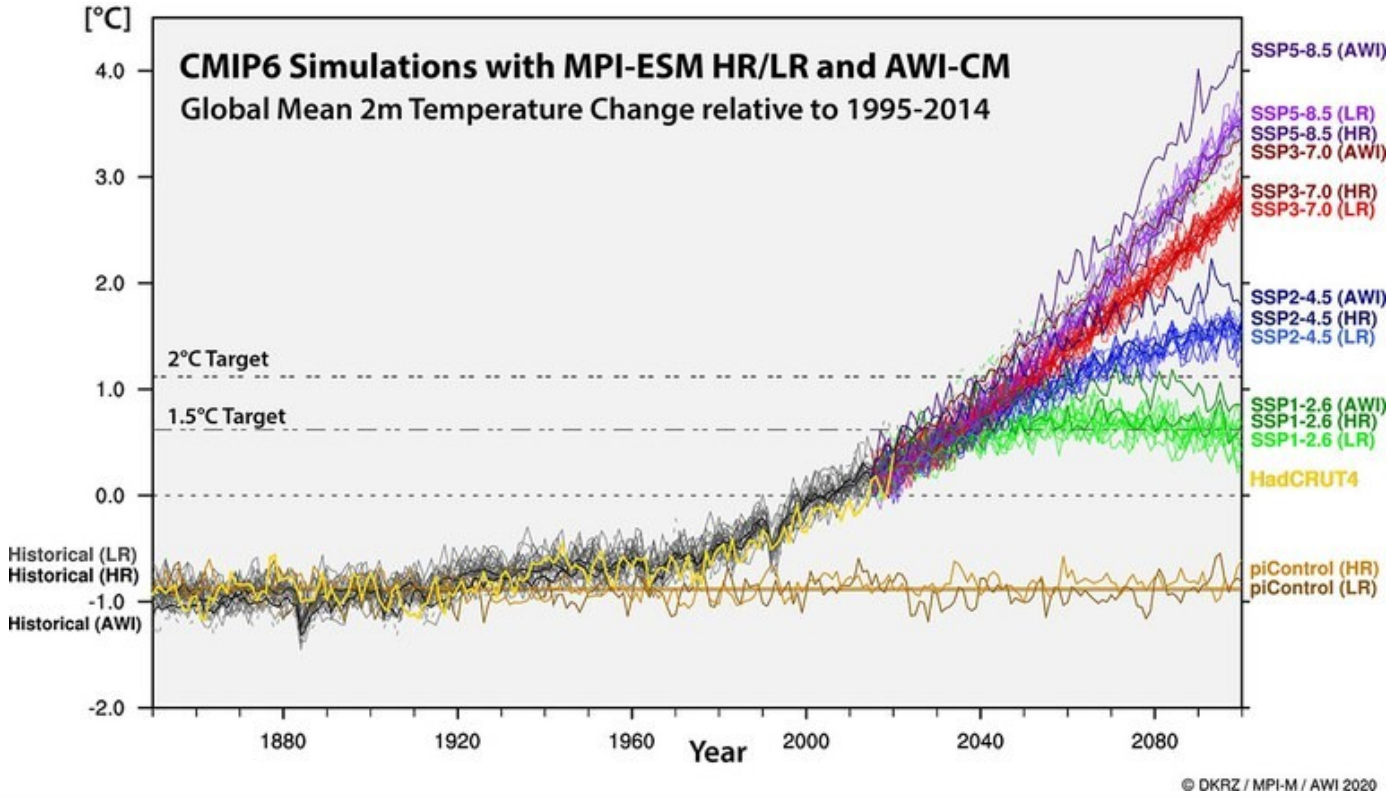
How the climatic variations of the Earth are studied

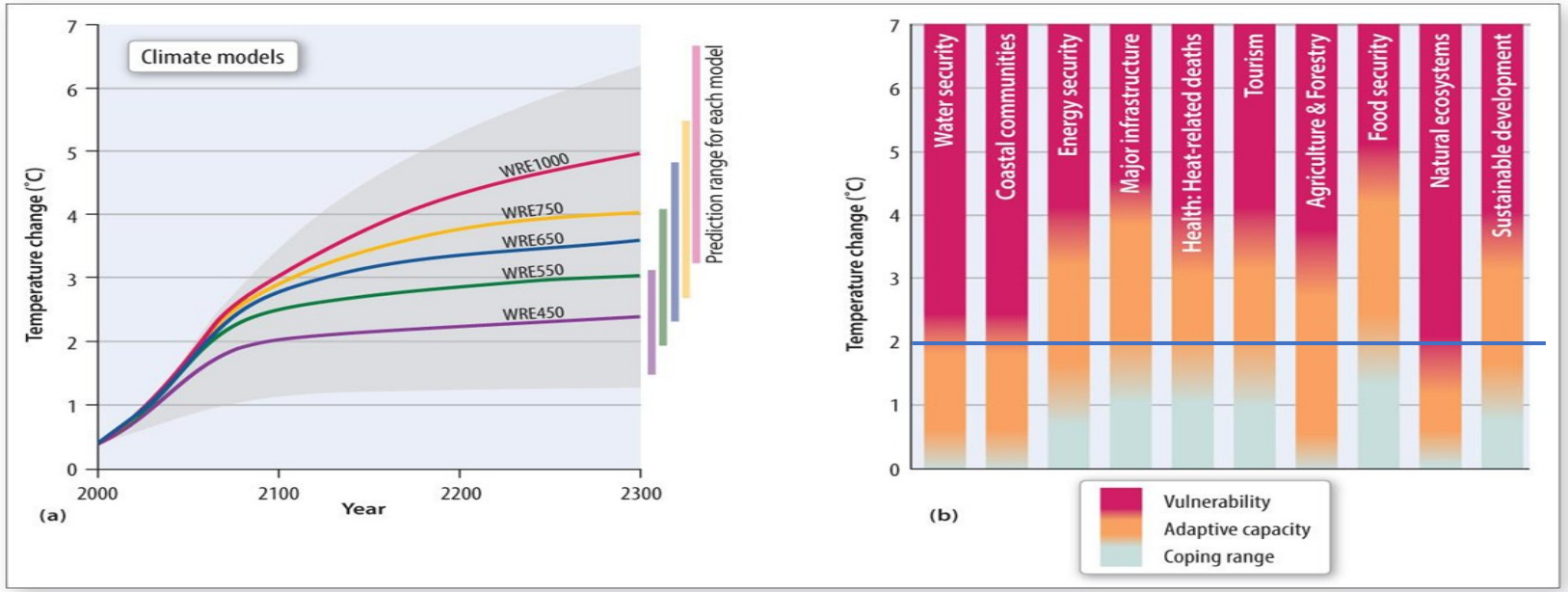
- Climate Models. Are they accurate?

IPCC SR1.5 (2018)

We need to limit the global warming to 1.5 – 2.0 °C





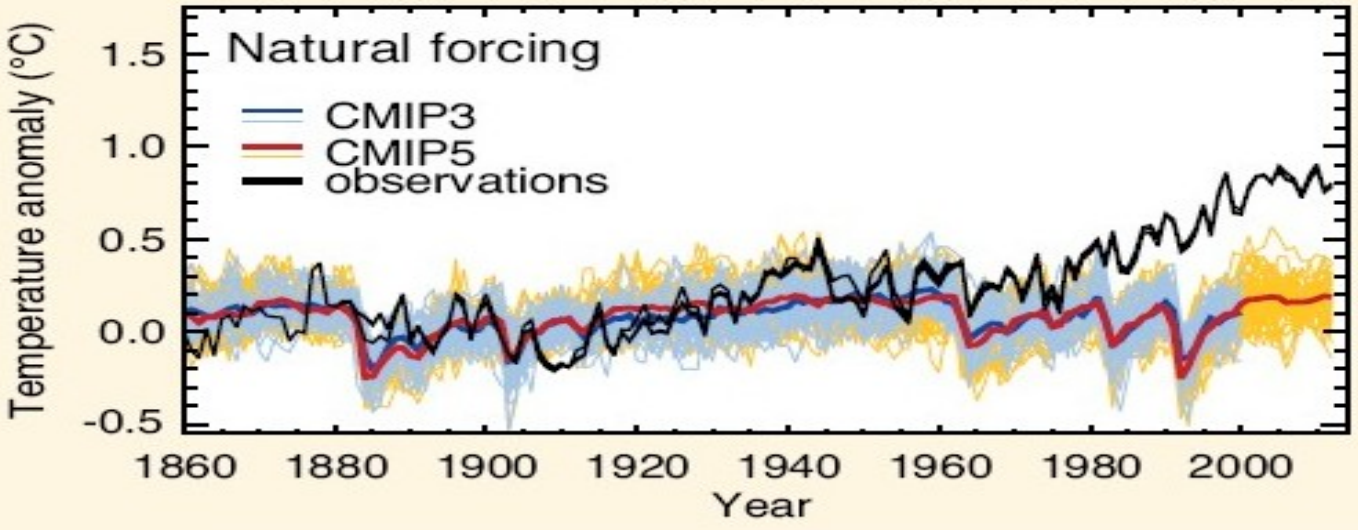


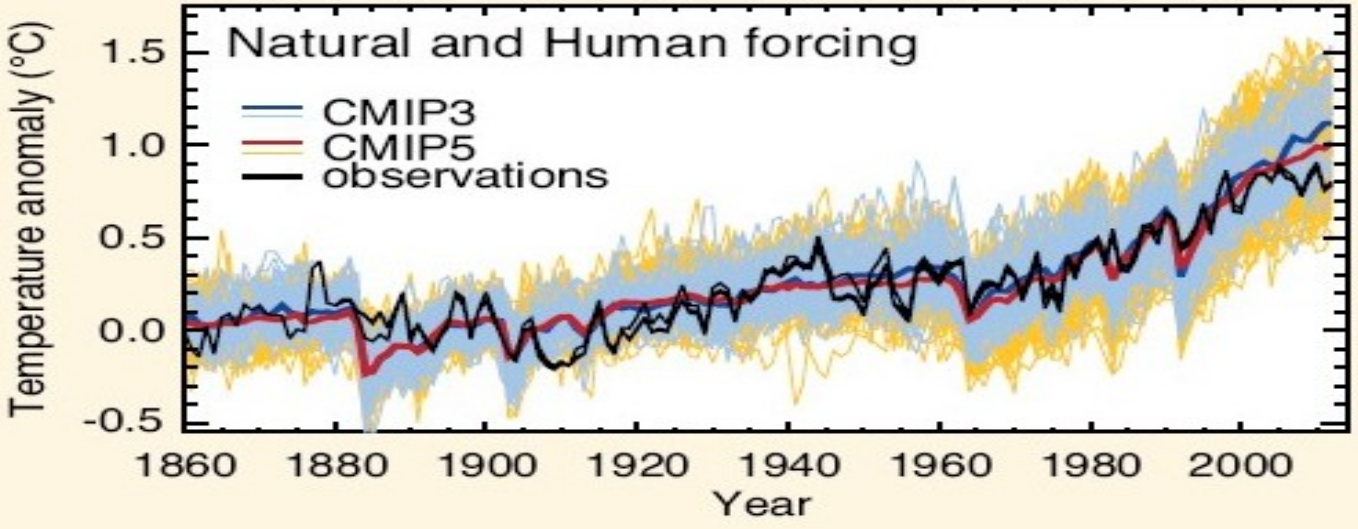
Open issues:

- Can we trust the climate models?
  - Issues regarding the model validations
  - Issues regarding the Equilibrium Climate Sensitivity
  - Issues regarding the Solar and other Climate Forcings
  - Issues regarding the Natural Climate Oscillations
- Can we trust the global surface temperature records?
  - Issues regarding the urban heat and other possible Surface Temperature Contaminations
  - Issues regarding the comparison between Satellites and Surface Measurements
  - Issues regarding the comparison between the Instrumental and Proxy temperature changes

The theory of anthropogenic warming of the IPCC:

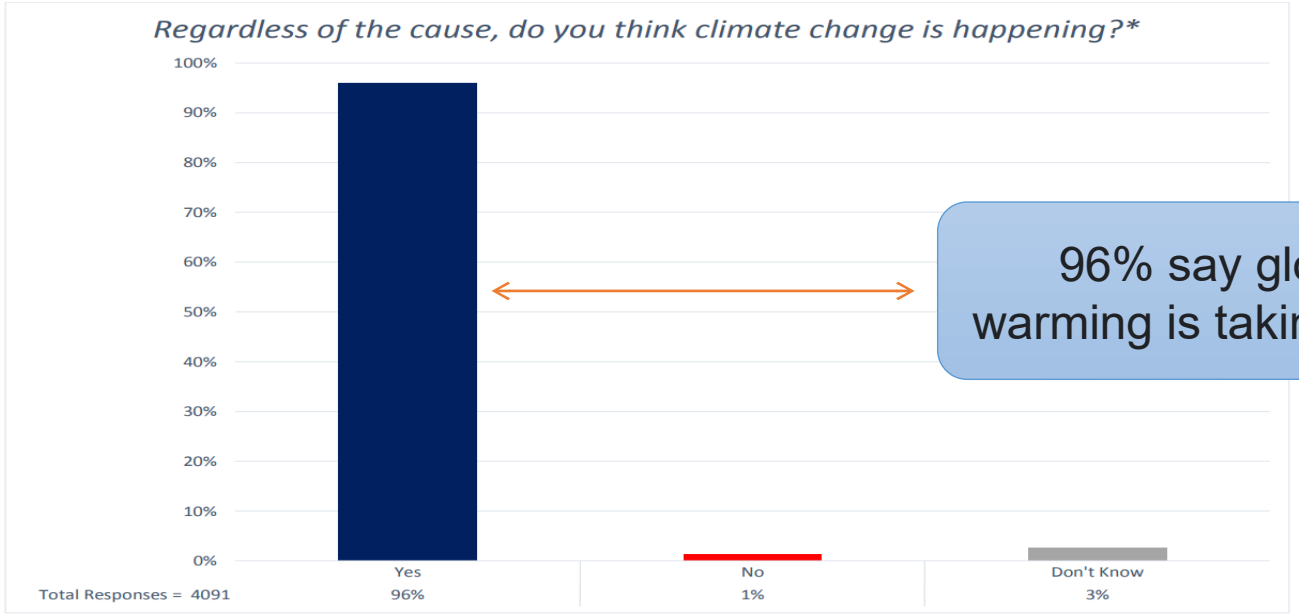
"100% of the global warming from 1850-1900 is anthropogenic"





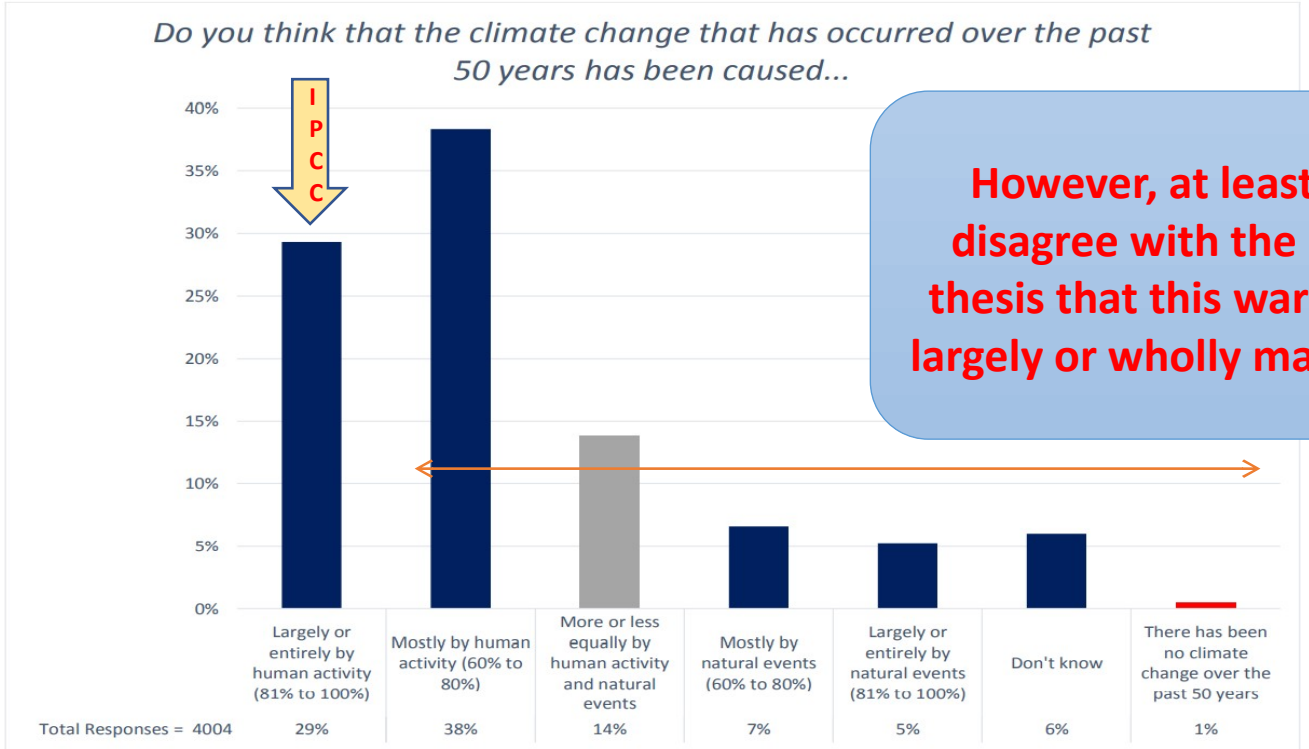
Without anthropogenic contribution, climate models do not reproduce any warming since 1850-1900

With the anthropogenic contribution, climate models reproduce the warming since 1850-1900

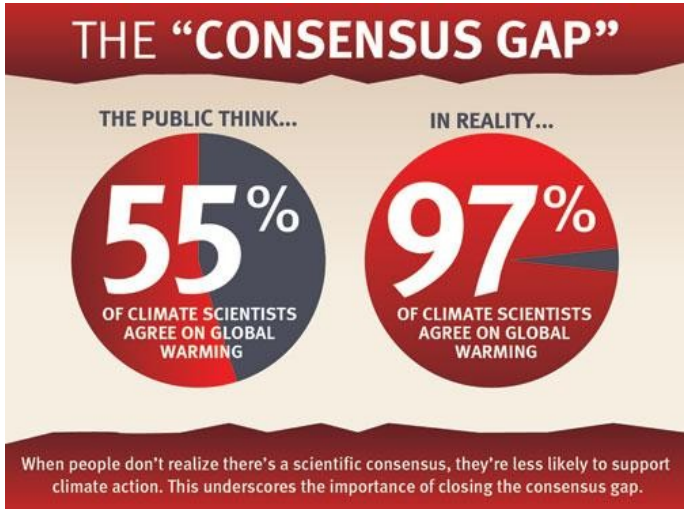


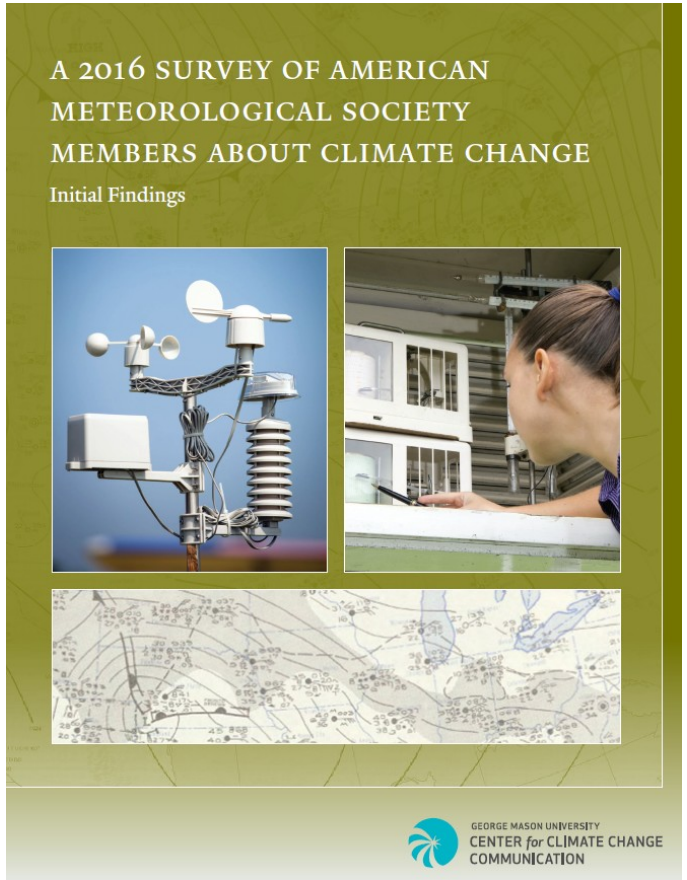
96% say global warming is taking place

*Question was preceded by this statement: "Please read the following information: The American Meteorological Society (AMS) defines climate change as: "Any systematic change in the long-term statistics of climate elements (such as temperature, pressure, or winds) sustained over several decades or longer. Climate change may be due to: natural external forcings, such as changes in solar emission or slow changes in the earth's orbital elements; natural internal processes of the climate system; or anthropogenic forcing."



However, at least 71% disagree with the IPCC's thesis that this warming is largely or wholly man-made

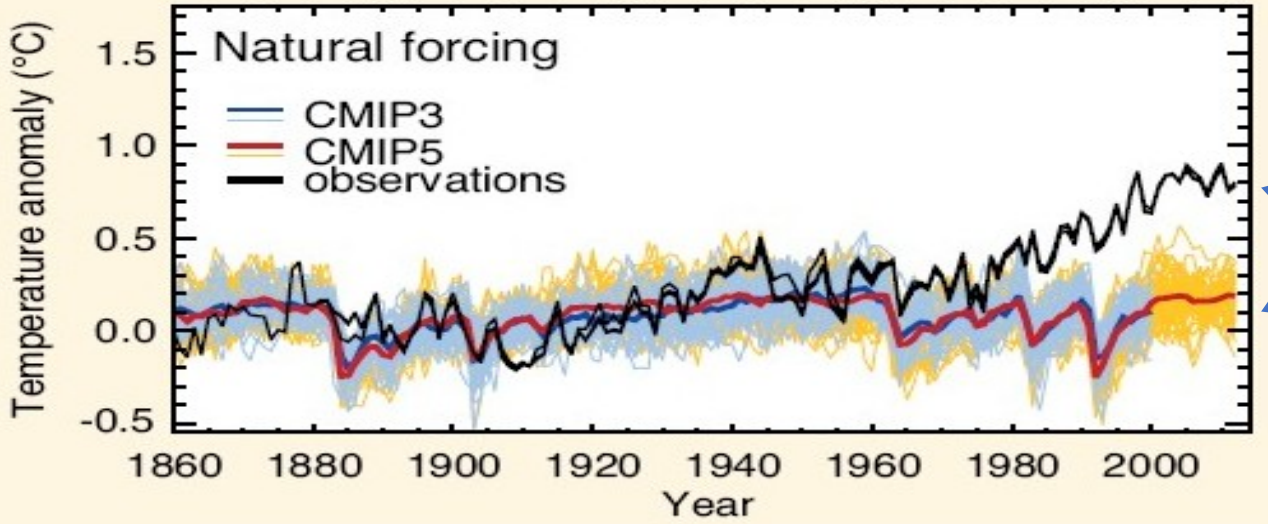


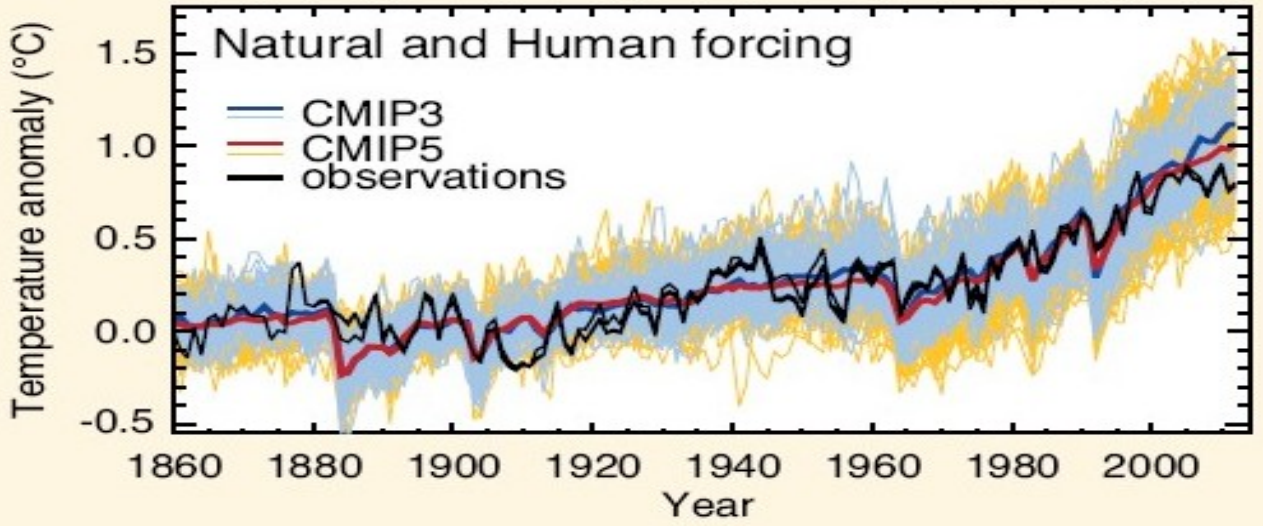


[A 2016 Survey of American Meteorological Society Members About Climate Change | Center For Climate Change Communication]

The theory of anthropogenic warming of the IPCC:

"100% of the global warming from 1850-1900 is anthropogenic"





Violation of the scientific method

The experimental data do not match the predictions of the model

Therefore, this "good" result could be a coincidence due to a careful calibration of the parameters inside the model to reproduce the trend of the data with the forcings used.

Humans are solely responsible for global warming

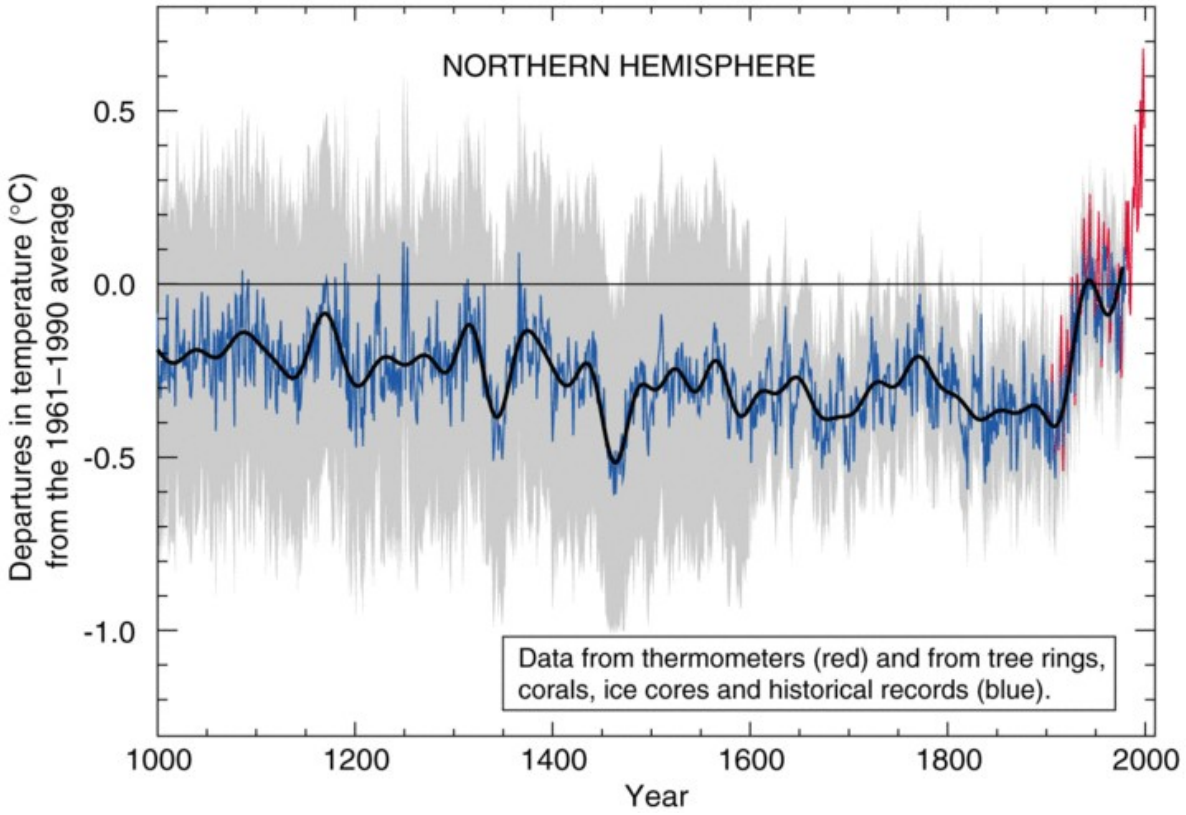


Figure 1: «Hockey Stick»

CLIMATE CHANGE 2001
The Scientific Basis

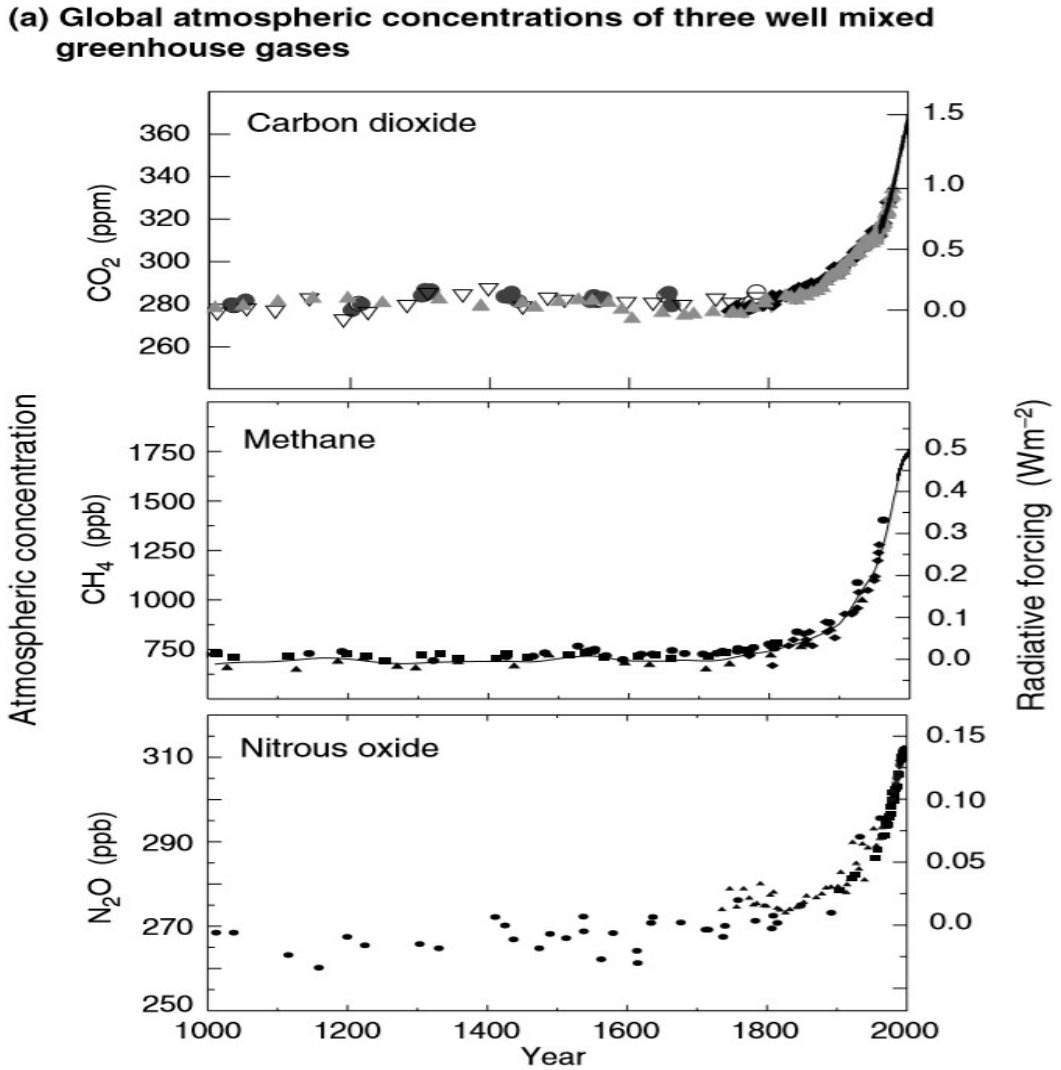
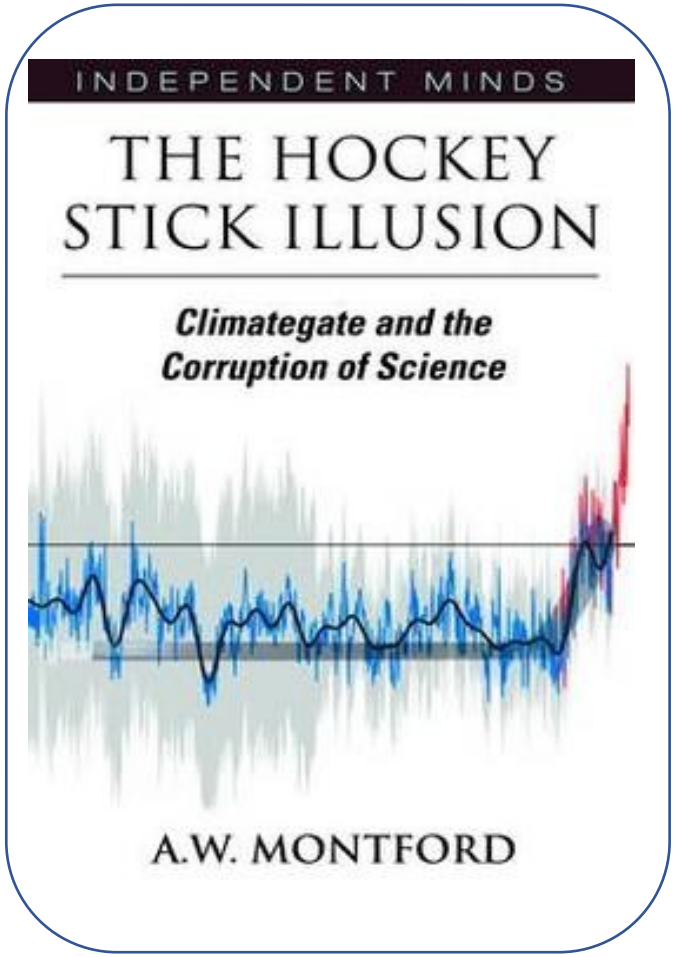
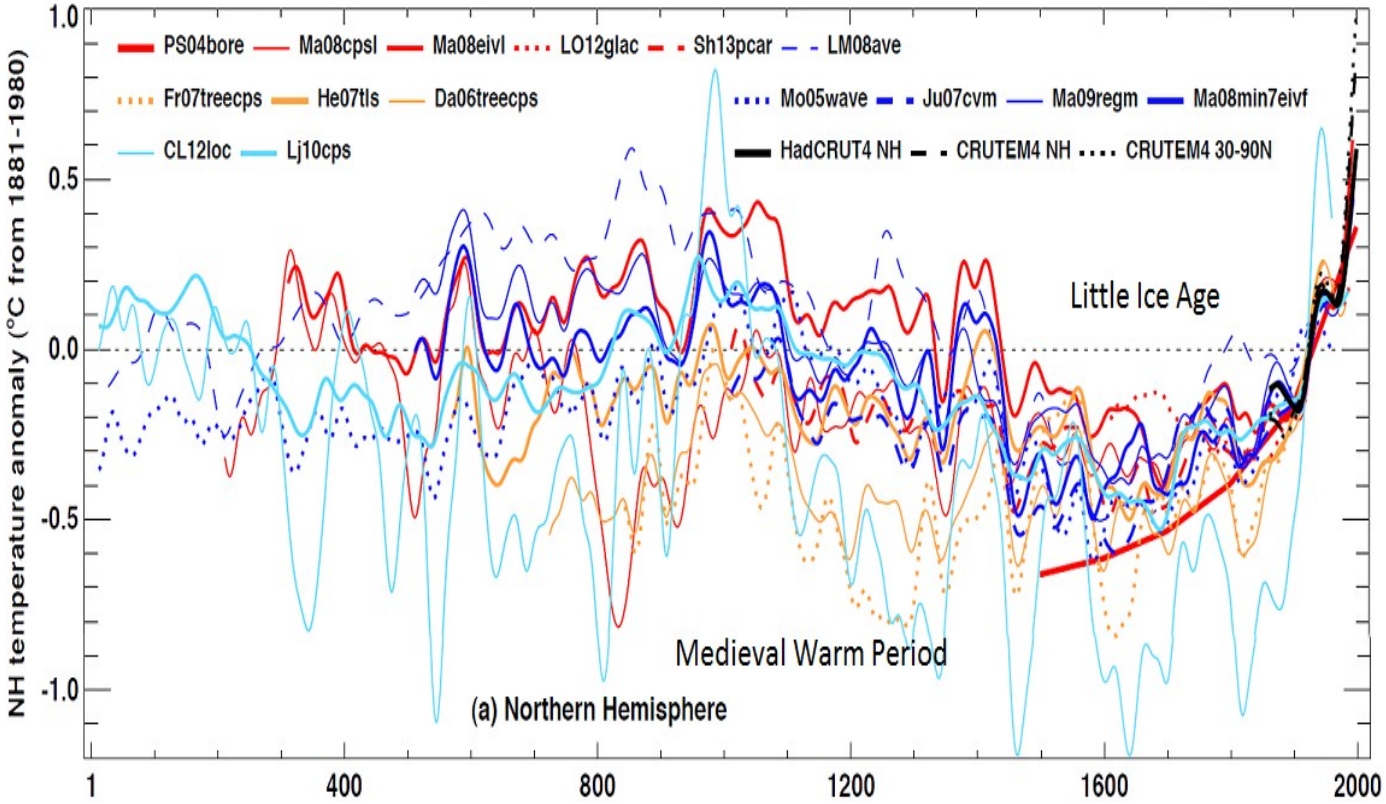


Figure 2: «Hockey Stick»

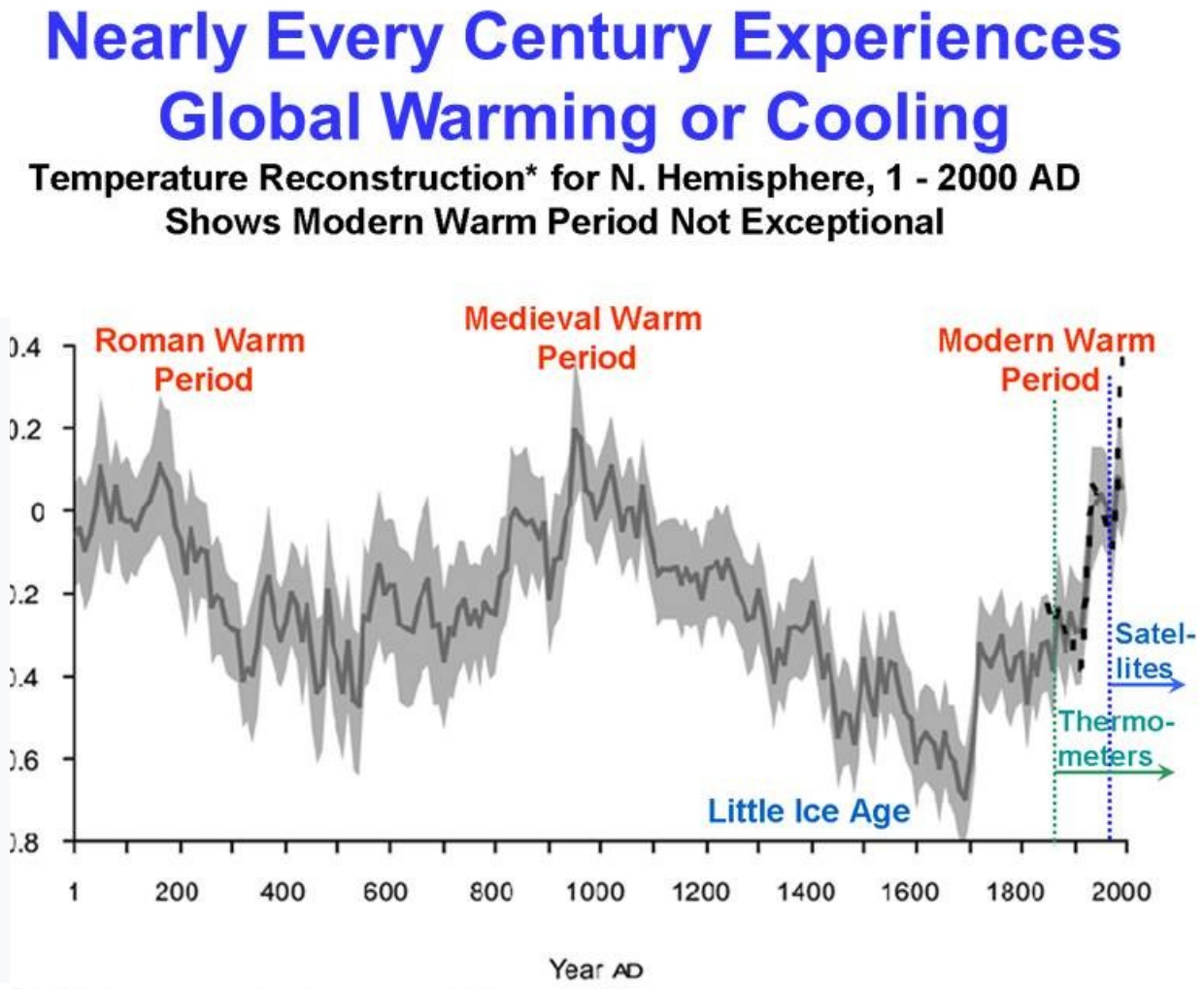
The IPCC used the “Hockey Stick” it in 2001 and 2007 and then abandoned it in 2013.



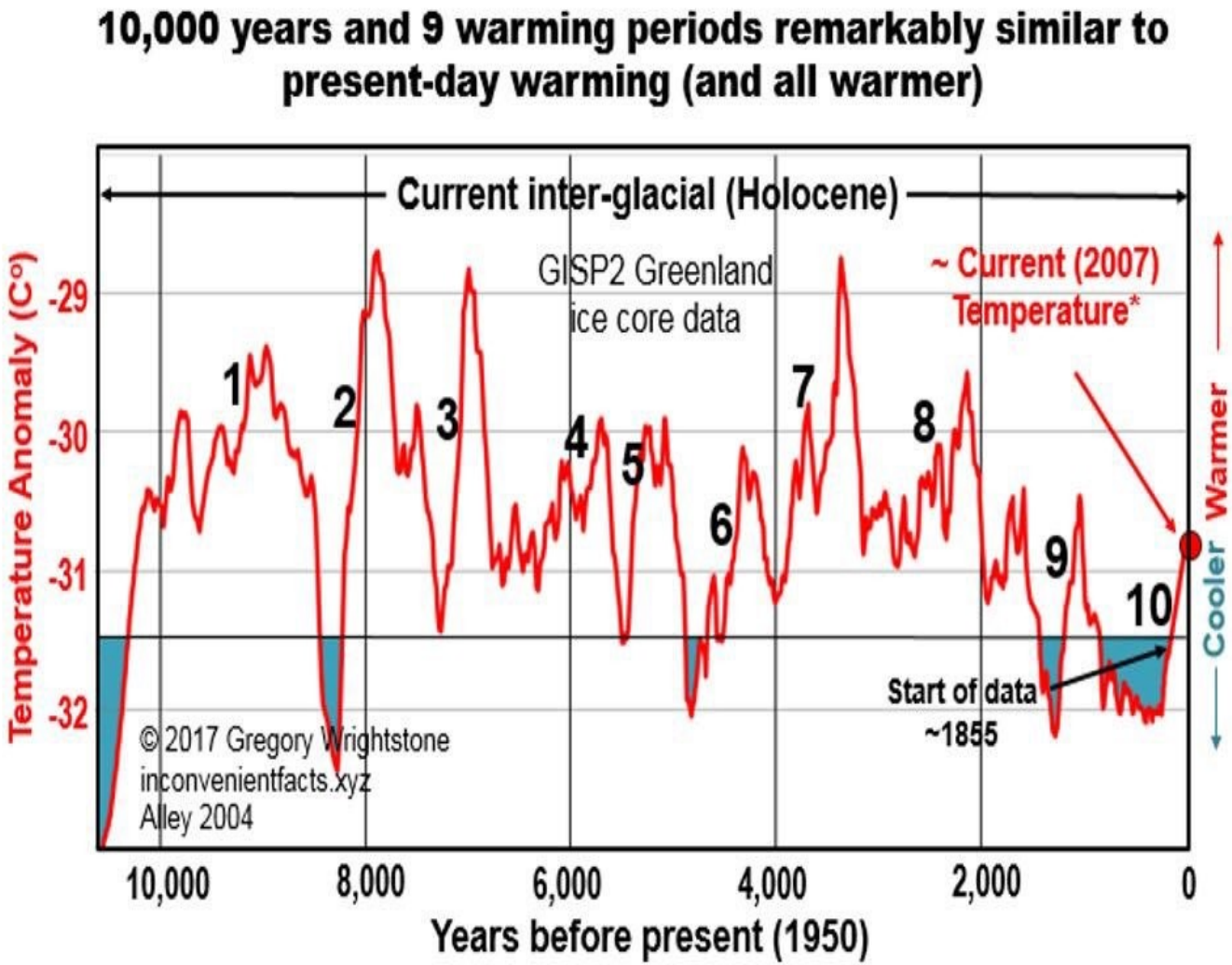


Steve McIntyre and Ross McKitrick (Energy & Environment ,Vol. 14, No. 6 (2003), pp. 751-771) **dimostrano** gli errori nell'*Hockey Stick* di Mann et al. (1998, 1999, ecc.)

We see one of the modern reconstructions
The "Hockey Stick" disappears
A great Millennial Cycle appears

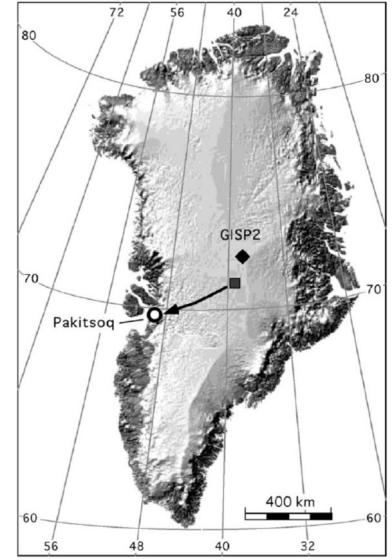


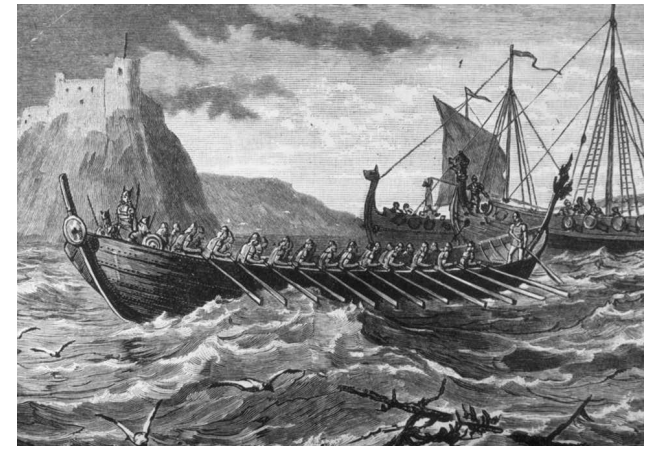
*Ljungqvist, F.C. 2010. A new reconstruction of temperature variability in the extra-tropical Northern Hemisphere during the last two millennia. Geografiska Annaler: Physical Geography, Vol. 92 A(3), pp. 339-351, September 2010. DOI: 10.1111/j.1468-0459.2010.00399.x



Alley, R.B.. 2004. GISP2 Ice Core Temperature and Accumulation Data. IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series #2004-013. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA.

Current Temp: Box JE, Yang L, Bromwich DH, Bai L (2009) Greenland Ice Sheet Surface Air Temperature Variability: 1840–2007. American Meteorological Society, Journal of Climate Vol 22, pp 4029 - 4049





RESEARCH ARTICLE | FEBRUARY 06, 2019

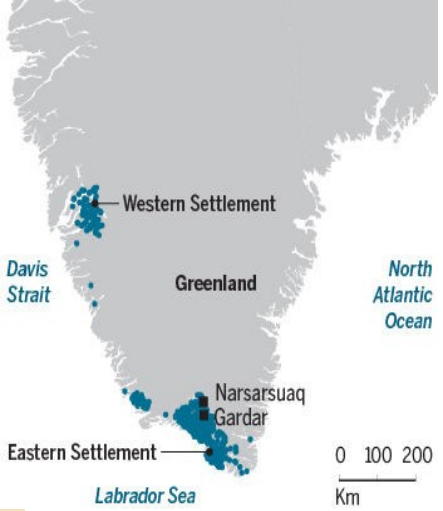
Medieval warmth confirmed at the Norse Eastern Settlement in Greenland

G. Everett Lasher; Yarrow Axford

Geology (2019) 47 (3): 267-270.

https://doi.org/10.1130/G45833.1 Article history

The Vikings in Greenland



https://ancientfoods.wordpress.com/2012/02/17/viking-barley-in-greenland/

Each grain of barley is only a couple of millimetres long, and the grain weighs less than 0.01 mg – yet the find is now regarded as an archaeological sensation.
Photos: Peter Steen Henriksen

Evidence suggests Vikings grew barley in south Greenland

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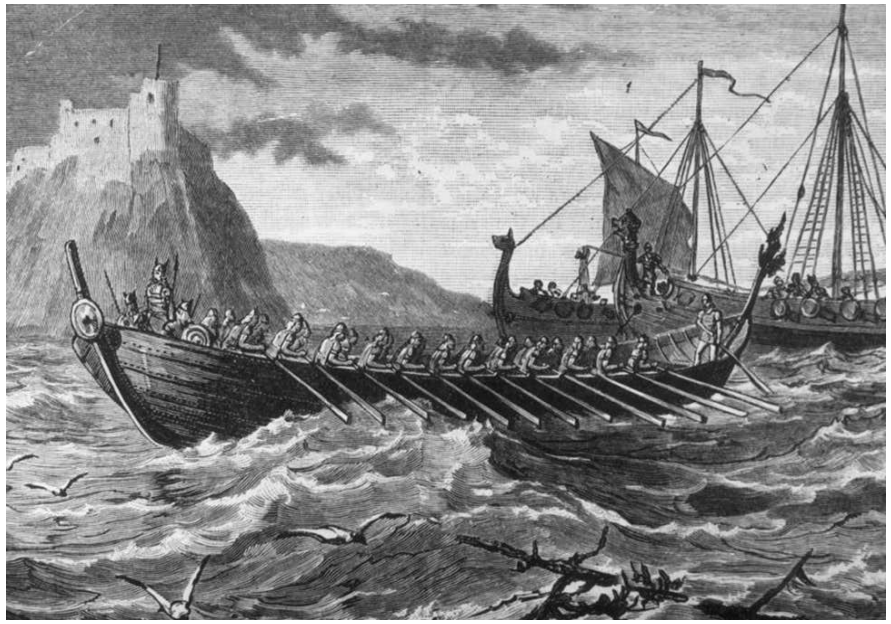
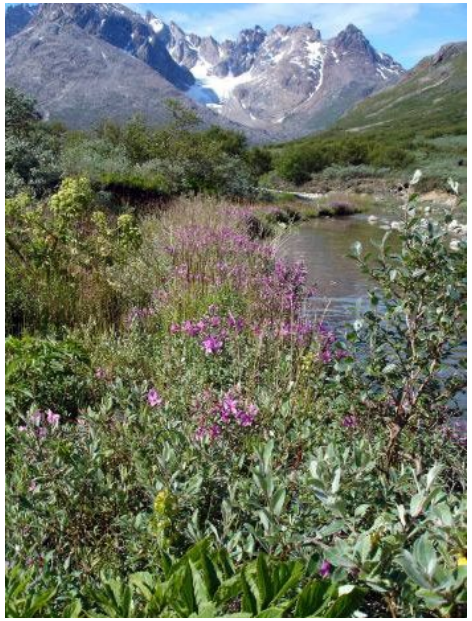
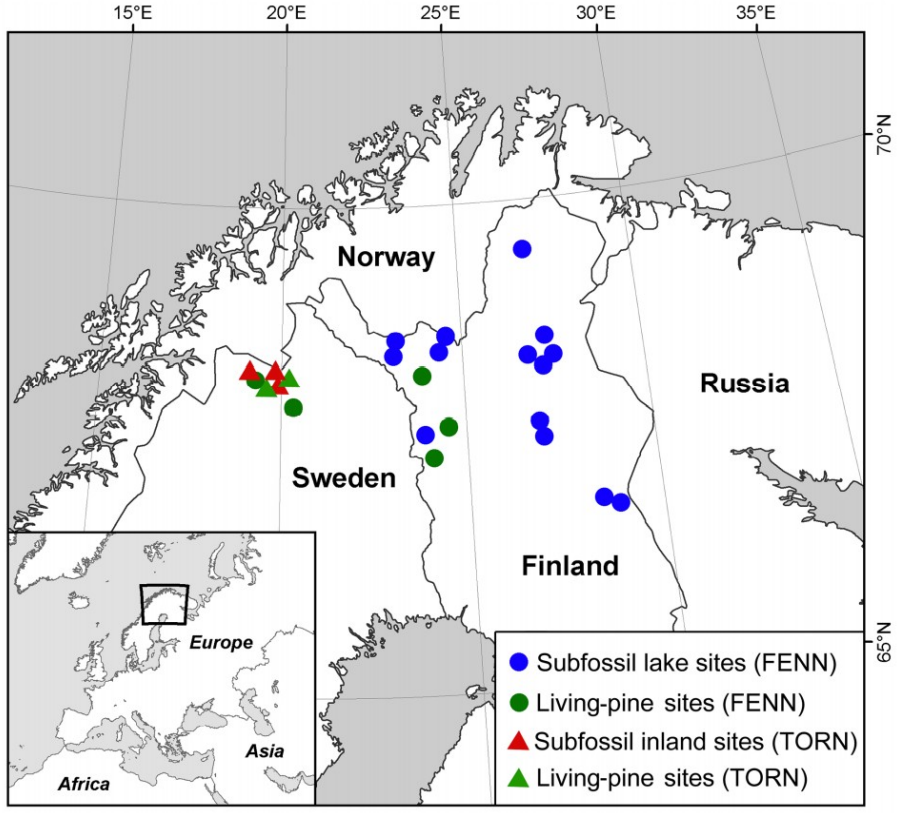
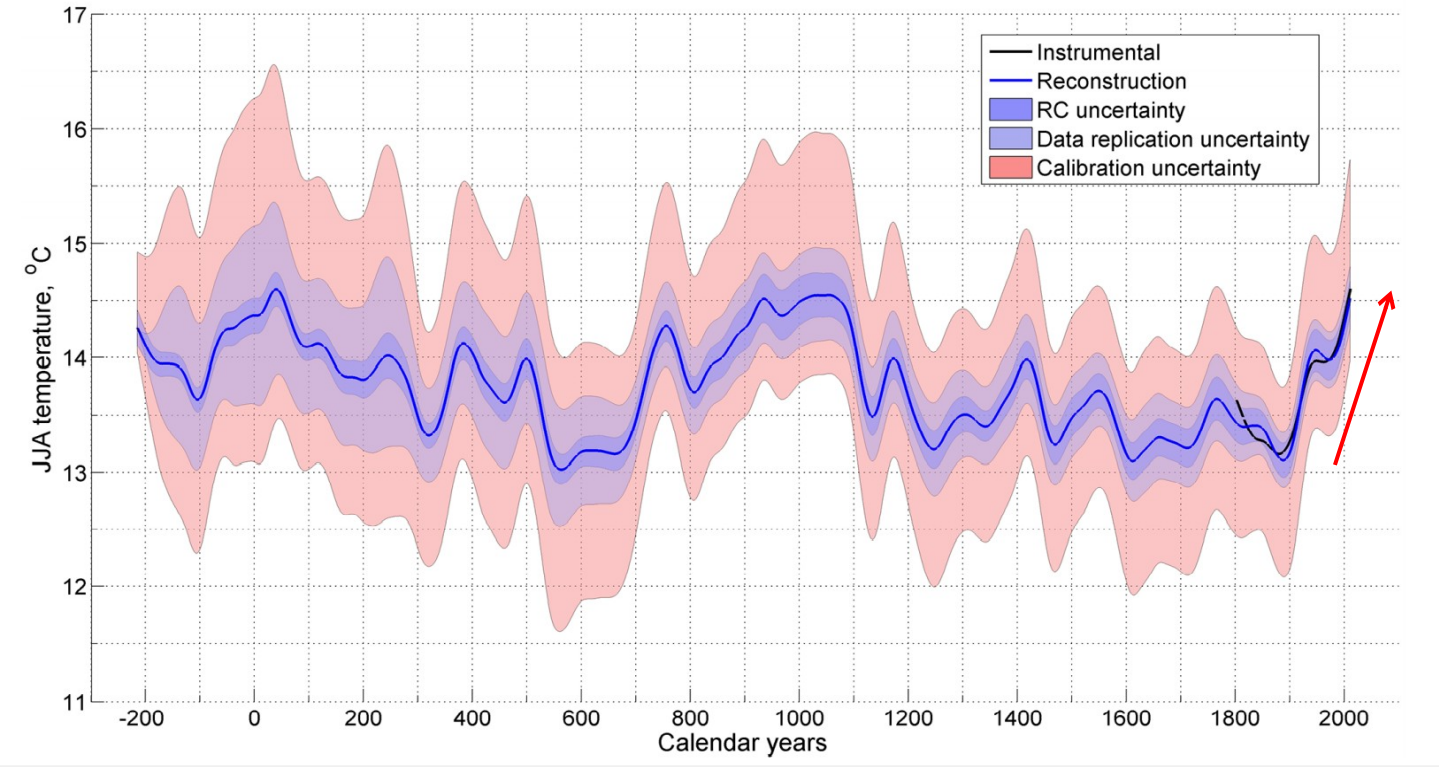




The Qinngua valley

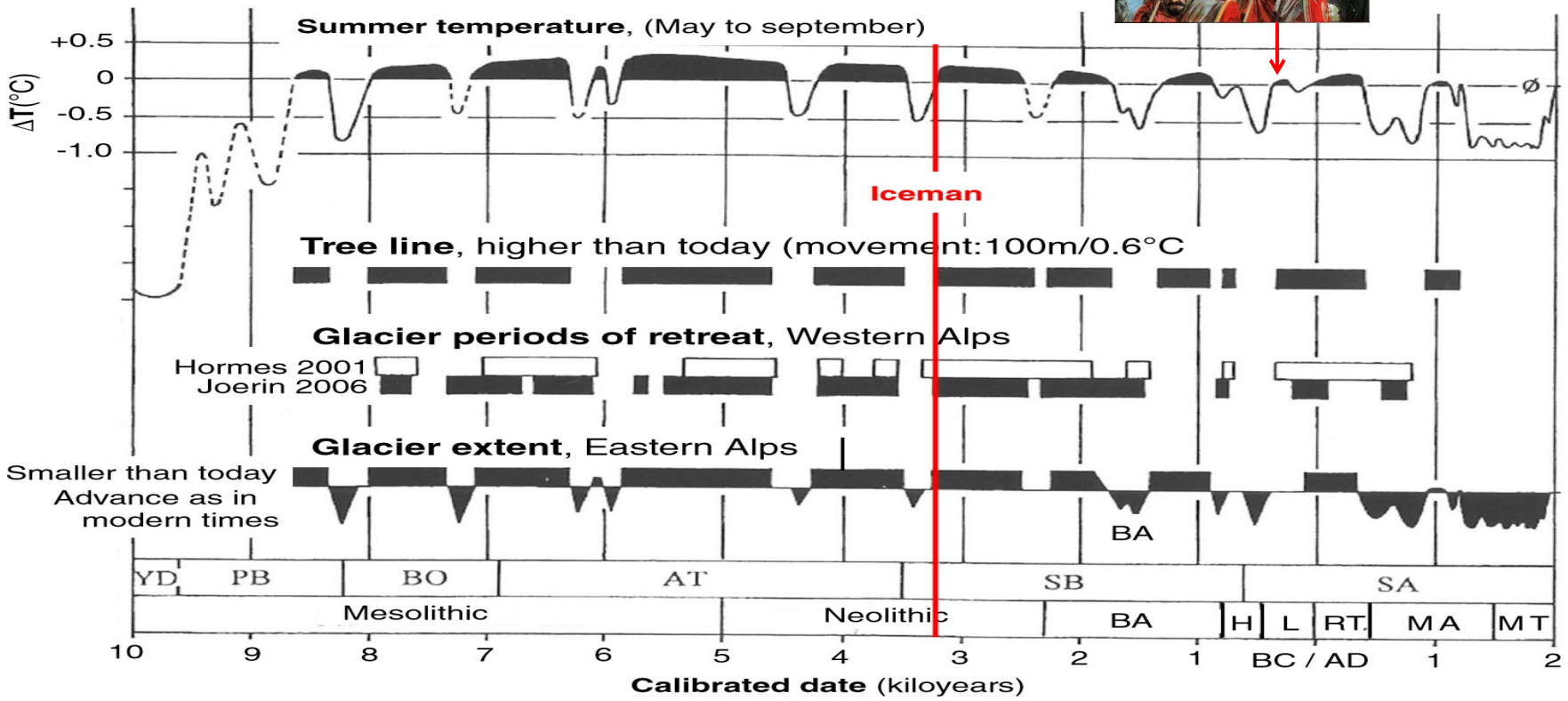




Matskovsky, V.V.; Helama, S.
Testing long-term summer temperature reconstruction based on maximum density chronologies obtained by reanalysis of tree-ring data sets from northernmost Sweden and Finland. Clim. Past **2014**, 10, 1473–1487.

A quasi-millennial oscillation in the Summer temperatures in the European Alps throughout the Holocene

Annibale



Kutschera, W., Patzelt, G., Steier, P., Wild, E.M.: 2017. The tyrolean iceman and his glacial environment during the holocene. Radiocarbon 59(2), pp. 395-405

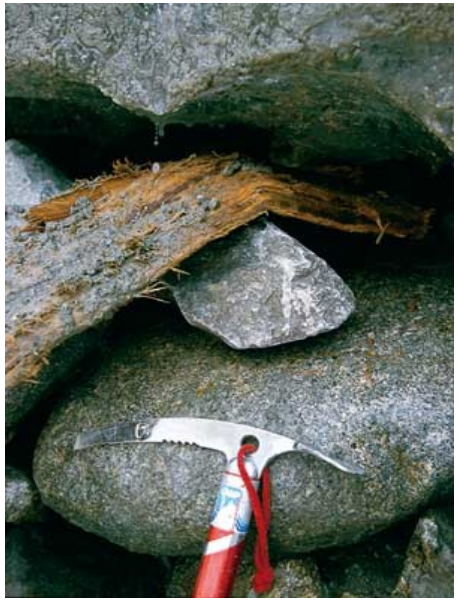
Figure 7 Schematic presentation of glacier and tree-line movements during the Holocene. The periods of smaller glaciers and higher tree lines are indicated with the box symbols. Glacial advances are indicated with filled triangles and curves. The largest advances took place during the Little Ice Age (~AD 1300 to 1850). The top curve depicts the relative summer temperature variations deduced mainly from the tree-line movement. The mean temperature between AD 1900 and 2000 is used as the zero-degree reference. The red vertical line marks the time of the Iceman (see Figure 1). At the bottom of the figure, the paleoclimatic periods (YD = Younger Dryas; PB = Preboreal; BO = Boreal; AT = Atlantic; SB = Subboreal; SA = Subatlantic) and the archaeological periods (BA = Bronze Age; H = Hallstatt period; L = La Tène period; L + H = Iron Age; RT = Roman times; MA = Middle Ages; MT = modern times) are indicated.

Trees under the glacials

Melting glaciers in Western Canada are revealing tree stumps up to 7,000 years old where the region's rivers of ice have retreated to a historic minimum, a geologist said today.

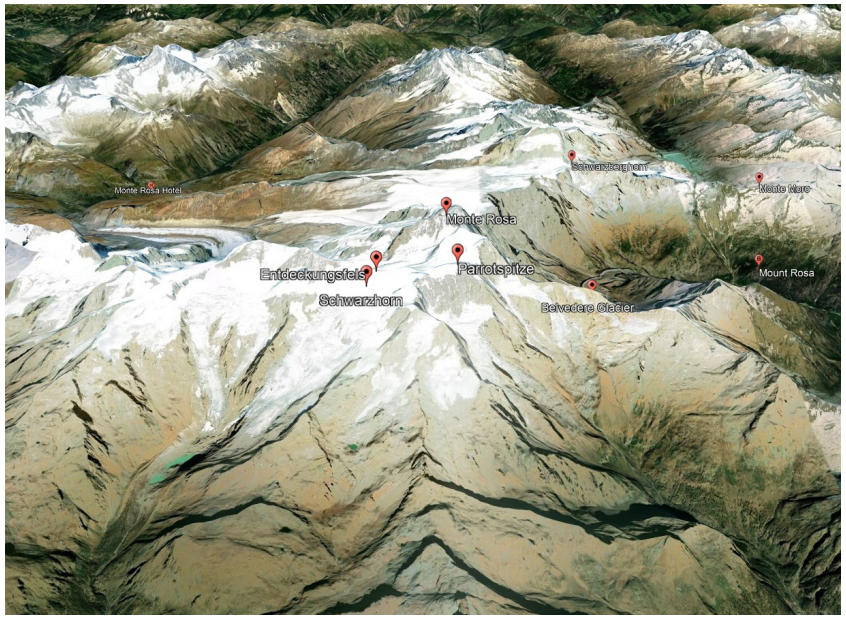
Glacier-buried forests from ~1000 years ago uncover a warm Medieval period

Figure 2. Students learn how scientists combine living and dead trees to create millennial-length records of temperature, such as the buried forests emerging here from the wasting margin of Mendenhall Glacier (Credit: Jesse Wiles). Davi et al., 2019



Christian Schlüchter: "Alpen ohne Gletscher? Holz- und Torffunde als Klimaindikatoren", Die Alpen, 6/2004; The Alps with little ice: evidence for eight Holocene phases of reduced glacier extent in the Central Alps, The Holocene, 2001, 11/3: 255-265

The Susten Pass (Switzerland) as it is today (above) and as it probably was in Roman times, 2000 years ago green and with different woods (below). (Die Alpen / Atelier Thomas Richner based on a draft from Christoph Schlüchter).



Marmot at 4,300 meters on Monte Rosa, dating back to 6,600 years ago

Found on east face of the Lyskamm, sample sent to the USA

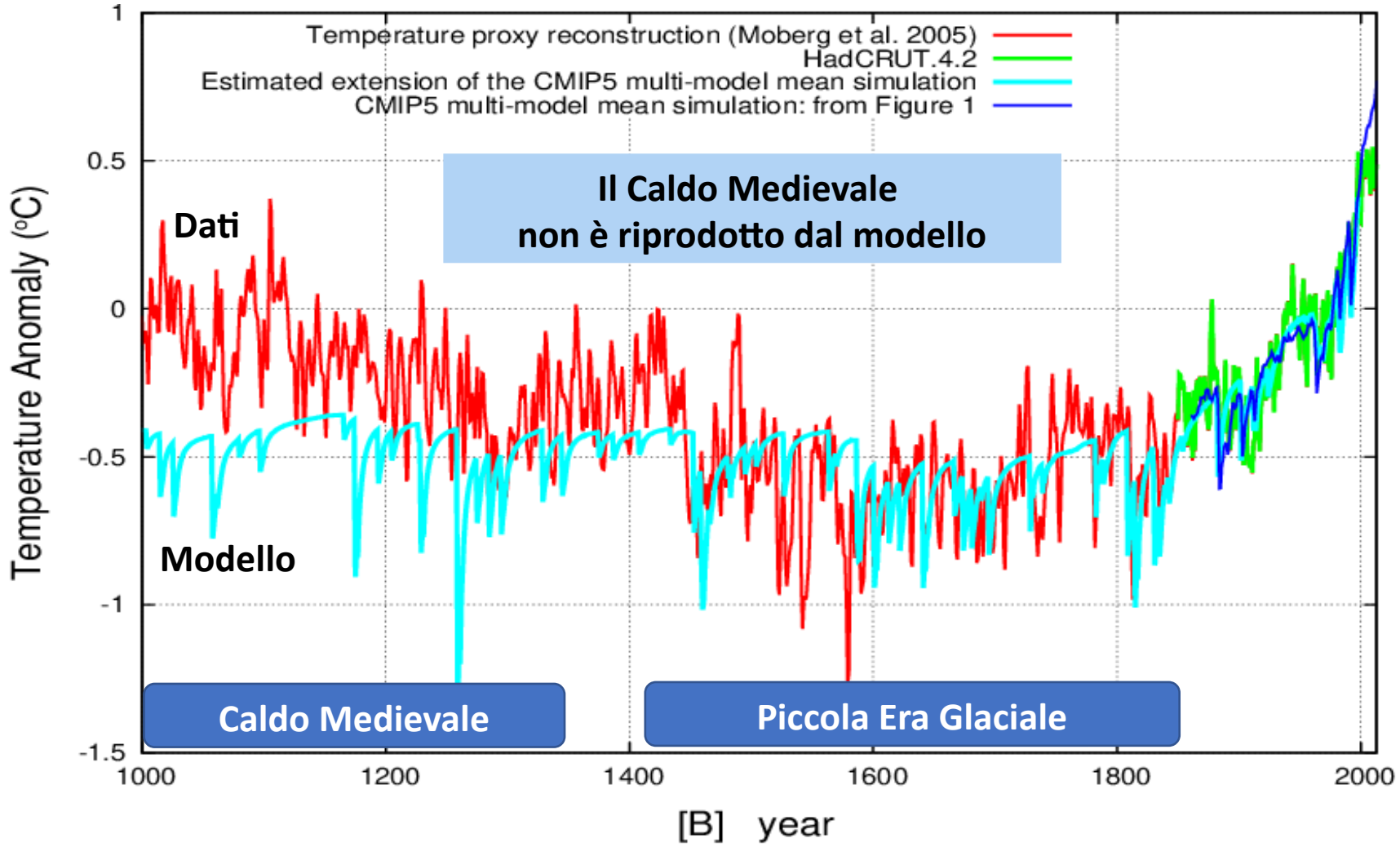
ANSA Editorial Staff
AOSTA

October 14, 2022
16:42
NEWS

The marmot found 'mummified' on Monte Rosa in recent months is a Neolithic specimen that lived 6,600 years ago.

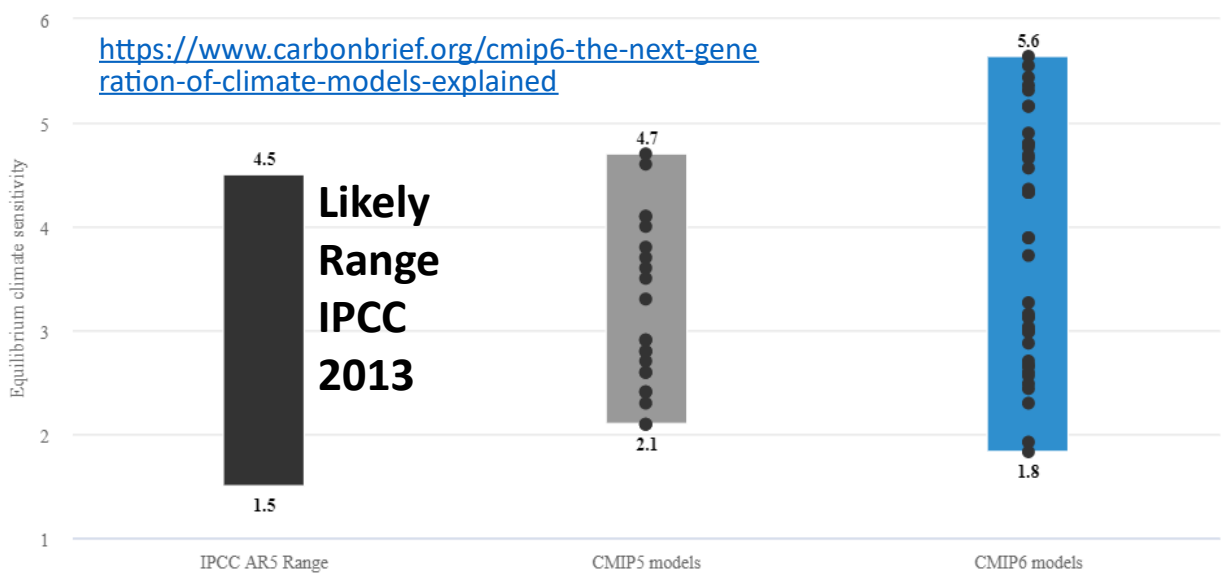
Comparison between a simulation of the IPCC Models (light blue and blue) vs the Temperatures (red and green)

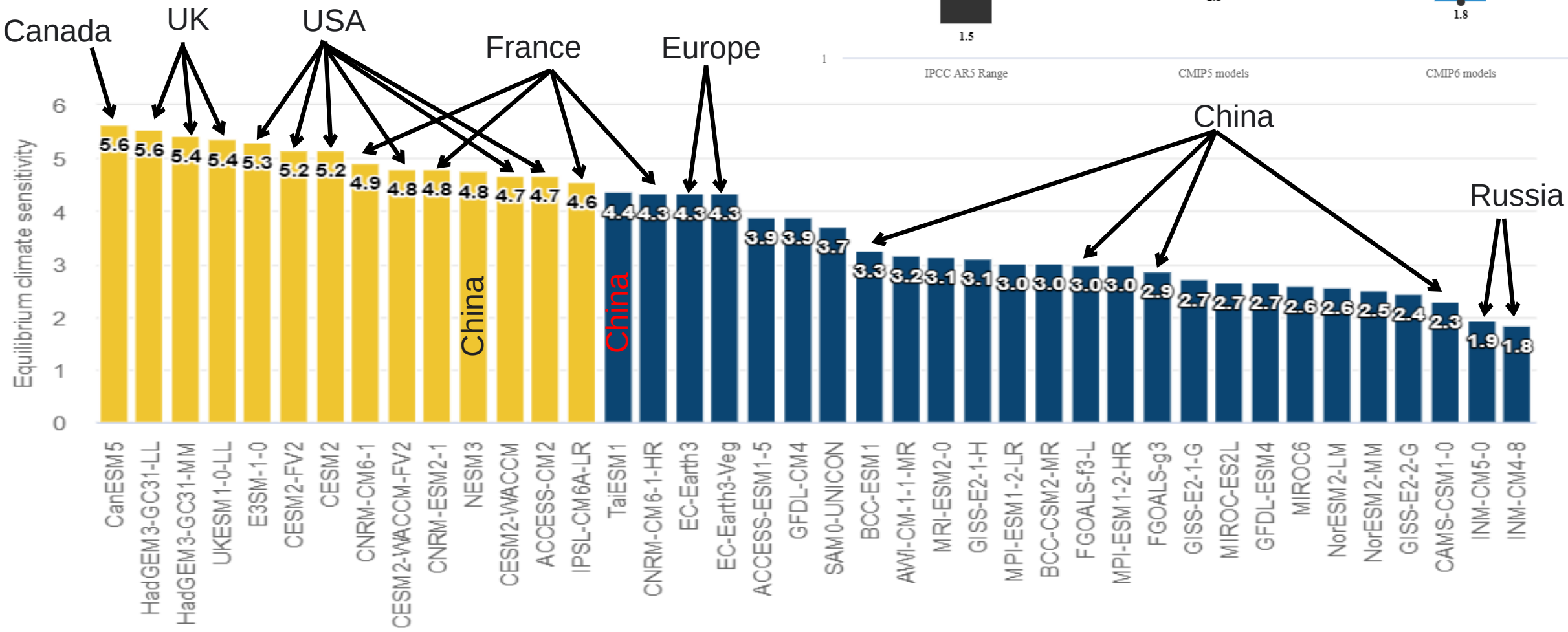
Scafetta, N. Reconstruction of the Interannual to Millennial Scale Patterns of the Global Surface Temperature. Atmosphere 2021, 12, 147. https://doi.org/10.3390/atmos12020147

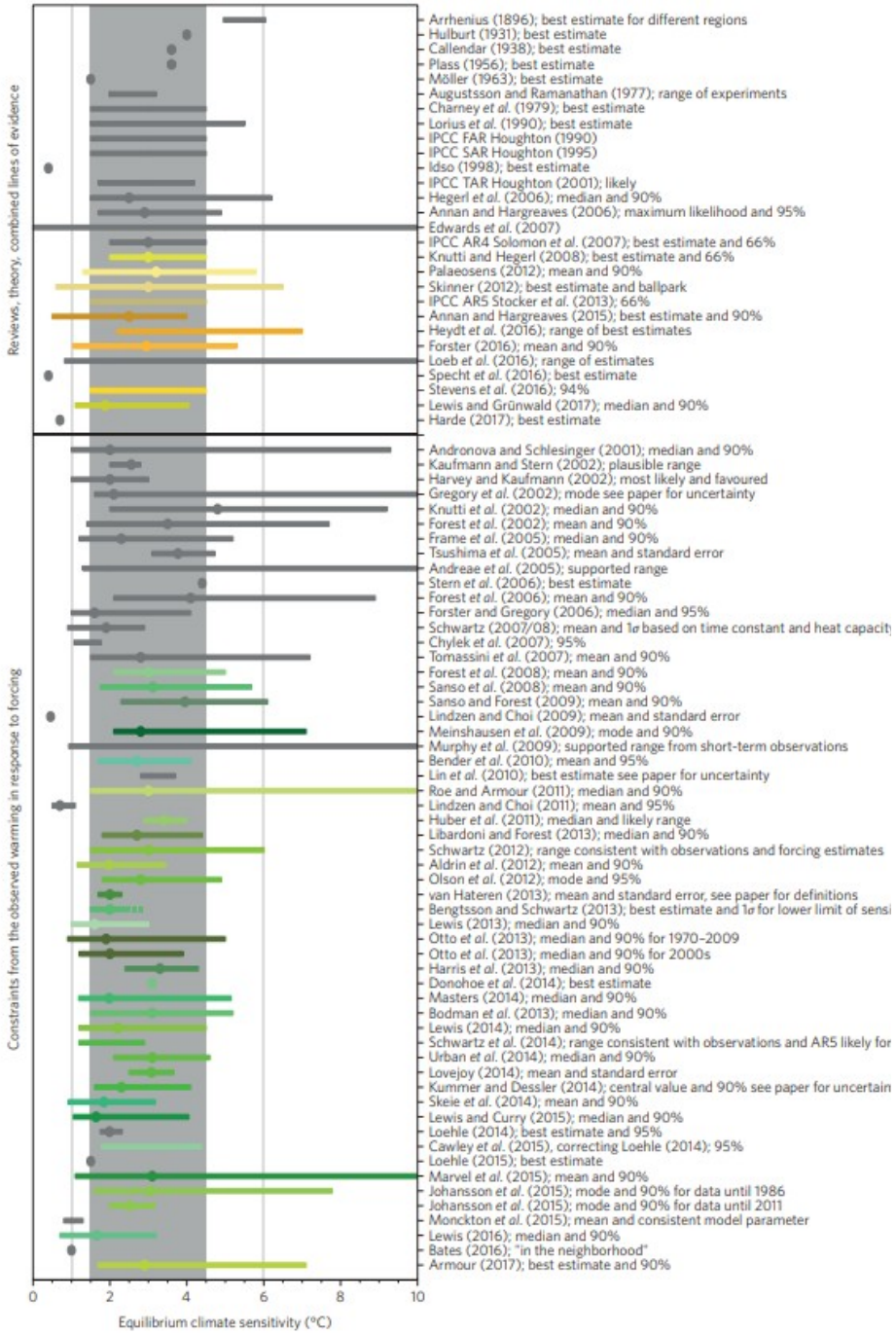


Global Climate Models (CMIP6) and the Equilibrium Climate Sensitivity (ECS)

ECS is an estimate of the eventual steady-state **global warming** at double CO_2.







re 2 | Overview of published best estimates and ranges for equilibrium climate sensitivity constrained by different lines of evi

NATURE GEOSCIENCE DOI: 10.1038/NGEO3017

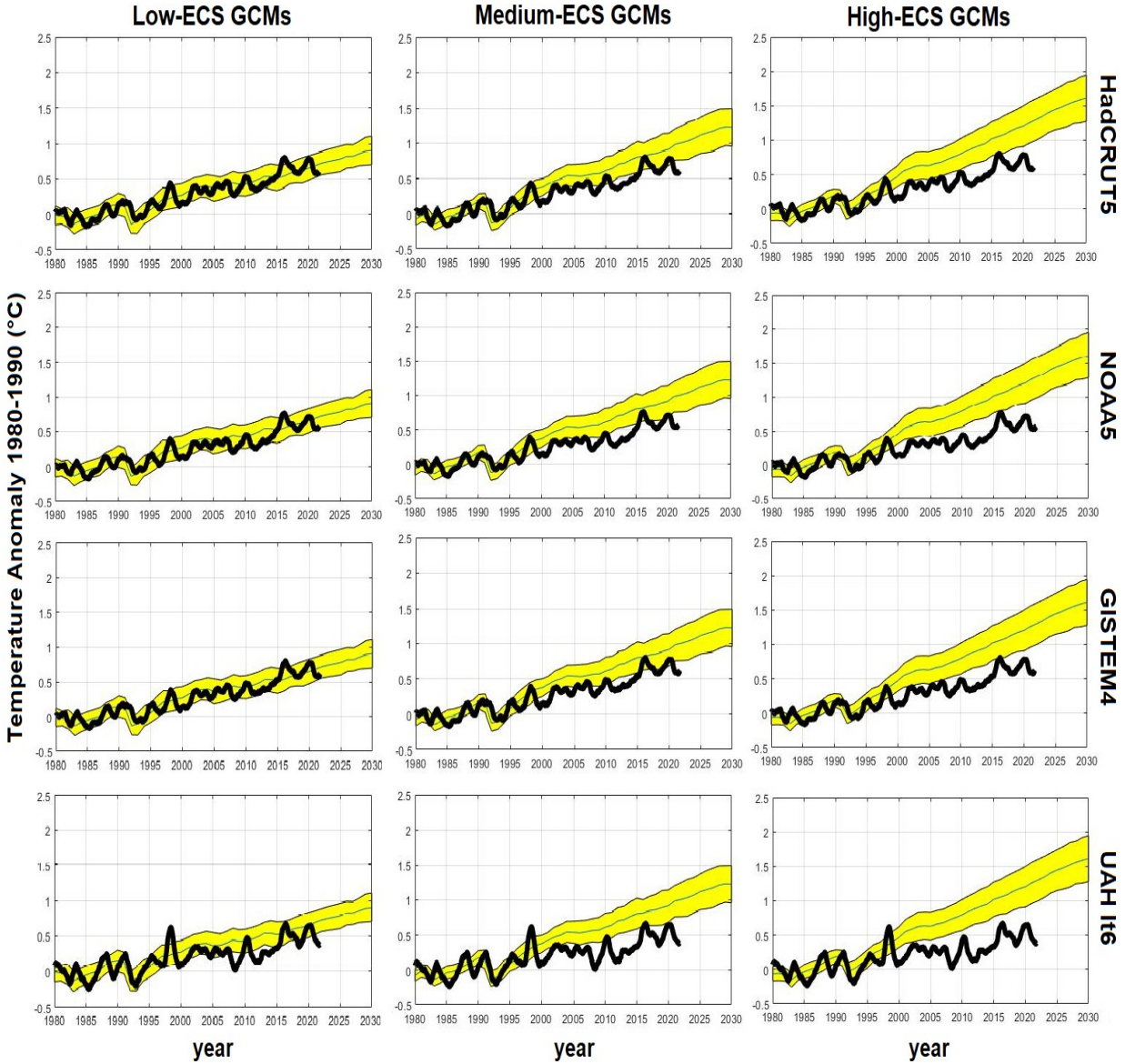
Discrepancy and lack of progress?

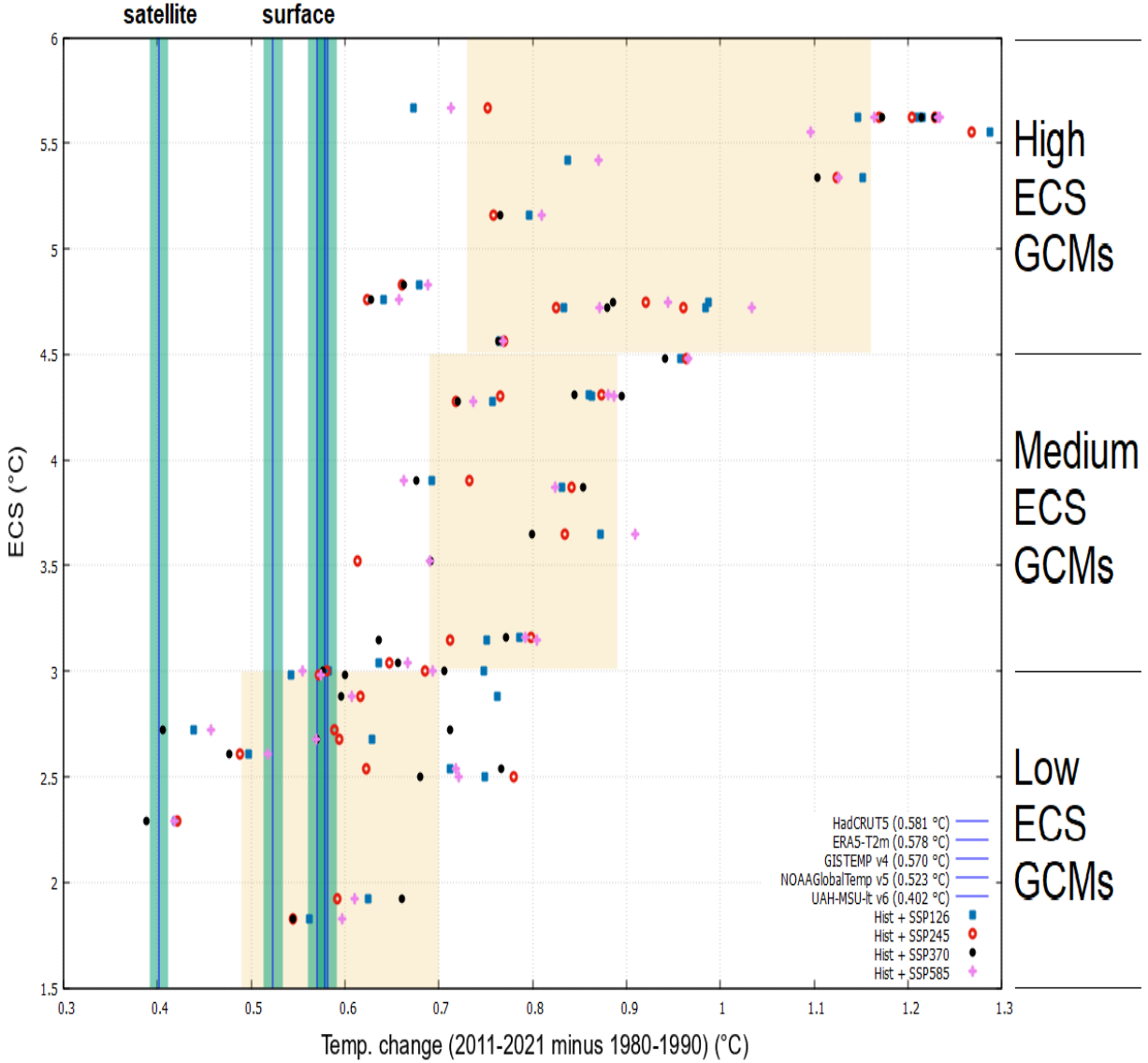
A striking feature of Figs 2 and 3 is that evidence from climate modelling favours values of ECS in the upper part of the 'likely' range, whereas many recent studies based on instrumentally recorded warming — and some from palaeoclimate — favour values in the lower part of the range. Since each line of evidence is affected by

Knutti, R., Rugenstein, M. & Hegerl, G. Beyond equilibrium climate sensitivity. *Nature Geosci* **10**, 727–736 (2017). https://doi.org/10.1038/ngeo3017

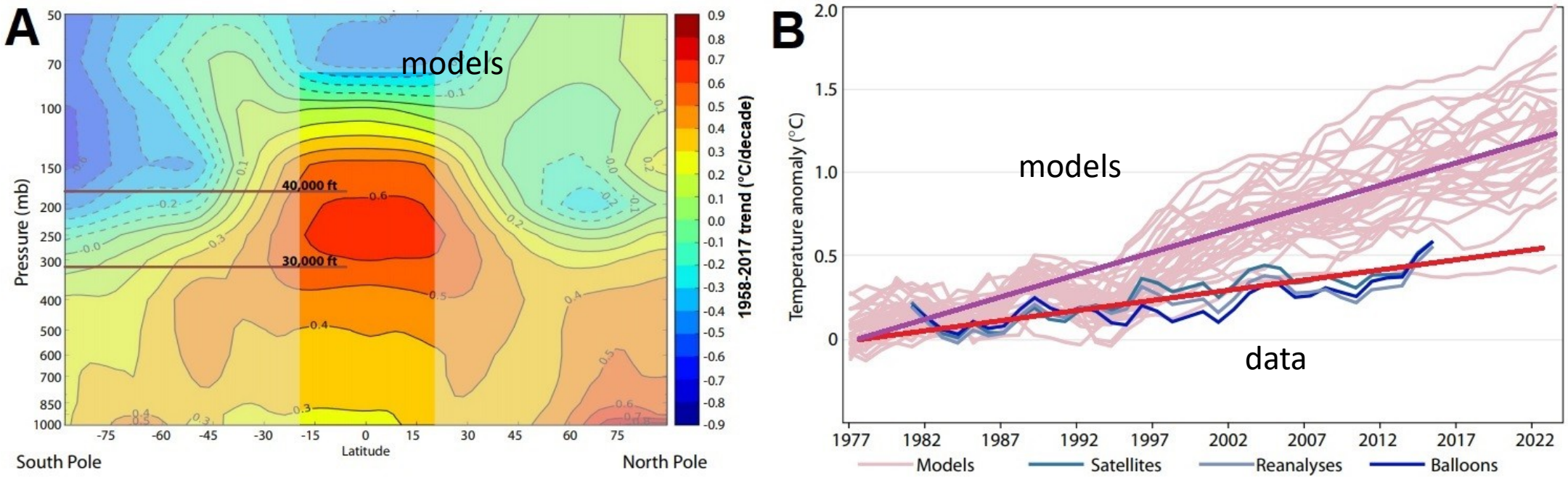
Climate Models versus Climate Data

Scafetta, N. CMIP6 GCM ensemble members versus global surface temperatures. *Clim Dyn* (2022). https://doi.org/10.1007/s00382-022-06493-w





The missing CO_2 Hot-Spot



Comparing modeled to observed trends over the past 60 years using a persistence-robust variance estimator shows that all models warm more rapidly than observations and in the majority of individual cases the discrepancy is statistically significant. We argue that this provides informative evidence against the major hypothesis in most current climate models.

McKitrick, R., and Christy, J. (2018). A test of the tropical 200- to 300-hPa warming rate in climate models. Earth and Space Science, 5, 529–536.

Mitchell DM, Lo YTE, Seviour WJM, Haimberger L, Polvani LM (2020) The vertical profile of recent tropical temperature trends: persistent model biases in the context of internal variability. Environ Res Lett 15:1040b4

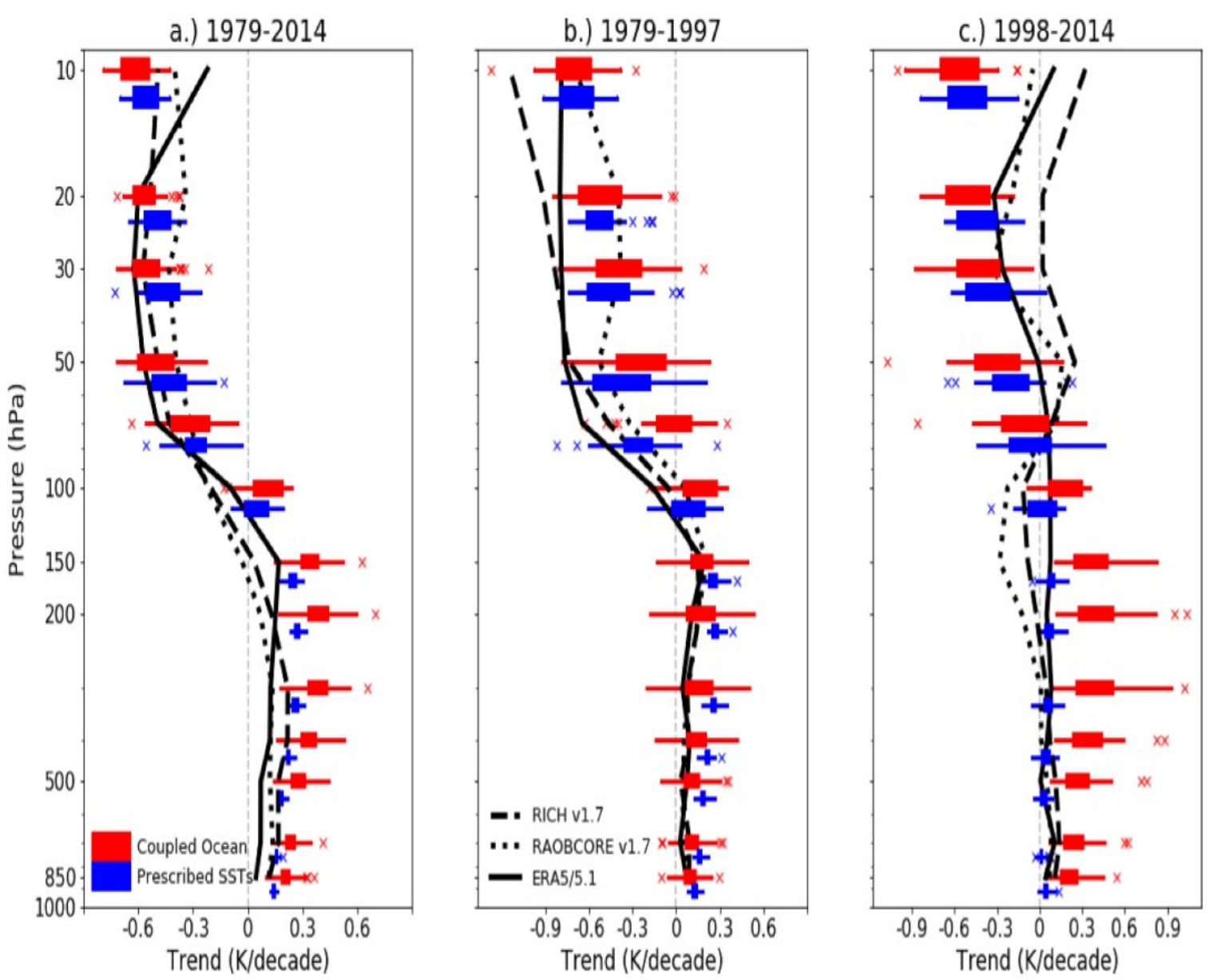
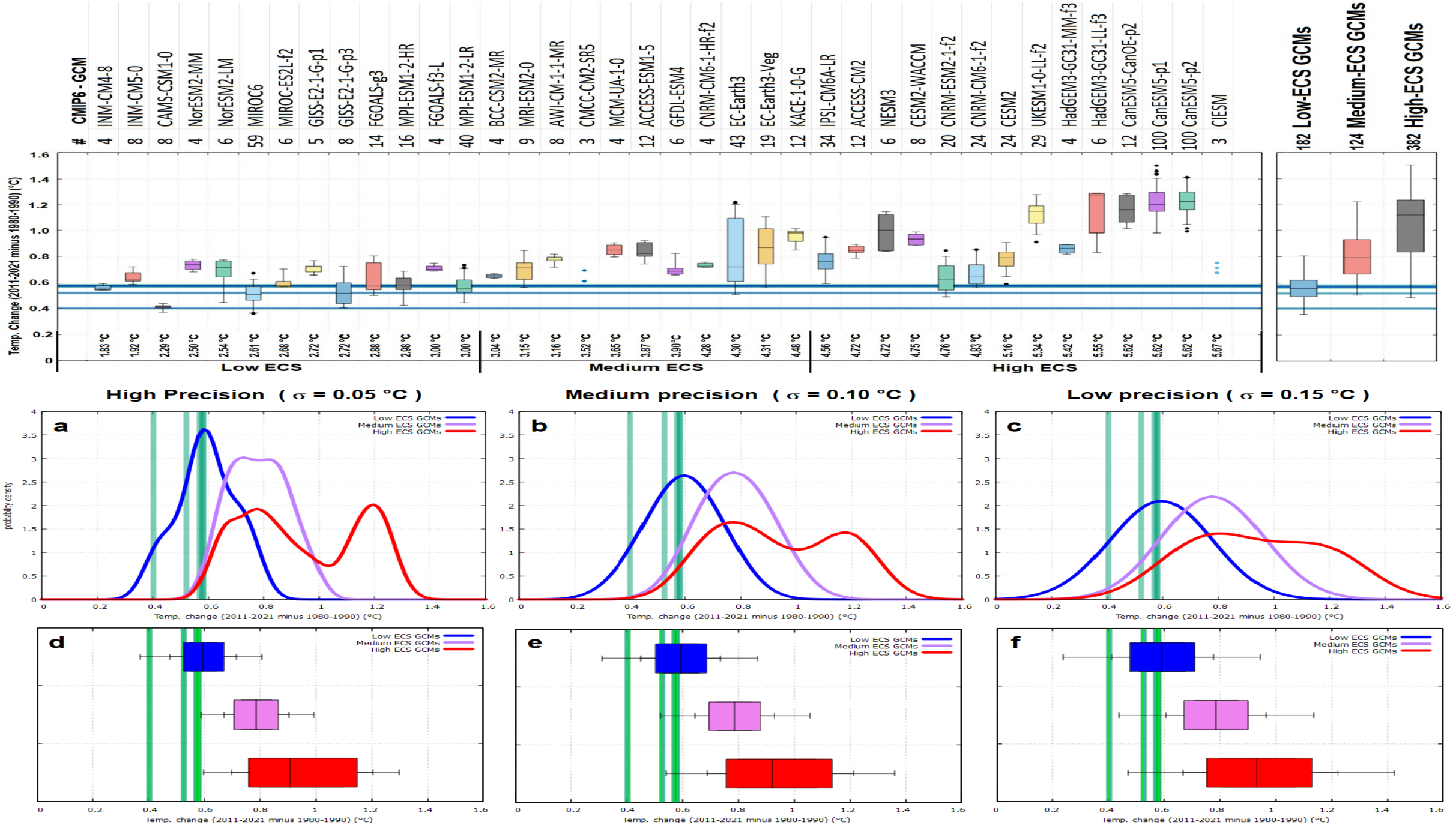
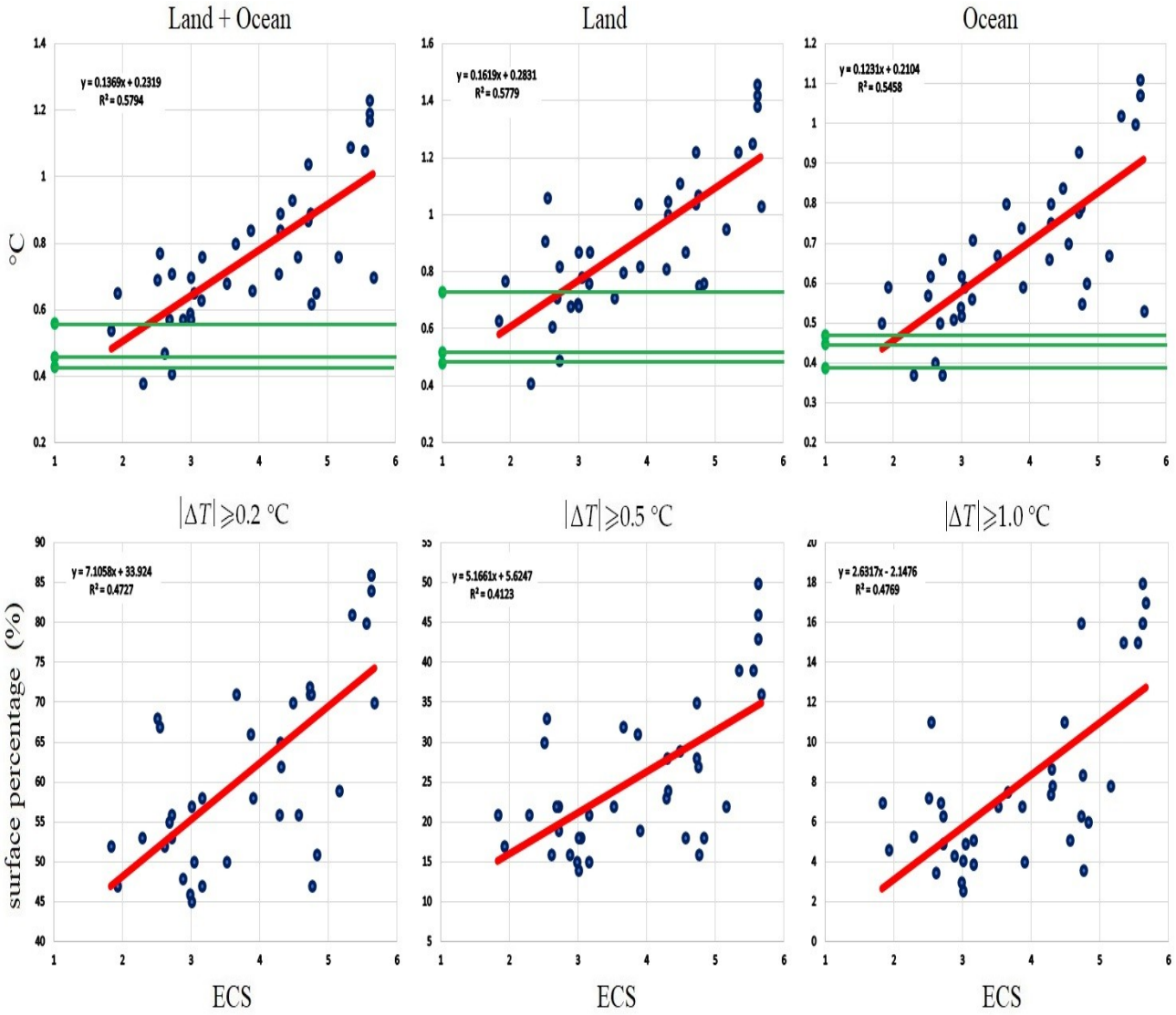


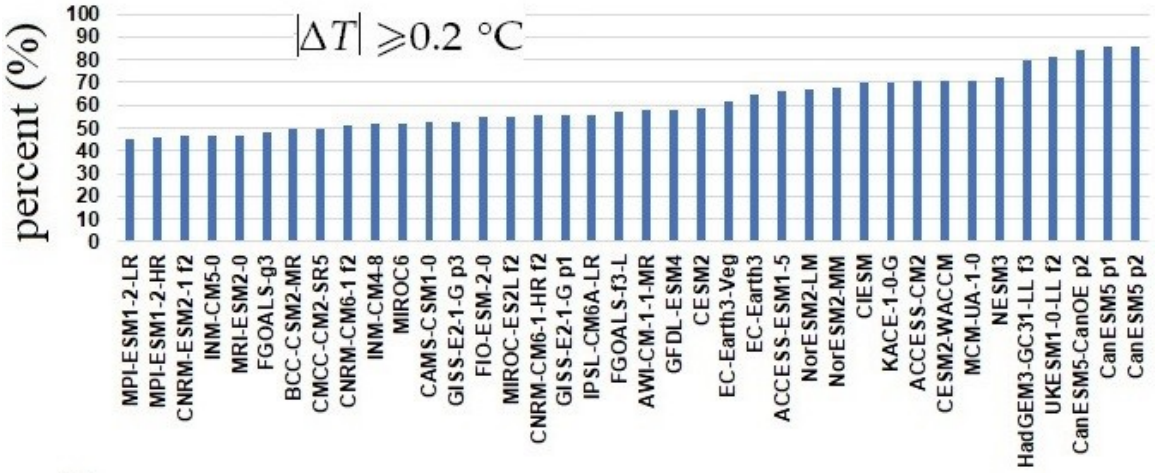
Figure 1. Vertical profiles of tropical (20S-20 N) temperature trends for the period 1979-2014. The black lines show the RICH1.7

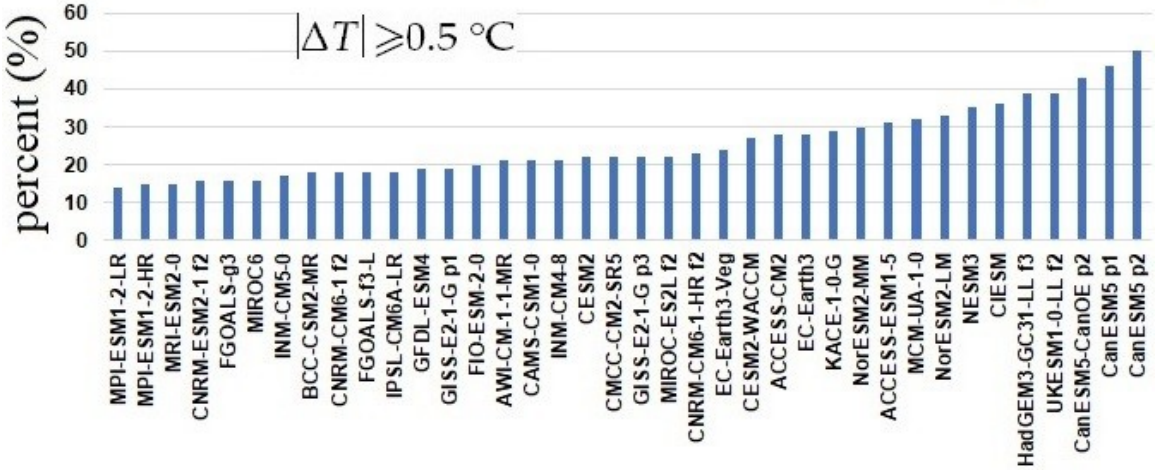

CMIP6 - GCM
4 INM-CM4-8
8 INM-CM5-0
8 CAMS-CSM1-0
4 NorESM2-MM
6 NorESM2-LM
59 MIROC6
6 MIROC-ES2L-f2
5 GISS-E2-1-G-p1
8 GISS-E2-1-G-p3
14 FGOALS-g3
16 MPI-ESM1-2-HR
4 FGOALS-f3-L
40 MPI-ESM1-2-LR
4 BCC-CSM2-MR
9 MRI-ESM2-0
8 AWI-CM-1-1-MR
3 CMCC-CM2-SR5
4 MCM-UA-1-0
12 ACCESS-ESM1-5
6 GFDL-ESM4
4 CNRM-CM6-1-HR-f2
43 EC-Earth3
19 EC-Earth3-Veg
12 KACE-1-0-G
34 IPSL-CM6A-LR
12 ACCESS-CM2
6 NESM3
8 CESM2-WACCM
20 CNRM-ESM2-1-f2
24 CNRM-CM6-1-f2
24 CESM2
29 UKESM1-0-LL-f2
4 HadGEM3-GC31-MM-f3
6 HadGEM3-GC31-LL-f3
12 CanESM5-CanOE-p2
100 CanESM5-p1
100 CanESM5-p2
3 CIESM
182 Low-ECS GCMs
124 Medium-ECS GCMs
382 High-ECS GCMs
Temp. Change (2011-2021 minus 1980-1990) (°C)
1.83 °C
1.92 °C
2.29 °C
2.50 °C
2.54 °C
2.61 °C
2.68 °C
2.72 °C
2.72 °C
2.88 °C
2.98 °C
3.00 °C
3.00 °C
3.04 °C
3.15 °C
3.16 °C
3.52 °C
3.65 °C
3.87 °C
3.90 °C
4.28 °C
4.30 °C
4.31 °C
4.48 °C
4.56 °C
4.72 °C
4.72 °C
4.75 °C
4.76 °C
4.83 °C
5.16 °C
5.34 °C
5.42 °C
5.55 °C
5.62 °C
5.62 °C
5.62 °C
5.67 °C
Low ECS
Medium ECS
High ECS
High Precision (σ = 0.05 °C)
Medium precision (σ = 0.10 °C)
Low precision (σ = 0.15 °C)
a
b
c
d
e
f
Low ECS GCMs
Medium ECS GCMs
High ECS GCMs
probability density
Temp. change (2011-2021 minus 1980-1990) (°C)

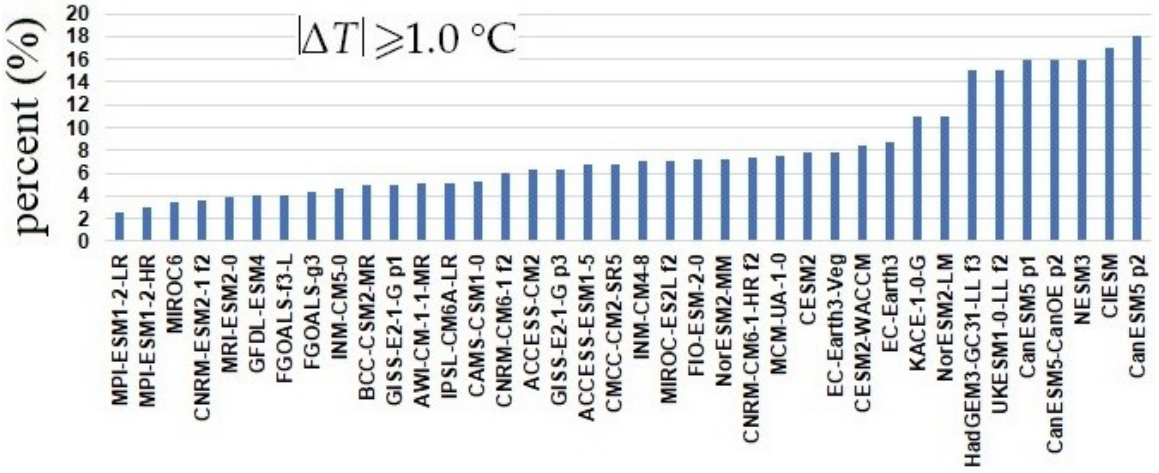
Scafetta N (2021) Testing the CMIP6 GCM simulations versus surface temperature records from 1980–1990 to 2011–2021: high ECS is not supported. Climate 9(11):161. https://doi.org/10.3390/cli9110161

ECS is not supported. Climate 9(11):161. https://doi.org/10.3390/cli9110161



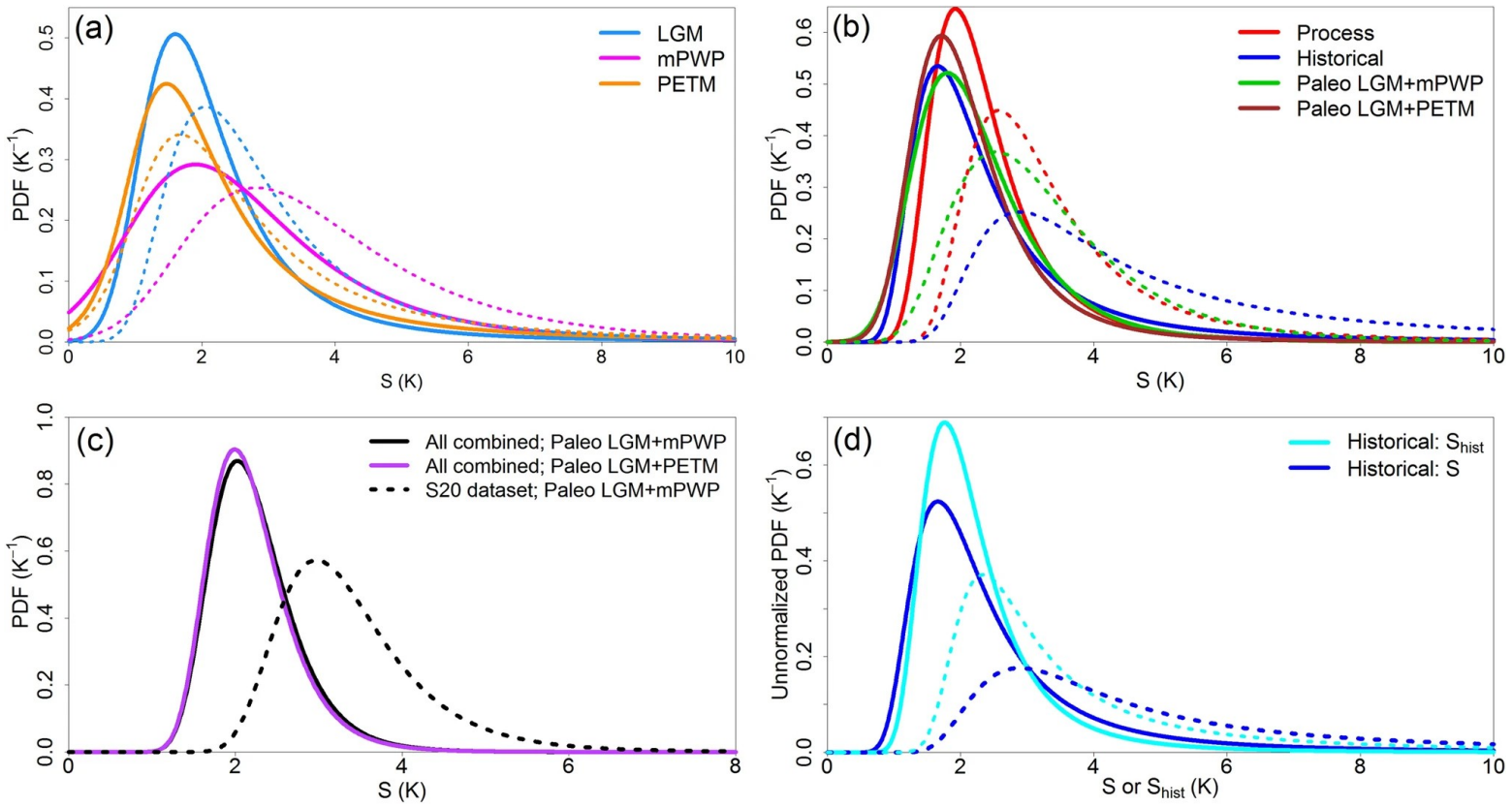




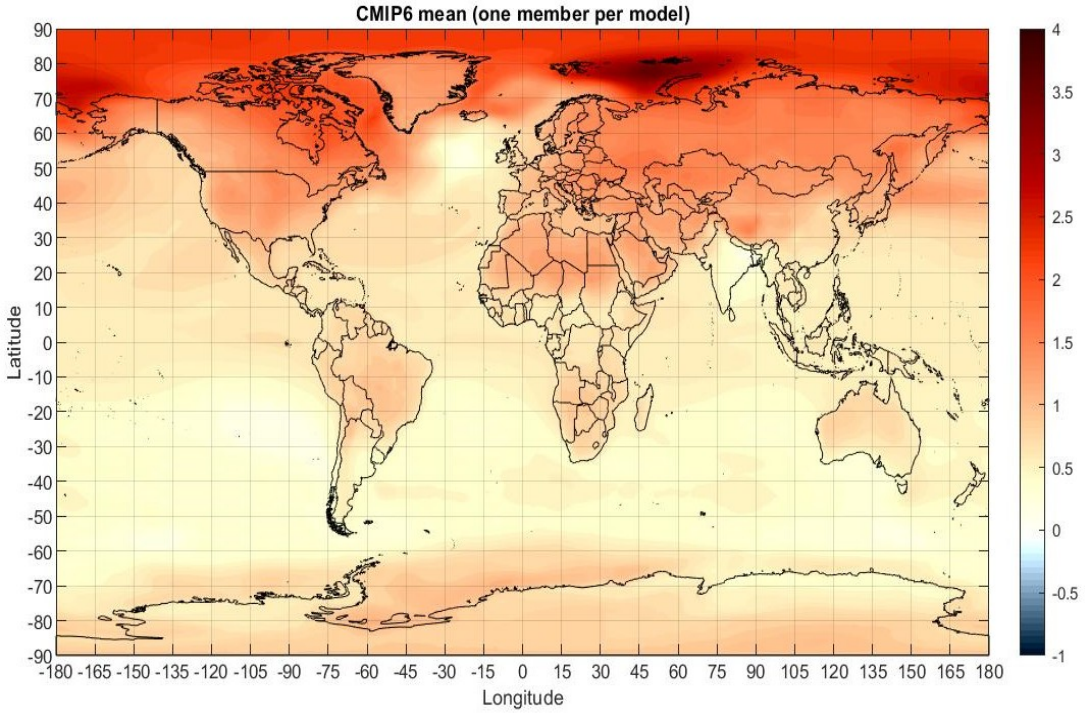


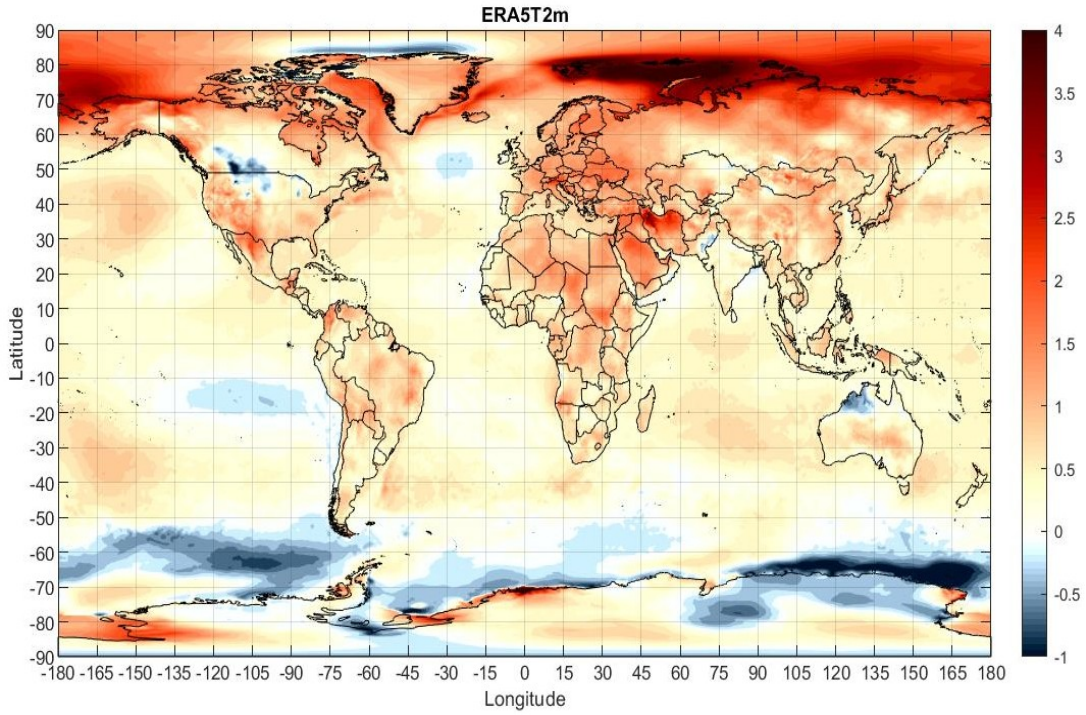
An independent recent evaluation of the ECS

Lewis, N. Objectively combining climate sensitivity evidence. *Clim Dyn* (2022). https://doi.org/10.1007/s00382-022-06468-x

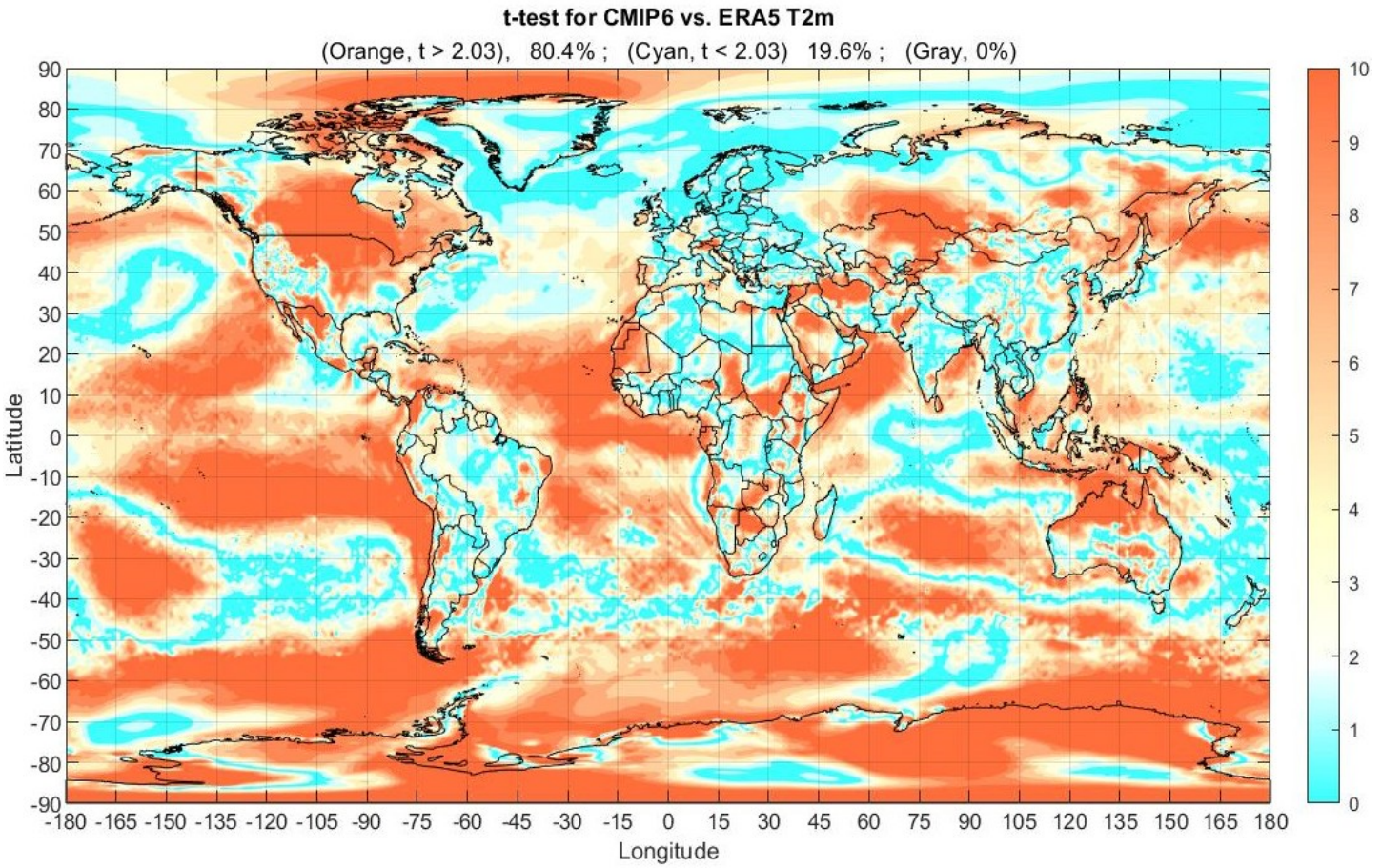


- Lewis' paper critiqued the methods used in the Sherwood et al. paper, finding significant errors, inconsistencies and other shortcomings. Lewis remedied these shortcomings and also revised key input data, almost entirely to reflect more recent evidence.
- The results of Lewis' analysis determined a *likely* range of 1.75 to 2.7°C for climate sensitivity.
- The central estimate from Lewis' analysis is 2.16 °C, which is well below the IPCC AR6 *likely* range.
- Lewis' analysis implies that climate sensitivity is more likely to be below 2 °C than it is to be above 2.5 °C.



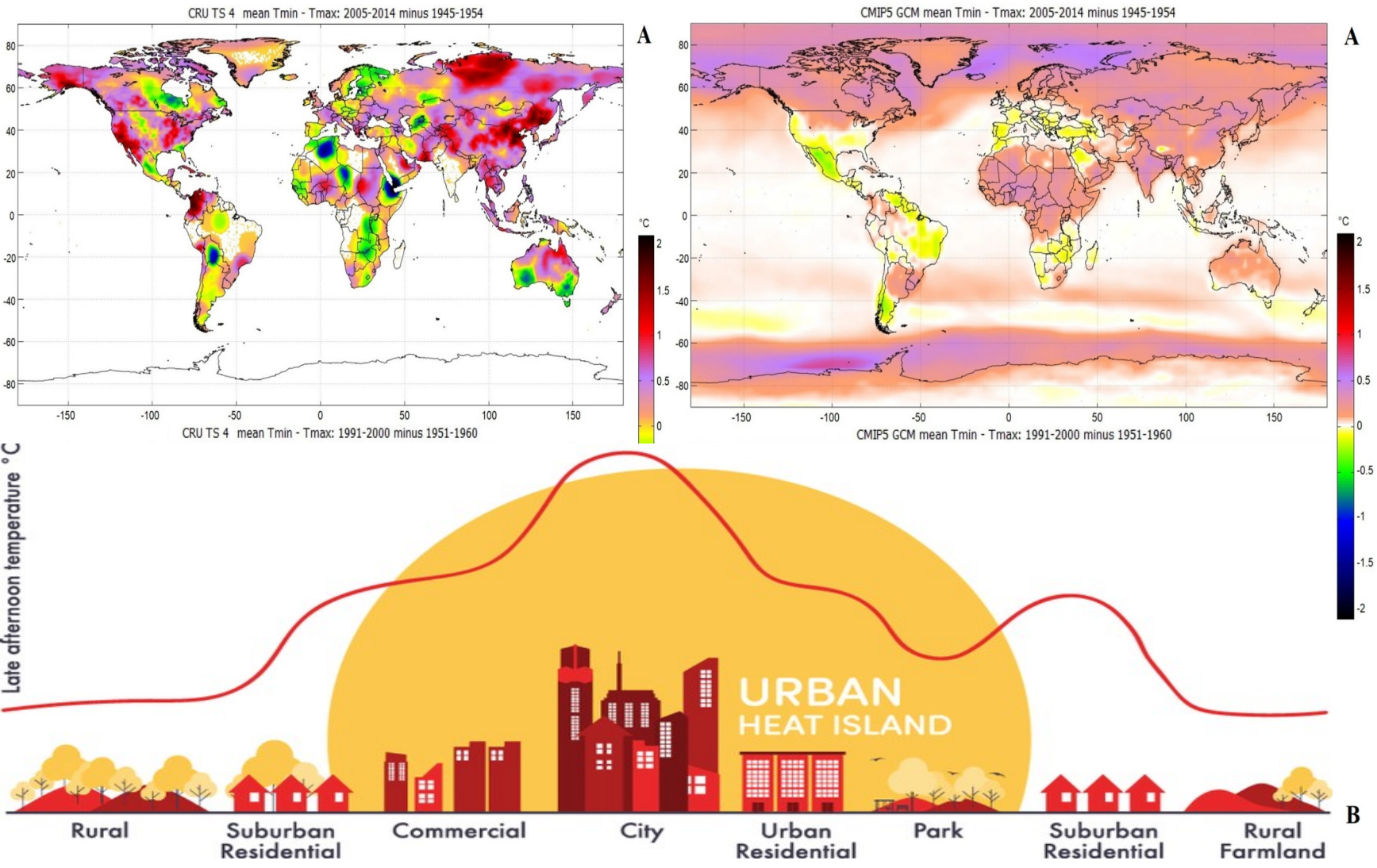


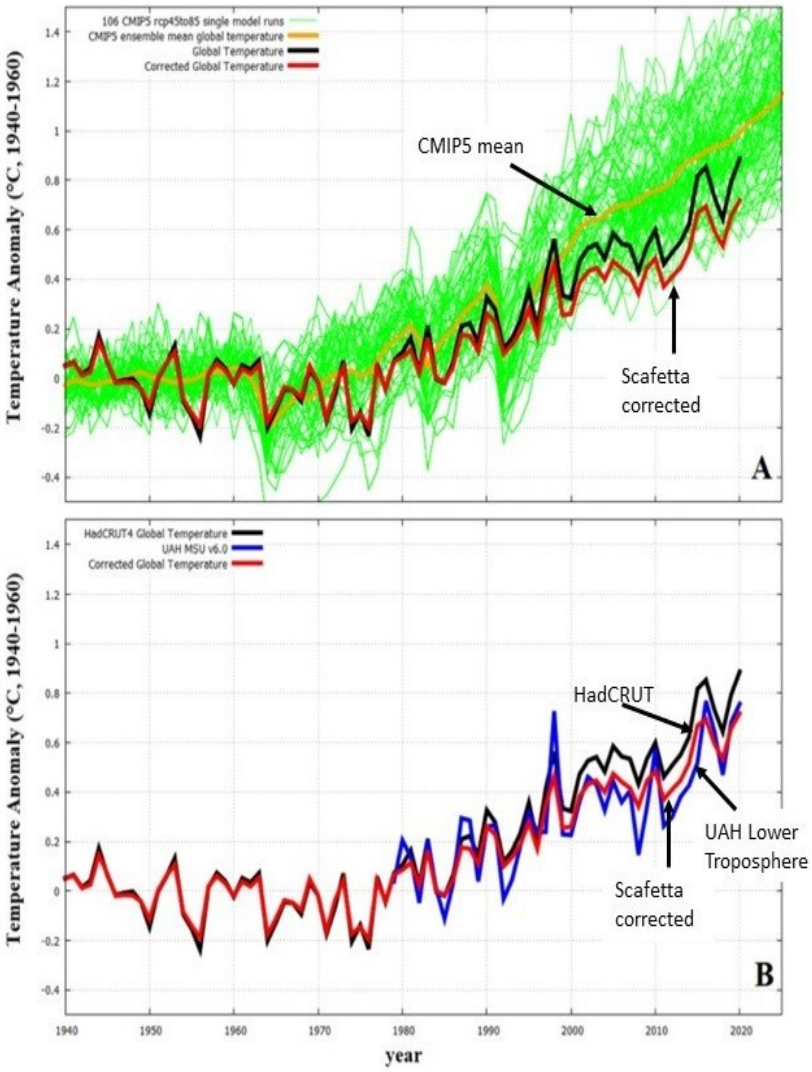
The CMIP6 GCMs are incompatible with the data over more than 80% of the world surface. The model-data agreement improves with the low ECS GCMs but it is still unsatisfactory



ECS
GCM
1.83 °C INM-CM4-8
1.92 °C INM-CM5-0
2.29 °C CAMS-CSM1-0
2.5 °C NorESM2-MM
2.54 °C NorESM2-LM
2.61 °C MIROC6
2.68 °C MIROC-ES2L-f2
2.72 °C GISS-E2-1-G-p1
2.72 °C GISS-E2-1-G-p3
2.88 °C FGOALS-g3
2.98 °C MPI-ESM1-2-HR
3 °C FGOALS-f3-L
3 °C MPI-ESM1-2-LR
3.04 °C BCC-CSM2-MR
3.15 °C MRI-ESM2-0
3.16 °C AWI-CM-1-1-MR
3.52 °C CMCC-CM2-SR5
3.65 °C MCM-UA-1-0
3.87 °C ACCESS-ESM1-5
3.9 °C GFDL-ESM4
4.28 °C CNRM-CM6-1-HR-f2
4.3 °C EC-Earth3
4.31 °C EC-Earth3-Veg
4.48 °C KACE-1-0-G
4.56 °C IPSL-CM6A-LR
4.72 °C ACCESS-CM2
4.72 °C NESM3
4.75 °C CESM2-WACCM
4.76 °C CNRM-ESM2-1-f2
4.83 °C CNRM-CM6-1-f2
5.16 °C CESM2
5.34 °C UKESM1-0-LL-f2
5.42 °C HadGEM3-GC31-MM-f3
5.55 °C HadGEM3-GC31-LL-f3
5.62 °C CanESM5-CanOE-p2
5.62 °C CanESM5-p1
5.62 °C CanESM5-p2
5.67 °C CIESM
a
b
c
d
°C
°C
°C
ratio
HadCRUT
ERA5
GISTEMP
NOAAv5
UAH-MSU
Hist + SSP5-8.5
Hist + SSP3-7.0
Hist + SSP2-4.5
Hist + SSP1-2.6
Total
Land
Ocean
Land / Ocean
Low ECS
Medium ECS
High ECS

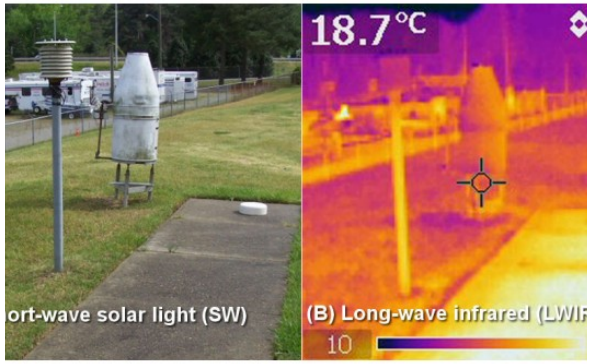
Land Surface warming biases



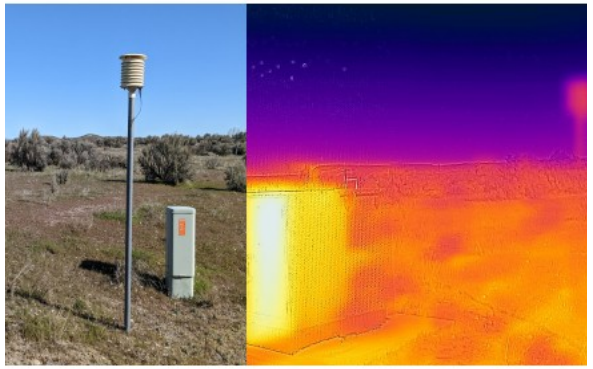


Scafetta, N. Detection of non-climatic biases in land surface temperature records by comparing climatic data and their model simulations. Clim Dyn 56, 2959–2982 (2021).

Visible and infrared photos of MMTS placement near roof and large parking lot at Woodland, CA, GHCN Station at the Yolo County Office of Weights and Measures. Source: Anthony Watts.



s 2A and 2B: Figure 2A (left) shows the USHCN station at Fayetteville, NC in visible light (SW - shortwave versus Figure 2B (right), the same station viewed in long-wave infrared (LWIR). Note the concrete slab is sign . The MMTS temperature sensor on the pole will "sense" the warmer air at night due to the emission of LWI Anthony Watts.

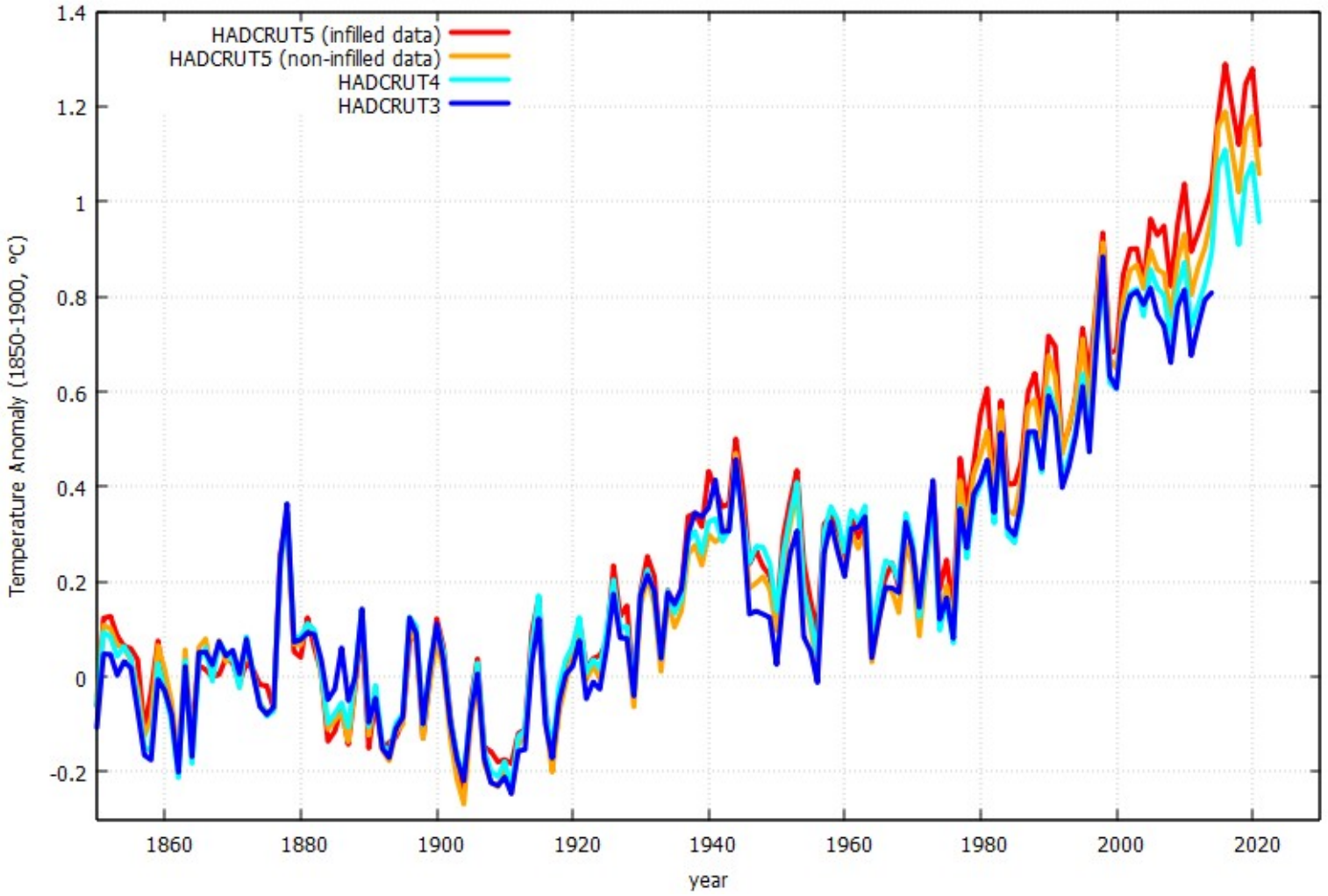


ground mounted power transformer at USHCN station in Glens Ferry, OR. This station w riginal 2009 report and was identified as being biased, but has not been corrected as of 202

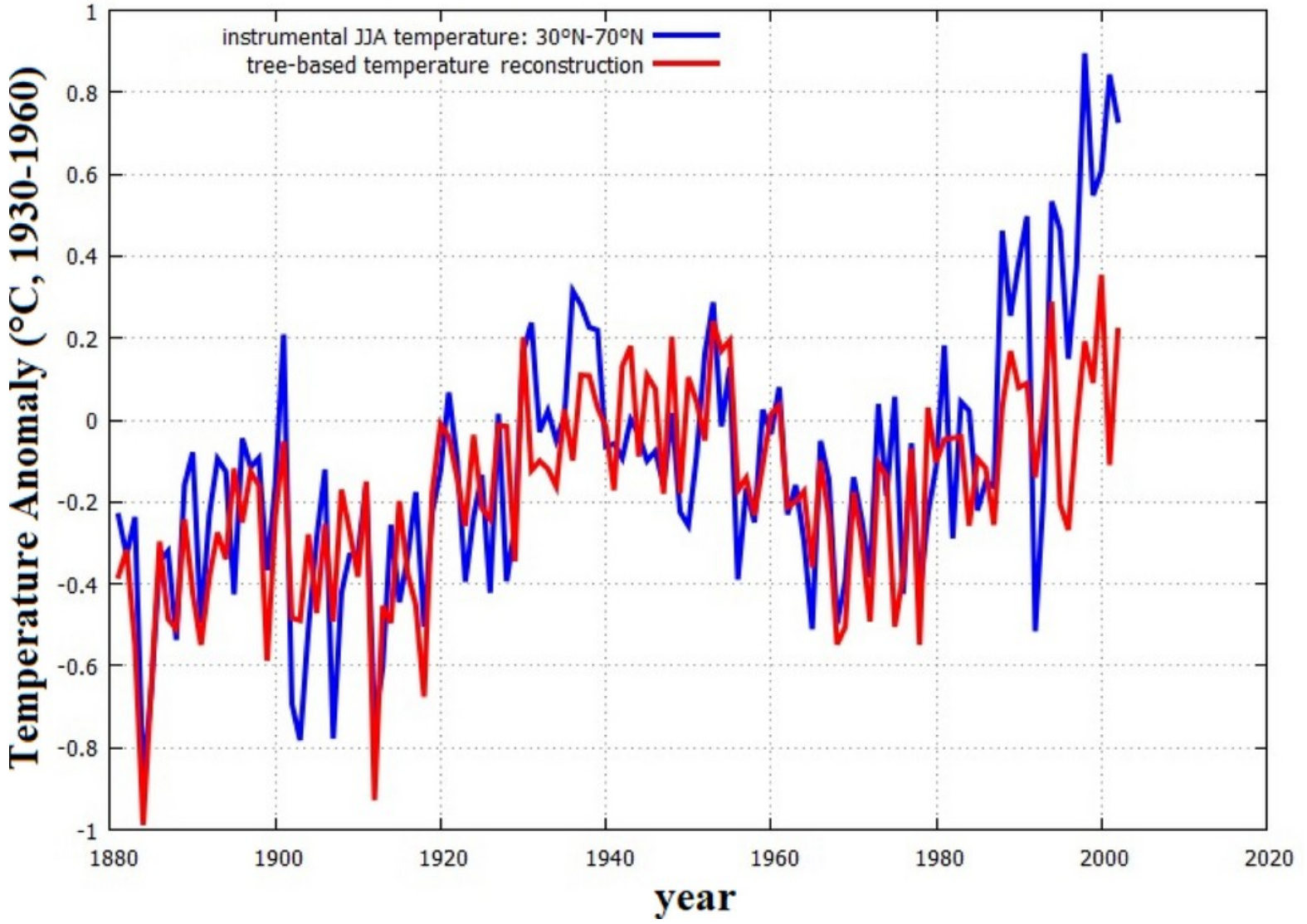
This report finds approximately 96 percent of U.S. temperature stations fail to meet what the National Oceanic and Atmospheric Administration (NOAA) considers to be "acceptable," uncorrupted placement.

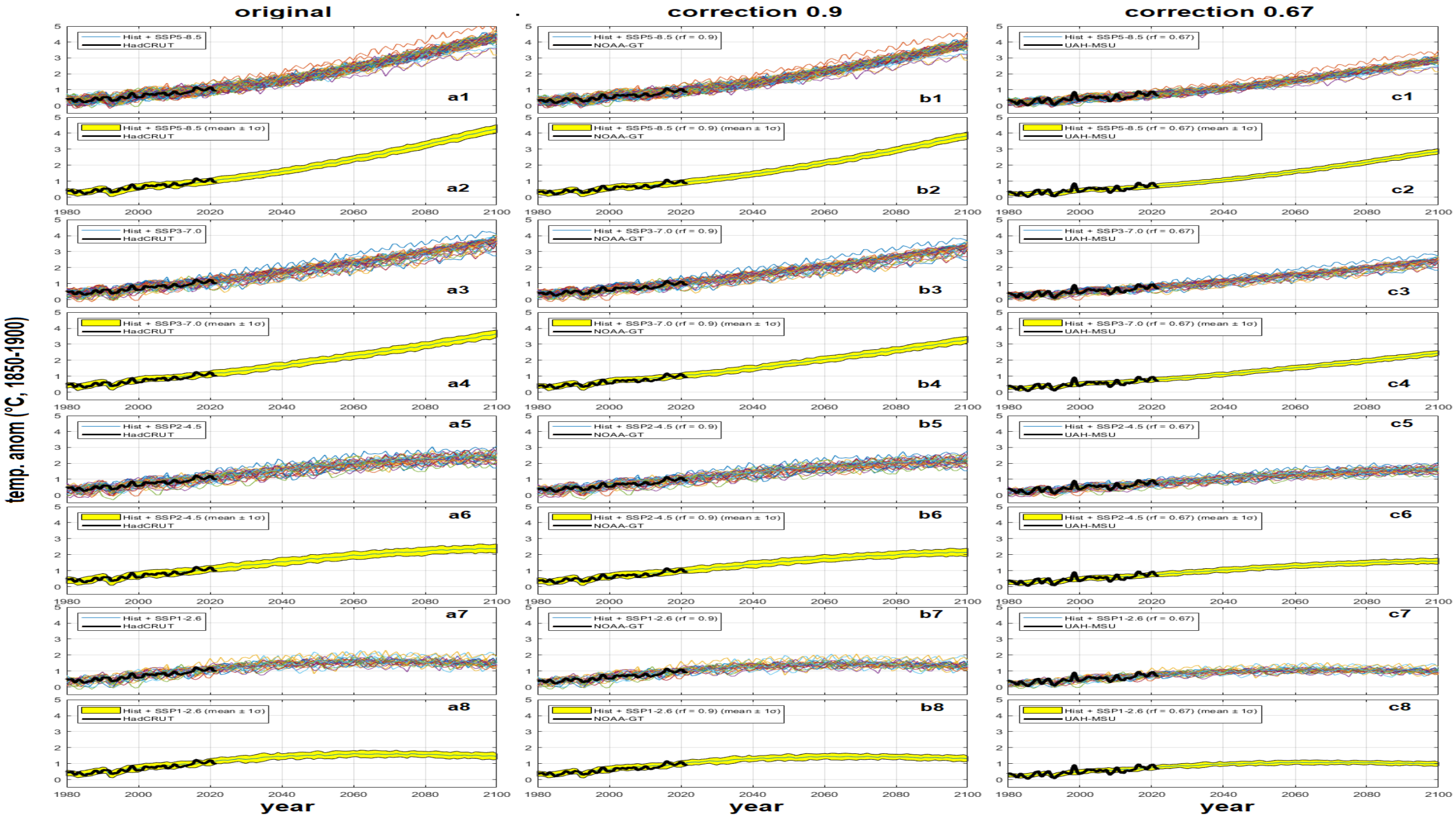
New versions of Climate records from 2014 to 2022…..

The 2000-2015 “pause” has disappeared!!

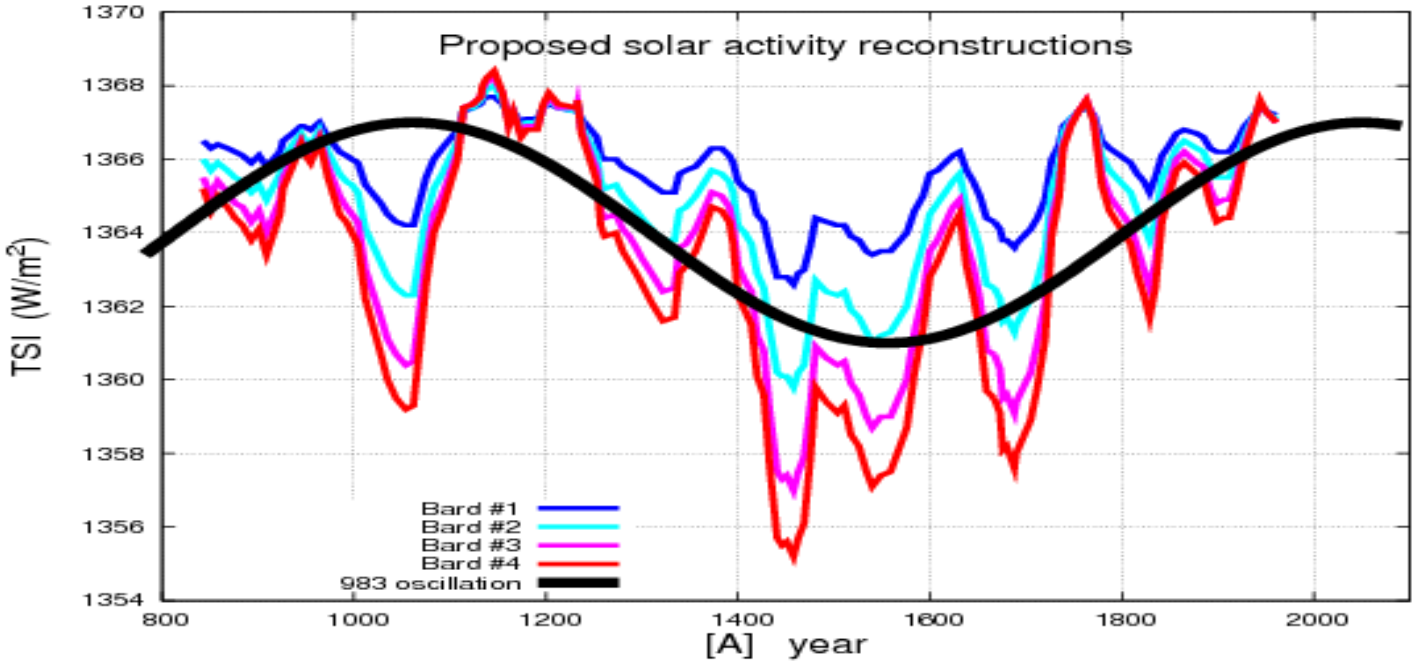


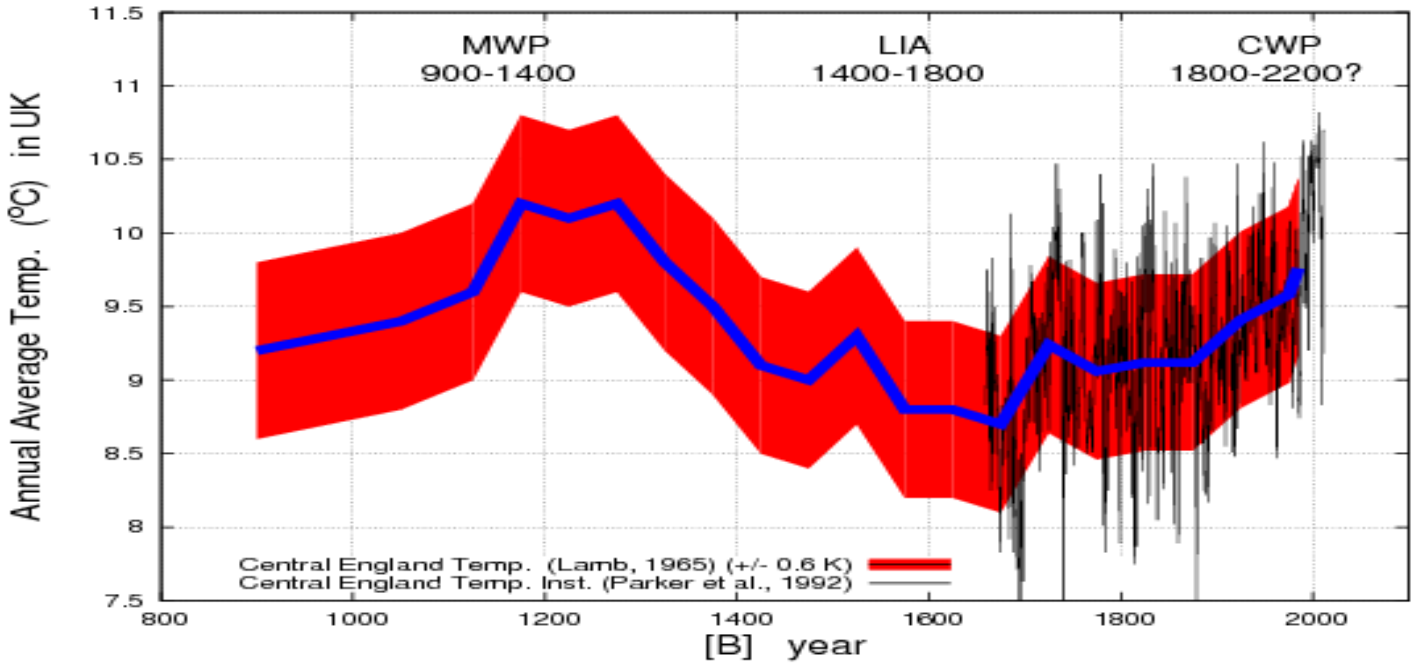
Tree-based mean temperature reconstructions (red) against the JJA instrumental temperatures averaged over 30–70 °N land areas (blue). The curves are scaled over the 1930–1960 period (Esper et al. 2018)




original
correction 0.9
correction 0.67
temp. anom (°C, 1850-1900)
year
Hist + SSP5-8.5
HadCRUT
Hist + SSP5-8.5 (mean ± 1σ)
Hist + SSP3-7.0
Hist + SSP3-7.0 (mean ± 1σ)
Hist + SSP2-4.5
Hist + SSP2-4.5 (mean ± 1σ)
Hist + SSP1-2.6
Hist + SSP1-2.6 (mean ± 1σ)
Hist + SSP5-8.5 (rf = 0.9)
NOAA-GT
Hist + SSP5-8.5 (rf = 0.9) (mean ± 1σ)
Hist + SSP3-7.0 (rf = 0.9)
Hist + SSP3-7.0 (rf = 0.9) (mean ± 1σ)
Hist + SSP2-4.5 (rf = 0.9)
Hist + SSP2-4.5 (rf = 0.9) (mean ± 1σ)
Hist + SSP1-2.6 (rf = 0.9)
Hist + SSP1-2.6 (rf = 0.9) (mean ± 1σ)
Hist + SSP5-8.5 (rf = 0.67)
UAH-MSU
Hist + SSP5-8.5 (rf = 0.67) (mean ± 1σ)
Hist + SSP3-7.0 (rf = 0.67)
Hist + SSP3-7.0 (rf = 0.67) (mean ± 1σ)
Hist + SSP2-4.5 (rf = 0.67)
Hist + SSP2-4.5 (rf = 0.67) (mean ± 1σ)
Hist + SSP1-2.6 (rf = 0.67)
Hist + SSP1-2.6 (rf = 0.67) (mean ± 1σ)
a1
a2
a3
a4
a5
a6
a7
a8
b1
b2
b3
b4
b5
b6
b7
b8
c1
c2
c3
c4
c5
c6
c7
c8

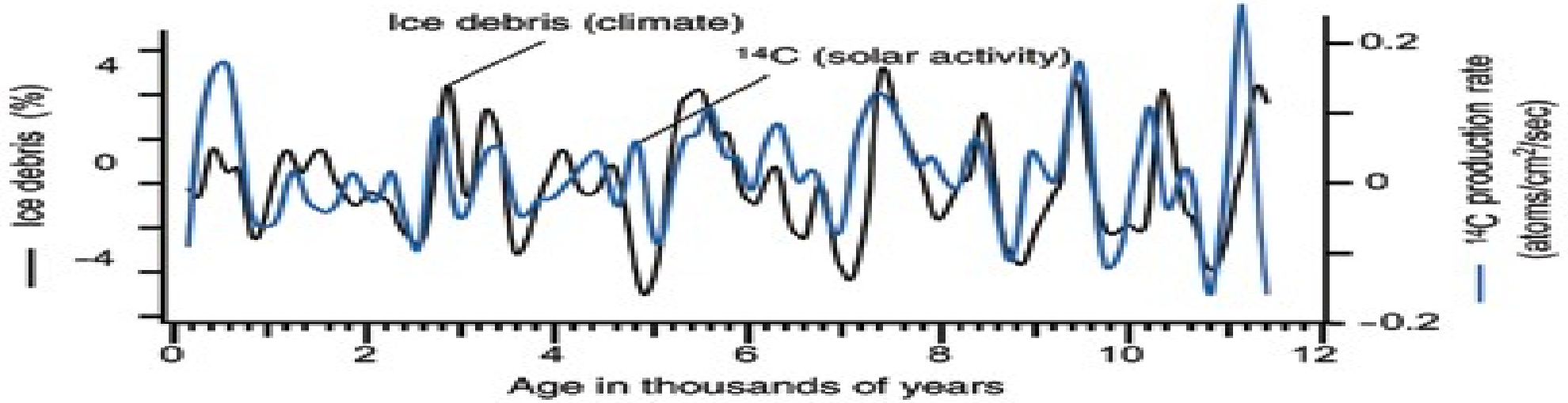
- Only solar activity has a millennial cycle.
- Which correlates with the millennial cycle of temperatures



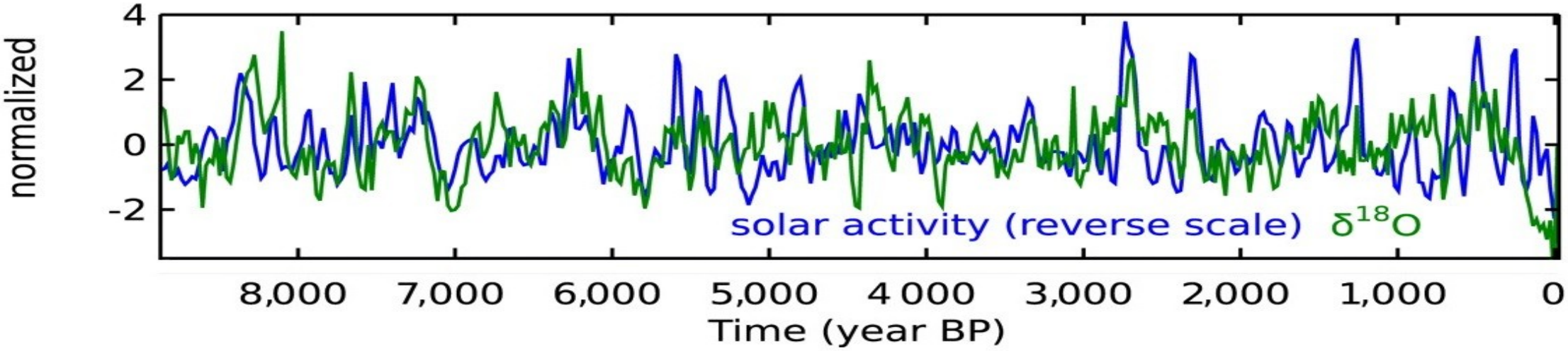


Central England Temperature

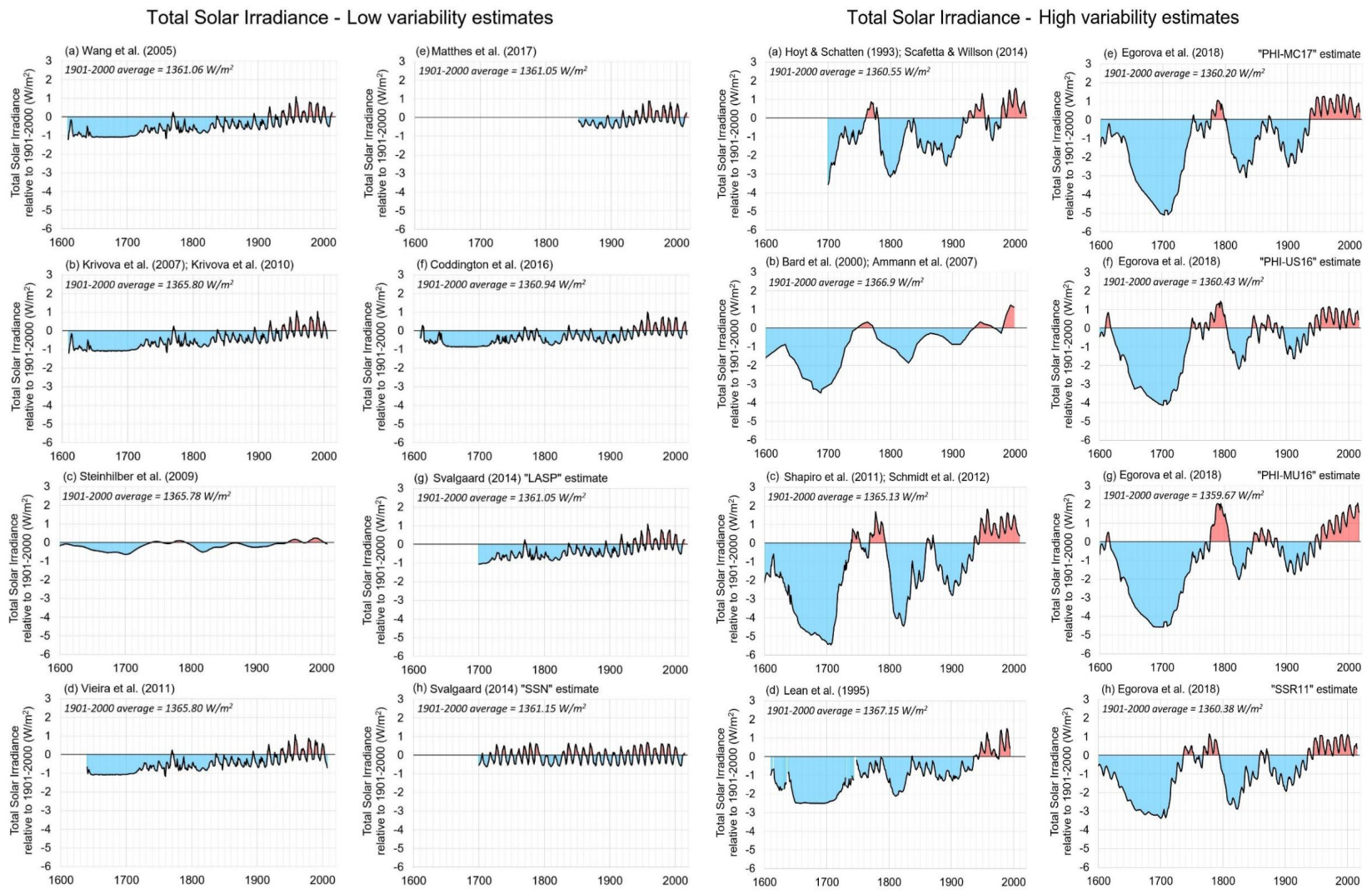
Kerr, R. A., 2001. A variable sun paces millennial climate. Science, 294, 1431-1433.

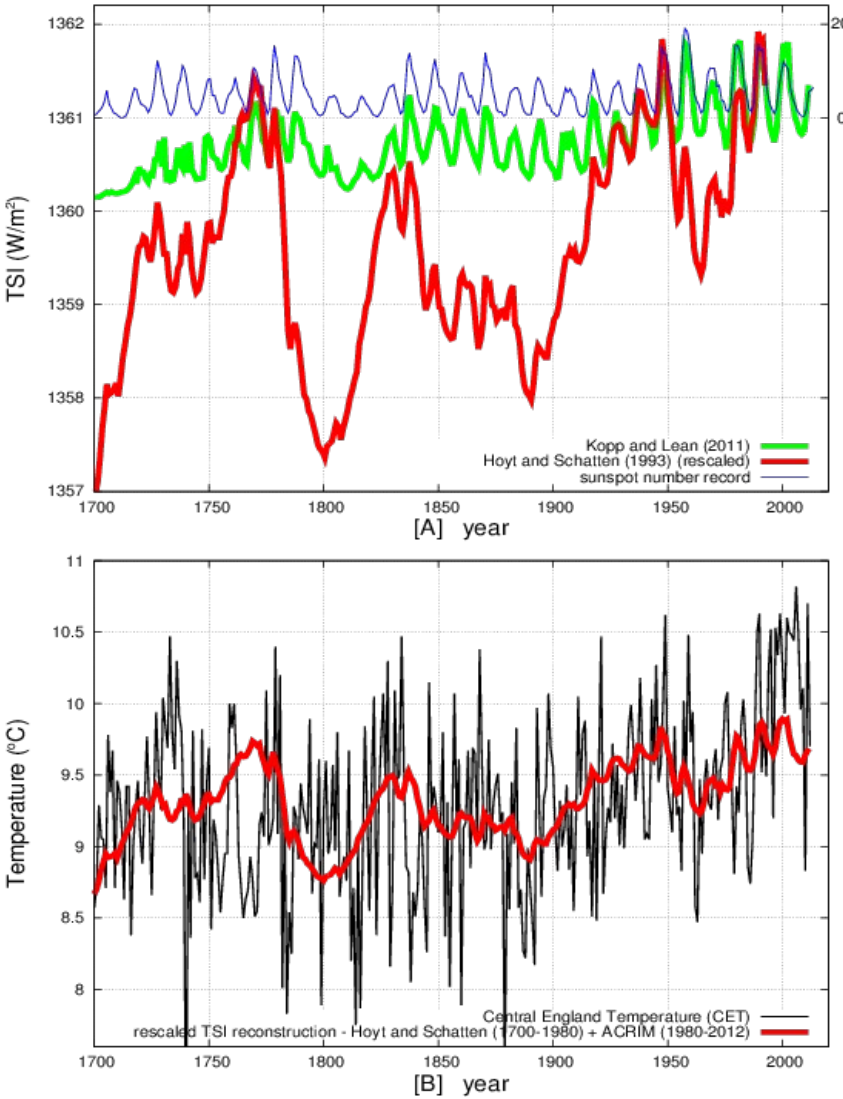


Steinhilber, F., Abreu, J. A., Beer, J., et al., 2012. 9,400 years of cosmic radiation and solar activity from ice cores and tree rings. PNAS, 109, 5967-5971, 2012.



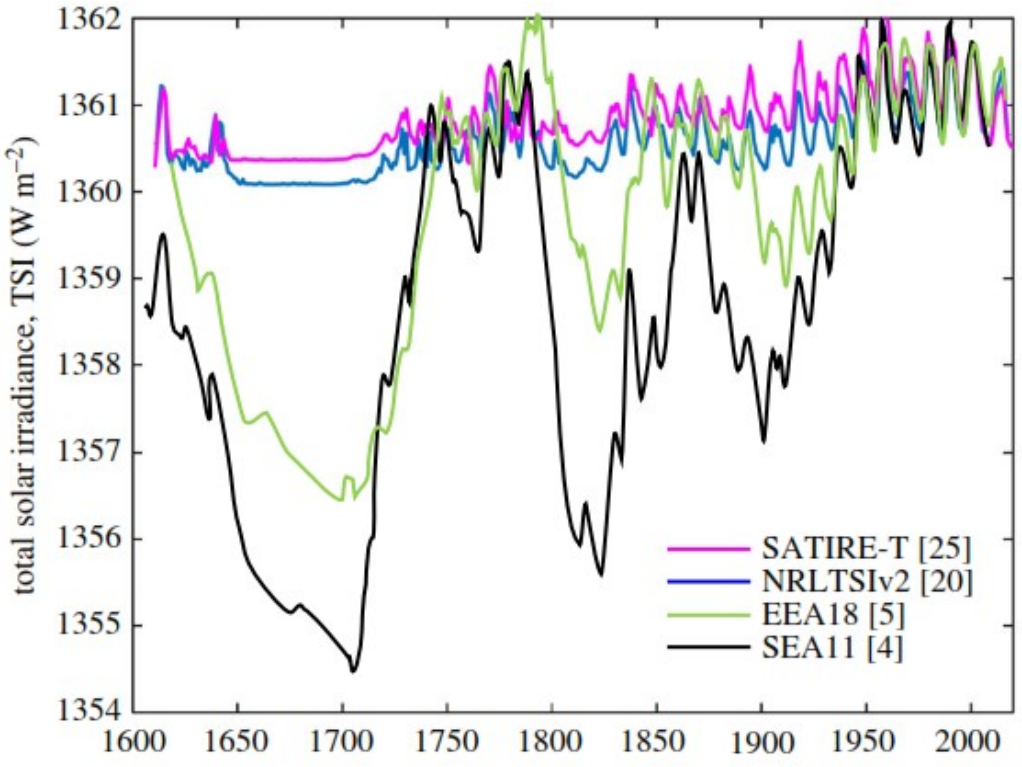
Total Solar Irradiance Records

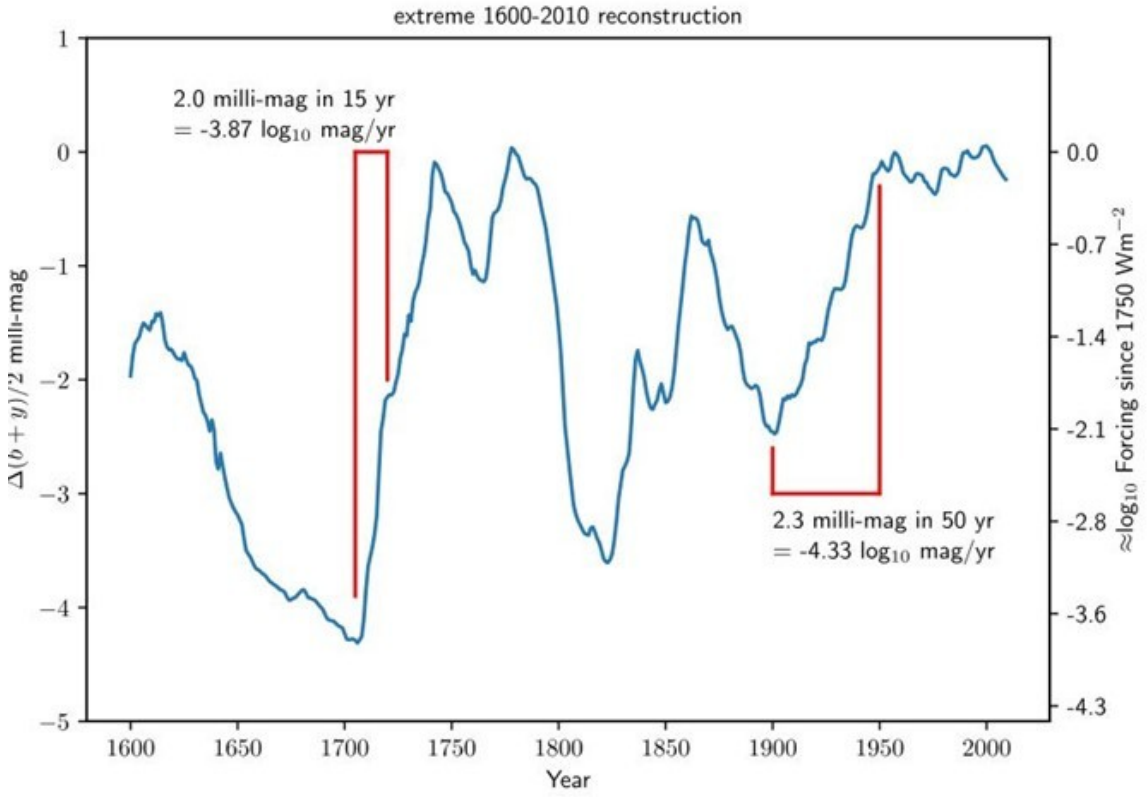




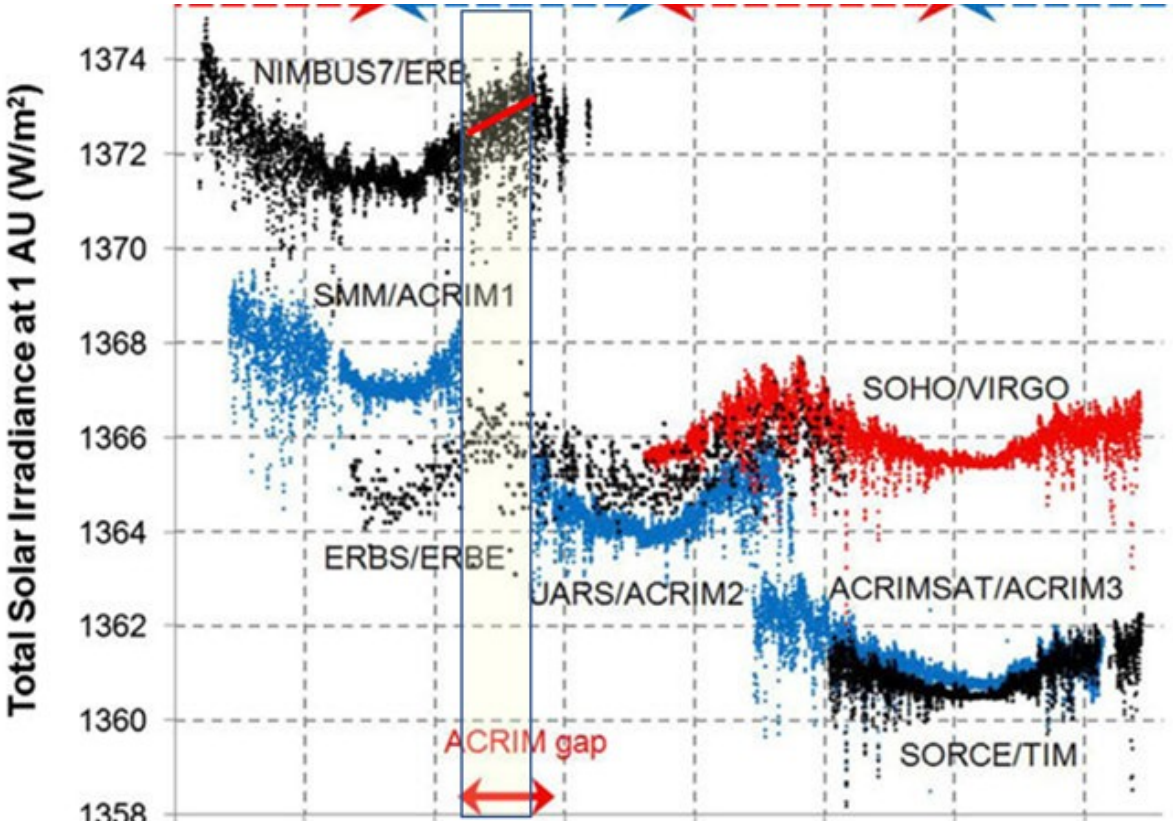
Connolly et al. How much has the Sun influenced Northern Hemisphere temperature trends? An ongoing debate. Research in Astronomy and Astrophysics (2021).

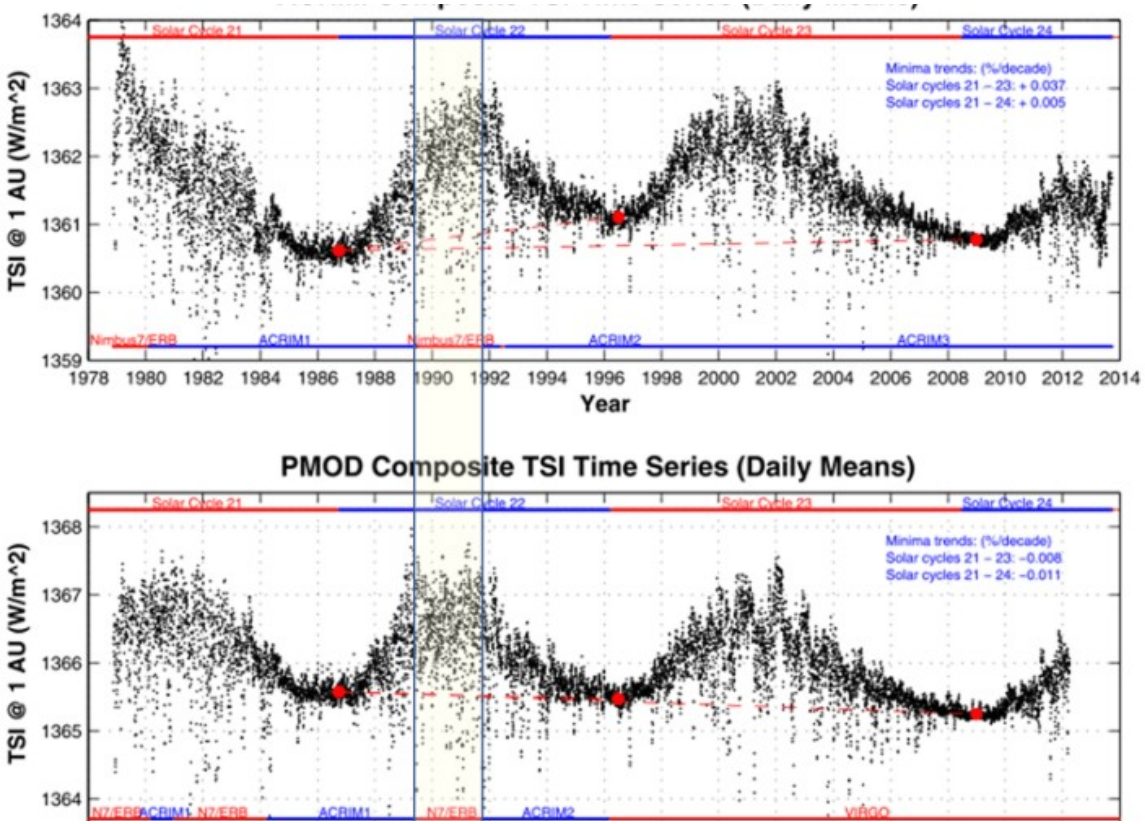
Uncertainty about solar reconstructions, and information on other sun-like stars



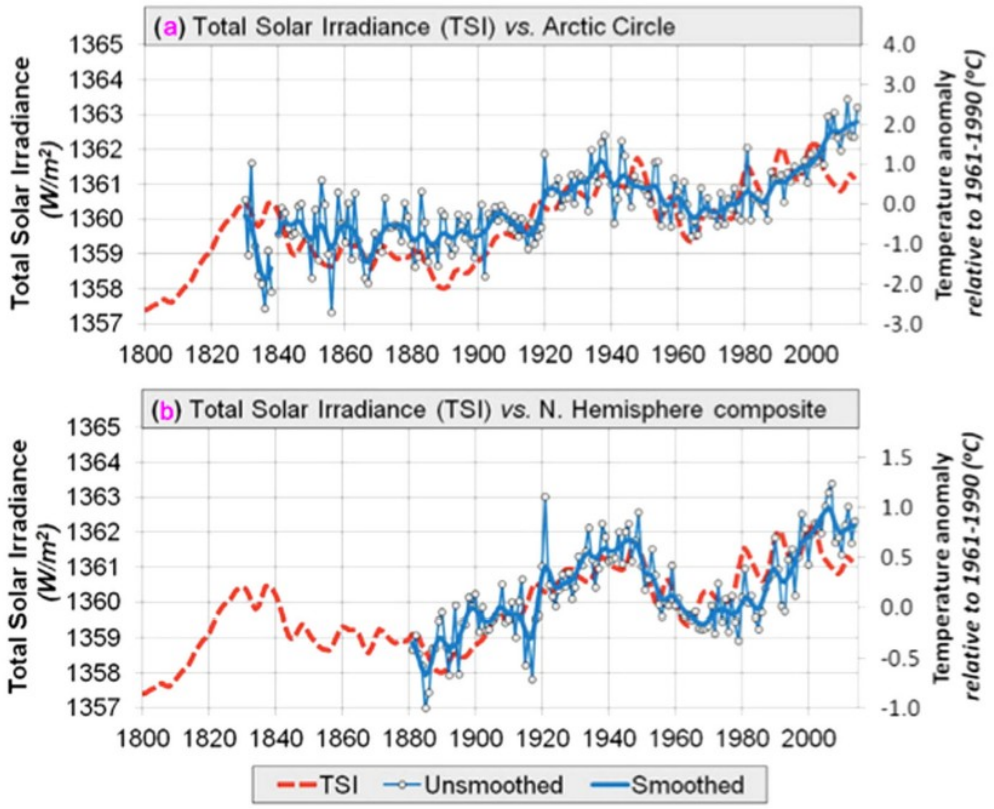


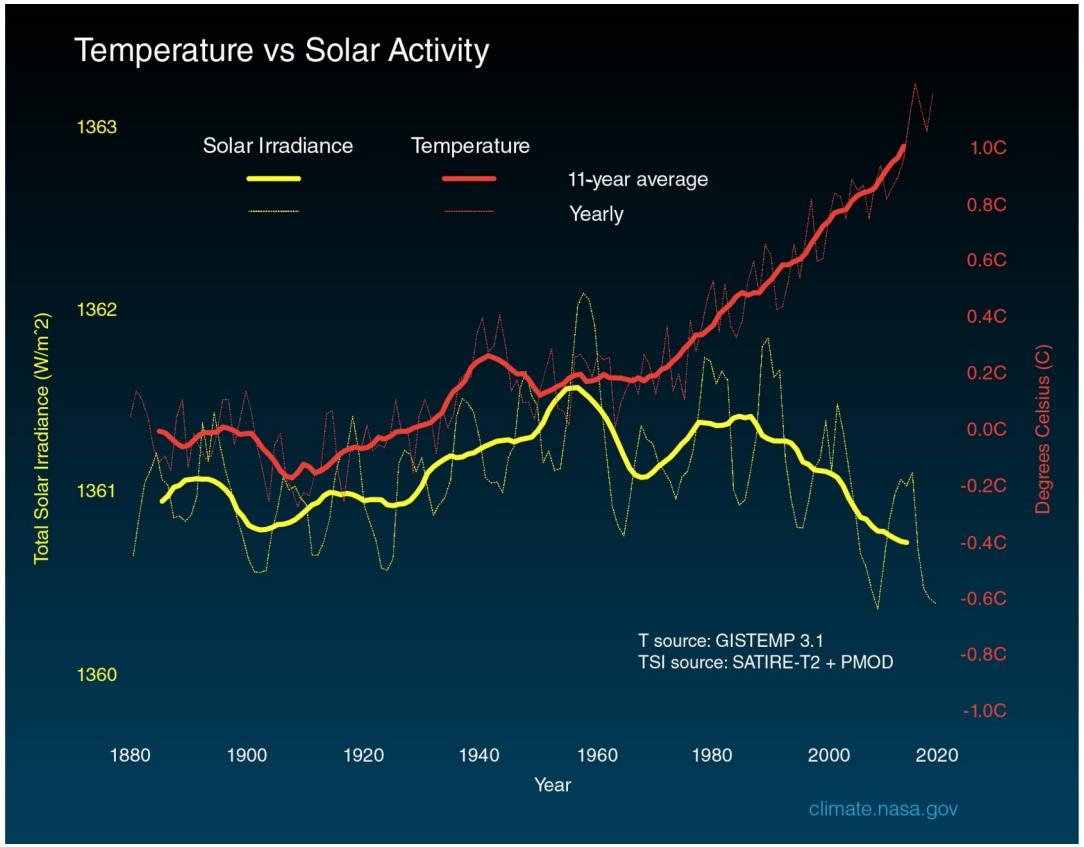
Uncertainty about the satellite solar reconstructions

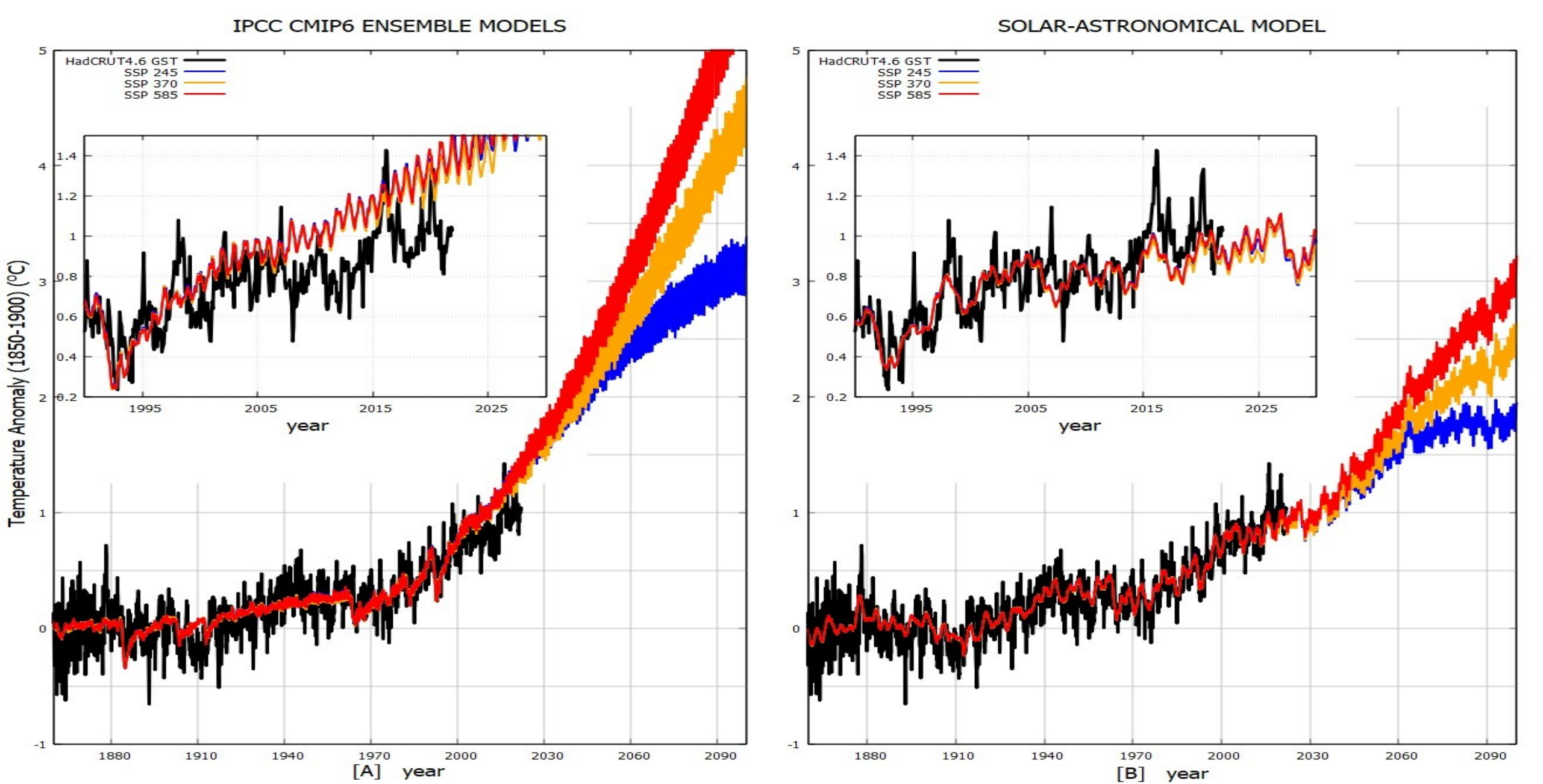




Different climate conclusions from different solar records

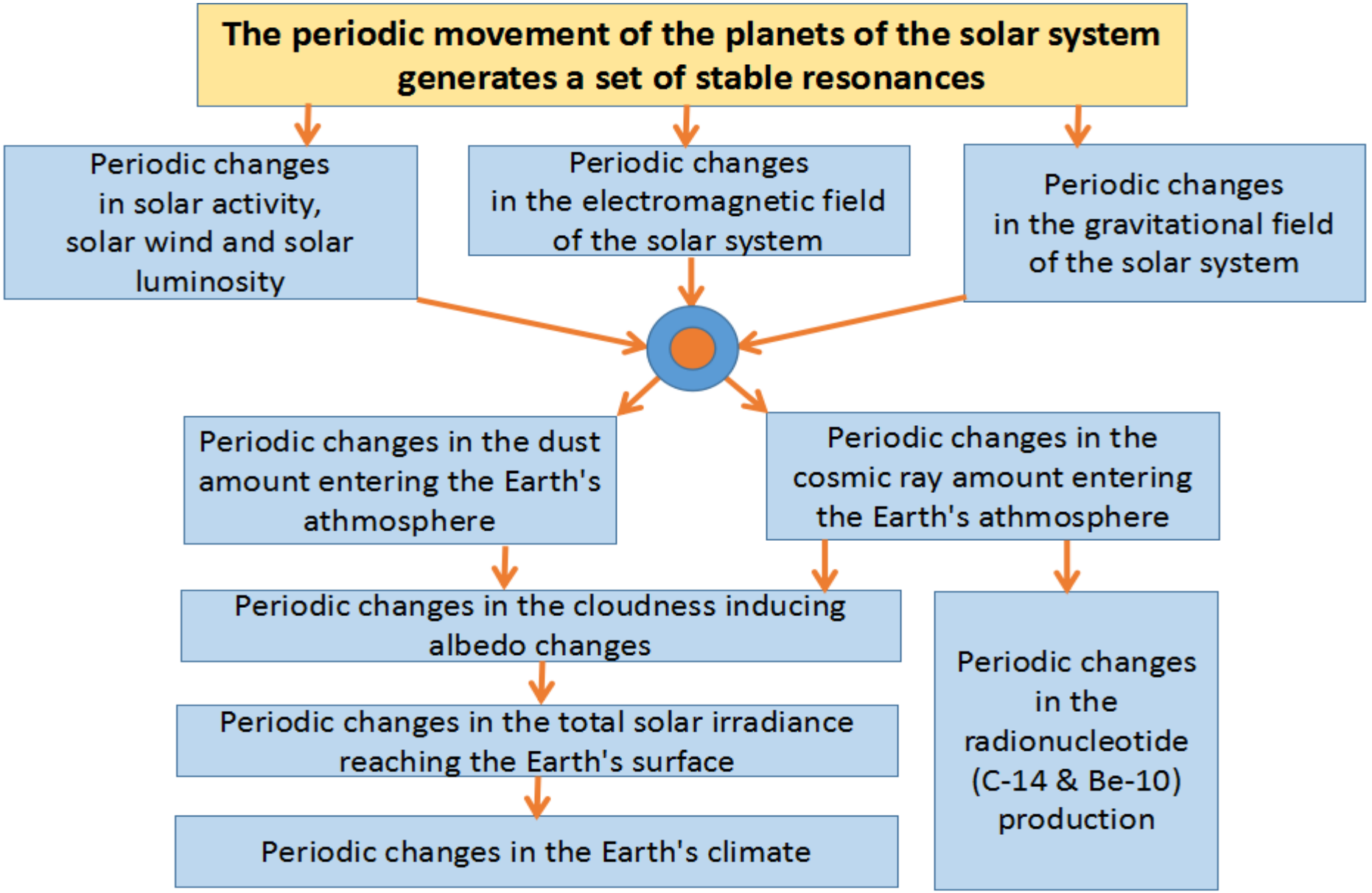






Update: Scafetta, N. 2013. Discussion on climate oscillations: CMIP5 general circulation models versus a semi-empirical harmonic model based on astronomical cycles. Earth-Science Reviews 126, 321-357.

The Bigger Picture



Scafetta N and Bianchini A (2022) The Planetary Theory of Solar Activity Variability: A Review. Front. Astron. Space Sci. 9:937930. doi: 10.3389/fspas.2022.937930

Crippa, M., Guizzardi, D., Muntean, M., Schaaf, E., Solazzo, E., Monforti-Ferrario, F., Olivier, J.G.J., Vignati, E., Fossil CO2 emissions of all world countries - 2020 Report, EUR 30358 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21515-8, doi:10.2760/143674, JRC121460.

[EDGAR - The Emissions Database for Global Atmospheric Research (europa.eu)](https://edgar.jrc.ec.europa.eu/booklet/Fossil_CO2_emissions_of_all_world_countries_booklet_2020report.pdf)

	Globe 2019 vs 1990 (CO_2)	EU27+UK 2019 vs 1990 (CO_2)	EU27+UK 2019 vs 2018 (CO_2)
Power Industry	+ 78%	- 39%	- 12%
Other industrial combustion	+ 67%	- 40%	- 2%
Buildings	+ 8%	- 23%	+ 1%
Transport	+ 78%	+ 18%	0%
Other sectors	+ 100%	- 22%	0%

New Coal Plants

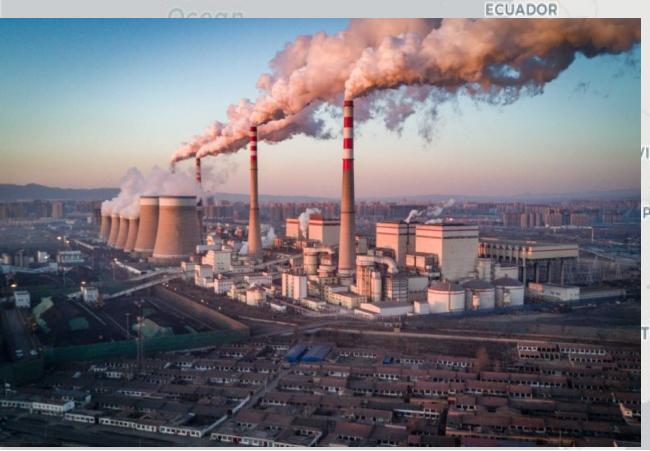
Global Coal Plant Tracker
PUBLISHED BY GLOBAL ENERGY MONITOR

RETURN TO ENDCOAL

Map | Table | About | Summaries | Restart

Search all data for project name, company, country

Status filtered
Tracking 1,052 coal-fired units



Basemap
Hybrid
Satellite

Coal plants: Status
select all | clear all
Mothballed
Shelved
Operating
Retired
Cancelled
Pre-permit
Announced
Construction
Permitted

Is there a climate emergency ?

Probably not!

—

- The Equilibrium Climate Sensitivity is very likely low: ECS<3°C
- Alternative climate records suggest that the actual ECS could even be lower than 2°C.
- Thus, the alarming projected warming for future decades is not supported by strong evidences.
- Climate adaptation policies should be preferred to the expensive mitigation ones