The "Art" of Calculating Total Solar Irradiance (TSI): Are the Scientific Review and Recommendations by the UN IPCC Reports Accurate or Correct?

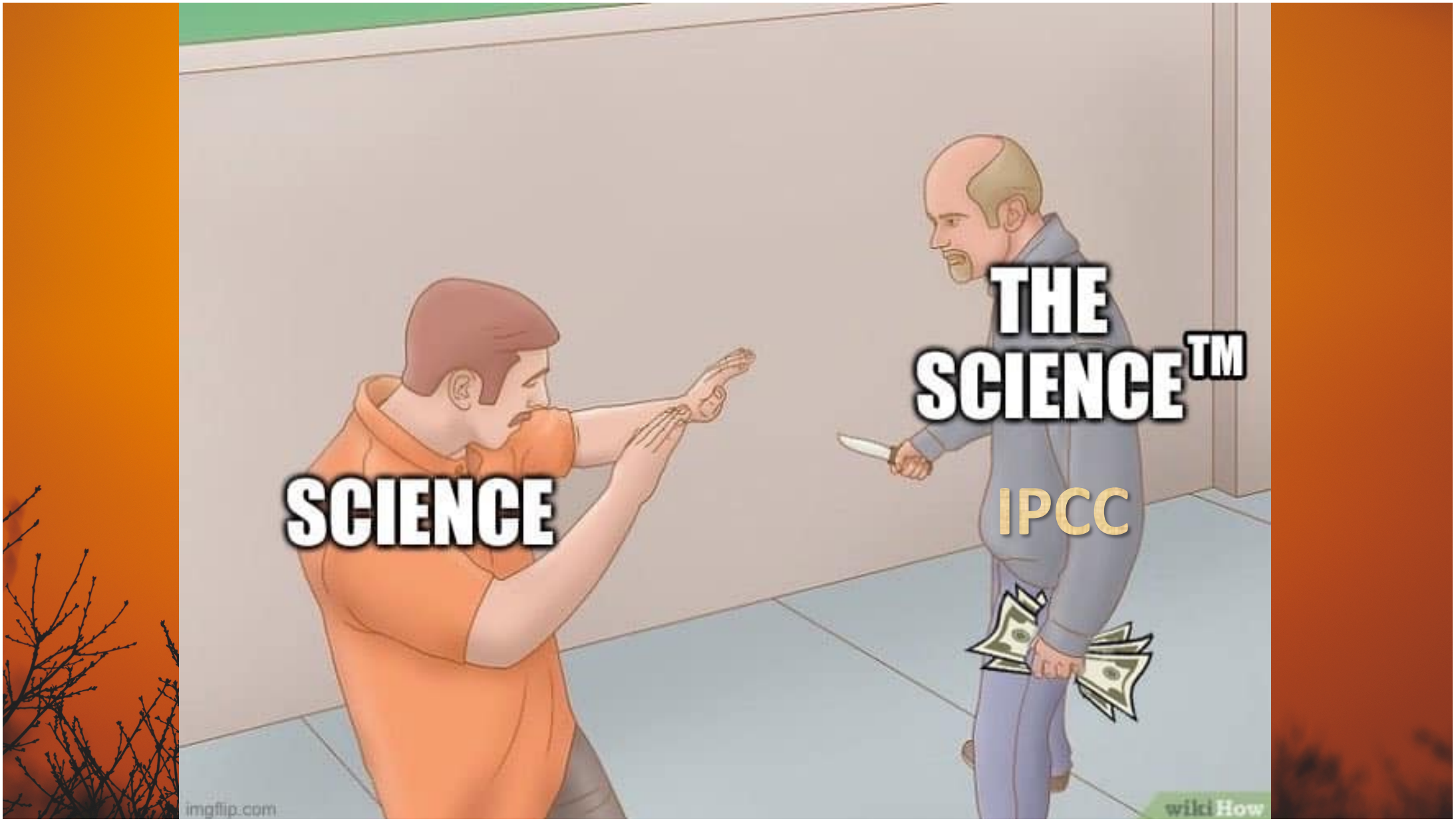
by Dr. Michael Connolly, Dr. Ronan Connolly and Dr. Willie Soon

Center for Environmental Research and Earth Sciences

(www.ceres-science.com)

June 14, 2024

EIKE's 16th International Climate Conference, Vienna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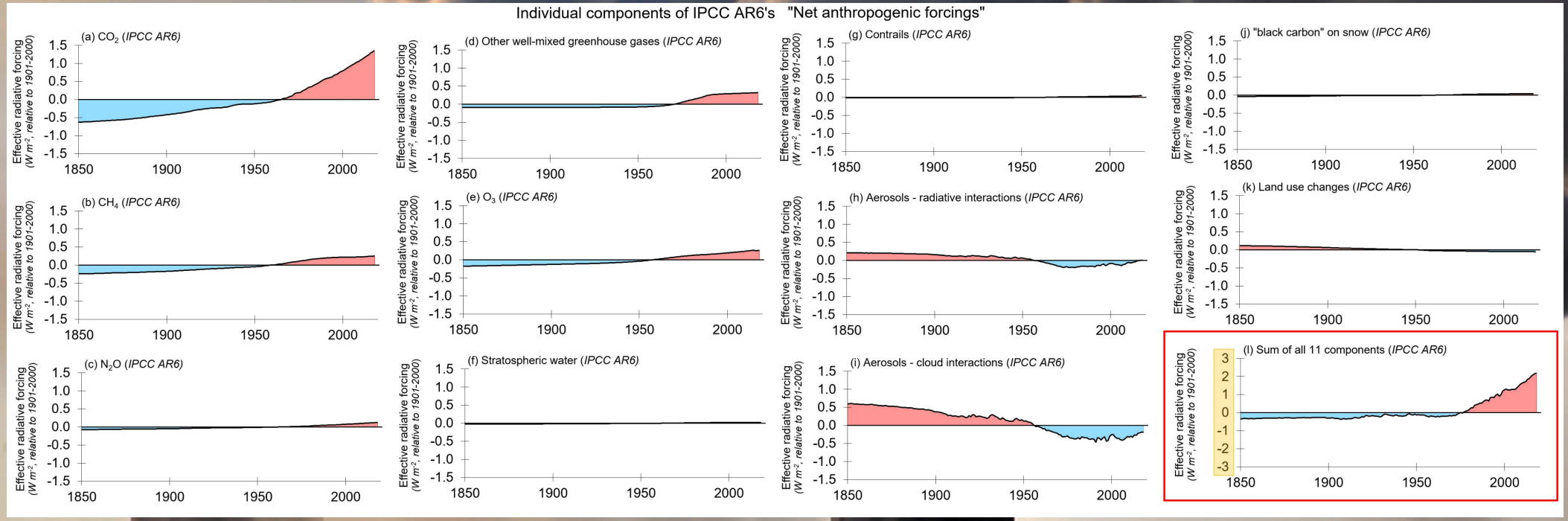
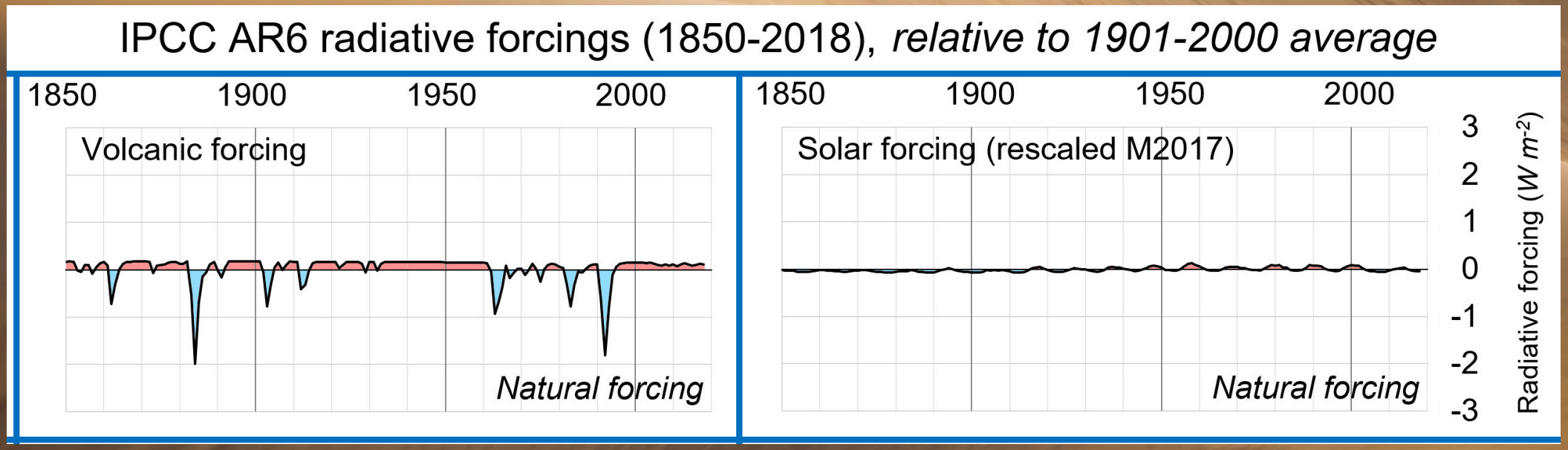
The IPCC's attribution process

- The computer model hindcasts used by the IPCC for their attribution involve plugging two types of climatic drivers:
  - natural factors and human-caused ("anthropogenic") factors
- IPCC describe drivers in terms of "radiative forcings" in Watts per m^2
- The hindcasts only consider two natural climatic drivers ("solar" and "volcanic")
- But, they consider 11 human-caused climatic drivers (mostly greenhouse gases and aerosol particles)

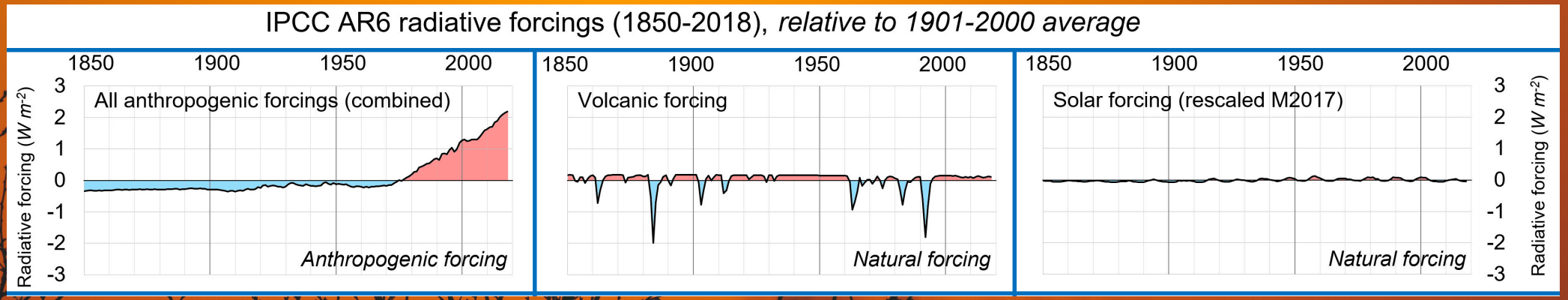
The IPCC thinks human-activities are the 11 smoking guns



They are not so interested in finding natural climate drivers



These are <u>all</u> the "natural and anthropogenic" forcings used for the IPCC AR6 hindcasts

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Let me introduce you to Mister BOB:
Bright Orange Ball

The weather-climate system is strictly powered by solar energy

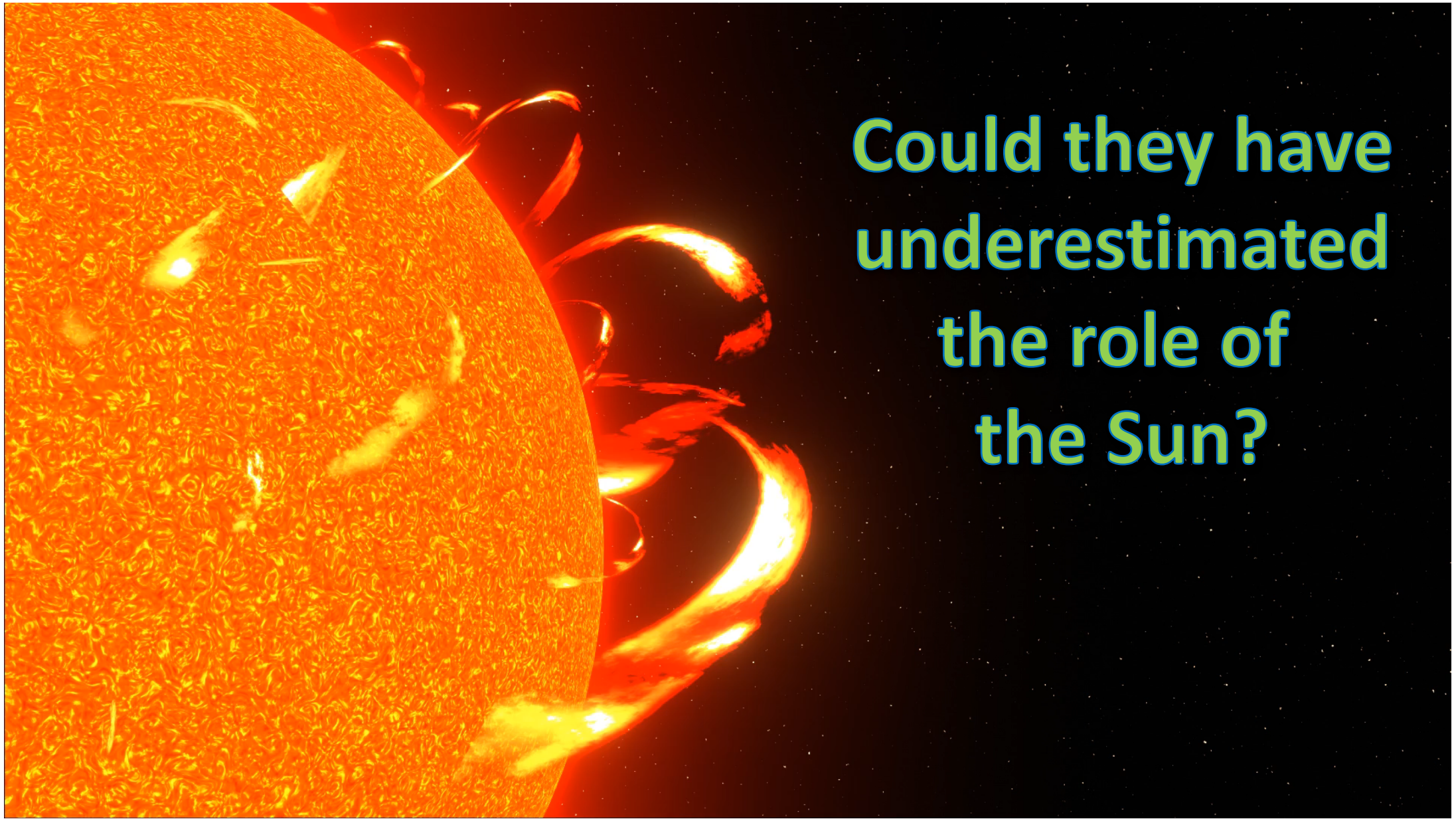
Power: 4×10^{26} W (Earth is 2 billion times weaker) 2×10^{17} W

radiogenic heat = 2×10^{13} W

(world's most powerful laser: 5-10 x 10^{15} W; 100 petawatts pulse coming*)

Adapted from Jurg Beer 2007's presentation

*Ruxin Li, Shanghai Superintense Ultrafast Laser Facility (January 24, 2018 Science Magazine News)

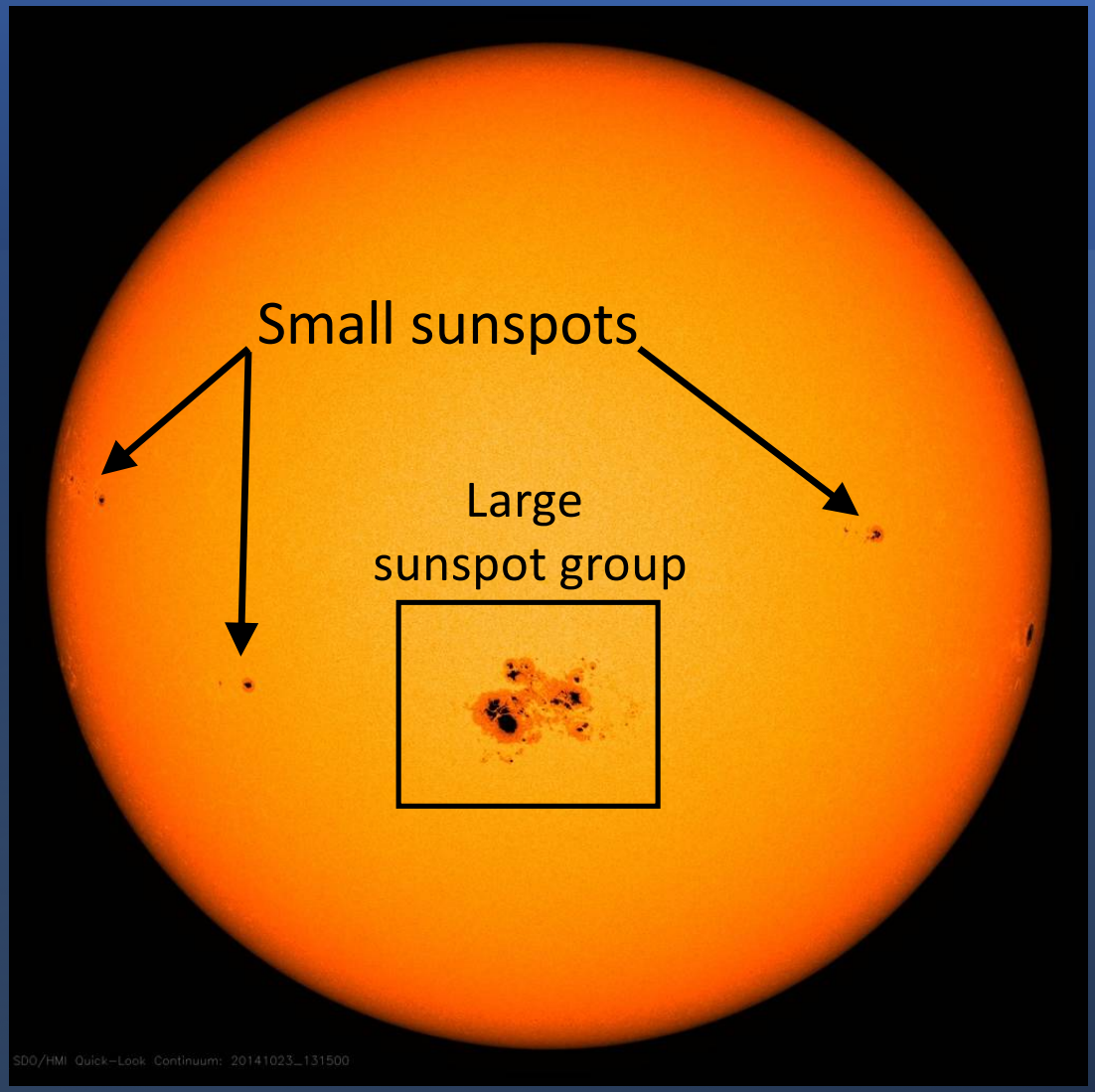

Could they have
underestimated
the role of
the Sun?

Oldest noticed feature on the Sun: “Sunspots”

Source: NASA GSFC

“Cosmic Cycles: The Sun” (https://svs.gsfc.nasa.gov/14313)

Some “sunspots”



Source: NASA

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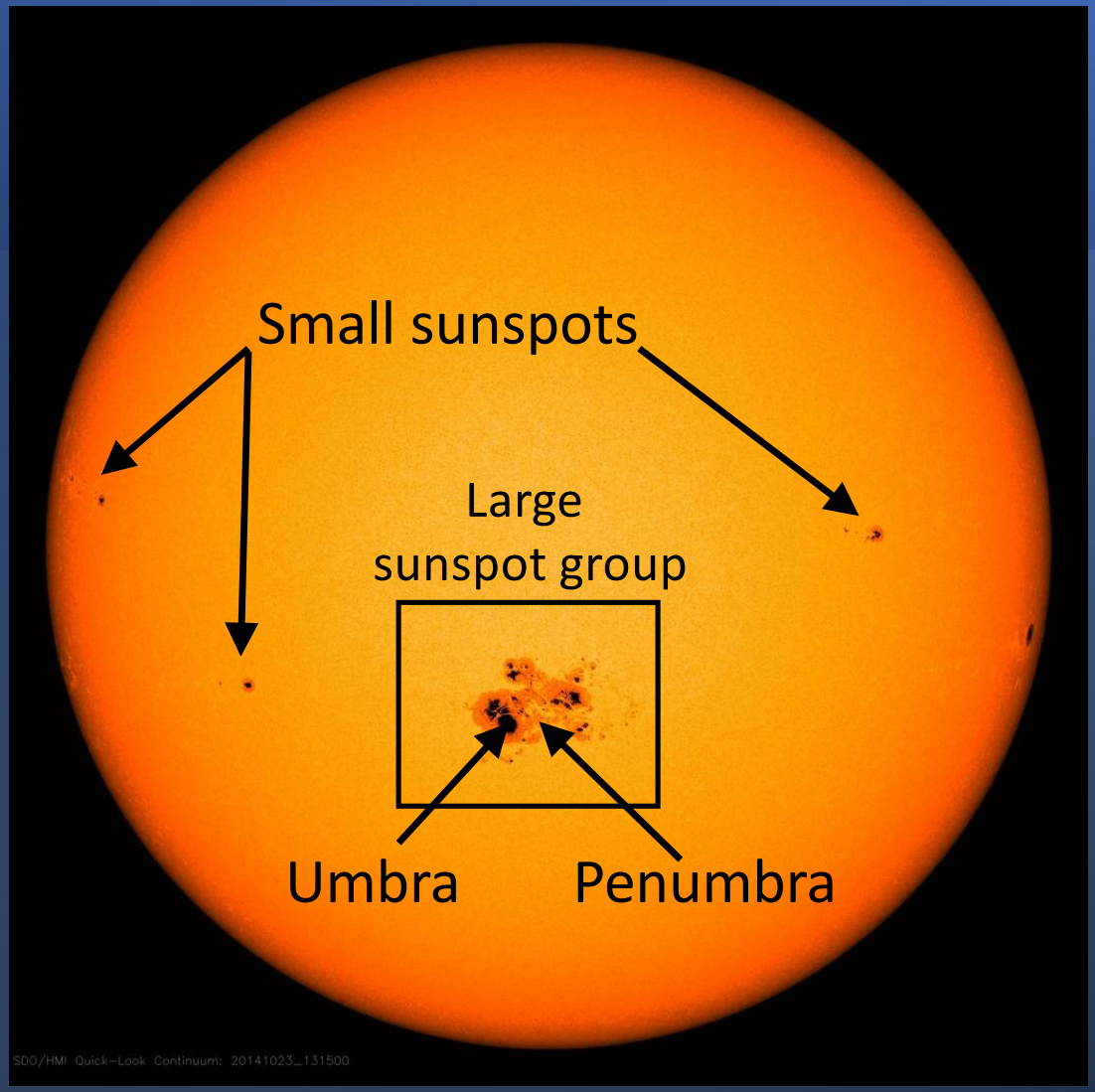
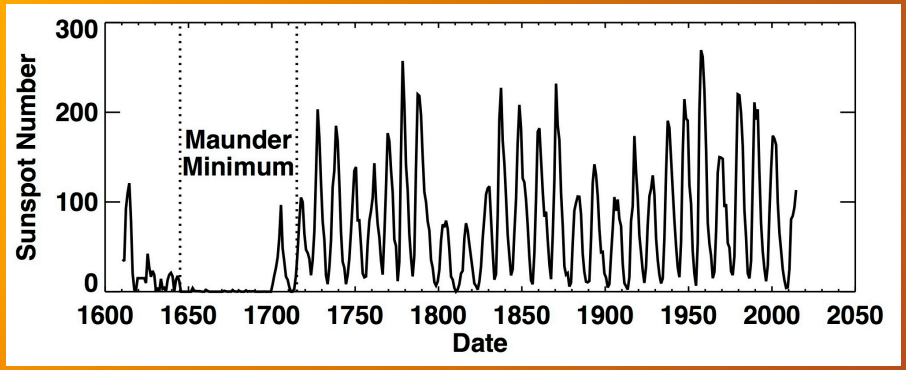


Source: NASA

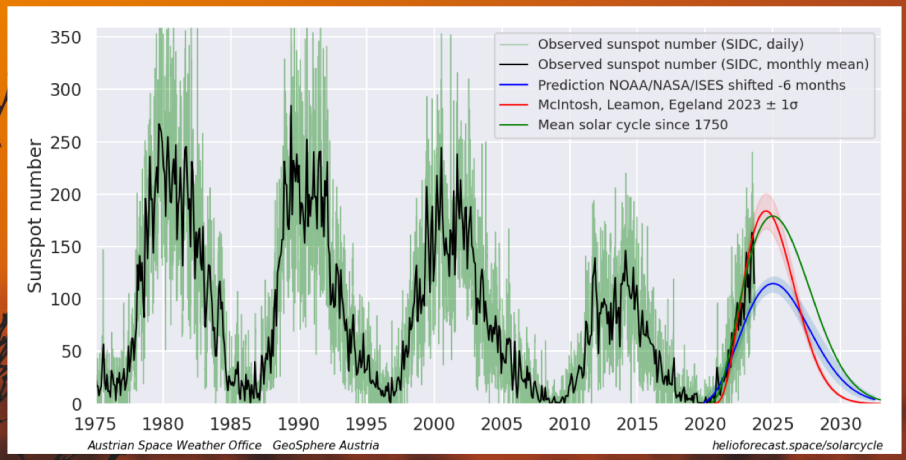
Sunspots have been recorded since Galileo

- Galileo noticed dark spots on the Sun with his early telescope in 1610 – called “sunspots”
- Number of sunspots increases to a maximum and then decreases to zero over a **roughly** 11 year cycle (“Sunspot cycle” or “solar cycle”)
- Sunspots disappeared from 1645-1715 (“Maunder Minimum”), but then reappeared
- Sunspot numbers (SSN) are clearly a measure of solar activity – but not a direct measurement of TSI – just a “solar proxy”
- There are other solar proxies, e.g., Ca(II)+H/K emission lines, penumbra/umbra ratios, etc.

Yearly sunspots (Galileo to present)



Daily sunspots (1975 to the future!)



Cliver et al.'s ongoing efforts to flatten the long-term SSN curve

RECALIBRATING THE SUNSPOT NUMBER (SSN): THE SSN WORKSHOPS

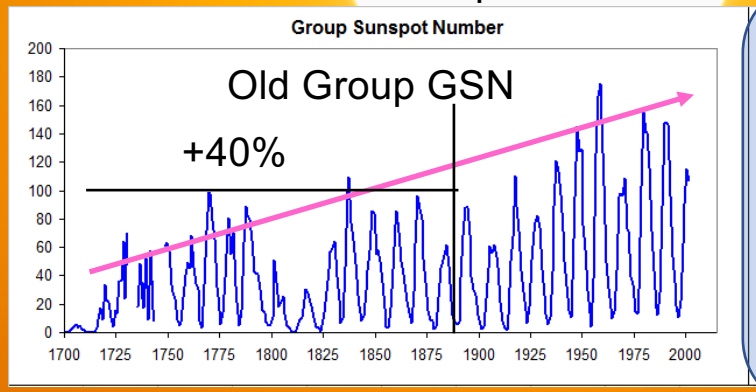
E. W. CLIVER[1], F. CLETTE[2] and L. SVALGAARD[3]

[1] *Space Vehicles Directorate, Air Force Research Laboratory, Sunspot, NM, 88349 USA*
[2] *Solar Influences Data Center, Royal Observatory of Belgium, 3 Rue Circulaire, 1180 Brussels, Belgium*
[3] *W.W. Hansen Experimental Physics Laboratory, Stanford University, Stanford, CA 94305 USA*

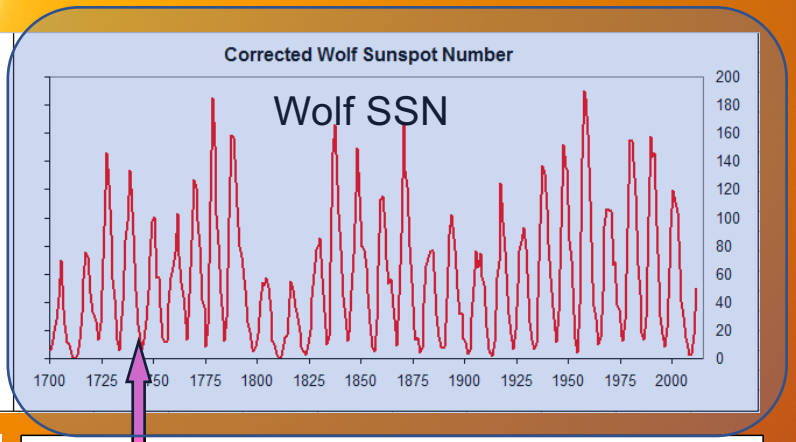
As can be seen from the references in the Schmidt *et al.* (2012) paper mentioned above, the Group SSN is widely used today. The acceptance of R_G is based on two factors. Since R_G was based on a critical assessment of R_I, it is implicit that "new" is "improved". Equally as important, R_G is based on a more extensive data set. As noted, for example, by Owens & Lockwood (2012), "Where possible, we use group sunspot number, R_G [Hoyt and Schatten, 1998], as it represents a more complete record than Zürich/International sunspot, R_Z, particularly prior to 1850 [Hathaway *et al.*, 2002]."

Cliver & co.: Can we heat up the past to match the present? Yes, we can!

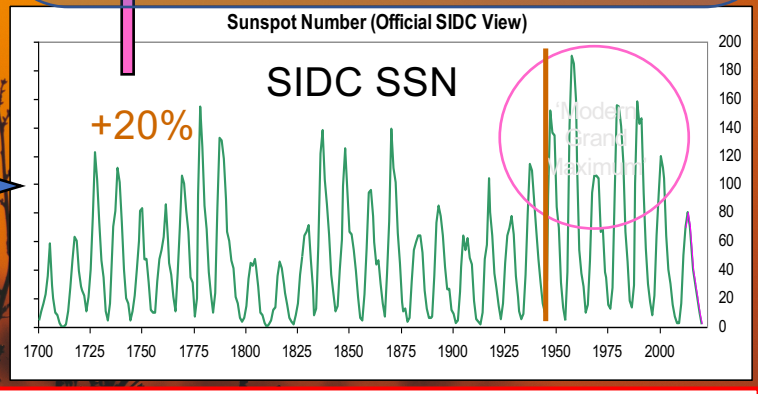
GSN = 12 * Groups



WSN = 10 * Groups + Spots



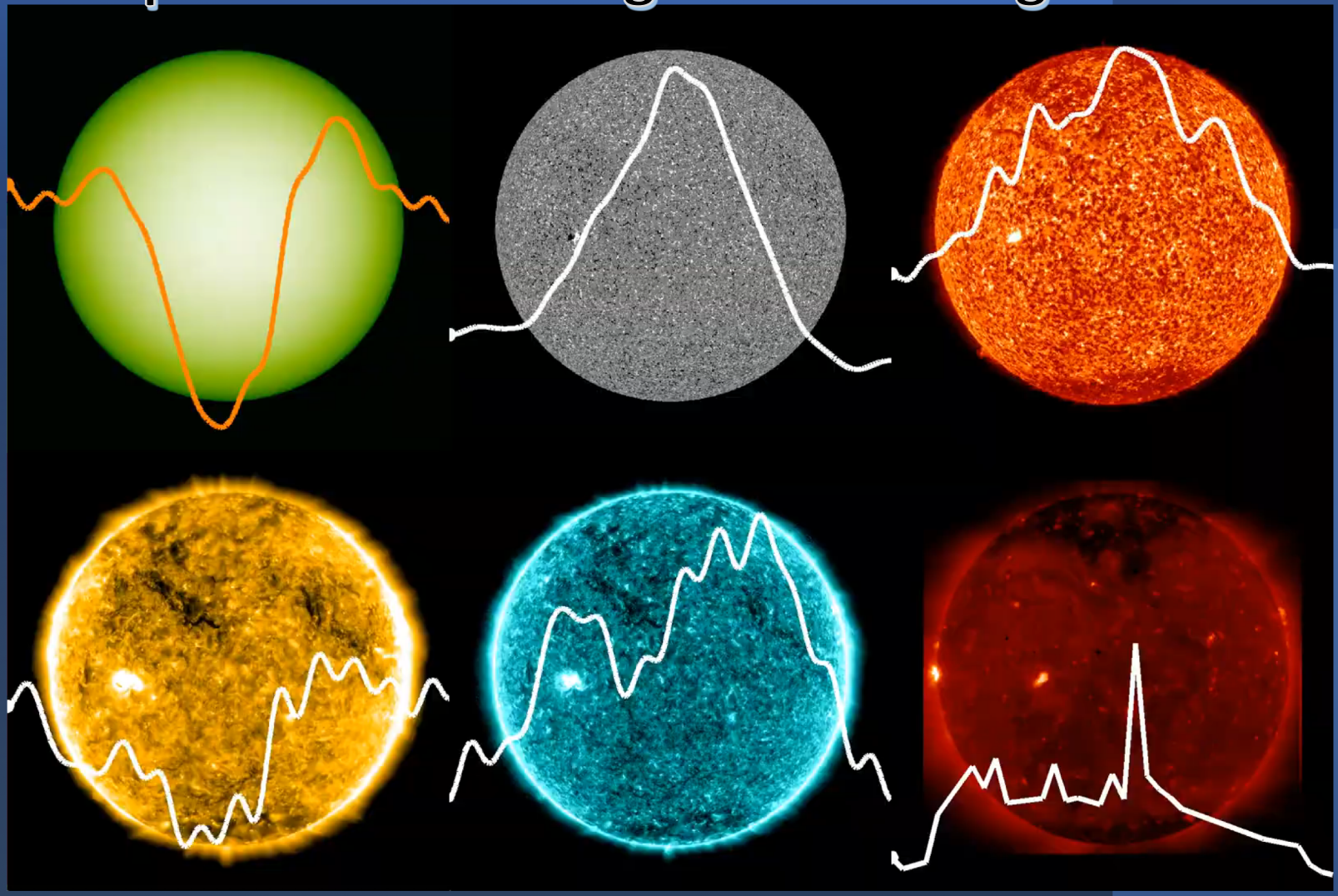
The old 'official' sunspot number [maintained by SIDC in Brussels] showed a clear 'Modern Maximum' in the last half of the 20th century.



Correct GSN by +40% before ~1882
Correct WSN by -20% after 1946, because of weighting of the count introduced then (the Waldmeier Jump)

The new SSN series suggest that there likely was no Modern Grand Maximum

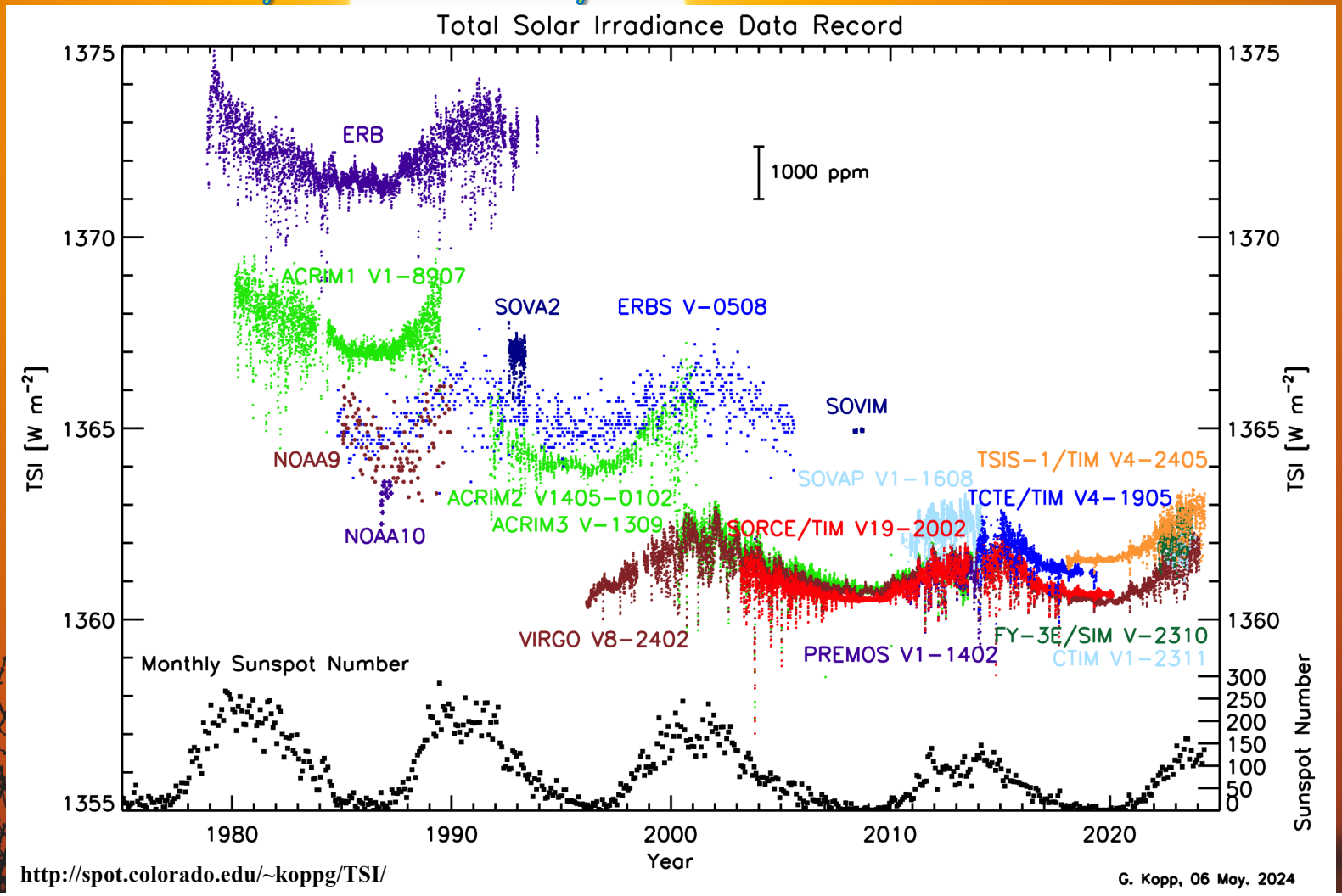
Different aspects of solar magnetism during solar rotation



Source: NASA

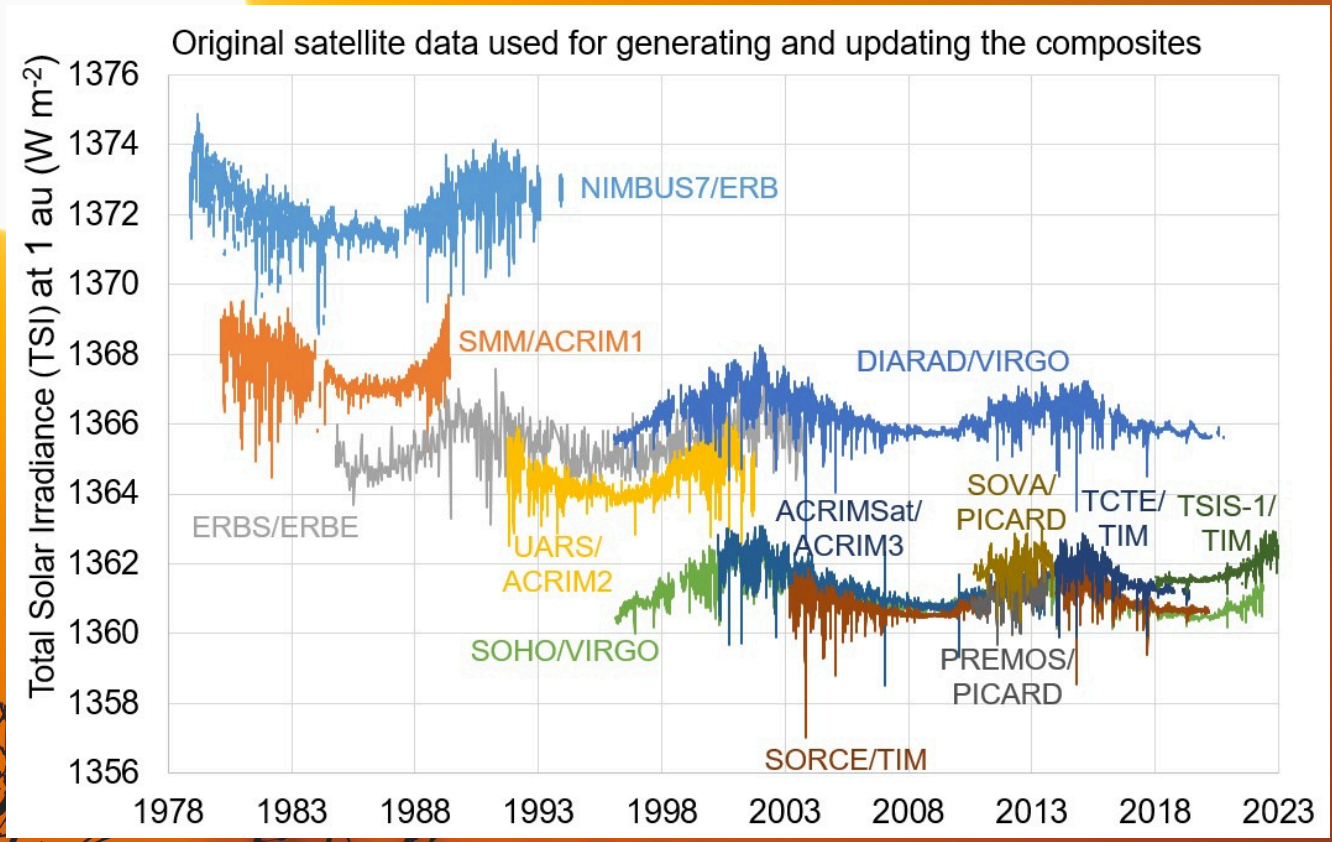
https://www.nasa.gov/feature/goddard/2020/a-new-look-at-sunspots-is-helping-nasa-scientists-understand-major-flares-and-life-around/

Thirteen instruments with 13 TSI values: How do you correctly normalize them all?



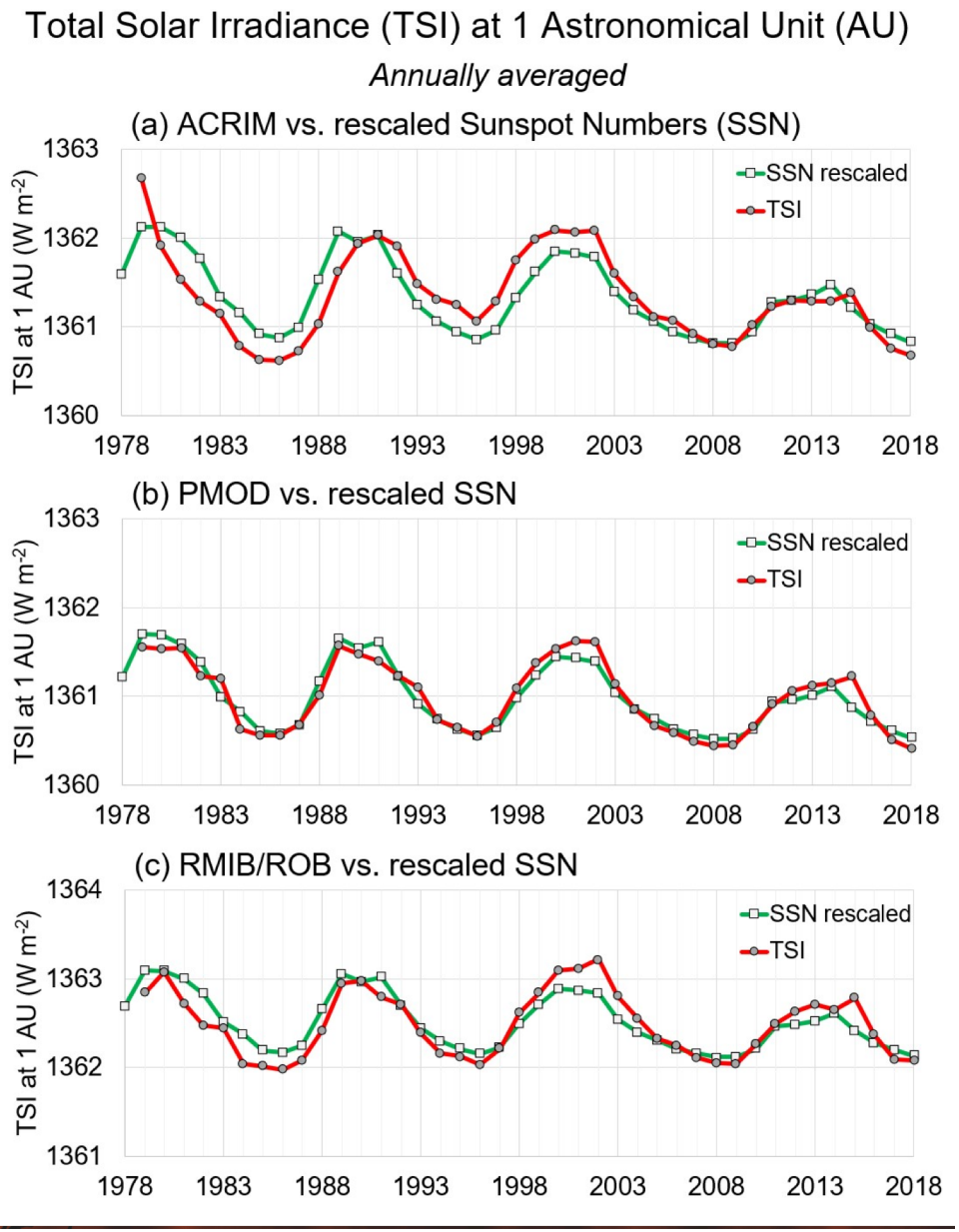
The satellite era TSI problem!

- Direct measurements of Total Solar Irradiance (TSI) above the Earth's atmosphere **only** began in 1978
- Each satellite only lasts 10-15 years. And implies a different average TSI!
- All capture the up/down roughly 11 year sunspot cycle.
- But, each shows different trends between cycles.

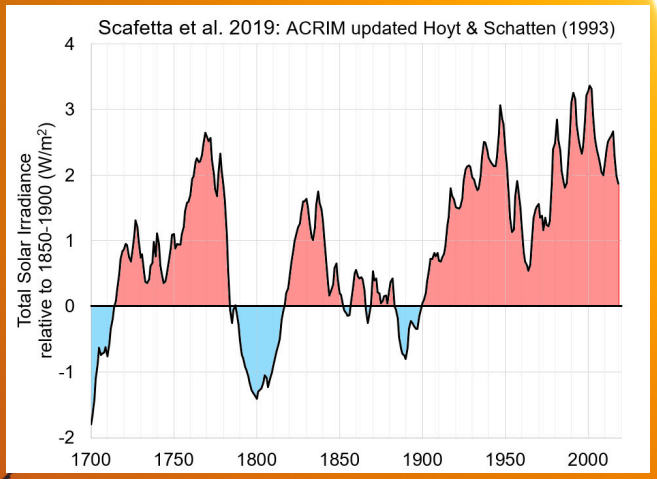


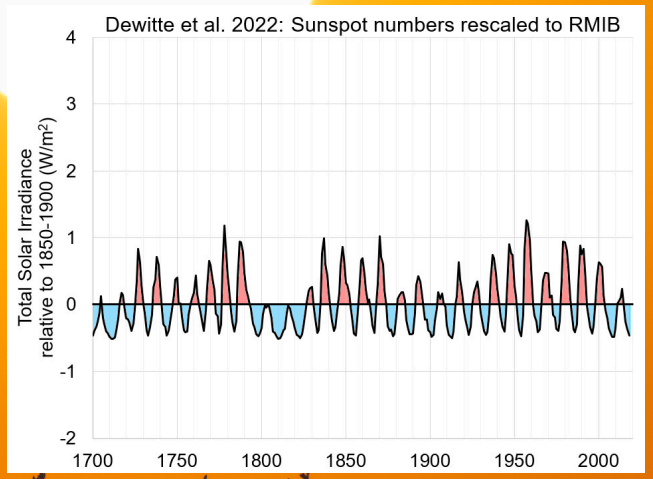
Using satellite TSI composites to calibrate solar proxies

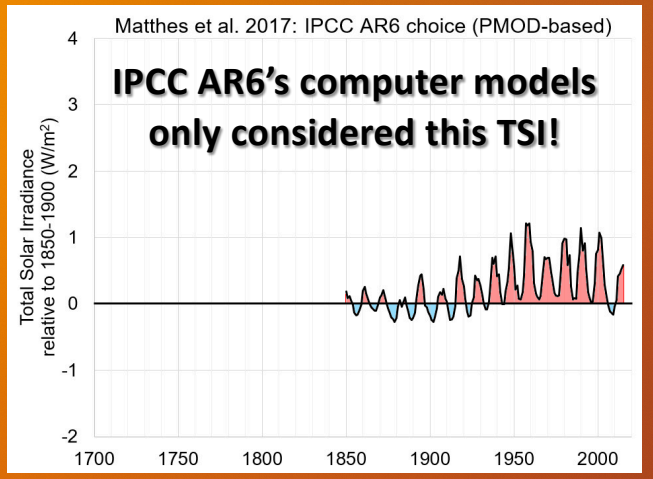
- By scaling a solar proxy to match TSI in the satellite era, you can extend the rescaled proxy TSI values for the entire solar proxy record
- But, the solar proxies do not capture all of the observed TSI variability during the satellite era – so they might be missing important trends for the pre-satellite era too
- PMOD matches almost exactly to SSN. PMOD-scaled reconstructions are simple! Just SSN and maybe 1 or 2 more proxies
- ACRIM suggests multiple different solar proxies needed – SSN is important but not enough!



Using satellite TSI composites to calibrate solar proxies: Three examples of very different TSI estimates





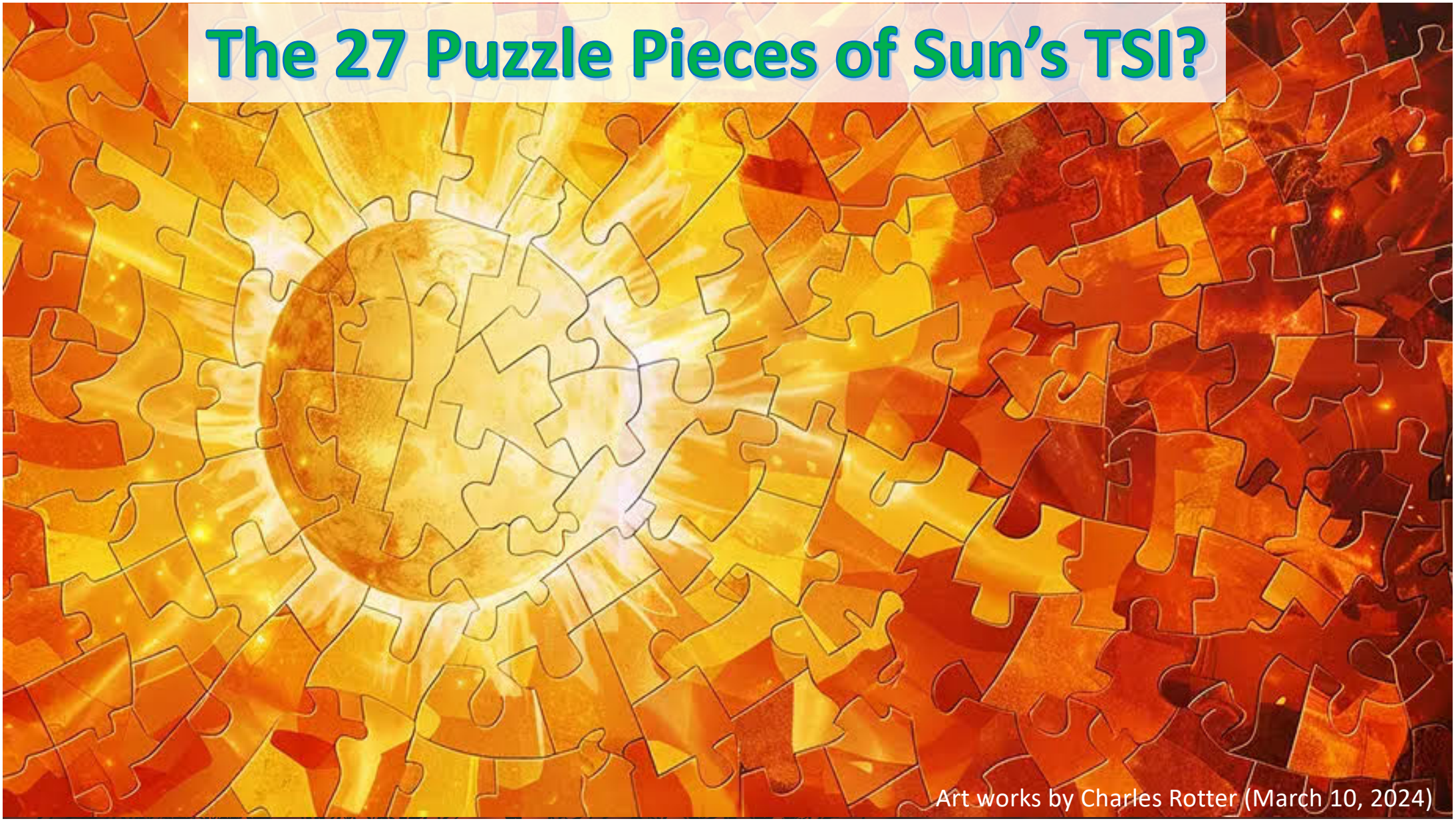


ACRIM-calibrated
5 solar proxies used

RMIB-calibrated
1 solar proxy used (SSN)

PMOD-calibrated
2-3 solar proxies used

The 27 Puzzle Pieces of Sun's TSI?



Art works by Charles Rotter (March 10, 2024)

Which of the 27 estimates is correct?

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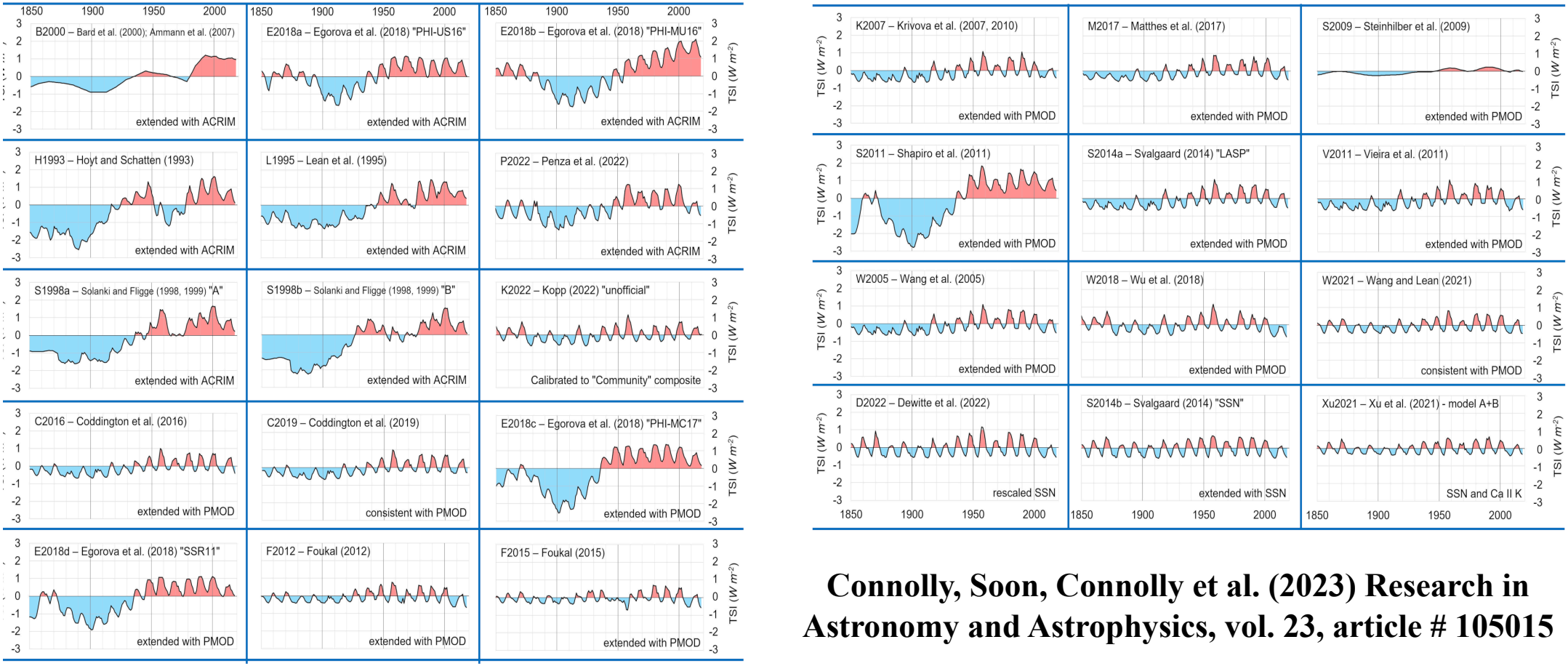
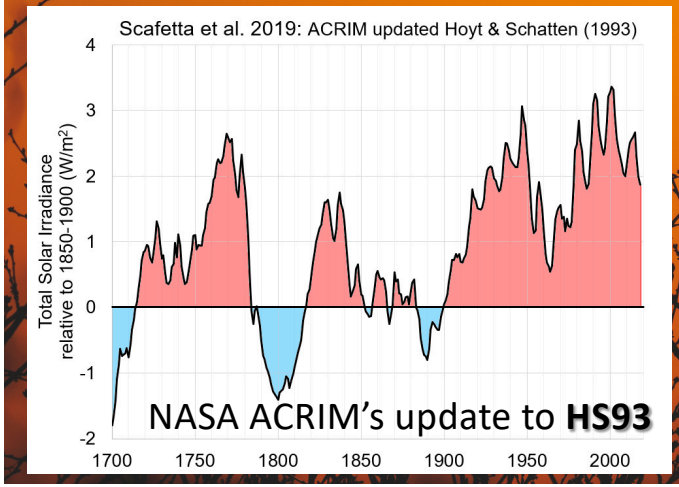
TSI reconstructions (1850-2018), *relative to 1901-2000 average*



Connolly, Soon, Connolly et al. (2023) Research in Astronomy and Astrophysics, vol. 23, article # 105015

A brief comment on Chatzistergos (2024)



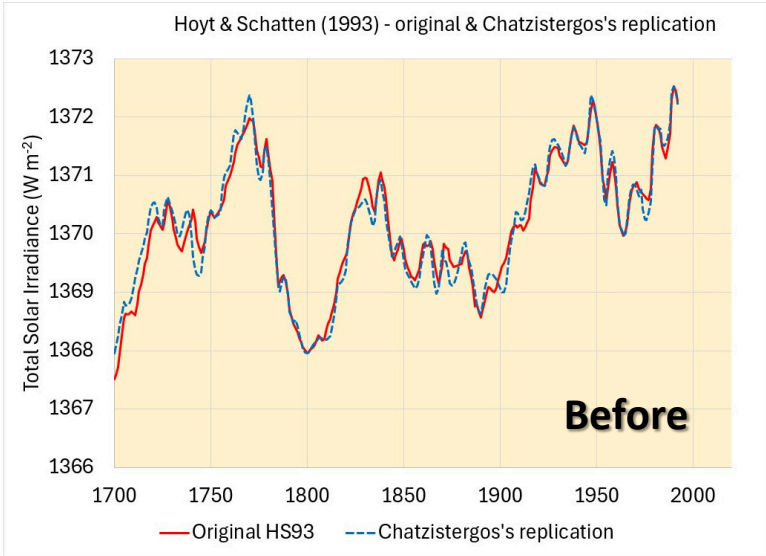
- Matthes et al. (2017) TSI reconstruction used by the IPCC AR6 computer models is average of two IPCC-friendly TSI reconstructions:
  1. NRL TSI 2 – Dr. Judith Lean & colleagues
  2. SATIRE-T – The Max Planck Institute for Solar System Research (MPS) team (led by Krivova & Solanki)

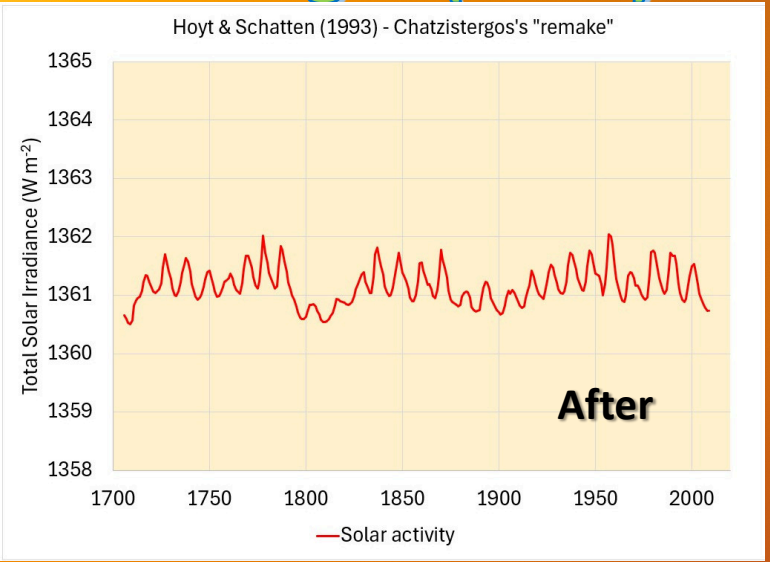
- In one of our 2023 papers, we explicitly contrasted Matthes et al. (2017) to NASA ACRIM's 2019 update to Hoyt & Schatten (1993) – "**HS93"** for short. We showed that if the IPCC AR6 modellers had used HS93 (as IPCC AR3 and AR4 had done), they would **not** have said global warming was mostly human-caused.

- In February 2024, Dr. Theodosios Chatzistergos (he/him), a post-doc at MPS who did his PhD for Krivova & Solanki, published a paper in which he claimed to have carried out his own "update" of HS93 and got it to match the SATIRE-T reconstruction:

  - T. Chatzistergos (2024). "A Discussion of Implausible Total Solar-Irradiance Variations Since 1700". *Solar Physics*, 299, 21. https://doi.org/10.1007/s11207-024-02262-6

A brief comment on Chatzistergos (2024)





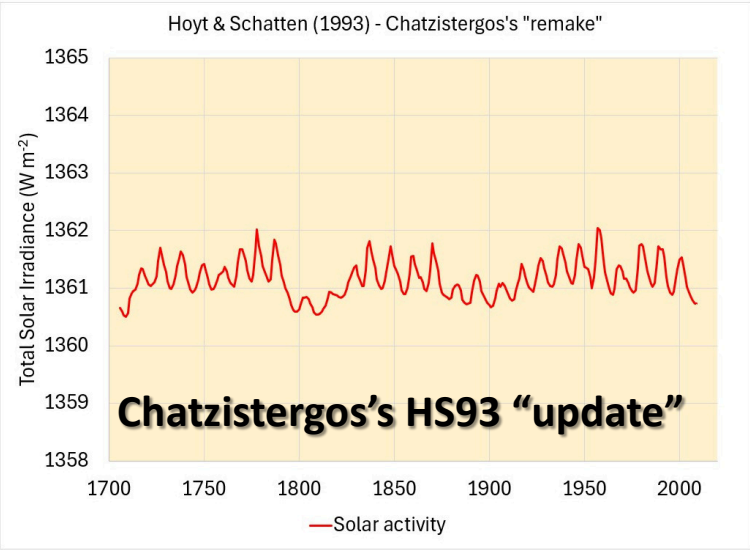
Chatzistergos took several steps for his “update” to HS93:

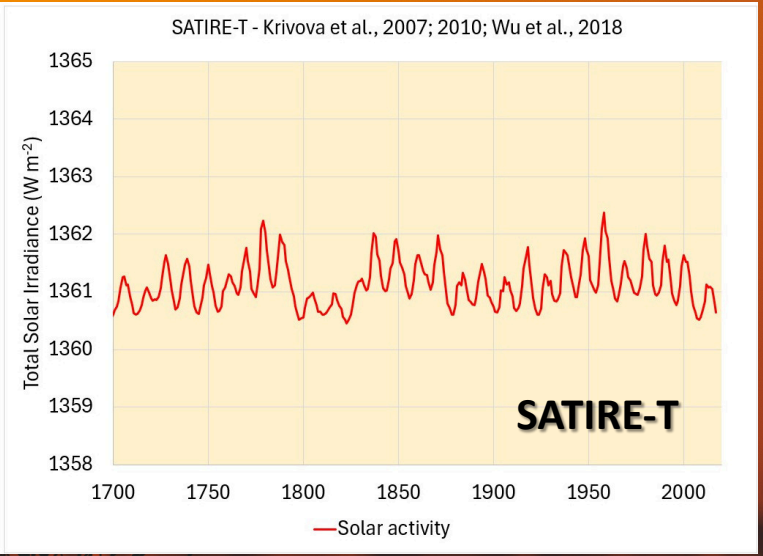
1. He digitized the various solar proxy records used by HS93 (1700-1992)
2. He replaced each of the proxy records with his (subjective) decisions on what he considered to be a more up-to-date version of the records. [**Note**: Douglas Hoyt has confirmed to us that he disputes almost every one of Chatzistergos’s proposed “updates”]
3. Chatzistergos then combined the proxies into a single TSI time series using approaches that he preferred (rather than the approach used by HS93).

A brief comment on Chatzistergos (2024)

- Chatzistergos notes that his “update” to HS93 is similar to SATIRE-T (actually not surprising because his TSI composite methodology is similar to SATIRE-T). For this reason, he claims that:
  1. Any studies (including ours) that used NASA ACRIM’s update to HS93 are somehow invalidated
  2. Studies that only consider TSI reconstructions like those of his bosses (at MPS) or the NRL group, e.g., the IPCC AR6 report, are validated.

- Wow! Is he/him right? Has he/him really shown us to be fools?

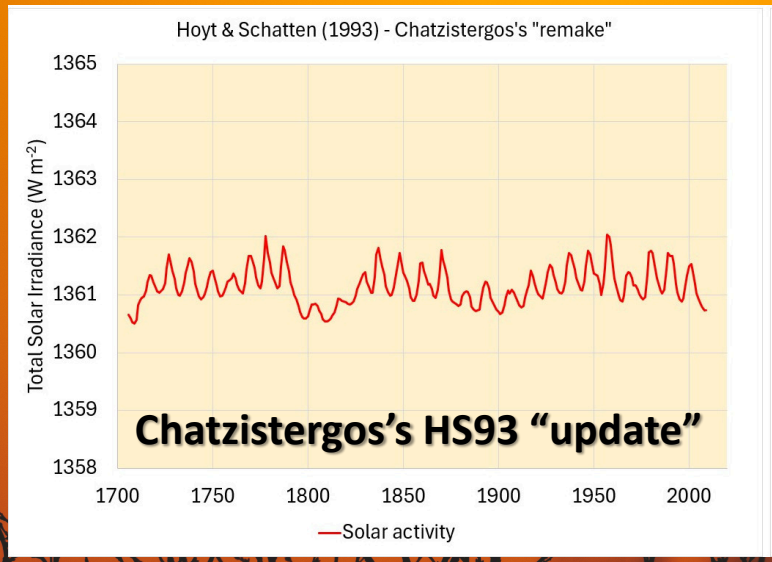


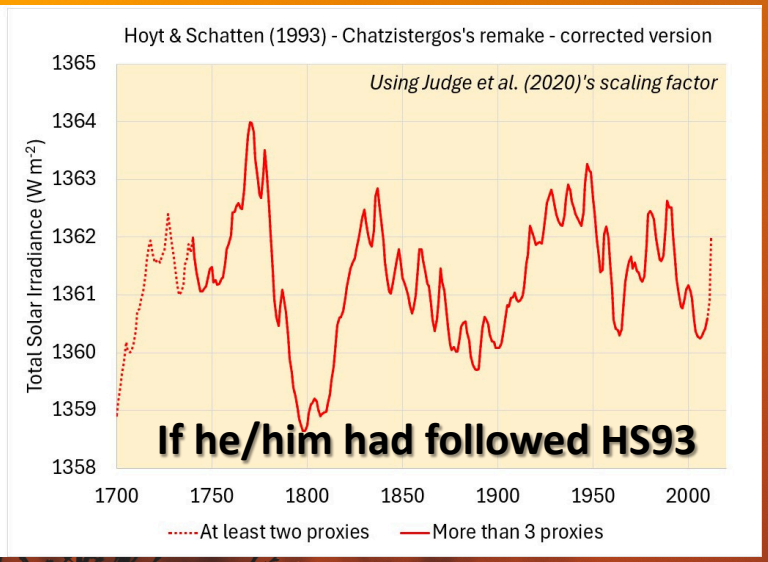


A brief comment on Chatzistergos (2024)

- No, we are **not** impressed. His “update” is more of a “remake” that a true update.

1. Each of the updates to the individual solar proxies were debatable… and in his communications with Hoyt, Hoyt repeatedly pointed out problems with Chatzistergos’s proposed “updates”, but these were ignored
2. Even if Chatzistergos’s updates to the individual proxies were valid (which is debatable!), his methodology for combining them into a multi-proxy TSI reconstruction completely dismissed the methodology and philosophy of HS93. If he/him had genuinely followed HS93’s approach, this is what he/him would have found:





- See https://www.ceres-science.com/post/response-to-chatzistergos-2024 for more details

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- IPCC AR4 in 2007 considered 6-10 TSI records: Chapter 2 and Supplementary Materials for Chapter 9

2

Changes in Atmospheric Constituents and in Radiative Forcing

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Piers Forster (UK), Venkatachalam Ramaswamy (USA)

Lead Authors:
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Supplementary Materials

Understanding and Attributing Climate Change

Coordinating Lead Authors:
Gabriele C. Hegerl (USA, Germany), Francis W. Zwiers (Canada)

Lead Authors:
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Table 2.10. *Comparison of the estimates of the increase in RF from the 17th-century Maunder Minimum (MM) to contemporary solar minima, documenting new understanding since the TAR.*

Reference	Assumptions and Technique	RF Increase from the Maunder Minimum to Contemporary Minima (W m^{-2})[a]	Comment on Current Understanding
Schatten and Orosz (1990)	Extrapolation of the 11-year irradiance cycle to the MM, using the sunspot record.	~ 0	Irradiance levels at cycle minima remain approximately constant.
Lean et al. (1992)	No spots, plage or network in Ca images assumed during MM.	0.26	Maximum irradiance increase from a non-magnetic sun, due to changes in known bright features on contemporary solar disk.
Lean et al. (1992)	No spots, plage or network and reduced basal emission in cell centres in Ca images to match reduced brightness in non-cycling stars, assumed to be MM analogues.	0.45	New assessment of stellar data (Hall and Lockwood, 2004) does not support original stellar brightness distribution, or the use of the brightness reduction in the Baliunas and Jastrow (1990) ‘non-cycling’ stars as MM analogues.
Hoyt and Schatten (1993)[b]	Convective restructuring implied by changes in sunspot umbra/penumbra ratios from MM to present: amplitude of increase from MM to present based on brightness of non-cycling stars, from Lean et al. (1992).	0.65	As above
Lean et al. (1995)	Reduced brightness of non-cycling stars, relative to those with active cycles, assumed typical of MM.	0.45	As above
Solanki and Fligge (1999)[b]	Combinations of above.	0.68	As above
Lean (2000)	Reduced brightness of non-cycling stars (revised solar-stellar calibration) assumed typical of MM.	0.38	As above
Foster (2004) Model	Non-magnetic sun estimates by removing bright features from MDI images assumed for MM.	0.28	Similar approach to removal of spots, plage and network by Lean et al. (1992).
Y. Wang et al. (2005)[b]	Flux transport simulations of total magnetic flux evolution from MM to present.	0.1	Solar model suggests that modest accumulation of magnetic flux from one solar cycle to the next produces a modest increase in irradiance levels at solar cycle minima.
Dziembowski et al. (2001)	Helioseismic observations of solar interior oscillations suggest that the historical Sun could not have been any dimmer than current activity minima.	~ 0	

SOL = solar irradiance
L95: Lean et al. (1995).
L95 (C00): temporally varying solar constant based on Lean et al. (1995) (Crowley, 2000).
L00: Lean (2000).
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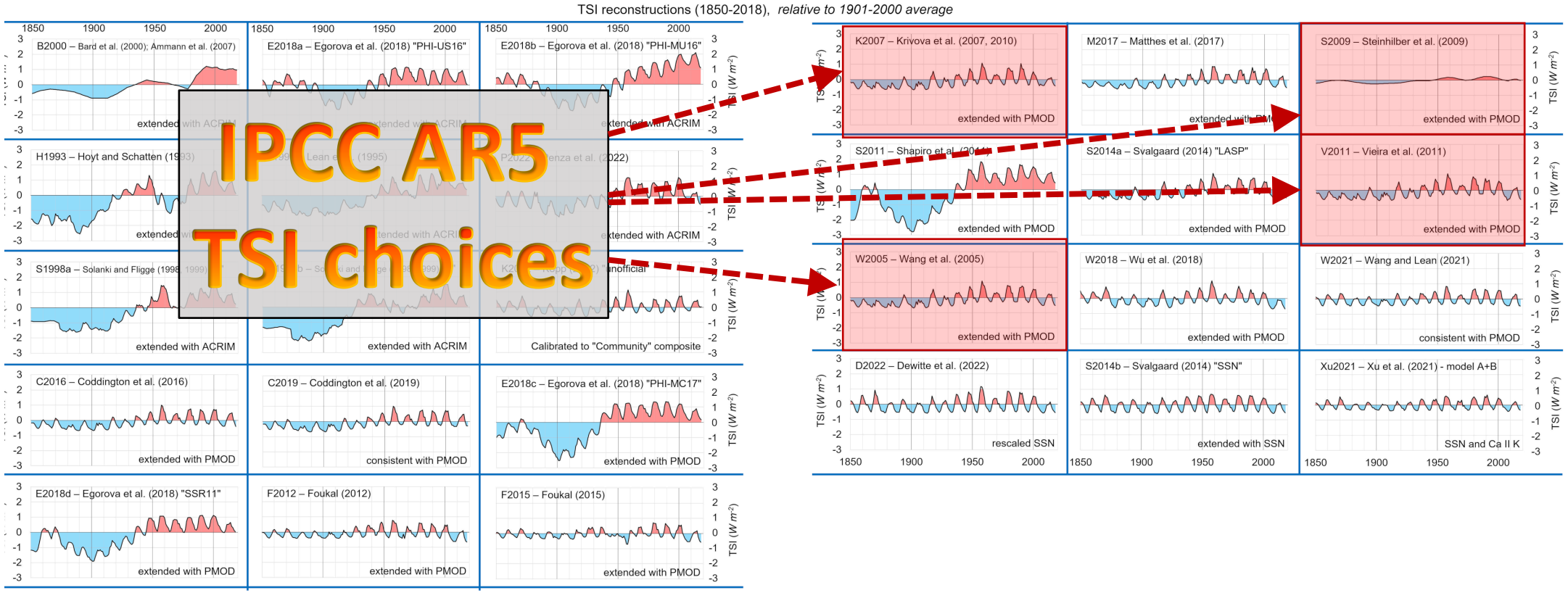
Dziembowski et al. (2001)	Helioseismic observations of solar interior oscillations suggest that the historical Sun could not have been any dimmer than current activity minima.	~ 0	

SOL = solar irradiance
L95: Lean et al. (1995).
L95 (C00): temporally varying solar constant based on Lean et al. (1995) (Crowley, 2000).
L00: Lean (2000).
L02: Lean et al. (2002).
HS: Hoyt and Schatten (1993).
SK: Solanki and Krivova (2003).

Note that HS93 was one of the main TSI reconstructions considered in IPCC AR4 (2007)

Which of the 27 estimates is correct?

- We compiled 27 different TSI estimates and updated them all to cover period 1850-2018
- 8 ACRIM, 15 PMOD, 1 “Community” composite and 3 “SSN-based” estimates
- IPCC AR5 considered 4 of these: K2007, S2009, V2011 and W2005
- IPCC AR6 only considered 1 of them: M2017 (the average of C2016 and K2007)



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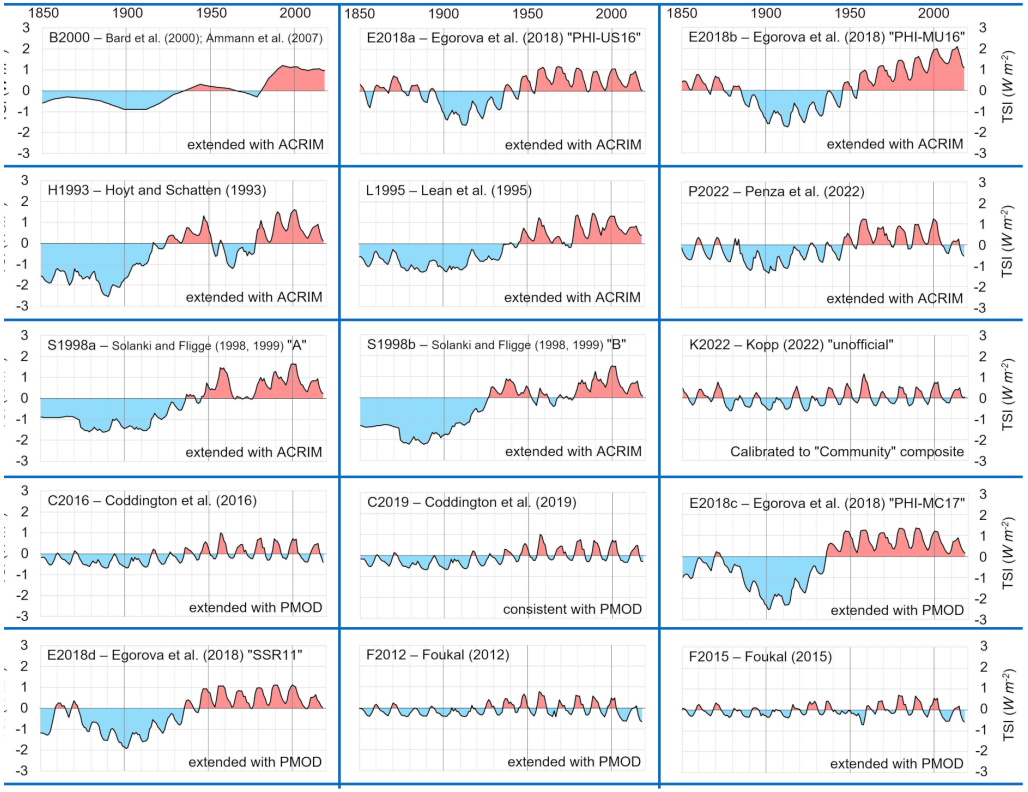
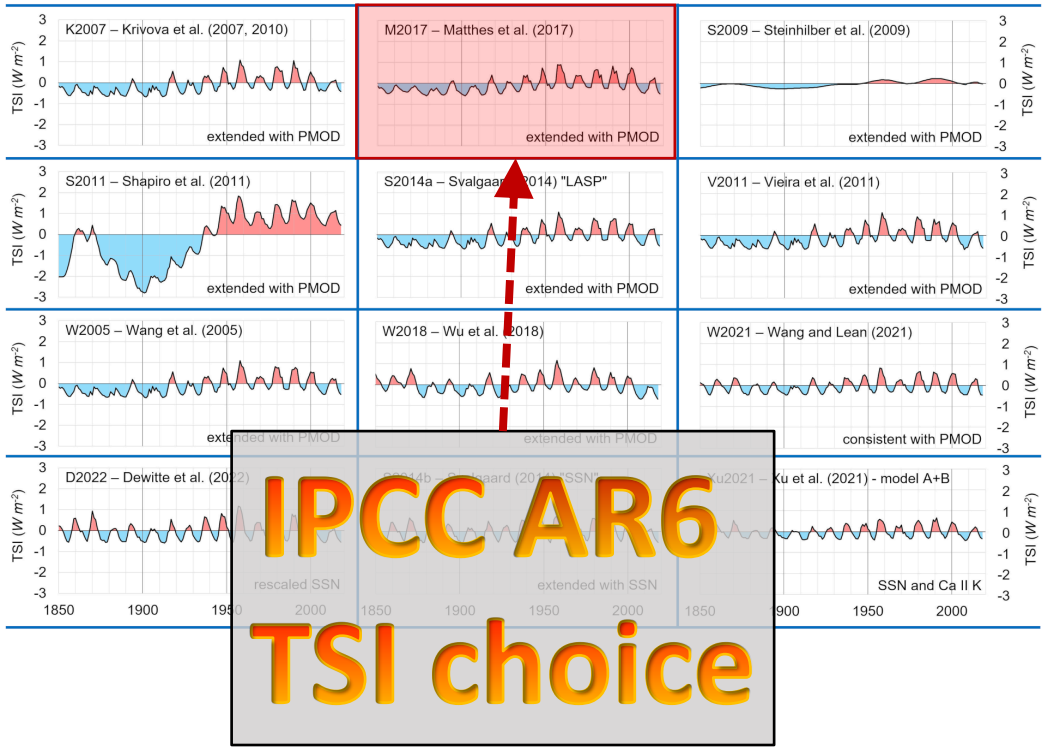
TSI reconstructions (1850-2018), *relative to 1901-2000 average*





IPCC AR6 TSI choice

Which of the 27 estimates is correct?

- We compiled 27 different TSI estimates and updated them all to cover period 1850-2018
- 8 ACRIM, 15 PMOD, 1 “Community” composite and 3 “SSN-based” estimates
- IPCC AR5 considered 4 of these: K2007, S2009, V2011 and W2005
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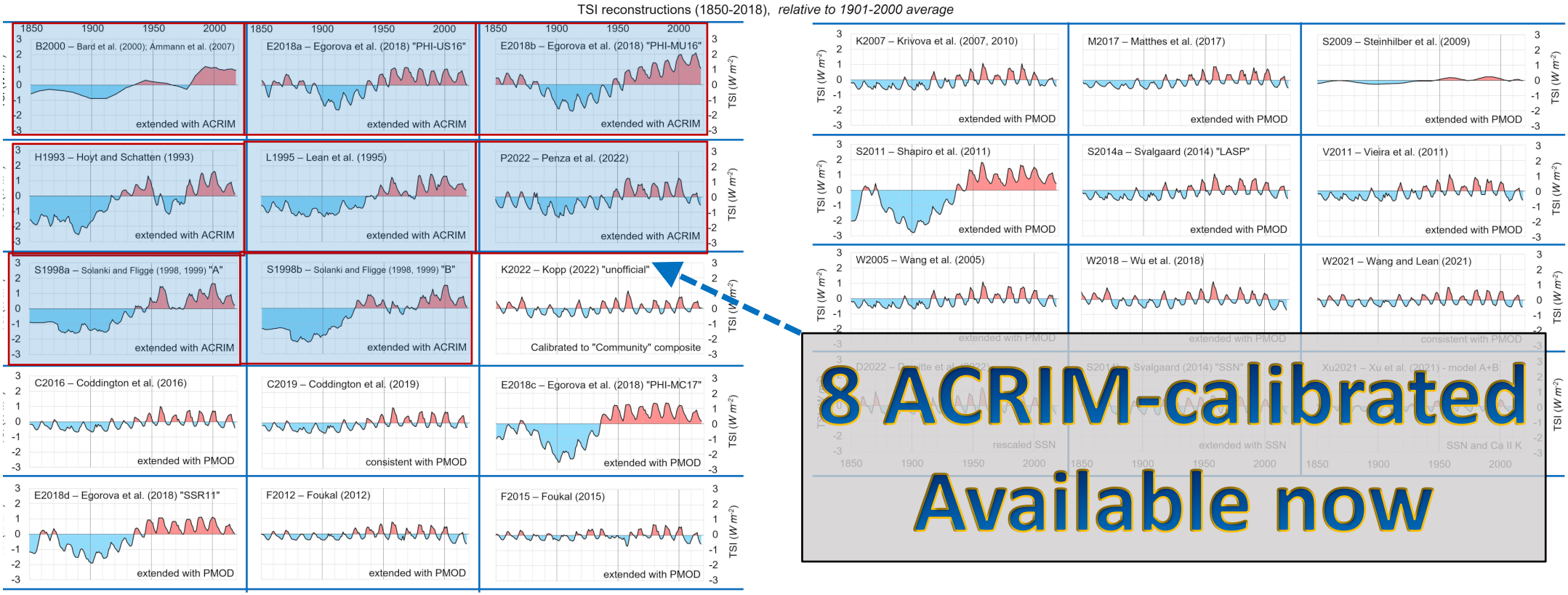
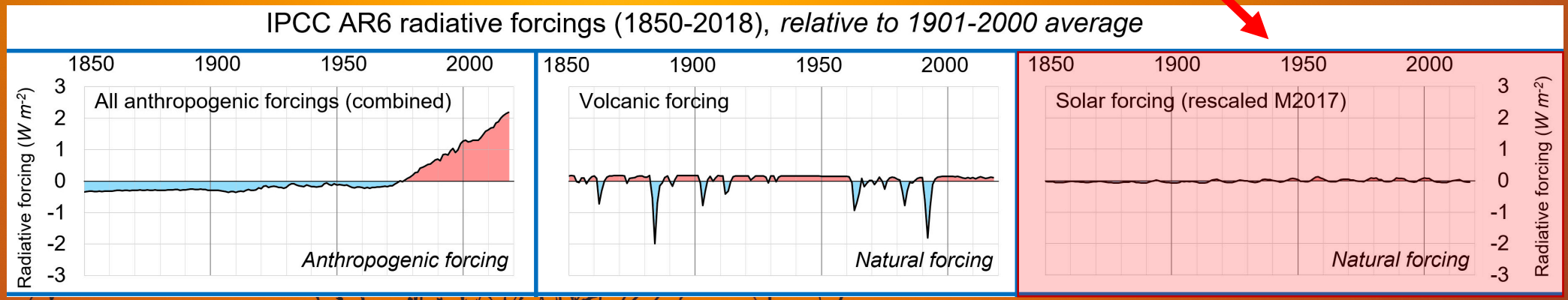
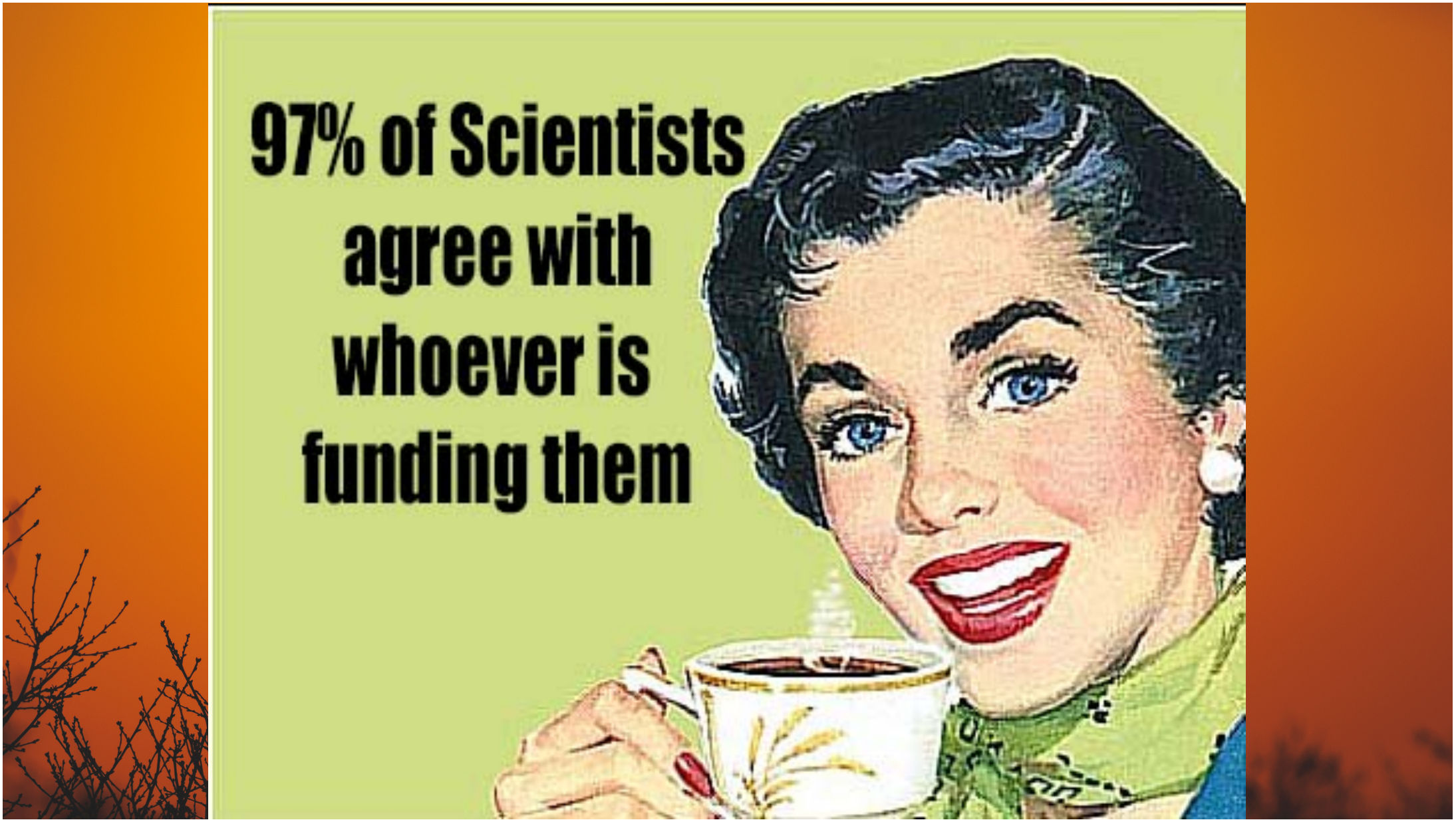


8 ACRIM-calibrated

Available now

Can you honestly say IPCC AR6 (2023)'s single choice of TSI is correct?




97% of Scientists
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September 2023

climate

Open Access Article

The Detection and Attribution of Northern Hemisphere Land Surface Warming (1850–2018) in Terms of Human and Natural Factors: Challenges of Inadequate Data

by Willie Soon [1,2], Ronan Connolly [1,3,*], Michael Connolly [1,3], Syun-Ichi Akasofu [4], Sallie Baliunas [5,†], Johan Berglund [6], Antonio Bianchini [7,8], William M. Briggs [9], C. J. Butler [10,†], Rodolfo Gustavo Cionco [11,12], Marcel Crok [13], Ana G. Elias [14], Valery M. Fedorov [15], François Gervais [16], Hermann Harde [17], Gregory W. Henry [18], Douglas V. Hoyt [19], Ole Humlum [20], David R. Legates [21,22,†], Anthony R. Lupo [23], Shigenori Maruyama [24,†], Patrick Moore [25], Maxim Ogurtsov [26,27], Coilín ÓhAiseadha [28], Marcos J. Oliveira [29], Seok-Soon Park [30], Shican Qiu [31], Gerré Quinn [32], Nicola Scafetta [33], Jan-Erik Solheim [34,†], Jim Steele [35,†], László Szarka [2], Hiroshi L. Tanaka [36,†], Mitchell K. Taylor [37], Fritz Vahrenholt [38], Víctor M. Velasco Herrera [39] and Weijia Zhang [40] — Hide full author list

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+ Show full affiliation list
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† Retired.

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https://doi.org/10.1088/1674-4527/acf18e

October 2023

Challenges in the Detection and Attribution of Northern Hemisphere Surface Temperature Trends Since 1850

Ronan Connolly[1,2], Willie Soon[1,3], Michael Connolly[1,2], Sallie Baliunas[4], Johan Berglund[5], C. J. Butler[6], Rodolfo Gustavo Cionco[7,8], Ana G. Elias[9,10], Valery M. Fedorov[11], Hermann Harde[12], Gregory W. Henry[13], Douglas V. Hoyt[14], Ole Humlum[15], David R. Legates[16], Nicola Scafetta[17], Jan-Erik Solheim[18], László Szarka[3], Víctor M. Velasco Herrera[19], Hong Yan[20], and Weijia Zhang[21]

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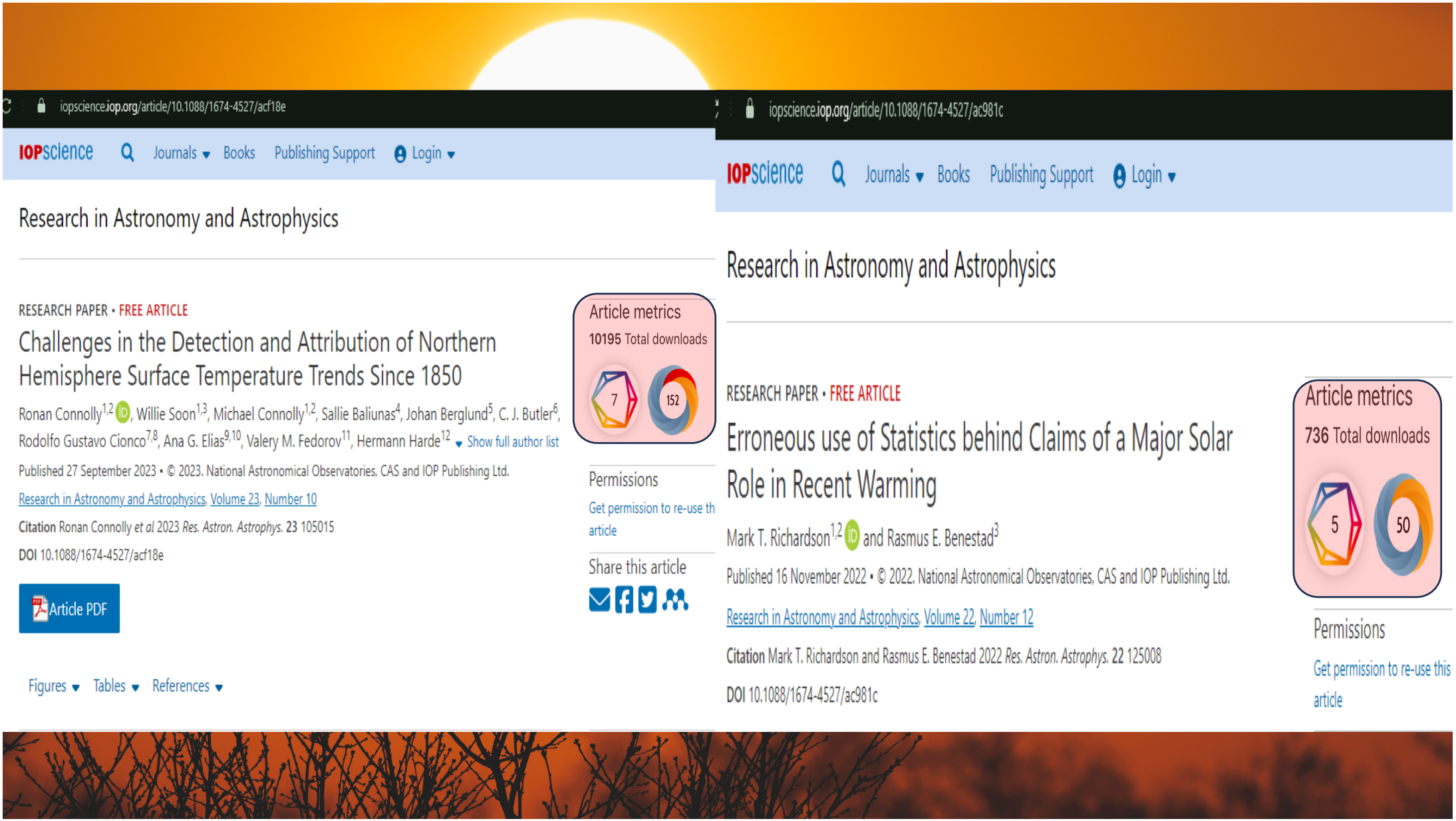
Abstract

Since 2007, the Intergovernmental Panel on Climate Change (IPCC) has heavily relied on the comparison between global climate model hindcasts and global surface temperature (ST) estimates for concluding that post-1950s global warming is mostly human-caused. In Connolly et al., we cautioned that this approach to the detection and attribution of climate change was highly dependent on the choice of Total Solar Irradiance (TSI) and ST data sets. We compiled 16 TSI and five ST data sets and found by altering the choice of TSI or ST, one could (prematurely) conclude anything from the warming being "mostly human-caused" to "mostly natural." Richardson and Benestad suggested our analysis was "erroneous" and "flawed" because we did not use a multilinear regression. They argued that applying a multilinear regression to one of the five ST series re-affirmed the IPCC's attribution statement. They also objected that many of the published TSI data sets were out-of-date. However, here we show that when applying multilinear regression analysis to an expanded and updated data set of 27 TSI series, the original conclusions of Connolly et al. are confirmed for all five ST data sets. Therefore, it is still unclear whether the observed warming is mostly human-caused, mostly natural or some combination of both.

Key words: Sun: activity – (Sun:) solar-terrestrial relations – Earth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Challenges in the Detection and Attribution of Northern Hemisphere Surface Temperature Trends Since 1850
Ronan Connolly[1,2], Willie Soon[1,3], Michael Connolly[1,2], Sallie Baliunas[4], Johan Berglund[5], C. J. Butler[6], Rodolfo Gustavo Cionco[7,8], Ana G. Elias[9,10], Valery M. Fedorov[11], Hermann Harde[12]
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RESEARCH PAPER • FREE ARTICLE
Erroneous use of Statistics behind Claims of a Major Solar Role in Recent Warming
Mark T. Richardson[1,2] and Rasmus E. Benestad[3]
Published 16 November 2022 • © 2022. National Astronomical Observatories, CAS and IOP Publishing Ltd.
Research in Astronomy and Astrophysics, Volume 22, Number 12
Citation Mark T. Richardson and Rasmus E. Benestad 2022 Res. Astron. Astrophys. 22 125008
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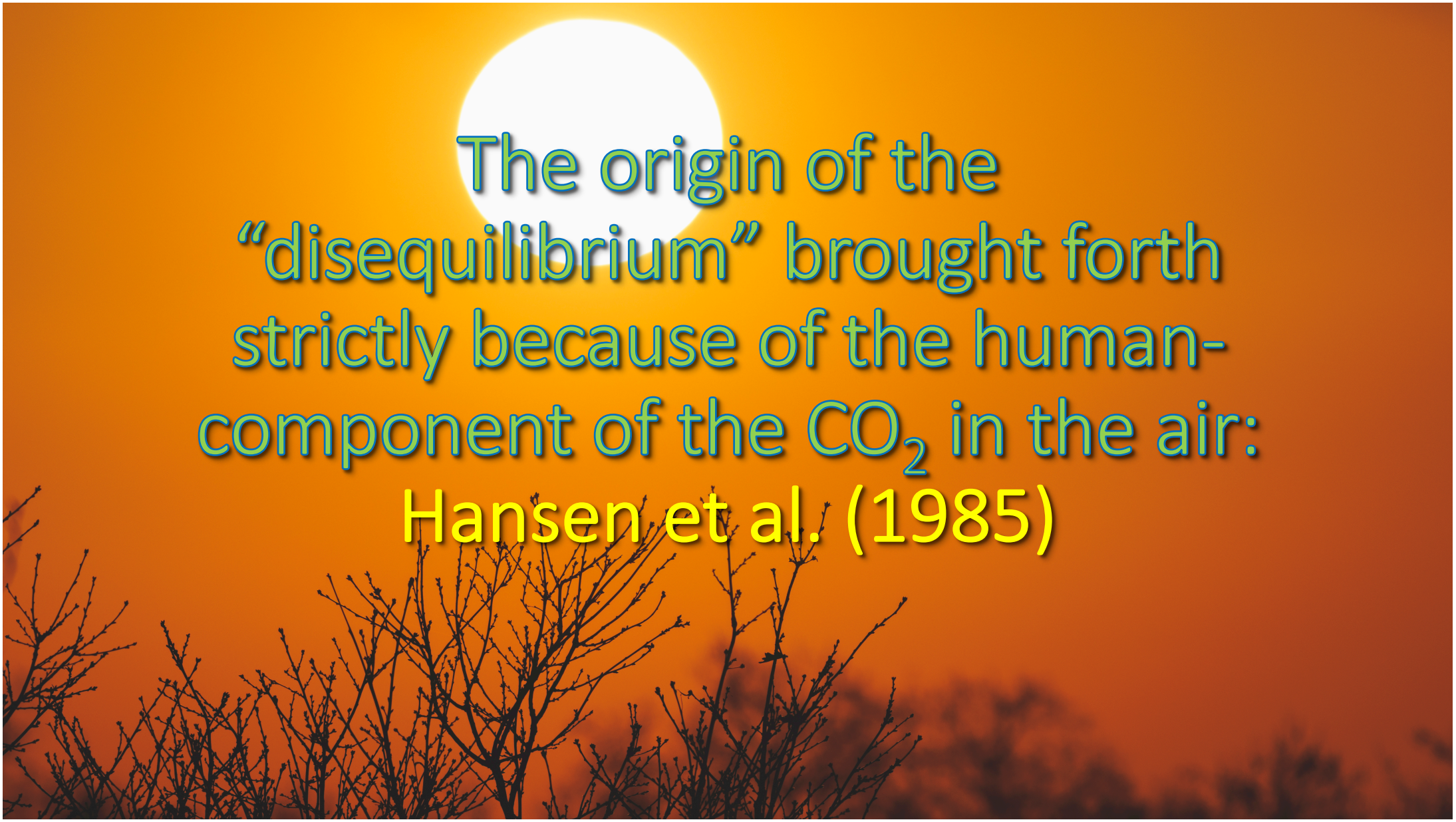

The origin of the
"disequilibrium" brought forth
strictly because of the human-
component of the CO_2 in the air:
Hansen et al. (1985)

The original speculation of EEI by Hansen et al. (1985)

Climate Response Times: Dependence on Climate Sensitivity and Ocean Mixing

Abstract. *The factors that determine climate response times were investigated with simple models and scaling statements. The response times are particularly sensitive to (i) the amount that the climate response is amplified by feedbacks and (ii) the representation of ocean mixing. If equilibrium climate sensitivity is 3°C or greater for a doubling of the carbon dioxide concentration, then most of the expected warming attributable to trace gases added to the atmosphere by man probably has not yet occurred. This yet to be realized warming calls into question a policy of "wait and see" regarding the issue of how to deal with increasing atmospheric carbon dioxide and other trace gases.*

EEI was wholly invented essentially to "kill" the "wait and see" policy response, not a scientific deduction!

J. Hansen
G. Russell
A. Lacis
I. Fung
D. Rind
NASA Goddard Space Flight Center, Institute for Space Studies, 2880 Broadway, New York 10025
P. Stone
Center for Meteorology and Physical Oceanography, Massachusetts Institute of Technology, Cambridge 02139

Hansen et al. (1985) Science, vol. 229, 857-859

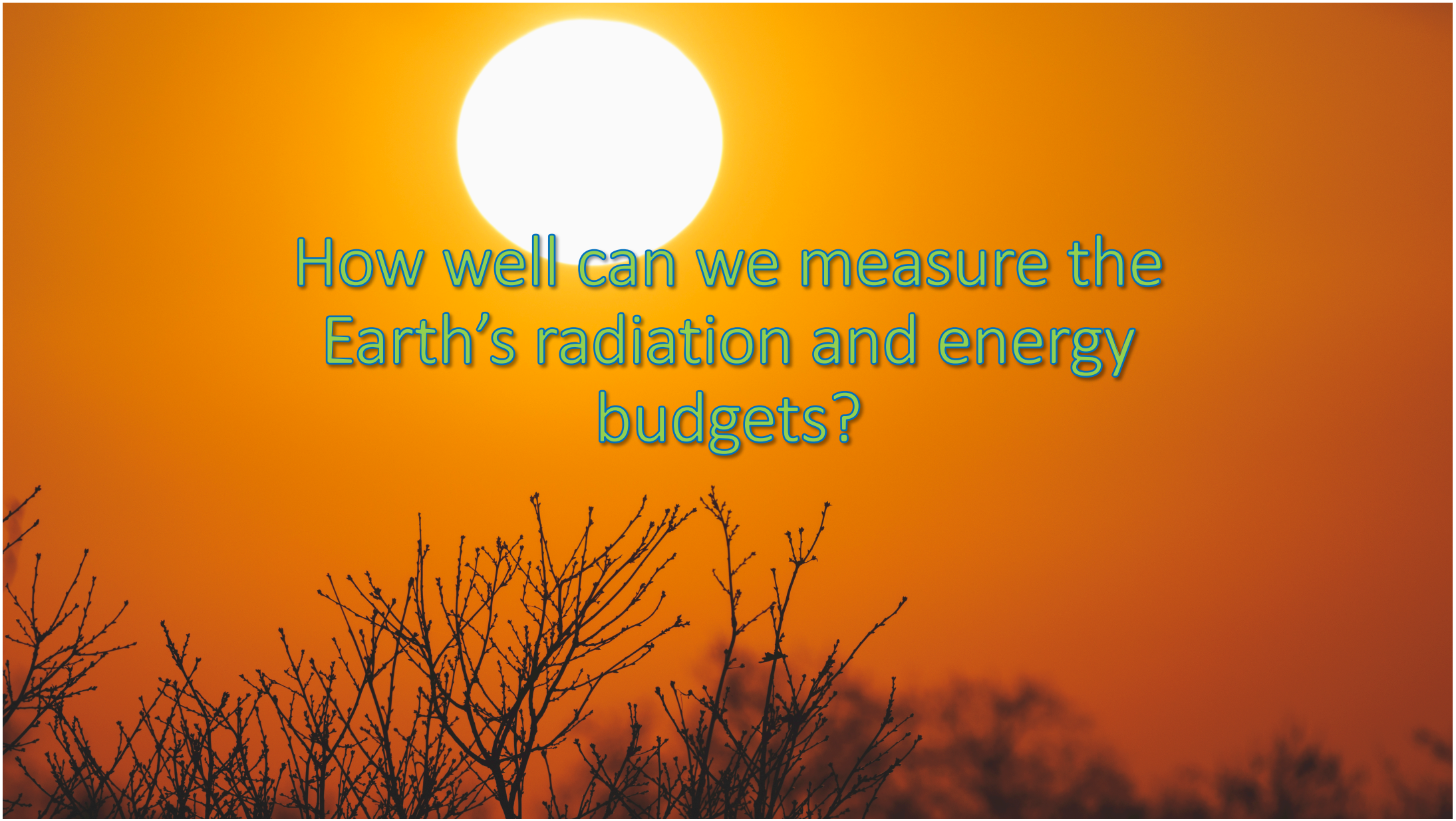
The original speculation of EEI by Hansen et al. (1985)

The assumption that a heat perturbation mixes as a passive tracer may break down as the climatic warming increases. In the ocean model of Bryan *et al.* (*15*), a warm anomaly of 0.5°C penetrates significantly (~25 percent) less than a similar cold anomaly. Furthermore, global warming will be accompanied by changes in evaporation, precipitation, and wind stress over the ocean surface, and possibly by the addition of fresh water from melting ice sheets—all of which may affect the rate of ocean mixing. There is evidence that some mechanisms of ocean overturning are capable of sudden changes (*16*), and the paleoclimate record reveals cases of large warming within periods of no more than several decades (*16*, *17*). Thus we cannot exclude the possibility that the climate may at some point undergo a rapid transition to the equilibrium climate for current atmospheric composition.

The existence of unrealized warming complicates the CO_2 and trace gas issue and limits the near-term effectiveness of reductions in greenhouse gas emissions. The strong dependence of this unrealized warming on the equilibrium climate sensitivity emphasizes the importance of narrowing uncertainties about the strength of climate feedback processes. This will require better understanding of many components of the climate system including clouds, the cryosphere, biogeochemical cycles, ocean mixing, vegetation, and the land surface.

EEI was wholly <u>invented</u> essentially to "kill" the "wait and see" policy response, not a scientific deduction!

Hansen et al. (1985) Science, vol. 229, 857-859


How well can we measure the Earth’s radiation and energy budgets?

NASA CERES vs. CERES vs. Ceres

- Today, the most-widely discussed dataset on energy budgets is that of NASA's Clouds and the Earth's Radiant Energy System (**NASA CERES**) satellite-based project.
- Our research team is the Center for Environmental Research and Earth Sciences (**CERES**)
- The acronym for both of our groups is based on the Roman goddess of agriculture, fertility and the seasons, **Ceres**.
- According to Roman mythology, winter is caused when Ceres's daughter (Proserpina) spends time in the underworld and Ceres is too busy searching for her to look after the climate. So, you could say **Ceres is the goddess of climate change**!
- The dwarf planet, **Ceres,** also is named after her.
- The **cereal** you might have had for breakfast is named after her as well. This is because the Romans believed she was the goddess who allowed "cereal crops" (wheat, barley, etc.) to grow.

Statuette of the Roman goddess, Ceres, by Augustin Pajou (c. 1768–70)

The best measurements of Earth's radiation budget by NASA CERES has an imbalance of 6.5 W/m²

Toward Optimal Closure of the Earth's Top-of-Atmosphere Radiation Budget

NORMAN G. LOEB,* BRUCE A. WIELICKI,* DAVID R. DOELLING,* G. LOUIS SMITH,+
DENNIS F. KEYES,# SEIJI KATO,* NATIVIDAD MANALO-SMITH,# AND TAKMENG WONG*

*NASA Langley Research Center, Hampton, Virginia
+National Institute of Aerospace, Hampton, Virginia
#Science Systems and Applications, Inc., Hampton, Virginia

(Manuscript received 14 May 2008, in final form 18 July 2008)

ABSTRACT

Despite recent improvements in satellite instrument calibration and the algorithms used to determine reflected solar (SW) and emitted thermal (LW) top-of-atmosphere (TOA) radiative fluxes, a sizeable imbalance persists in the average global net radiation at the TOA from satellite observations. This imbalance is problematic in applications that use earth radiation budget (ERB) data for climate model evaluation, estimate the earth's annual global mean energy budget, and in studies that infer meridional heat transports. This study provides a detailed error analysis of TOA fluxes based on the latest generation of Clouds and the Earth's Radiant Energy System (CERES) gridded monthly mean data products [the monthly TOA/surface averages geostationary (SRBAVG-GEO)] and uses an objective constrainment algorithm to adjust SW and LW TOA fluxes within their range of uncertainty to remove the inconsistency between average global net TOA flux and heat storage in the earth–atmosphere system. The 5-yr global mean CERES net flux from the standard CERES product is 6.5 W m^{-2}, much larger than the best estimate of 0.85 W m^{-2} based on observed ocean heat content data and model simulations. The major sources of uncertainty in the CERES estimate are from instrument calibration (4.2 W m^{-2}) and the assumed value for total solar irradiance (1 W m^{-2}). After adjustment, the global mean CERES SW TOA flux is 99.5 W m^{-2}, corresponding to an albedo of 0.293, and the global mean LW TOA flux is 239.6 W m^{-2}. These values differ markedly from previously published adjusted global means based on the ERB Experiment in which the global mean SW TOA flux is 107 W m^{-2} and the LW TOA flux is 234 W m^{-2}.

Loeb et al. (2009) Journal of Climate, vol. 22, 748-766

Toward Optimal Closure of the Earth's Top-of-Atmosphere Radiation Budget

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*NASA Langley Research Center, Hampton, Virginia
+National Institute of Aerospace, Hampton, Virginia
#Science Systems and Applications, Inc., Hampton, Virginia

"The 5-yr global mean CERES net flux from the standard CERES product **is 6.5 W/m^2, much larger than the best estimate of 0.85 W/m^2 based on** observed ocean heat content data and **model simulations**. The major source of uncertainty in the CERES estimate are from instrument calibration (4.2 W/m^2) and the assumed value for total solar irradiance (1 W/m^2)."

Loeb et al. (2009) Journal of Climate, vol. 22, 748-766

The best measurements of Earth's radiation budget by NASA CERES has an imbalance of 6.5 W/m²

TABLE 1. Global mean clear- and all-sky SW, LW, and net TOA radiative fluxes, solar irradiance, and CRE for satellite-based data products (units in W m^{-2}).

		CERES				
Product name	ERBE S-4	ES-4 Ed2_rev1	SRBAVG-nonGEO Ed2D_rev1	SRBAVG-GEO Ed2D_rev1	GEWEX SRB Version 2.86	ISCCP FD
Time period	02/85 – 01/89			03/00 – 02/2005		
Solar irradiance	341.3	341.3	341.3	341.3	341.8	341.5
LW (All sky)	235.2	239.0	237.7	237.1	240.4	235.8
SW (All Sky)	101.2	98.3	96.6	97.7	101.7	105.2
Net (All Sky)	4.9	4.0	7.0	6.5	−0.3	0.5
LW (Clear Sky)	264.9	266.6	266.4	264.1	268.1	262.3
SW (Clear Sky)	53.6	49.3	51.2	51.1	54.5	54.2
Net (Clear Sky)	22.8	25.4	23.7	26.2	19.2	25.0
LW CRE	29.7	27.6	28.7	27.0	27.7	26.5
SW CRE	−47.6	−49.0	−45.4	−46.6	−47.2	−51.0
NET CRE	−17.9	−21.4	−16.7	−19.7	−19.5	−24.5

CERES's Energy Budget is not closed, should be zero!

Loeb et al. (2009) Journal of Climate, vol. 22, 748-766

Atmos. Chem. Phys., 11, 13421–13449, 2011
www.atmos-chem-phys.net/11/13421/2011/
doi:10.5194/acp-11-13421-2011

Atmospheric Chemistry and Physics

Earth's energy imbalance and implications

J. Hansen[1,2], M. Sato[1,2], P. Kharecha[1,2], and K. von Schuckmann[3]

[1]NASA Goddard Institute for Space Studies, New York, NY 10025, USA
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[3]Centre National de la Recherche Scientifique, LOCEAN Paris, hosted by Ifremer, Brest, France

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Revised: 30 November 2011 – Accepted: 7 December 2011 – Published: 22 December 2011

How does he know this?

The precision achieved by the most advanced generation of radiation budget satellites is indicated by the planetary energy imbalance measured by the ongoing CERES (Clouds and the Earth's Radiant Energy System) instrument (Loeb et al., 2009), which finds a measured 5-yr-mean imbalance of 6.5 W m^{-2} (Loeb et al., 2009). Because this result is implausible, instrumentation calibration factors were introduced to reduce the imbalance to the imbalance suggested by climate models, 0.85 W m^{-2} (Loeb et al., 2009).

Can the climate models really calculate clouds correctly?

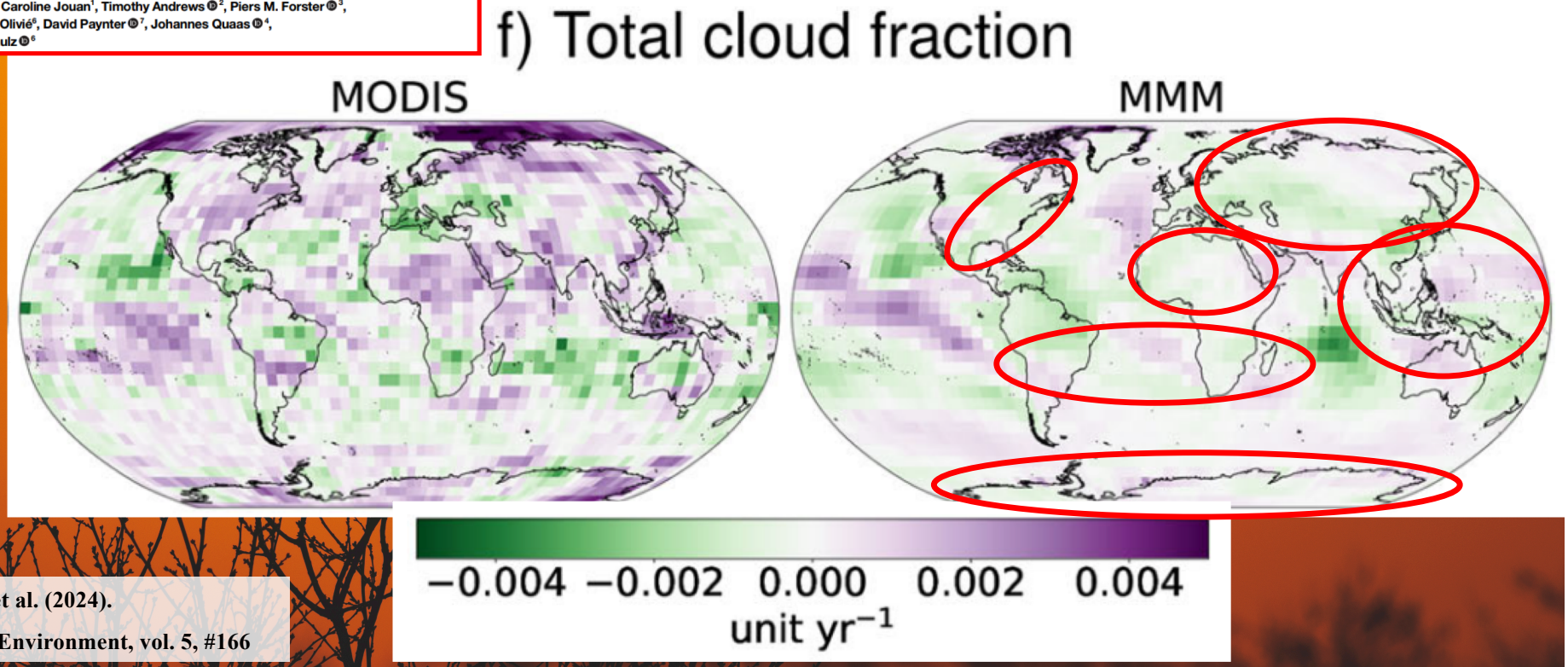
communications earth & environment Article

https://doi.org/10.1038/s43247-024-01324-8

Recent reductions in aerosol emissions have increased Earth's energy imbalance

Check for updates

Øivind Hodnebrog[1], Gunnar Myhre[1], Caroline Jouan[1], Timothy Andrews[2], Piers M. Forster[3], Hailing Jia[4,9], Norman G. Loeb[5], Dirk J. L. Olivié[6], David Paynter[7], Johannes Quaas[4], Shiv Priyam Raghuraman[8] & Michael Schulz[6]



Hodnebrog, Myhre, Loeb et al. (2024).
Communications Earth & Environment, vol. 5, #166

How does the planetary albedo compare with computer model estimates?

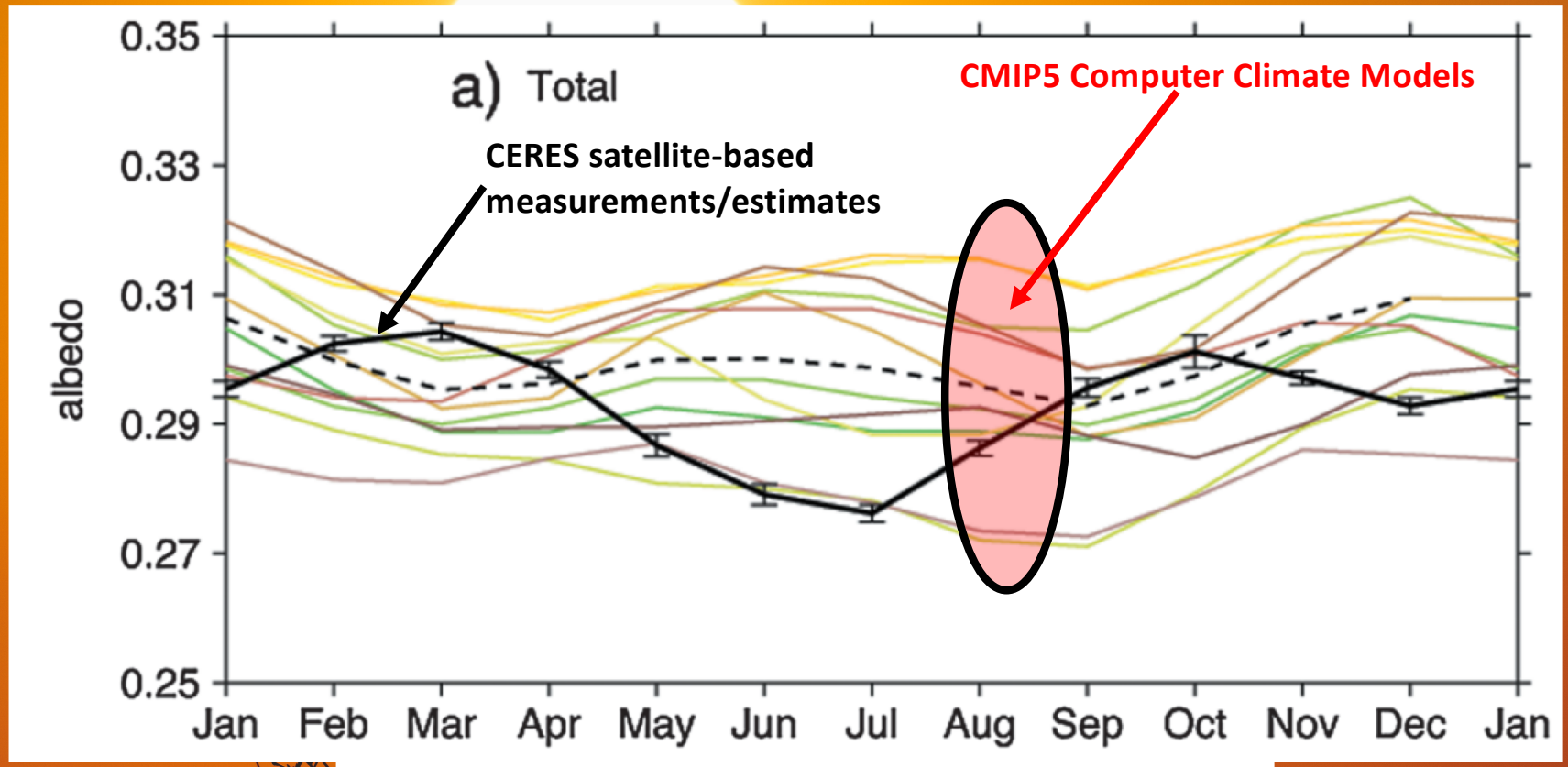
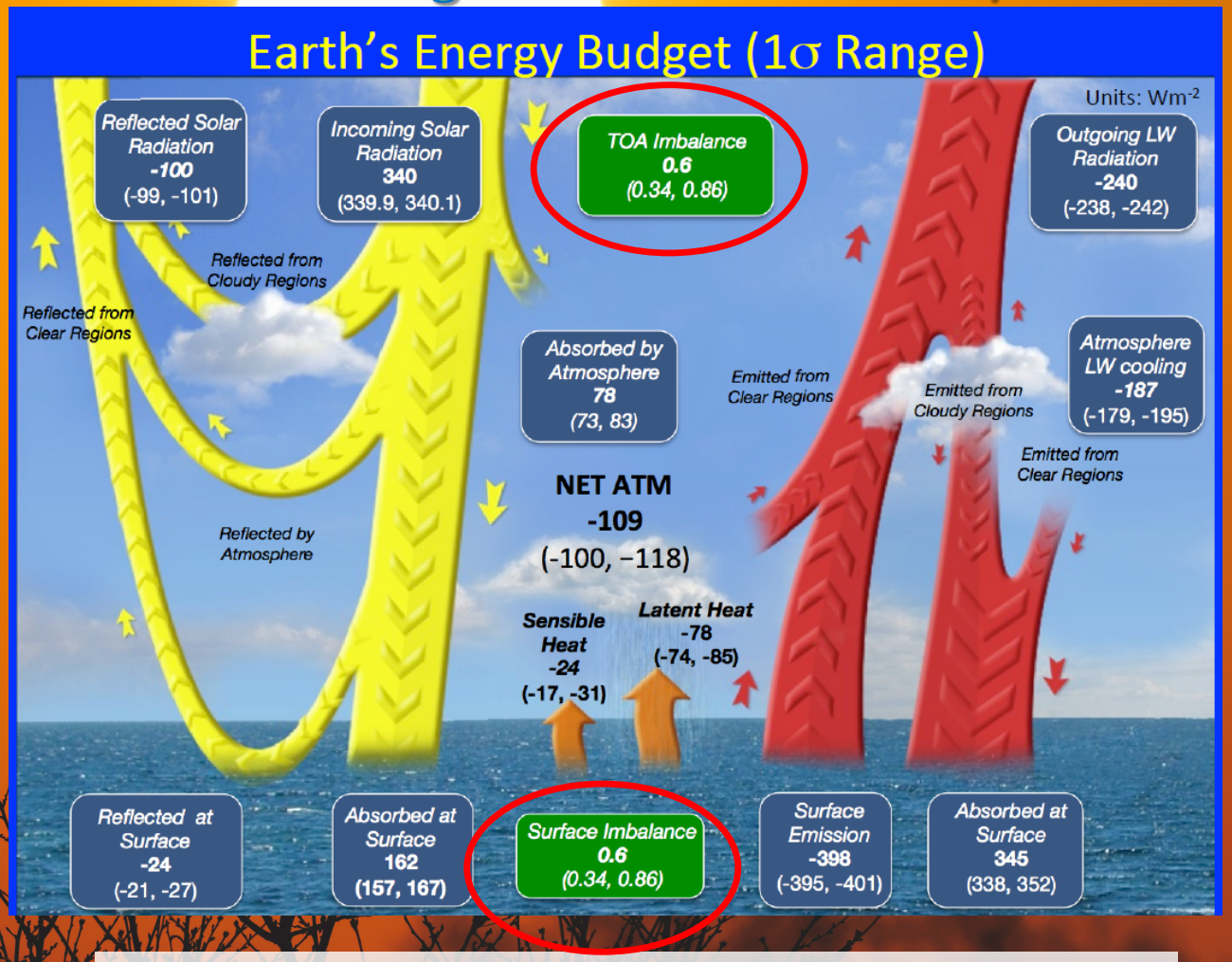


Figure 11. The global mean annual cycle of (a) TOA albedo, (b) atmospheric contribution to the TOA albedo, and (c) the surface contribution to the TOA albedo. The solid lines are CERES observations taken from Figure 5, and the colored lines are 10 year average seasonal cycle of individual CMIP5 models, and the dashed lines are the multimodel mean seasonal cycle.

Source: Stephens et al. (2015)
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014RG000449

Beware of the highly misleading post-2009 paper by NASA CERES: The budget imbalance of 6.5 W/m² is hidden!



Norman Loeb (2014) August 5's Colloquium and Lecture at Langley

The budget imbalance of 6.5 W/m² is hidden… plus the uncertainty of ± 17 W/m²

nature geoscience

PROGRESS ARTICLE

PUBLISHED ONLINE: 23 SEPTEMBER 2012 | DOI: 10.1038/NGEO1580

An update on Earth's energy balance in light of the latest global observations

Graeme L. Stephens[1]*, Juilin Li[1], Martin Wild[2], Carol Anne Clayson[3], Norman Loeb[4], Seiji Kato[4], Tristan L'Ecuyer[5], Paul W. Stackhouse Jr[4], Matthew Lebsock[1] and Timothy Andrews[6]

The challenge ahead

Satellite observations combined with other data (Box 1) now convincingly support previous observation-based estimates of the surface downward longwave flux. The revised estimates of these fluxes range between 342 and 350 Wm^{-2}, and are between 10 and 17 Wm^{-2} larger than past estimates that have relied primarily on global models. Recent satellite observations of global precipitation also indicate that Earth produces more precipitation than previously accounted for. Thus the flux of latent heat leaving the surface that sustains this increased precipitation is also larger than has been assumed. This elevated flux offsets much of the revised larger

The net energy balance is the sum of individual fluxes. The current uncertainty in this net surface energy balance is large, and amounts to approximately 17 Wm^{-2}. This uncertainty is an order of magnitude larger than the changes to the net surface fluxes associated with increasing greenhouse gases in the atmosphere (Fig. 2b). The uncertainty is also approximately an order of magnitude larger than the current estimates of the net surface energy imbalance of 0.6 ±0.4 Wm^{-2} inferred from the rise in OHC[13,14]

Box 1 | Updated energy balance

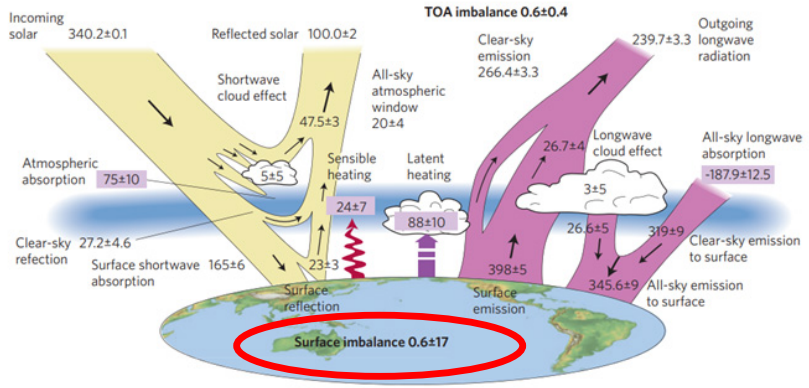


Figure B1 | The global annual mean energy budget of Earth for the approximate period 2000–2010. All fluxes are in Wm^{-2}. Solar fluxes are in yellow and infrared fluxes in pink. The four flux quantities in purple-shaded boxes represent the principal components of the atmospheric energy balance.

Stephens, Loeb et al. (2012) Nature Geoscience, vol. 5, 691-696

Have you ever seen such a **crazy** quantification of a hypothetical quantity called EEI ?

0.6 ± 17 W/ m²

Conclusions

- The IPCC insist that they have already resolved the best solar activity ("TSI") records, for their latest 6th Assessment Report (2021), they only considered one estimate. But, we have found 27. They are wrong on their dogmatic choice of TSI!
- The proposal of Earth's Energy Imbalance, simply because of anthropogenic component of CO_2 emissions, was strictly a political construct rather than serious scientific proposition.
- The measurements of the Earth's Energy Budget, on a global-scale, are highly uncertain and mostly unresolved because the total global energy budget is not accounted for up to **6.5 W/m²** at the TOA and up to **17 W/m²** at the surface.

"The central mystery of climate science"

"The people who are supposed to be the experts and who claim to understand the science are precisely the people who are blind to the evidence...I hope that a few of them will make the effort to examine the evidence in detail and see how it contradicts the prevailing dogma, but I know that the majority will remain blind. That to me is the central mystery of climate science. It is not a scientific mystery but a human mystery. How does it happen that the whole generation of scientific experts is blind to obvious facts?" **– Freeman Dyson, foreword in a GWPF report on "Carbon Dioxide: The Good News" by Indur Goklany (2015)**

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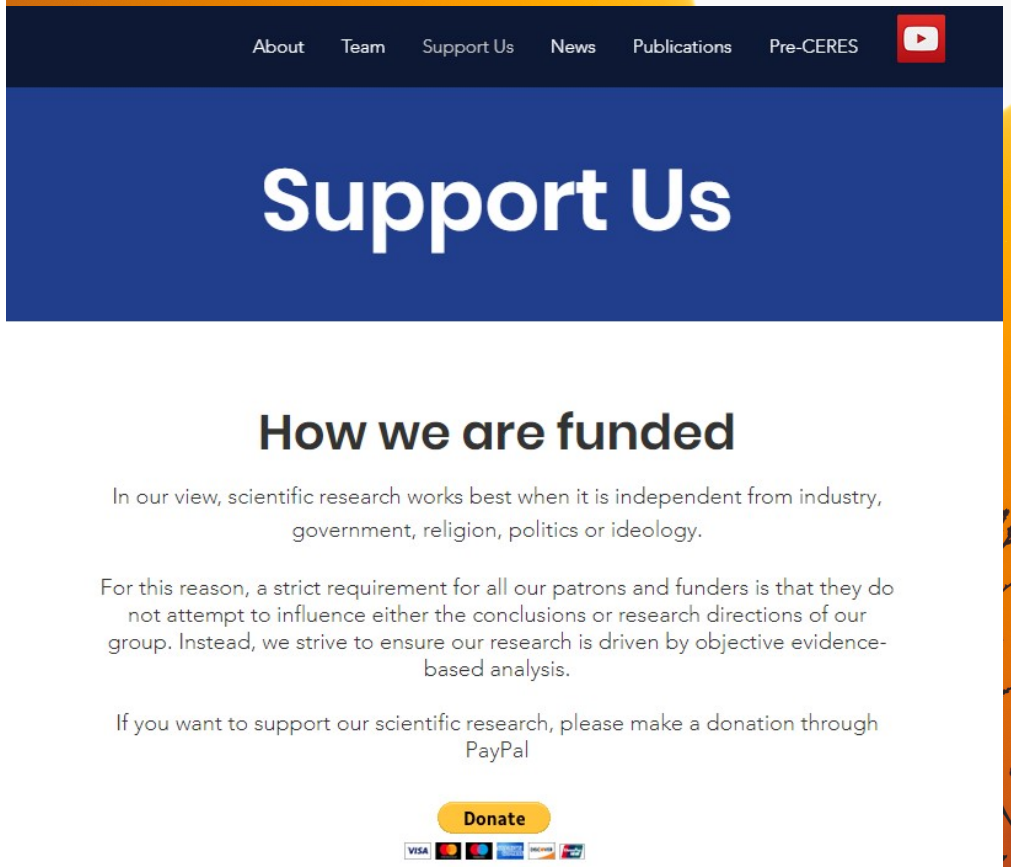

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