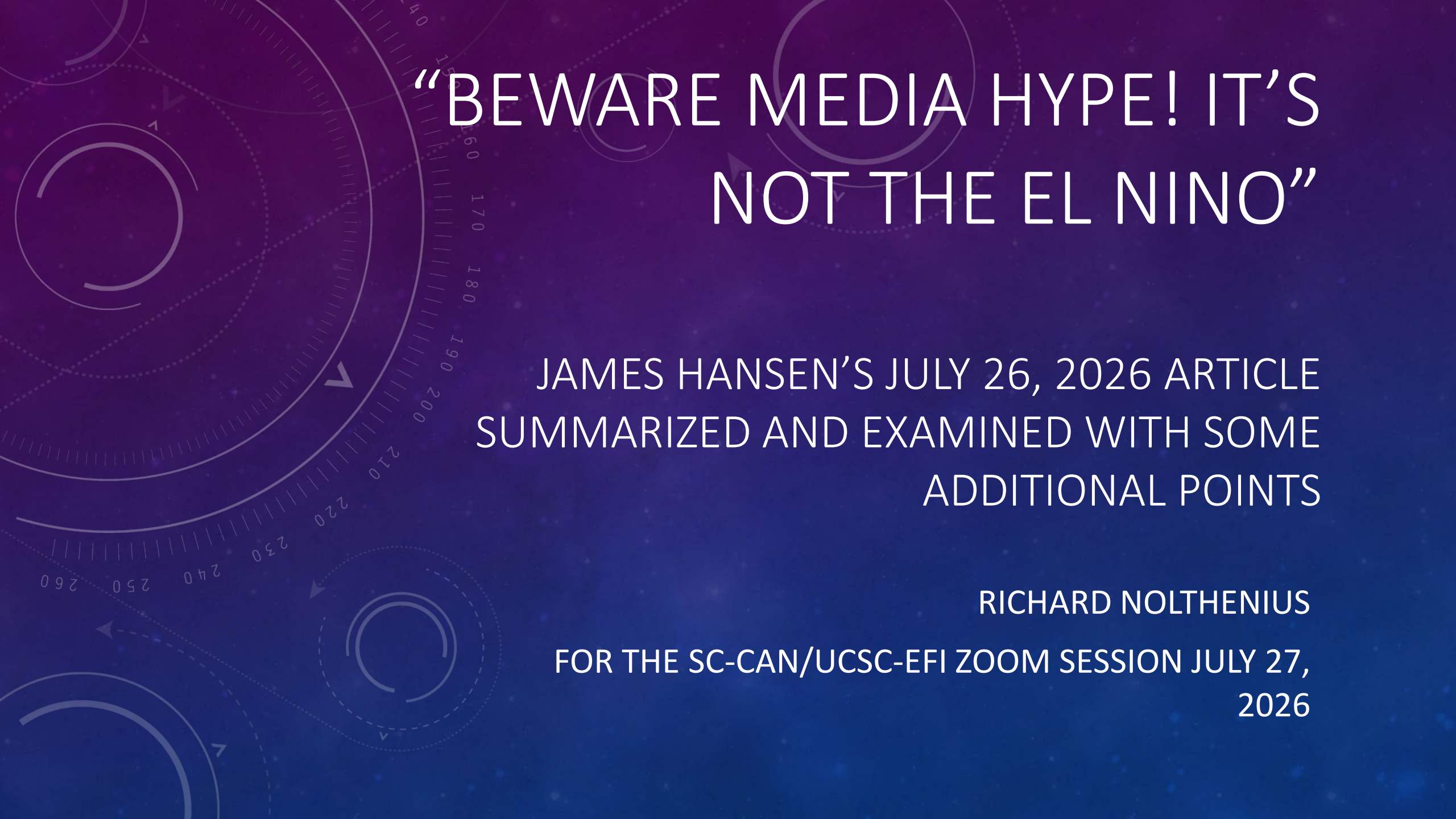




“BEWARE MEDIA HYPE! IT’S NOT THE EL NINO”

JAMES HANSEN’S JULY 26, 2026 ARTICLE
SUMMARIZED AND EXAMINED WITH SOME
ADDITIONAL POINTS

RICHARD NOLTHENIUS

FOR THE SC-CAN/UCSC-EFI ZOOM SESSION JULY 27,
2026

ABSTRACT: THE LATEST DATA SHOW THAT EARTH ENERGY IMBALANCE (EEI) REMAINS ON THE RISE – ONLY EXPLAINABLE BY HIGHER ECS THAN IPCC LIKES TO ASSUME, TOGETHER WITH STRONGER EFFECTS OF CLOUD FEEDBACKS

Beware Media Hype. It's Not the El Nino!

23 July 2026

James Hansen, Pushker Kharecha, Dylan Morgan and Jasen Vest

Abstract. Emerging climate extremes should draw public attention to human-caused climate change. We expect unusual sea surface temperature (SST) and global warming the rest of this year to make 2026 hotter than 2024, despite 2024 being a peak El Nino year, while 2026 is only the lead-in year of an emerging El Nino. Beware the “surprise” record high being blamed on an extreme El Nino on top of global warming otherwise consistent with IPCC estimates. Instead, record warmth provides additional evidence of high climate sensitivity and increased net climate forcing in the past decade. These two factors are driving an unusual increase in global SSTs with major consequences. If you bear with our discussion to the end, you will find some possible good news. Figures in this post are continually updated on our [website](#).² We are now on [Substack](#).³

Global warming in the pipeline

James E. Hansen,¹ Makiko Sato,¹ Leon Simons,² Larissa S. Nazarenko,^{3,4} Isabelle Sangha,¹ Karina von Schuckmann,⁵ Norman G. Loeb,⁶ Matthew B. Osman,⁷ Qinjian Jin,⁸ Pushker Kharecha,¹ George Tselioudis,³ Eunbi Jeong,⁹ Andrew Lacis,³ Reto Ruedy,^{3,10} Gary Russell,³ Junji Cao,¹¹ Jing Li¹²

*Correspondence: James E. Hansen <jeh1@columbia.edu>

ABSTRACT

Improved knowledge of glacial-to-interglacial global temperature change implies that fast-feedback equilibrium climate sensitivity (ECS) is $1.2 \pm 0.3^\circ\text{C}$ (2σ) per W/m^2 . Consistent analysis of temperature over the full Cenozoic era – including “slow” feedbacks by ice sheets and trace gases – supports this ECS and implies that CO_2 was about 300 ppm in the Pliocene and 400 ppm at transition to a nearly ice-free planet, thus exposing unrealistic lethargy of ice sheet models. Equilibrium global warming including slow feedbacks for today’s human-made greenhouse gas (GHG) climate forcing (4.1 W/m^2) is 10°C , reduced to 8°C by today’s aerosols. Decline of aerosol emissions since 2010 should increase the 1970-2010 global warming rate of 0.18°C per decade to a post-2010 rate of at least 0.27°C per decade. Under the current geopolitical approach to GHG emissions, global warming will likely pierce the 1.5°C ceiling in the 2020s and 2°C before 2050. Impacts on people and nature will accelerate as global warming pumps up hydrologic extremes. The enormity of consequences demands a return to Holocene-level global temperature. Required actions include: 1) a global increasing price on GHG emissions, 2) East-West cooperation in a way that accommodates developing world needs, and 3) intervention with Earth’s radiation imbalance to phase down today’s massive human-made “geo-transformation” of Earth’s climate. These changes will not happen with the current geopolitical approach, but current political crises present an opportunity for reset, especially if young people can grasp their situation.

RELATED RECENT PAPER:

“Equilibrium global warming (ESS; next slide) including slow feedbacks, is $+10^\circ\text{C}$ (for today’s observed climate forcing)”

Anthropogenic aerosols have reduced ESS to $+8^\circ\text{C}$ (but we’re scrubbing the air of our aerosols, so expect ESS to indeed be $+10^\circ\text{C}$)

DEFINITION: ECS *vs.* ESS

- ECS = “**Equilibrium Climate Sensitivity**” (to a doubling of CO₂ concentration) but with only the fast climate feedbacks: meaning - keep “*ice sheets, vegetation and other long-lived GHGs fixed (except the specified CO₂ doubling)*”.
- ESS = “**Earth System Sensitivity**” (includes the slow feedbacks too; large ice sheet changes, full ocean turnover, large scale changes to the biosphere, all GHG changes).
- ESS is approximately 2x ECS... says paleo and climate models. EFi is, and the world too, we contend, **needs to be concerned with the long term.**

THE INFLUENTIAL CHARNEY REPORT OF 1979, DEFINING ECS ... HAD A MAJOR ERROR:

- *“The (Charney) report assumed that the delay of global warming caused by the ocean’s thermal inertia was only 15 years, independent of climate sensitivity. (and this is false).*
- *“With that assumption, they concluded that climate sensitivity ECS for $2\times\text{CO}_2$ is near or below the low end of Charney’s $\text{ECS}=1.5\text{-}4.5^\circ\text{C}$ range.*
- *“If climate sensitivity was low and the lag between emissions and climate response was only 15 years, climate change would not be nearly the threat that it is.” – Hansen et al. 2022*
- Note - 1979: This was BEFORE climate change really kicked in, since aerosol masking was very effective in counteracting CO_2 rise until the 1970 Clean Air Act took effect - unappreciated in Charney’s day.

Hansen Provides a Check: His prediction is for 2026 to take over the lead as the hottest year of this epoch, from 2024's El Nino year. +1.5C is increasingly looking to be in the rear view mirror.

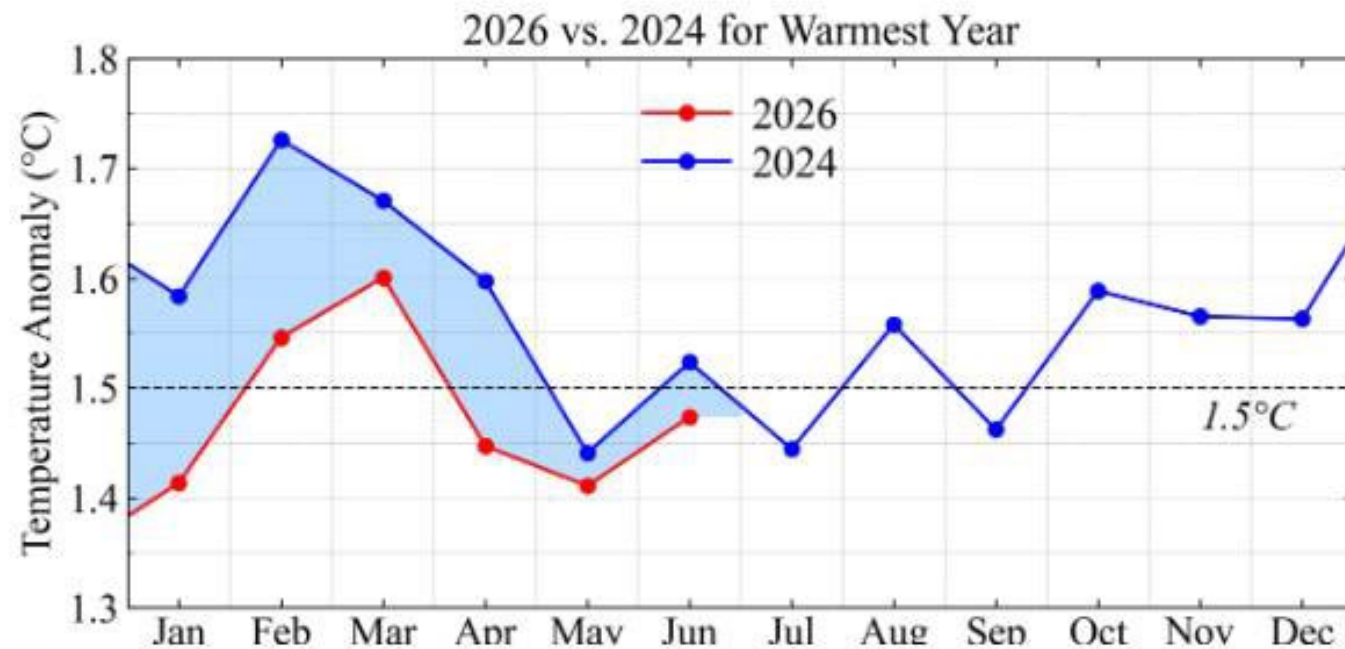


Fig. 1. Global surface temperature anomaly in GISS analysis¹ relative to 1880-1920 mean.

OCEAN TEMPERATURES HAVE BEEN ACCELERATING SINCE NEW LAWS (~2015)SCRUBBED SULFUR FROM MARINE FUELS. A DARKER OCEAN ABSORBS MORE SUNLIGHT.

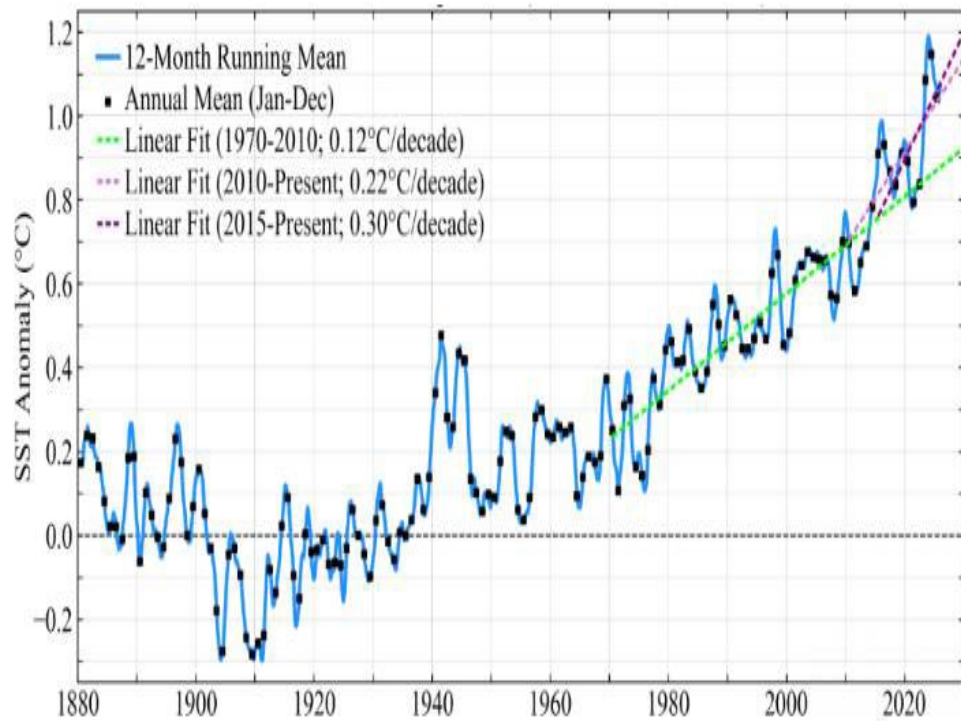


Fig. 3. Sea surface temperature (relative to 1880-1920 base period).¹

“The GHG forcing is known accurately, and there has been no large change in its growth rate in the past decade that could account for accelerated global warming. The aerosol forcing is unmeasured “

(and contends is the main cause)

93% OF GLOBAL WARMING HAS BEEN DEPOSITED INTO THE OCEANS, NOT THE AIR NOR LAND. THE OCEANS. THEY ARE THE HEAT BATH THAT WILL PREVENT COOLING OF EARTH

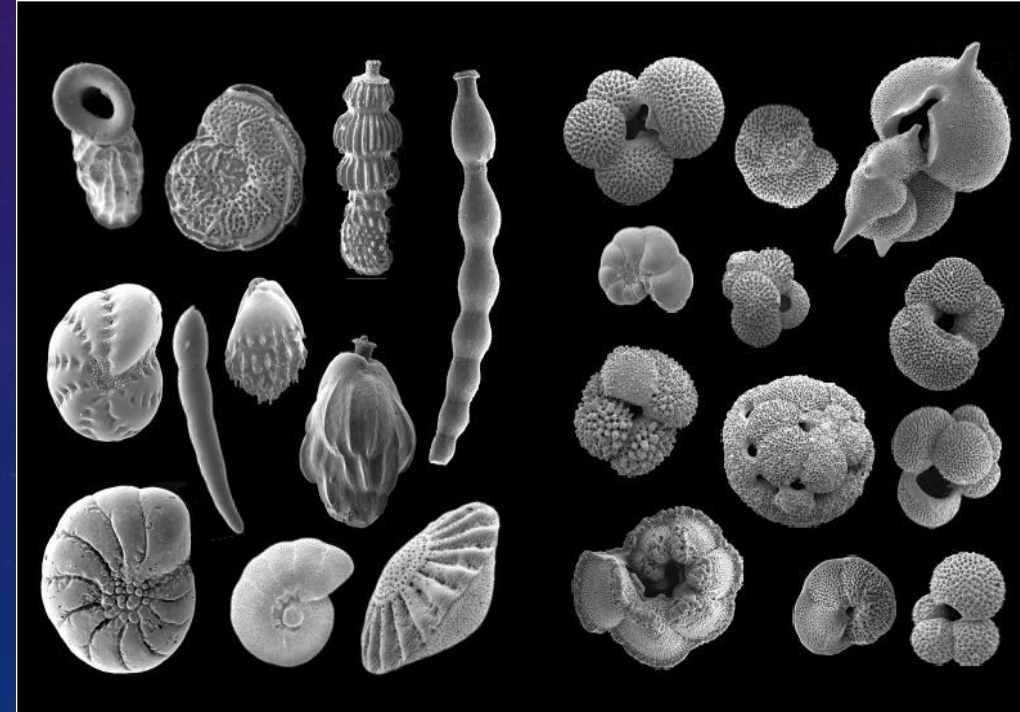
- Until about 10-15 yrs ago, the graphs were showing that SST's anomaly (Sea Surface Temperatures) were about $\frac{1}{2}$ that of the total global surface average. Water has great thermal capacitance and can hold much more heat per pound of material than can land or air. It doesn't rise as fast.
- Now, this latest data is showing global SST's have zoomed to +1.1C. That's not half, that's 73% of today's global surface average = +1.5C.
- **Implication? Heat in the pipeline: That global average T is set to accelerate upwards from here. Indeed, temperatures are already doing so, and it looks to continue.**

SO... HOW TO EVALUATE ESS? HANSEN USES PALEO DATA AT TIMES WHEN CLIMATE FORCING IS ZERO: AT GLACIAL MAX, AND THEN AT WARM INTERGLACIAL STABILITY TIMES

- Earth was in ~equilibrium at the LGM; Last Glacial Maximum 20,000 yrs ago (20kya).
- And, Earth was in ~equilibrium in the early Holocene. Can't use today – we're NOT in equilibrium!; Humans have affected climate as far back as the dawn of civilization, through deforestation and rice cultivation (the Ruddiman Hypothesis), and today even radically larger forcing is in effect.
- Hansen uses 7,000 years ago as Holocene's equilibrium time for T and CO2 benchmarks.

WHAT WAS GLOBAL AVG TEMPERATURE DROP RELATIVE TO HOLOCENE, AT LAST GLACIAL MAXIMUM (LGM)?

- Older studies mistakenly used micro-fossil species distributions as a temperature proxy.
- But the evolutionary adaptation time scale depends on individual species member's lifetimes, and is short compared to the ~30,000 yr time scales of climate change. So, the argument has shifted, and LGM temperature drop was more severe than the milder latitude shifting of species distributions would suggest, because of their effective evolutionary adaptation.
- Therefore, Hansen *et al.* not use micro-fossils to find the temperature at the LGM.
- Instead, use geochemical-based T proxies...



CLIMAP(1981) AND LATER MARGO DATA CAN BE RULED OUT; GIVE FAR TOO WARM AN ESTIMATE OF LGM TEMPERATURE

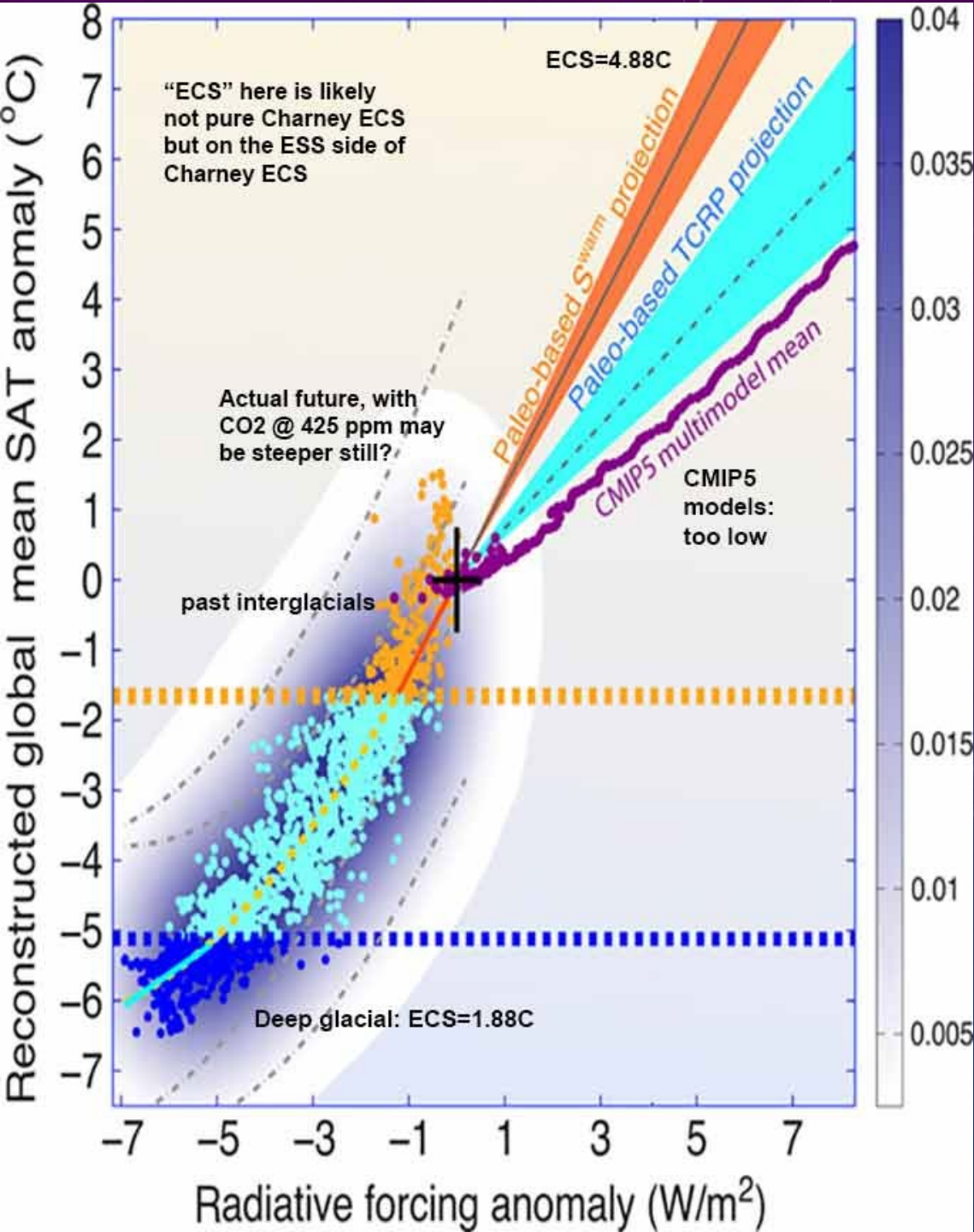
- *“A warm LGM suggested by CLIMAP and MARGO49 data (only $\sim 3^{\circ}\text{C}$ cooler than the Holocene) can be firmly rejected, because it is now certain that their SST (sea surface temperature) data yield a planet out of energy balance (Earth Energy Imbalance == EEI) by more than 2 W/m^2 , as discussed above.”*
- *“An energy imbalance of $+2 \text{ W/m}^2$ is enough to raise the temperature of the upper kilometer of the ocean 2.2°C or melt ice to raise sea level 22 m in a century – and 10 times those amounts (220 m) in a millennium. Such change rates did not occur.” (Hansen et al. p. 11)*

SO; WARM LGM ESTIMATES NOT FAVORED... NEW LGM TEMPERATURE STUDIES ARE IN GOOD AGREEMENT...

- Selzer *et al.* ([2021](#)) use noble gases solubility to find mid/low-latitude lands cooled 5.8C at LGM vs. Holocene. Now add Arctic Amplification via ice sheet albedo effect, and get -7C for global avg cooling at LGM.
- Tierney *et al.* ([2020](#)), in line with prior arguments, exclude microfossils dependence and use other T proxies to get -6.1C for 23-19 kya period, but this time was not well centered on equilibrium LGM, and Tierney suggests (personal comm. to Hansen) that -7C is a better number.
- Osman *et al.* ([2021](#)) similarly find T = 7C cooler, for 21-18 kya period.

LIKE OTHERS, STEINTHORSDOTTIR *et al.* 2020 FIND ECS MUST BE MUCH HIGHER THAN THE USUAL +3C IN OLDER CLIMATE MODELS...

- ... in order to explain the high temperatures of the Miocene epoch; +7C hotter than today yet at pCO₂ of only <~500 ppm, not much above today's 425ppm, and, too, at lower solar radiation.
- *"A problem remains that climate models cannot reproduce MCO(Miocene climate maximum) temperatures with less than ~800 ppm pCO₂, while most previously published proxies record [that] pCO₂ < 450 ppm"*



FRIEDRICH *et al.* 2016 FIG 3. FINDS ECS VARIES FROM +1.88C TO 4.88C IN/OUT OF GLACIALS. DOTS ARE PALEO DATA: A STRAIGHT SLANTING TREND EQUIV TO CONSTANT ECS.

THE STRONG UPWARD CURVATURE SAYS HIGHER ECS APPLIES AT HIGHER TEMPERATURES.

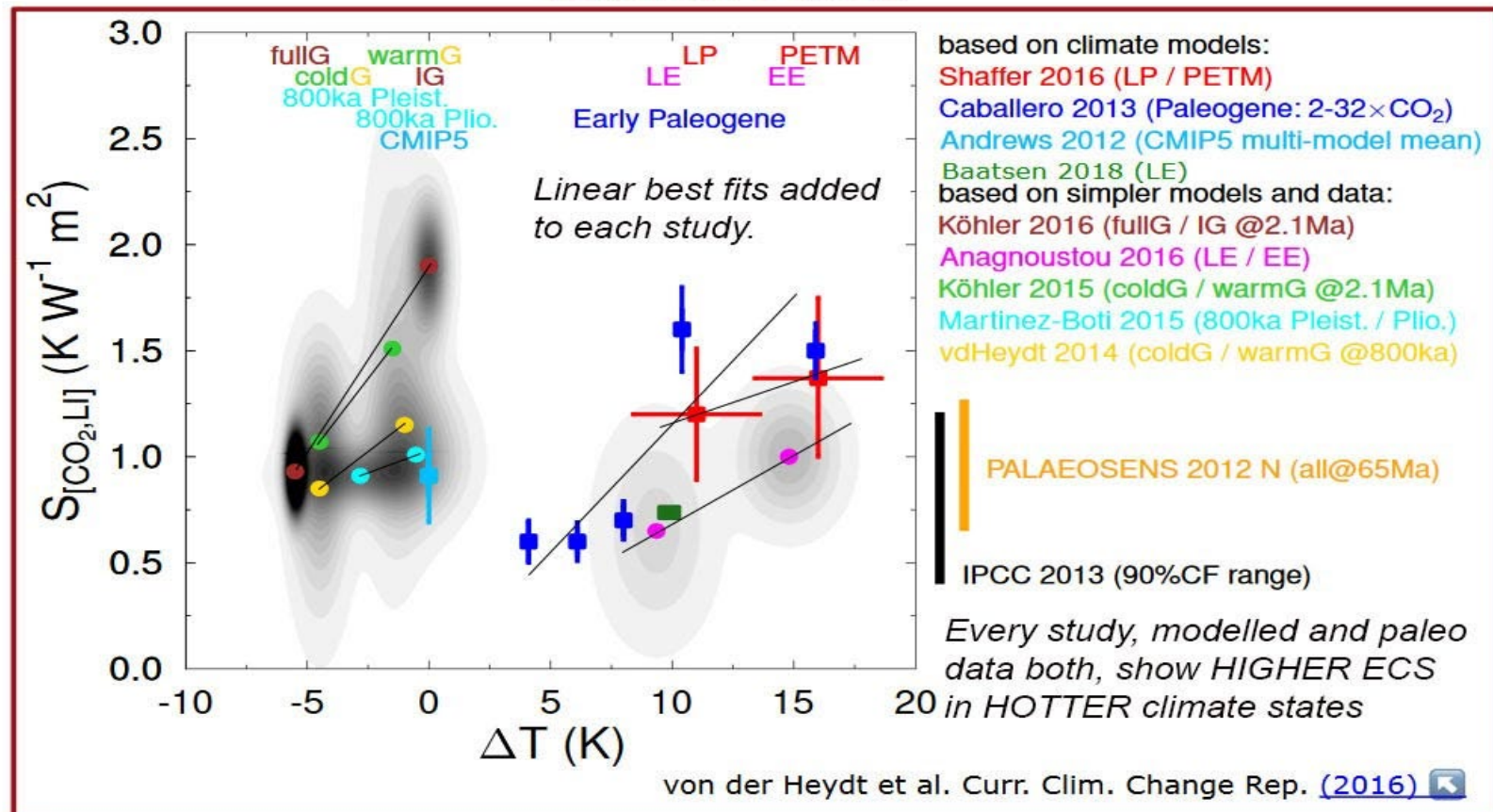
THE ORANGE LINEAR BAND ASSUMES ECS=4.88C HOLDS TODAY AND FOR THE FUTURE.

HOWEVER, THIS ORANGE FUTURE SLOPE LOOKS SHALLOWER (LOWER ECS) THAN THE ORANGE PALEO DOTS INDICATE – MEANING, AN ECS EVEN HIGHER IS QUITE POSSIBLE, SINCE $\text{ECS}=+4.9^{\circ}\text{C}$ WAS WHAT APPLIED DURING THE INTERGLACIALS OF THE PAST 2 MILLION YEARS, WHEN ATMOSPHERIC CO_2 NEVER GOT ABOVE 280ppm – YET WE'RE AT 429 ppm NOW.

MICHAEL MANN'S JUDGEMENT? *“THIS STUDY IS SOUND, AND QUITE DEFENSIBLE”* ([SOURCE](#))

VON DER HEYDT *et al.* 2016 SUMMARIZING STUDIES SHOWING ECS DEPENDENCE ON UNDERLYING CLIMATE STATE. EVIDENCE IS STRONG THAT ECS/ESS IS HIGHER IN HOTTER CLIMATE STATES, EVEN WHEN EARTH IS ICE-FREE SO ICE ALBEDO ISN'T THE CAUSE (EOCENE e.g.).

State dependent ECS from palaeoclimate data and models



GISS CLIMATE MODELLING: FAST FEEDBACKS MOSTLY REALIZED BY ~100 YRS. SLOW FEEDBACKS TAKE ~2,000 YRS TO REACH ESS T RISE. BUT NOTE HIGHER ECS MEANS LONGER TIME TO EQUILIBRIUM.

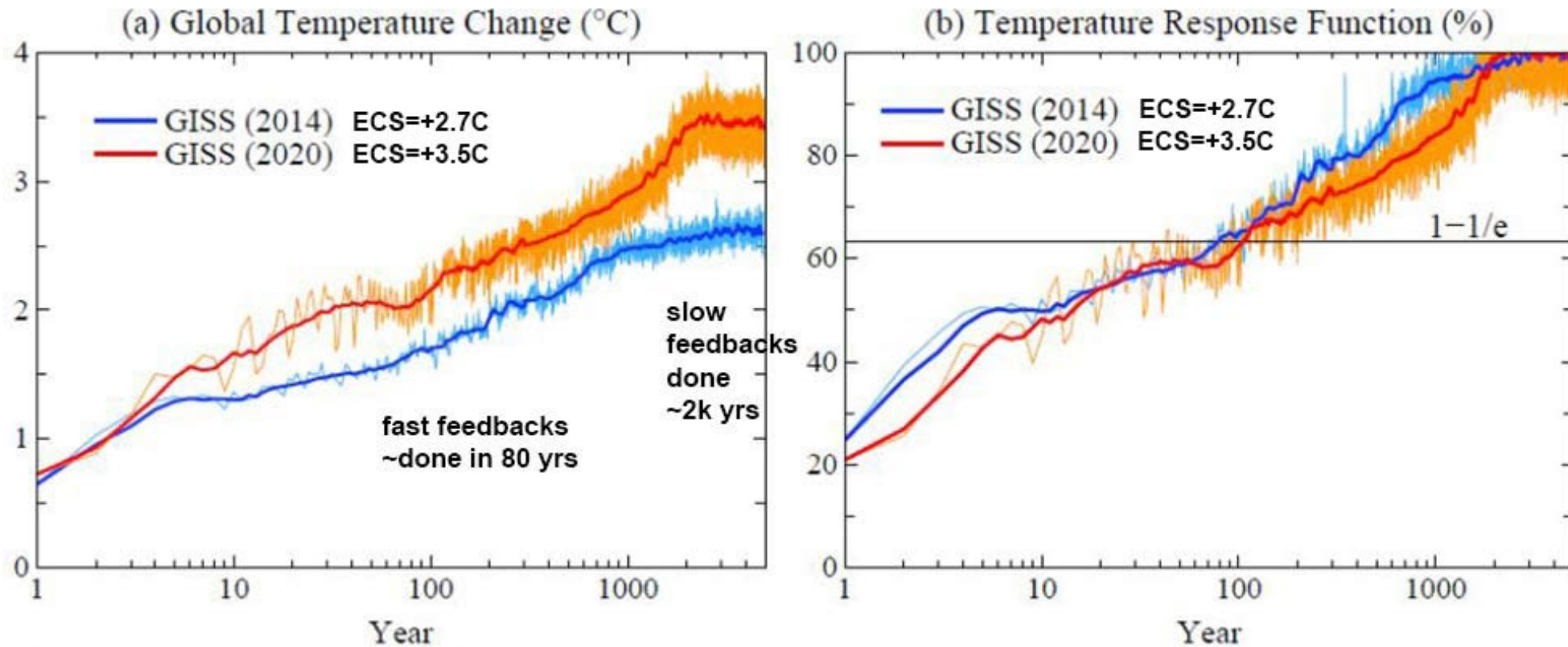


Fig. 4. (a) Global mean surface temperature response to instant CO₂ doubling and (b) normalized response function (percent of final change). Thick lines in Figs. 4 and 5 are smoothed⁷³ results.

EEI vs. TEMPERATURE TIME SCALES: THIS IS AMONG THE MOST ALARMING CONCLUSIONS OF THE 2022 HANSEN WORK...

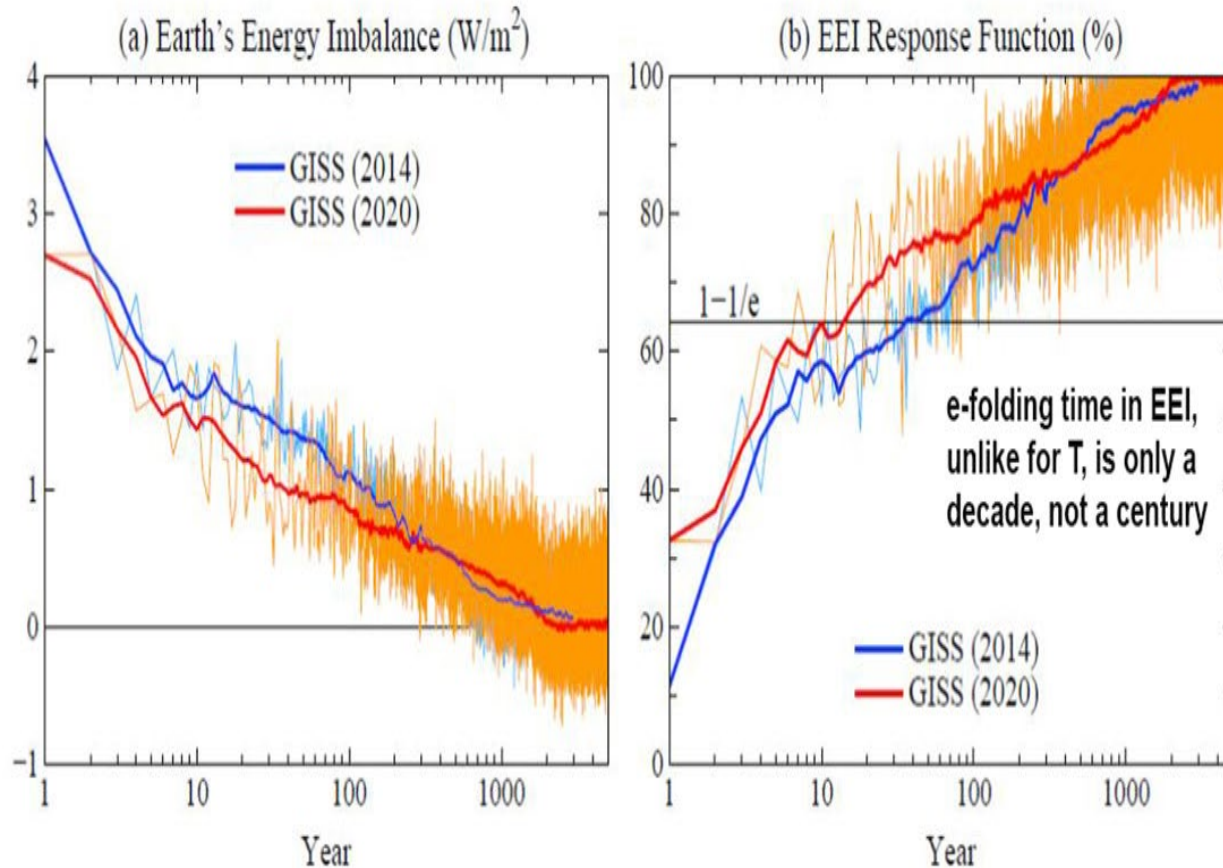


Fig. 5. (a) Earth's energy imbalance (EEI) for $2\times\text{CO}_2$, and (b) EEI normalized response function.

- Note that for EEI, fast feedbacks adjustment takes only ~ 1 decade. It is EEI which we can hope to affect through legal policy. But **temperature** is what governs climate effects, and it takes fully $\sim 10\times$ longer (a century or more) for temperature to adjust to EEI fast feedbacks and then transition to the slower rise to ESS.
- **Meaning: Current temperature change is truly “in the pipeline” and will emerge, almost regardless of any realistic policy changes. Current policy is only making this situation even worse.**

THIS EEI *vs* TEMPERATURE TIME SCALE DIFFERENCE...

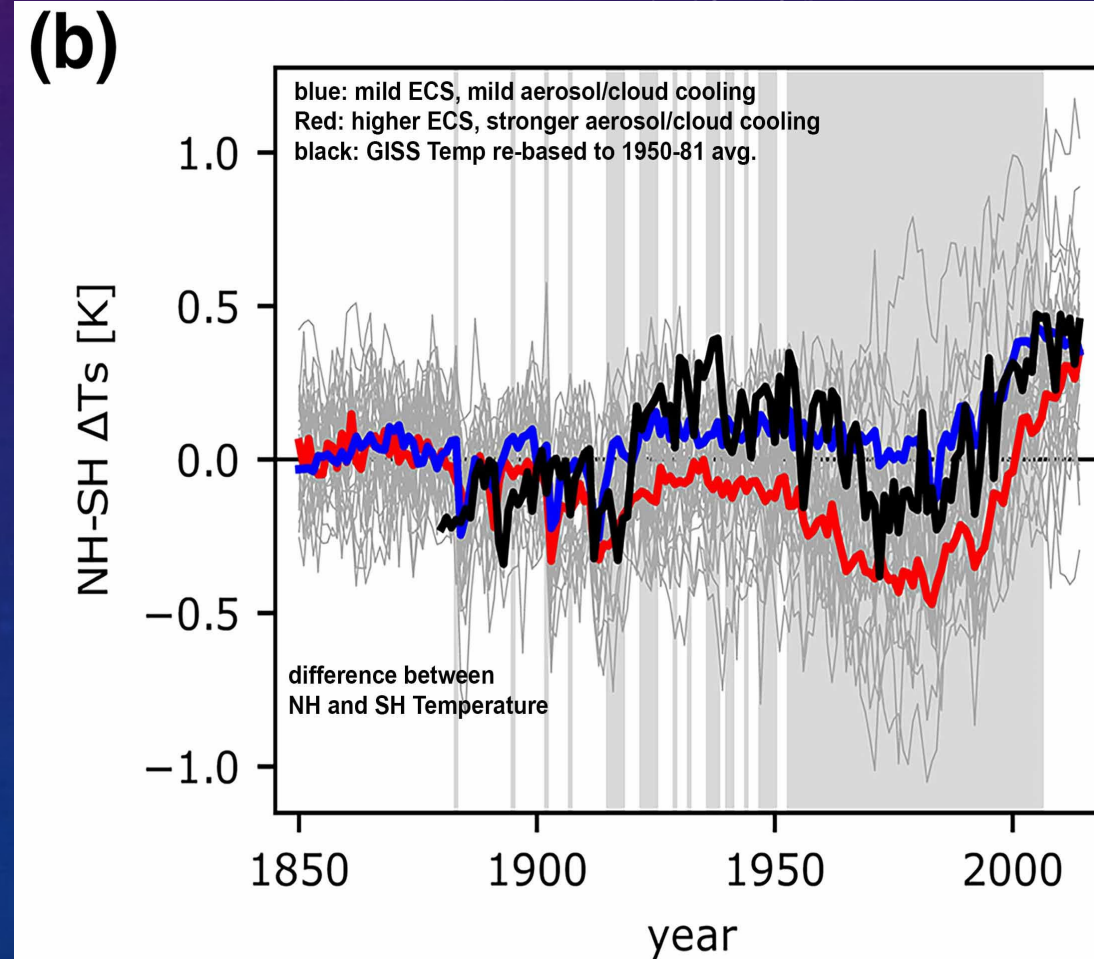
- “...has practical implications. First, EEI defines the rate that heat is pumped into the ocean, so if EEI is reduced, ocean warming is slowed. Second, rapid EEI decline implies that it is wrong to assume that global warming can be stopped by a reduction of climate forcing by the amount of EEI. Instead, the required reduction of forcing is larger than EEI. (p. 15)
- “The difficulty in finding additional reduction in climate forcing of even a few tenths of a W/m^2 is substantial” (Hansen J, Sato M, Kharecha P et al. Young People’s Burden: Requirement of Negative CO2 emissions. *Earth Syst Dyn* 2017;8:577-616)

AN ESS OF $\sim +10^{\circ}\text{C}$ GLOBAL AVG TEMPERATURE CHANGE
FROM OBSERVED FORCING, IMPLIES AN ECS = $\sim 4.5\text{-}6^{\circ}\text{C}$

- *“The LGM-Holocene climate change implies ECS = $3.3\text{-}5.1^{\circ}\text{C}$ for $2\times\text{CO}_2$ ”*
- *“Osman, Tierney et al. LGM cooling of 6.8°C for 23-19 ky BP yields ECS = $3.7\text{-}5.1^{\circ}\text{C}$.” (p.13)*
- Get similar, for the ECS of previous glacial-to-interglacial...
- *“the Prior-to-the-Eemian Glacial Maximum – to -Eemian Interglacial, is seen to have ECS $\sim 4 - 6^{\circ}\text{C}$.” (p.13)*

CONTRARY STUDY: WANG *et al.* 2021 ARGUE THE “WOLF PACK” IPCC AR6 CLIMATE MODELS (HIGH ECS~+5C) OVERESTIMATE HOW EFFECTIVE AEROSOLS ARE IN COOLING CLIMATE.

- To explain: Climate models can reproduce recent observed warming in two different ways: Mild **(blue) ECS w mild aerosol/cloud cooling**, or **(red) High ECS w strong aerosol/cloud cooling**
- How to decide? Most aerosols are produced in the land-dominated NH (northern hemisphere), so, use GISS climate modelling with red, then blue, assumptions and compare NH and SH, see which best agrees with observations.
- They find, the mild assumption (blue) a better fit.



THE HANSEN *et al.* 2022 (“PIPELINE”) AUTHORS ARE IN DISAGREEMENT WITH THIS CONCLUSION

- Hansen’s paper came out in 2022, and does not reference Wang *et al.* (2021), unfortunately. It would be a good question to ask Hansen *et al.*, and Wang, on reconciling their different results.
- But other work unrelated to Hansen’s is also in conflict with the Wang *et al.* 2021 conclusion.
- In particular, the new 2015 maritime laws, further strengthened in 2020 limiting SO₂ emissions in North Atlantic shipping has provided a good test to resolve this controversy (see coming slides)

THE HIGH ECS ARGUED FROM CLOUD FEEDBACKS AND ESS DATA, IS ONLY CONSISTENT WITH OBSERVED WARMING IF AEROSOL COOLING (BLUE) IS STRONG (HANSEN FIG. 6 BELOW). SO, WHAT DIRECT EVIDENCE ARGUES FOR STRONG AEROSOL COOLING? ...

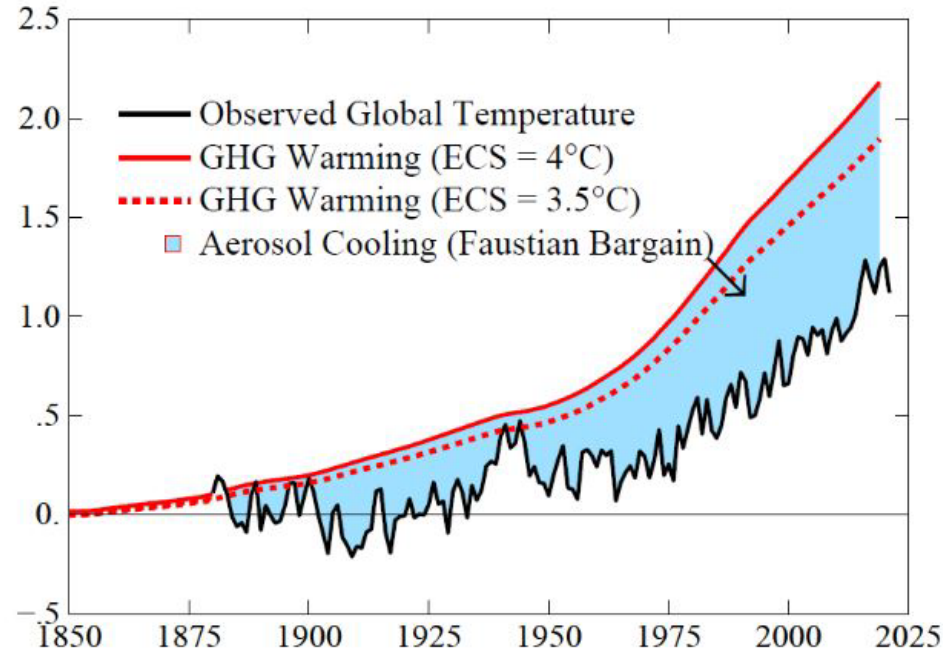


Fig. 6. Observed global mean surface temperature (black line) and expected warming from observed GHG changes with two alternative choices for ECS. The difference (blue area) is an estimate of the cooling effect of the (unmeasured) aerosol forcing. The temperature peak in the World War II era is in part an artifact of inhomogeneous ocean data during that period.⁵⁴

GHG (ANTARCTIC VOSTOK ICE CORE CO₂) FORCING TO PRODUCE OBSERVED GLOBAL TEMPERATURES (VOSTOK T_{x0.75} TO CORRECT FOR SOUTH POLAR AMPLIFICATION, TO AGREE WITH OBSERVED T_{global}) IMPLIES FORCING (GHG+AEROSOLS) IS ABOVE IPCC, AND...

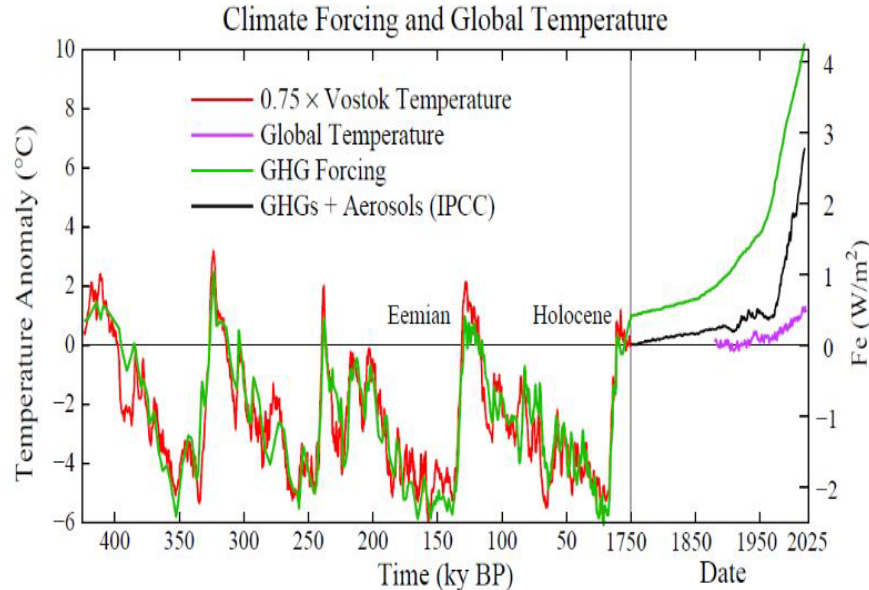


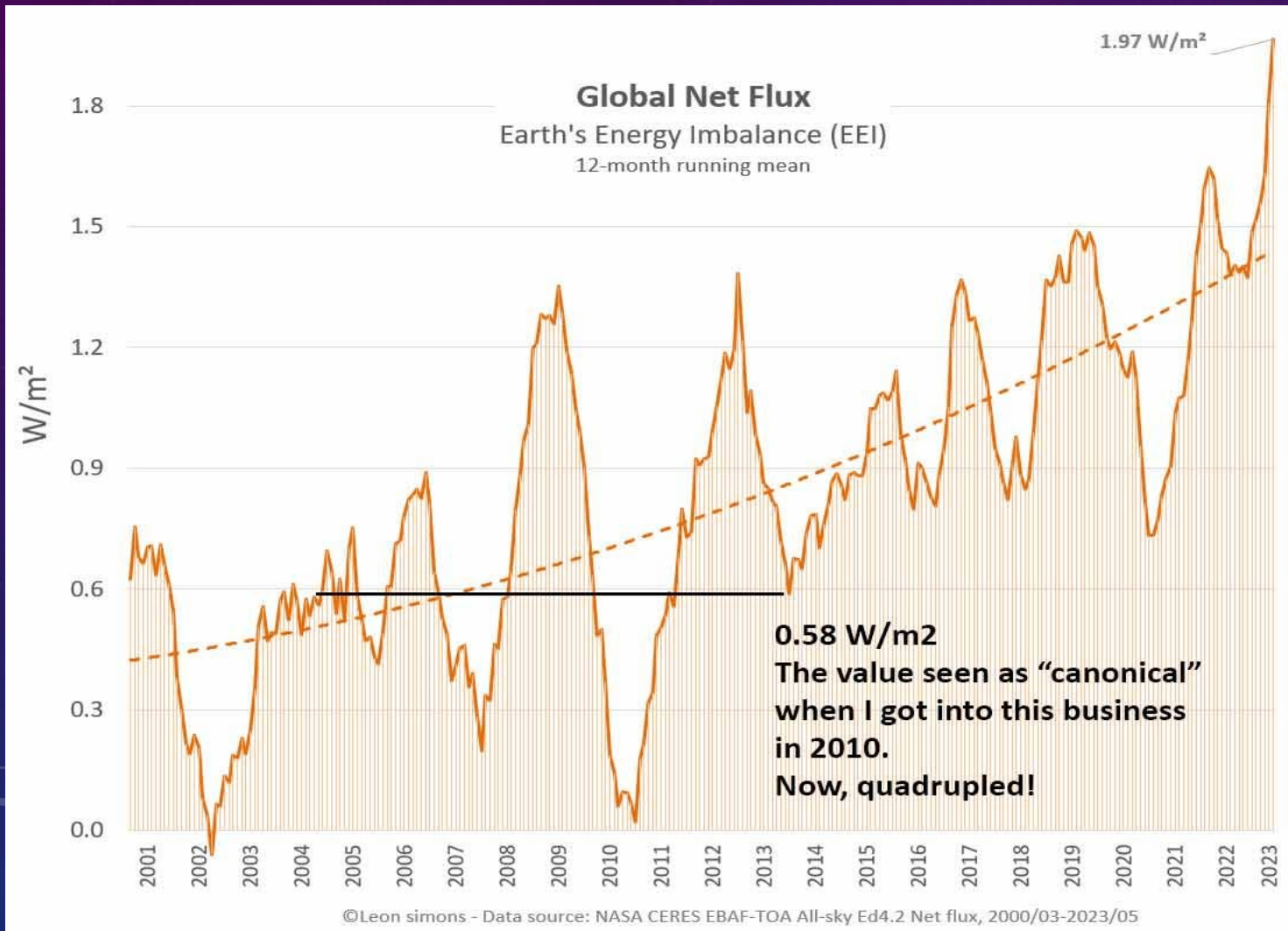
Fig. 7. Global mean surface temperature (left scale) and climate forcings (right). Scale factor between temperature and forcings is 2.4°C per W/m^2 (see text). Antarctic (Vostok) temperature change based on water isotopes^{87,88} is multiplied by 0.75. Time scale is expanded post 1750. Modern temperature is NASA GISS analysis.^{89,90} Zero point for GHG forcing is the mean for 10-8 ky BP, a period expected to precede significant human effects. GHG + IPCC aerosol forcing is indistinguishable from IPCC¹³ all-anthropogenic forcing (Supporting Material).

- ...shows GHG forcing (green curve) is already, today, at $2 \times \text{CO}_2_{\text{pre-ind}} = 4 \text{ W}/\text{m}^2$.
- Yet actual $\text{CO}_2 = 422 \text{ ppm}$ is only $1.5 \times \text{CO}_2_{\text{pre-ind}}$
- **With such strong forcing (green), why is it still so cool (black)? ...**

*“WE CONCLUDE THAT THE GHG INCREASE SINCE 1750
ALREADY PRODUCES A CLIMATE FORCING EQUIVALENT TO
THAT OF 2xCO₂”*

- *“(Our formulae yield $F_e \sim F_s = 4.08 \text{ W/m}^2$ for 2021 and 4.13 W/m^2 for 2022; IPCC AR6 has $F_s = 4.14 \text{ W/m}^2$ for 2021).” (p. 8)*
- In other words, the IPCC AR6 and Hansen are in agreement on this forcing, yet...
- Yet we're not at 2xCO₂_{pre-ind}, we're at only 1.5xCO₂_{pre-ind}
- So, why are we not hotter today? Conclude: ECS is higher than 3C, and being masked by understated aerosol cooling from human-caused aerosols.

THE RISE IN EARTH'S ENERGY IMBALANCE (HEAT IN, MINUS HEAT RADIATED) IS DRAMATIC IN PAST DECADE; EEI IN 2023 WAS $\sim 4\times$ WHAT IT WAS JUST 15 YEARS AGO. A STRONG CASE IS MADE THE CULPRIT IS AEROSOL MASKING



- NASA CERES data, 2023 (not from Hansen's paper)
- Note that EEI defines the RATE, the SPEED, at which global temperature rises. A constant EEI drives a constant RATE of RISE of global temperature!

HANSEN'S FIG 5 – AEROSOL FORCING FROM IPCC AR6 AND FORSTER ET AL 2025, SHOWING AEROSOL COOLING NOW DECREASING, CAUSING NET ANTHRO FORCING UPWARD TO ACCELERATE

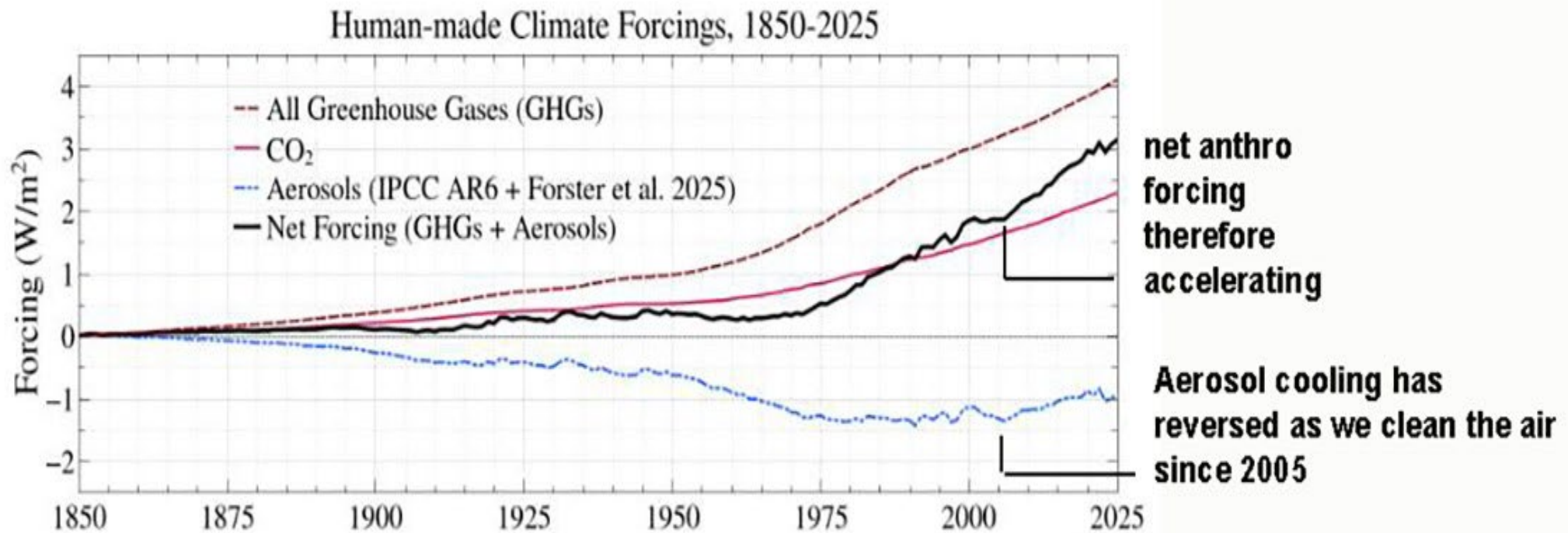
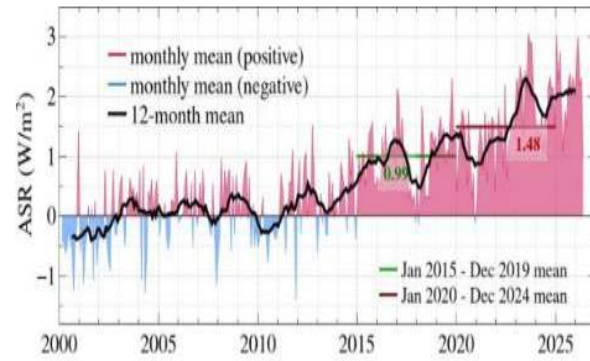
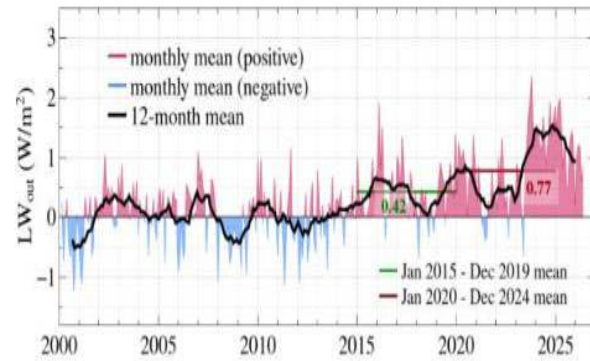


Fig. 5. All Greenhouse gases, CO_2 , aerosol, and net climate forcings.^{7,8,9,10}



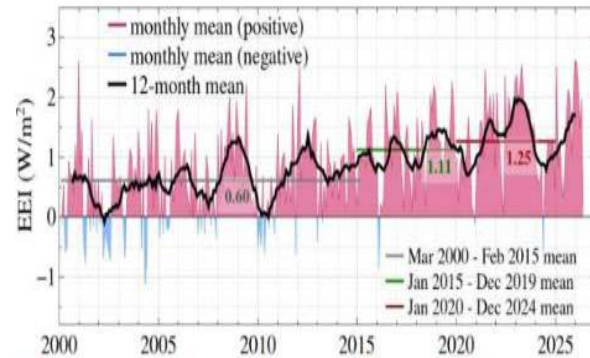
This graph...
(absorbed
solar
radiation)

minus...



This graph
(IR radiated to
outer space
by Earth)

gives...



This graph
(Earth Energy
Imbalance)
Despite
renewables,
it's heading UP

MEASURED ABSORBED
RADIATION FROM THE SUN IS
GOING UP, AND IR OUTGOING
FROM EARTH ISN'T KEEPING UP.

THE BOTTOM GRAPH IS THE
RESULT: PROPORTIONAL TO THE
RATE OF
TEMPERATURE RISE FOR EARTH!

Fig. 6. Earth's satellite-observed absorbed solar radiation (ASR) and longwave (thermal) emission to space (LW),¹¹ both relative to their 2000-2010 averages, and the absolute Earth energy imbalance (EEI) calibrated with aid of Argo-measured heat storage in the ocean.¹²

THEREFORE; ACCELERATED WARMING IS IN THE PIPELINE. CHINA CLEAN AIR EFFORTS, BEGUN IN 2010, ARE IMPLICATED AS A ONE CAUSE, AS IS NEW SHIPPING SO₂ REGULATIONS, LOSS OF REFLECTIVE LOW CLOUDS, SMOKE-TAINTED GREENLAND SNOW...

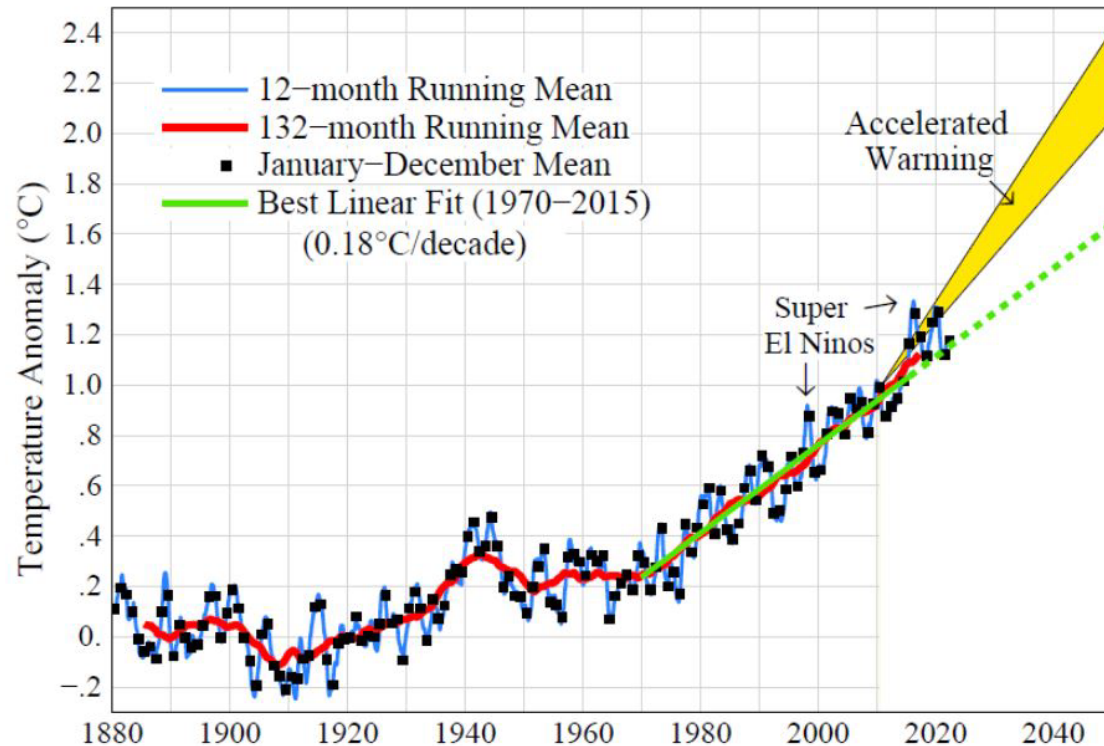
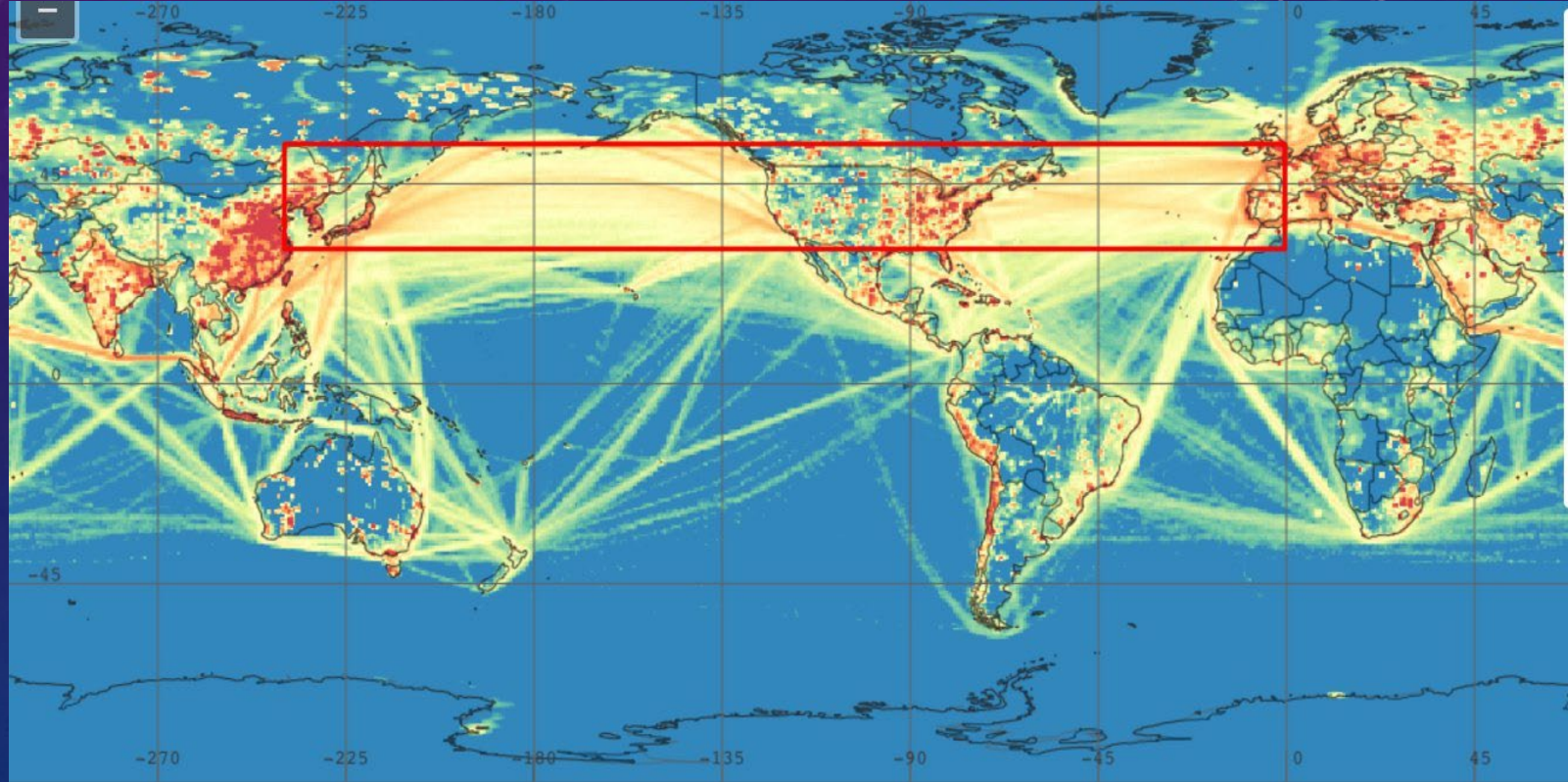
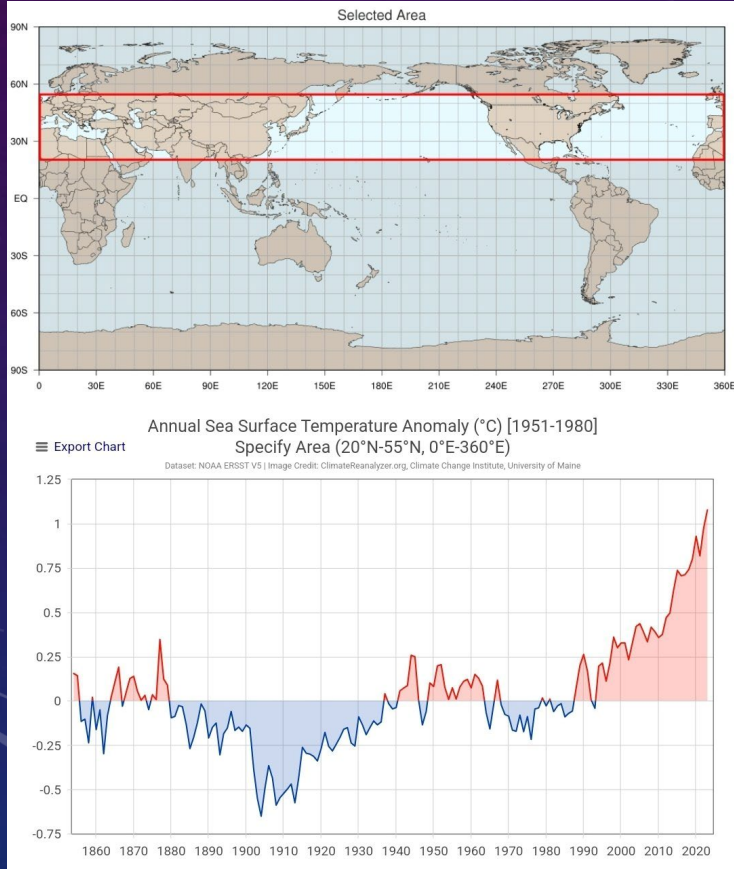
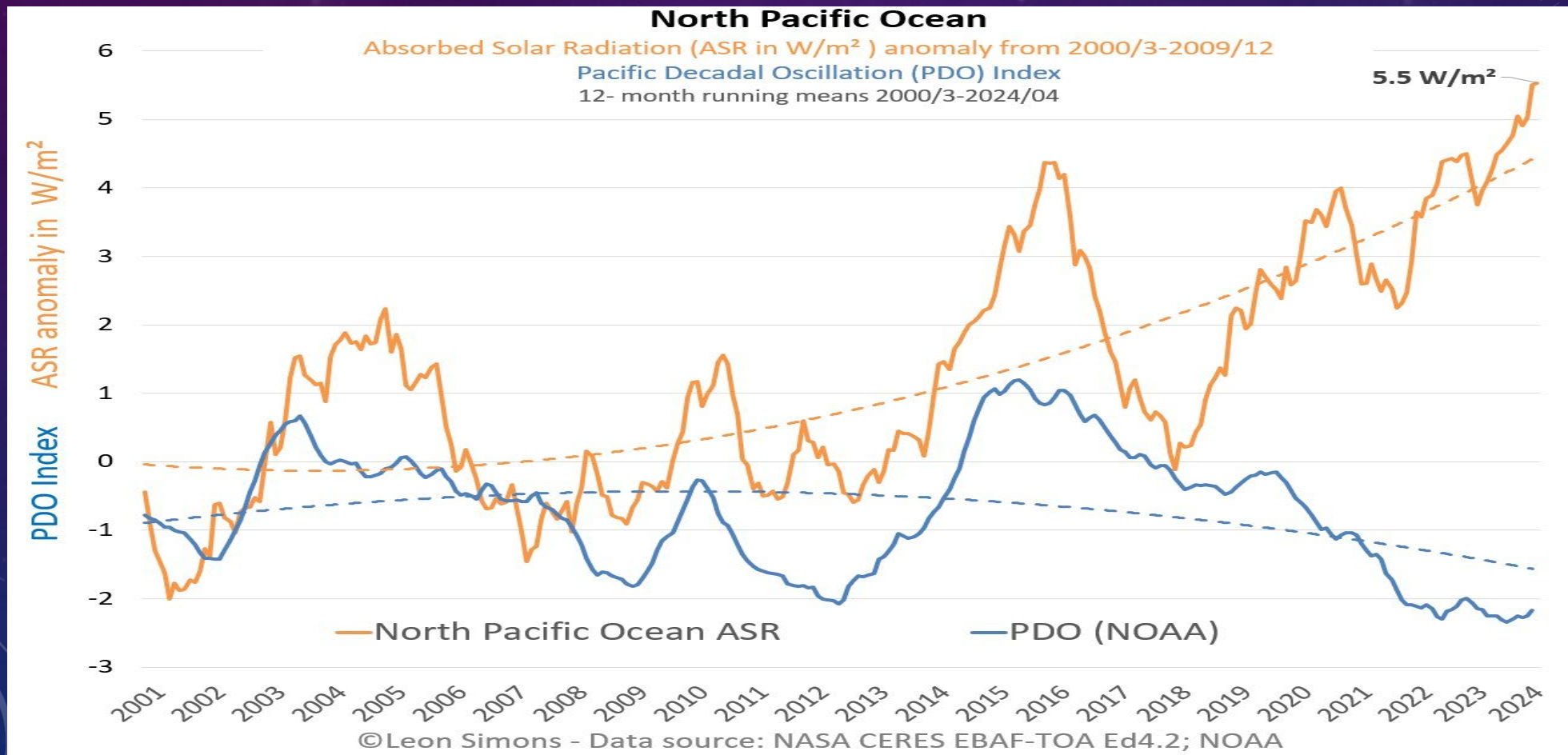


Fig. 19. Accelerated warming rate post-2010 (yellow area) if aerosol reductions approximately double the net (GHG + aerosol) climate forcing. Upper and lower edges of the yellow area are 0.36 and 0.27°C per decade warming rates.

RAPID RISE POST 2020, IN SST'S ALONG NH SHIPPING LATITUDES. Michael Mann in '23 said he still saw ocean heat content since late 20th century rising ~linearly and not ready to sign on to Hansen's accel conclusions... but note total ocean heat content goes vastly deeper than solar-accessed depth, and so is slower to respond; I agree w/ Hansen *et al.* Mann has also begun to come around on this.



PRIOR TO 2015-2020's SO₂ RESTRICTIONS, PDO INDEX AND ABSORBED SOLAR RADIATION IN NORTH PACIFIC FOLLOWED EACH OTHER WELL. NOW, DIVERGING RADICALLY AS ASR (=ORANGE ABSORBED SOLAR RADIATION) BREAKS FROM PDO OSCILLATIONS AND CLIMBS STEEPLY. THIS, EVEN THOUGH THE PDO HAS BEEN IN A COOLING PHASE (BLUE) FOR THIS DATA.



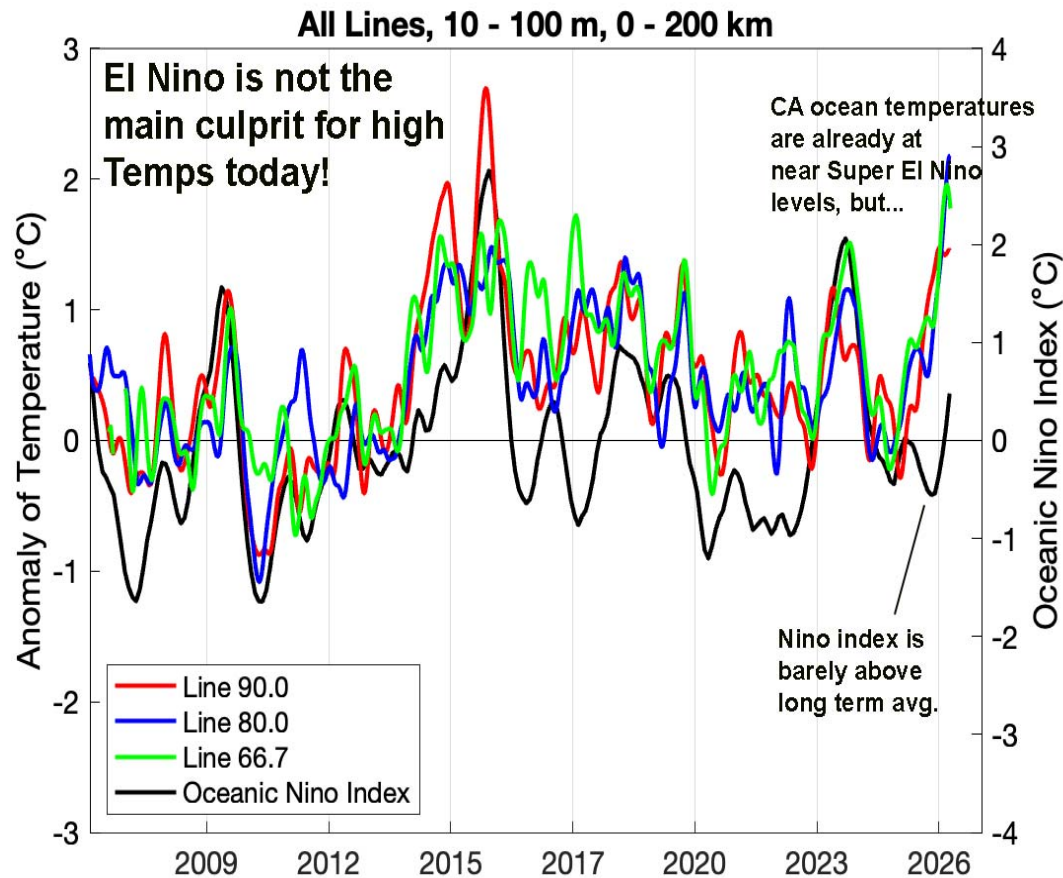
SUMMARY STATEMENTS... ESS IS ABOUT +10C

- *“During the past 800,000 years, CO₂ provided ~80% of GHG climate forcing, so, the total GHG forcing is 25% larger than the CO₂ alone forcing. Thus, the climate sensitivity in which non-CO₂ GHG feedbacks are allowed to change increases from ~4°C to ~5°C. ”*
- (Interpretation; the rising Permafrost methane and NO_x emissions, and methane clathrates in shallow ocean sediments... are feedback'd as well)
- *“When all feedbacks, including ice sheets, are allowed to respond to the climate forcing, the equilibrium response is approximately doubled, i.e., ESS is ~10°C*
- *With all trace gases included, the increase of GHG effective forcing between 1750 and 2021 is 4.09 W/m², which is equivalent to increasing the 1750 CO₂ amount (278 ppm) to 561 ppm (formulae in Supporting Material). We have already reached the GHG climate forcing level of doubled CO₂.”*

SUMMARY STATEMENTS: ECS AT PETM (55Mya)...

- *“The Paleocene-Eocene Thermal Maximum (PETM) provides an opportunity to assess climate sensitivity in the absence of large ice sheets. PETM warming of about 5-6°C was driven by an approximate doubling of CO₂, which occurred over a period of 3,000-10,000 years.*
- *If we assume that forcing by non-CO₂ GHGs increased in the same proportion (~25%) to CO₂ forcing as in the period covered by ice core data, we obtain an ECS estimate of 4-5°C for 2×CO₂.*
- *High ECS in a warm ice-free climate may be a result of amplifying cloud feedbacks, and a rising tropopause may also contribute to high ECS in warm climates.”*
- *(55Mya the continent positions were little changed from today).*

X. PROCHASKA ADDS THIS GRAPH, SHOWING HANSEN'S TITLE IS APPROPO, EVEN JUST WITH LOCAL CALIFORNIA DATA.

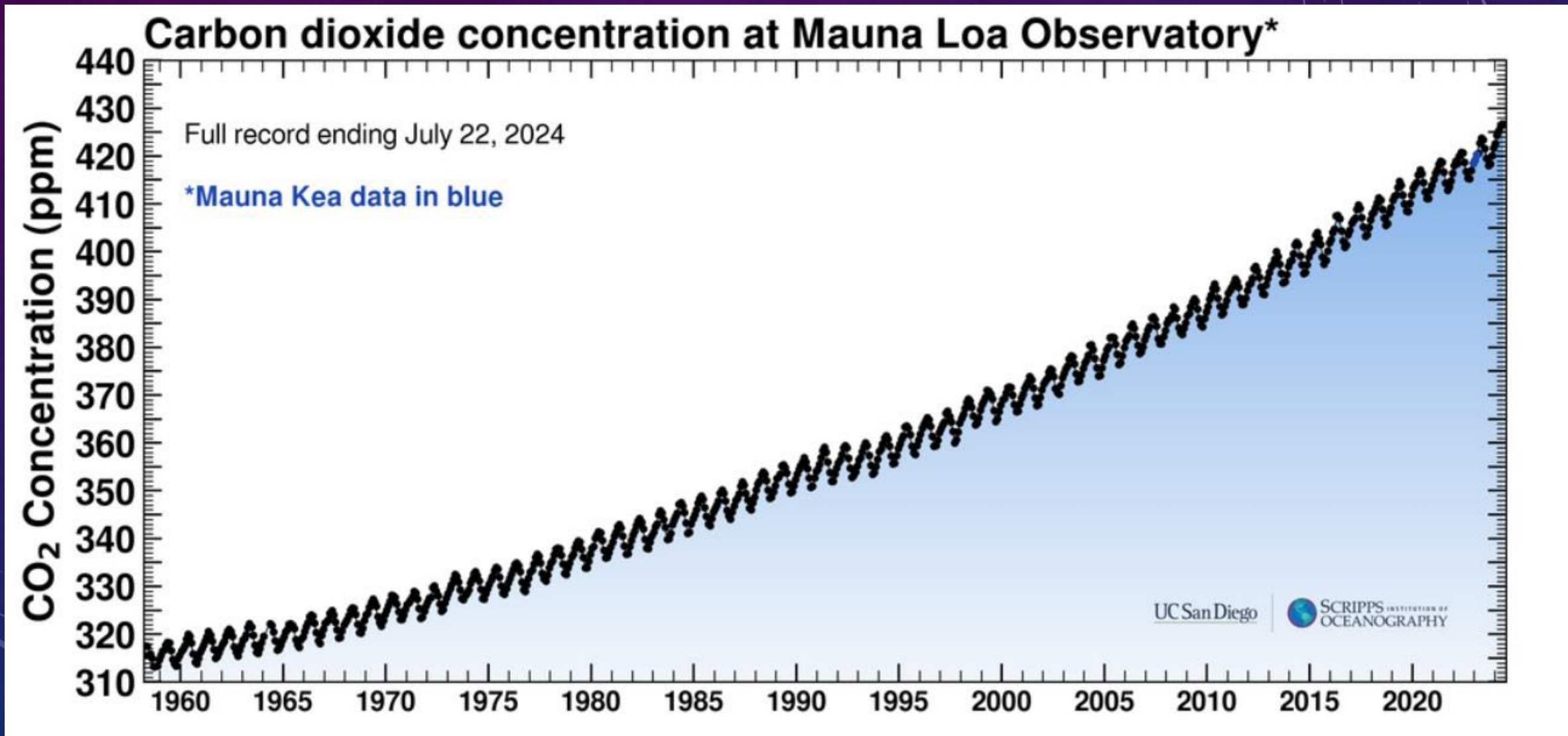


- California off shore ocean temperatures for the past 20 years. The super El Nino of 2015 stands out. The Nino Index at that time reached 3.0. Contrast with today, when the temperature anomaly is already almost at the 2015 highs, yet the Nino index=0.5 is barely above the long term average of this 20 yr period.
- **Today's high temperatures: It's NOT the El Nino!**

RECALL FROM NOLTHENIUS (2022 P. 19) REFERENCE TO CARBON EMISSION FROM PEAT LANDS AT TODAY'S CLIMATE FORCING: HANSEN COMMENTS...

*(p. 26) "Another potential feedback contribution, from peat, seems almost unavoidable. Northern peatlands today contain more than 1000 Gt carbon, much of which could be mobilized on millennial time scales at PETM warming levels. Numerous hyperthermal events in the Cenozoic record testify to the importance of such feedbacks, because the events seem to be spurred by modest orbital forcings and include negative carbon isotope excursions. Emissions from such feedbacks, including the terrestrial biosphere and permafrost, seem to be more chronic than catastrophic on the short-term, but **if policies are not designed to terminate growth of these feedbacks (Section 6), it may become impossible to avoid climate catastrophe.**"*

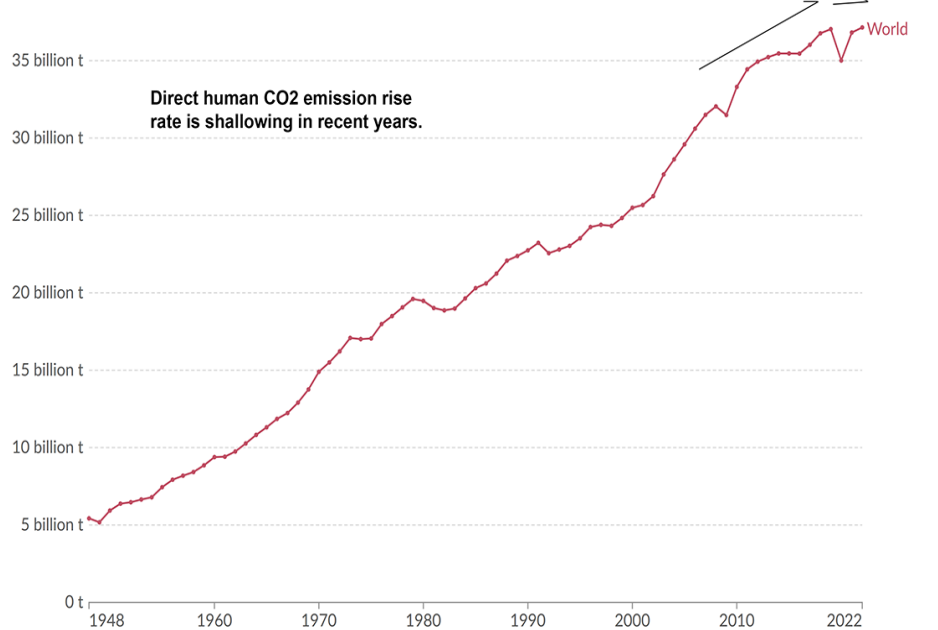
NO HINT OF A PAUSE IN EXPONENTIAL ATMOSPHERIC CO₂ RISE, EVEN WITH THE COVID RECESSION AND SHALLOWING EMISSIONS RATES. TODAY=425 PPM



FINALLY: (NOT HANSEN) GROWING EVIDENCE THAT ATMOSPHERIC CO₂ CONCENTRATION IS NOW RISING SIGNIFICANTLY FASTER THAN DIRECT HUMAN CO₂ EMISSIONS. ARE INDIRECT ANTHRO EMISSIONS TAKING OVER, AS NORMAL LAND/OCEAN CAPTURE DROPS?

Annual CO₂ emissions

Carbon dioxide (CO₂) emissions from fossil fuels and industry¹. Land-use change is not included.



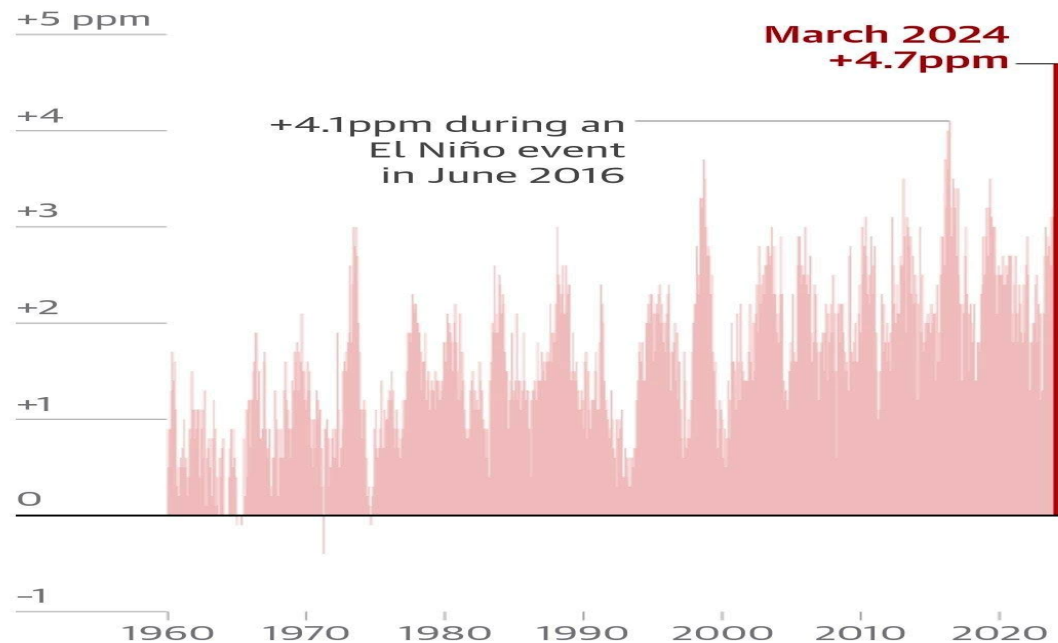
Data source: Global Carbon Budget (2023)

OurWorldInData.org/co2-and-greenhouse-gas-emissions | CC BY

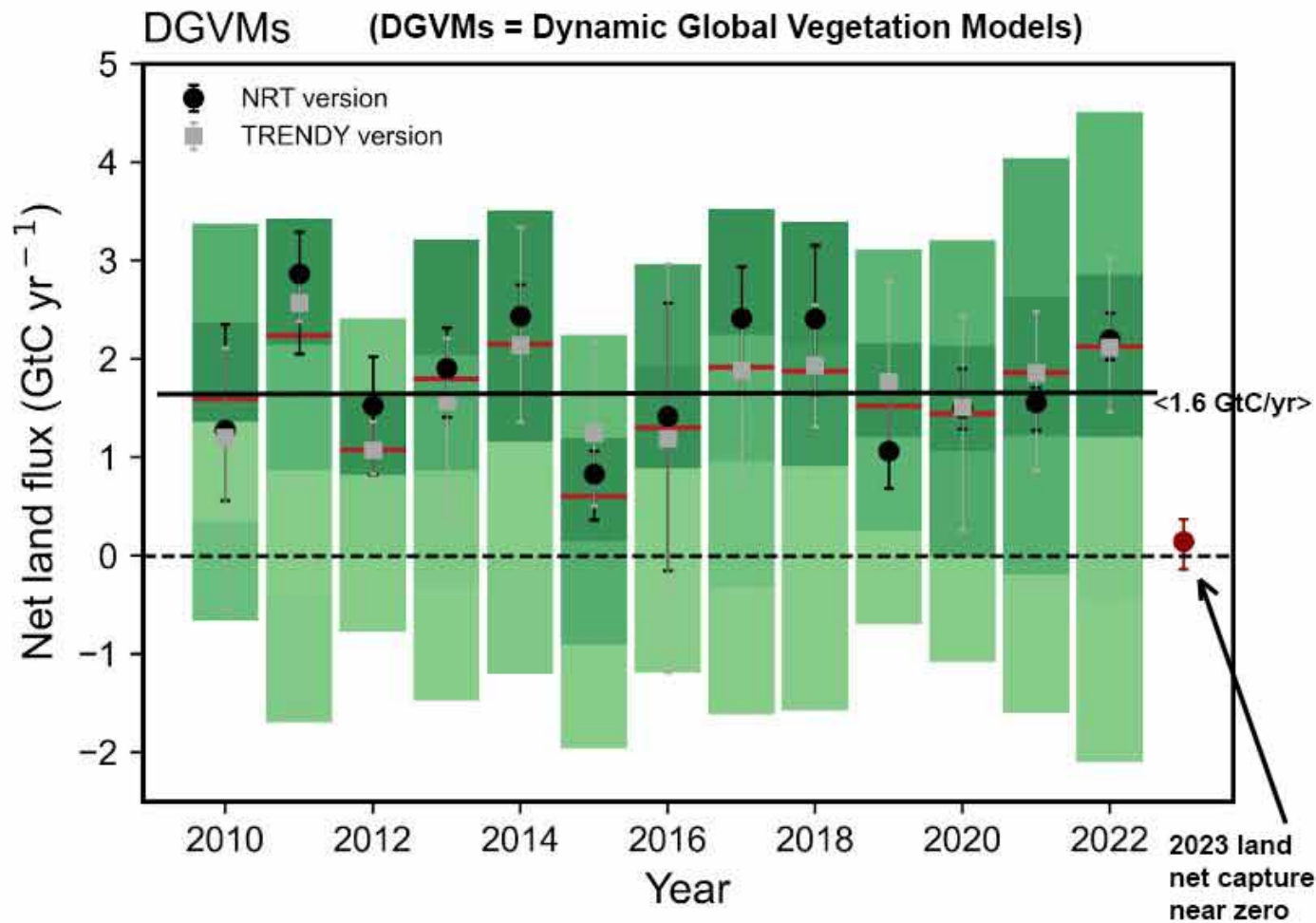
1. Fossil emissions: Fossil emissions measure the quantity of carbon dioxide (CO₂) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO₂ includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

A record annual increase in the amount of atmospheric CO₂

Monthly year-over-year change measured in parts per million at the Mauna Loa observatory



Guardian graphic. Source: Dr. Xin Lan, NOAA/GML and Dr. Ralph Keeling, Scripps Institution of Oceanography



Supplementary Figure 2 Comparison of global net land CO_2 fluxes between the 3 DGVMs used in this study (black dots for NRT version, a red dot for NRT version in 2023, gray squares for TRENDY version) and the distribution of 21 TRENDY models (green bars, with color intensity representing the number of DGVMs falling into each interval) used in latest Global Carbon Budget edition[7]. Note that the 3 DGVMs have been biased corrected to have the same net land sink than the average of TRENDY models during 2019-2022, but their anomalies are feely calculated for all years including in 2023.

ALIGNS WITH KE *et al.* 2024 —... SHOWING NET LAND CAPTURE OF CO_2 HAS DROPPED TO ZERO AS OF 2023

CENOZOIC CO₂ AND CLIMATE HISTORIES REVEAL WHERE CLIMATE IS HEADED...

- *“if present human-made climate forcings remain in place. GHG climate forcing is now 4.6 W/m² relative to the mid-Holocene (7kyBP) or 4.1 W/m² relative to 1750. We argue that 4.6 W/m² is the human-made forcing, but there is little point to debate whether it should be 4.6 W/m² or 4.1 W/m² because the GHG forcing is increasing 0.5 W/m² per decade (Section 6.7).*
- *“One merit of consistent analysis for the full Cenozoic era is revelation that the human-made climate forcing exceeds the forcing at transition from a largely ice-free planet to glaciated Antarctica, even with inclusion of a large, negative, aerosol climate forcing. Equilibrium global warming for today’s GHG level is 10°C for our central estimate ECS = 1.2°C ± 0.2°C per W/m² (equiv to ECS=+5C), including the amplifications from disappearing ice sheets and non-CO₂ GHGs (Sec. 4.4). (Anthro generated) Aerosols reduce equilibrium warming to about 8°C. Equilibrium sea level change is +60 m (about 200 feet).”*

A LAST SECOND ADDITION...

- How much total summed \$ investment has there been in CO2 removal research and development since 2009? \$3 billion.
- ...Far less than the real estate value of a single square mile of our little beach town of Santa Cruz.
- Globally, we are not serious about dealing with climate change.