



Fact-check of Science Feedback’s alleged “fact-check” by CERES-Science

Dr. Willie Soon, Dr. Ronan Connolly & Dr. Michael Connolly

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www.ceres-science.com

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Introduction

On January 22nd, 2024, Climate Feedback (a subsidiary of Science Feedback) posted an alleged “fact-check” claiming to have debunked several statements made by Dr. Willie Soon, CERES-Science co-team leader, during an interview with Tucker Carlson that went online on January 9th, 2024.

They summarized their overall assessment of the interview with their lowest “[scientific credibility level](#)” rating as:

INCORRECT

[Science Feedback](#) is the parent organization of two sister “fact-checking organizations”: [Climate Feedback](#) and [Health Feedback](#). Because Science Feedback is currently one of the “independent fact-checker organizations” used by three of the largest global social media platforms (Facebook, Instagram and TikTok), this alleged fact-check has been used to substantially interfere with the ability of users of those platforms to see or share any of the content related to that Tucker Carlson interview.

Furthermore, the accusations of “misinformation” alleged against both Dr. Willie Soon and Tucker Carlson could be professionally damaging.

Science Feedback apparently does not currently allow a mechanism for a right of reply to their alleged fact-check articles. Neither do the three social media platforms mentioned, who argue that they are “independent” from the fact-checking organizations and do not have the resources or infrastructure to evaluate the accuracy of the fact-checkers.

Therefore, we are posting this response to Climate Feedback’s accusations of “misinformation” they have made against Dr. Willie Soon and the Tucker Carlson Network on our www.ceres-science.com website.

Details on Science Feedback’s assessment

The assessment made by Climate Feedback is entitled,

“Evidence greenhouse gasses cause global warming denied by Willie Soon in Tucker Carlson interview, resulting in mass social media climate misinformation”

It was published on 22 Jan 2024 and the editor involved was Dr. Stephen Bell

- <https://climatefeedback.org/claimreview/evidence-greenhouse-gasses-cause-global-warming-denied-willie-soon-tucker-carlson-interview-mass-social-media-climate-misinformation/> (Archived link)

[Dr. Simon Bell](#), the writer of the Climate Feedback article claiming to have fact-checked Dr. Soon’s interview, is a scientist and he has (at the time of writing), published [22 papers](#) – mostly in the fields of soil sciences and carbon sequestration.

It appears that none of these papers have direct relevance for the topics covered by Dr. Soon that he was “fact-checking”.

Of course, Dr. Bell is still entitled to his own scientific opinions on these topics. But, so is Dr. Soon. And, given that Dr. Soon has published more than 100 peer-reviewed papers on these topics ([bio here](#)), and has collaborated with more than 100 scientists in the last 5 years alone, his expertise on these topics is perhaps more extensive than Dr. Bell.

Nonetheless, the way in which Science Feedback is currently set up means that whoever they nominate as the editor for a fact-check (in this case, Dr. Bell) is *de facto* the judge, prosecution, defence, and jury on whatever scientific assessments they decide.

That said, Science Feedback claims that all the ratings for their fact-check articles for either Climate Feedback or their sister website, Health Feedback, are made following a specific process and methodology that they provide on their website:

- <https://science.feedback.org/process/> (Archived link)
- <https://climatefeedback.org/claim-reviews-framework/> (Archived link)

For each claim and for the overall content, they provide color-coded labels summarizing their overall assessment, which they describe as follows:

“We rate the scientific credibility of claims following our scale of scientific credibility. In our claim reviews, the background color of the tag indicates the scientific credibility level according to this color code.



Our “verdict tags” also feature a word summarizing the reason that the claim earned its credibility rating.”

- <https://climatefeedback.org/claim-reviews-framework/> (Archived link)

In our response, we have used this methodology provided by Science Feedback to assess their alleged fact-check of the interview with Dr. Soon. All of the rating labels and terms we used are taken from their methodology page.

Summary of our fact-check

Our overall verdict (following the methodology described by Science Feedback) of Dr. Bell's assessment of Tucker Carlson's interview with Dr. Willie Soon is:

INACCURATE

INCORRECT

FLAWED REASONING

These are the three lowest “scientific credibility level” ratings provided by Science Feedback. So, in this case at least, the editor of their article has completely inverted their stated methodology.

In the following sections, we will systematically consider and assess each claim and sub-claim in turn – again using Science Feedback's stated methodology. However, because Dr. Bell has made so many false or misleading claims in his article for Climate Feedback, this detailed response is quite a long read. With that in mind, below, for convenience, we have provided each of the claims and subclaims we will address and our rating of those claims:

- Claim 1.** Dr. Willie Soon received “much” of his research funding from the oil & gas industry.

INACCURATE MISLEADING
- Claim 2.** Greenhouse gasses drive recent global warming, not the Sun.

INACCURATE UNSUPPORTED

 - Subclaim 2.1:** Solar activity cannot explain any global warming since the 1960s.

LACKS CONTEXT MISLEADING INACCURATE INCORRECT
 - Subclaim 2.2:** Eunice Foote discovered “the greenhouse effect” in 1856.

INACCURATE UNSUPPORTED
 - Subclaim 2.3:** A solar-driven global warming is contradicted by the observed stratospheric cooling.

INACCURATE UNSUPPORTED
 - Subclaim 2.4.** Soon's arguments for a solar explanation are debunked by criticisms of Svensmark's “galactic cosmic ray” theory.

INACCURATE UNSUPPORTED
 - Subclaim 2.5.** The IPCC (2021) reports' estimates of the solar contribution to global warming have debunked Soon's papers.

INCORRECT
- Claim 3.** CO₂ causes “multiple direct and indirect environmental impacts”.

INACCURATE INCORRECT FLAWED REASONING UNSUPPORTED

 - Subclaim 3.1.** Human-caused CO₂ and methane emissions have caused more than 1°C global warming since the mid-19th century.

INACCURATE UNSUPPORTED

- **Subclaim 3.2.** Human-caused CO₂ emissions have also caused 7 other forms of climate change (ocean warming, ice sheets shrinking, glaciers retreating, snow cover decreasing, sea level rising, Arctic sea ice decreasing, extreme weather increases).
 [FLAWED REASONING] [INACCURATE]
- **Subclaim 3.3.** CO₂ is directly linked to ocean acidification.
 [UNSUPPORTED]
- **Subclaim 3.4.** Global warming has harmed and will continue to harm polar bear populations.
 [MISLEADING] [INACCURATE] [INCORRECT]
- **Claim 4.** Dr. Soon used flawed reasoning in his discussion of the relevance of Titan.
 [MISLEADING] [LACKS CONTEXT]
 - **Point of agreement 1.** The main factor in Titan’s colder temperature is its greater distance from the Sun.
 [CORRECT]
 - **Point of agreement 2.** Titan’s atmosphere is very different from the Earth’s atmosphere.
 [CORRECT]
 - **Point of agreement 3.** The term “fossil fuel” is misleading and possibly inappropriate because hydrocarbons are found in Titan and elsewhere.
 [CORRECT]
 - **Subclaim 4.1.** The greenhouse effect on Titan is still substantial.
 [LACKS CONTEXT]
- **Claim 5.** The scientific community disagrees with Dr. Soon on the causes of climate change
 [INACCURATE] [FLAWED REASONING]
 - **Subclaim 5.1.** Several studies have shown Dr. Soon’s views on the causes of climate change to be fringe among the scientific community.
 [LACKS CONTEXT] [INCORRECT]
 - **Subclaim 5.2.** The IPCC’s latest report (AR6) “directly contradicts Soon” in their very first line.
 [INACCURATE] [INCORRECT]
 - **Subclaim 5.3.** The IPCC’s AR6 report represented a more comprehensive review of the relevant scientific literature than Dr. Soon’s research.
 [INACCURATE] [FLAWED REASONING]

Detailed response to each claim and subclaim

Claim 1. Dr. Willie Soon received “much” of his research funding from the oil & gas industry.

Climate Feedback’s statement:

“Dr. Willie Soon, an astrophysicist and aerospace engineer who has received “much” of his research funding from the oil and gas industry...”

Dr. Bell’s references:

- <https://www.desmog.com/willie-soon/>
- <https://www.nytimes.com/2015/02/22/us/ties-to-corporate-cash-for-climate-change-researcher-Wei-Hock-Soon.html>

CERES-Science’s reply:

This false accusation about Dr. Soon has been repeated for years, but is completely false, as Dr. Soon summarized in [this 9.5 minute clip](#) from a April 11, 2022 talk in Washington D.C.:

Have you seen this man ? (The search for Dr. Willie Soon’s evil doppelgänger)



For further information and context, we recommend also viewing the other clips from the talk that can be found on our website here: <https://www.ceres-science.com/post/the-weaponization-of-science-politics-vilification-and-the-climate-debate-dr-willie-soon>

This false claim was invented in 2015 by the former Greenpeace USA research director, [Roland “Kert” Davies](#), in conjunction with Greenpeace, as part of a Greenpeace fundraising campaign. It followed several years of Roland Davies carrying out an apparently personal vendetta against Dr. Soon by trying to smear him by any means possible.

In 2015, he falsely presented some out-of-context information in a misleading way to imply that Dr. Soon's research was compromised and that Dr. Soon was corrupt. Although Davies' claims could easily be shown to be disinformation with some basic journalism, apparently several high profile journalists uncritically repeated the disinformation without carrying out their own due diligence. Disappointingly, this included the February 22, 2015 New York Times article that Dr. Bell linked to.

According to Davies, Dr. Soon had "...accepted more than \$1.2 million in money from the fossil-fuel industry over the last decade while failing to disclose that conflict of interest in most of his scientific papers." ([New York Times, Feb 22, 2015; archived](#))

This claim is false and was fabricated by manipulating and distorting the reality to make it **sound like** Dr. Soon was directly receiving large sums of money from "the fossil-fuel industry" to get rich. And that he was somehow altering his scientific research in order to promote the interests of "the fossil-fuel industry". An additional unstated implication of this untrue claim was that Dr. Soon was getting rich by abandoning his scientific integrity and that all of his scientific research was corrupted, biased and agenda-driven – rather than scientific and objective.

The reality was that, during the 2001-2015 period that Davies was criticizing, Dr. Soon received all of his bi-weekly salary from the Harvard Smithsonian Center for Astrophysics (CfA). All of the funding for his research was managed and allocated by the CfA. The CfA keeps 40% of all the funds they receive for their staff for administrative purposes. Dr. Soon's average annual salary over the entire period worked out at between \$40-75k per year (before tax). This is a far cry from the headline-grabbing accusations that the New York Times incompetently repeated from Davies.

So, where did Davies' sensational claims come from? They came from Davies deliberately misrepresenting, distorting and describing out-of-context several half-truths.

Roland Davies was highlighting the fact that some of the funding sources CfA used for paying Dr. Soon's salary included corporate groups. He "neglected" to mention that this was in addition to government grants including NASA and the US Airforce Office.

Davies mainly criticized two of the corporate sources. The first was an electricity utility company (Southern Company) that produced electricity from nuclear, solar, wind, biomass, but also fossil fuels (as all largescale electricity producers do). Davies used flawed reasoning to misleadingly imply that Dr. Soon was working for "the fossil-fuel industry".

The other funding source he criticized was the Charles G. Koch Charitable Foundation, a philanthropic organization that supports many projects including criminal justice reform, free speech, healthcare and education. Although this foundation was not part of "the fossil fuel industry" in any way, Davies implied that – because Koch had earned some of his wealth from oil refinery and chemicals – any of the philanthropic work that his foundation invested in must somehow be part of "the fossil fuel industry". That is, Davies again used flawed reasoning to misleadingly imply that Dr. Soon was working for "the fossil-fuel industry".

Davies then added up the total amount received by the CfA over the 15 year period to be more than \$1.2 million and dishonestly claimed that this was "money from the fossil-fuel industry".

Davies falsely implied that Dr. Soon had received all of this money directly. He studiously neglected to mention that the CfA took 40%, and that Dr. Soon's entire salary from the CfA was managed, approved and allocated by the CfA and provided to Dr. Soon as a biweekly salary.

Given the high profile nature of outlets such as the New York Times, it is perhaps possible that Dr. Bell had not done the due diligence of fact-checking the accuracy of his sources. Therefore, for this particular claim, Dr. Bell might have been repeating misinformation rather than deliberately repeating disinformation.

Nonetheless, this does not change the fact that this claim is Inaccurate and Misleading.

INACCURATE

MISLEADING

Claim 2. Greenhouse gasses drive recent global warming, not the Sun

Climate Feedback's statement:

“Incorrect: The hypothesis that the Sun is responsible for climate change is inconsistent with real-world observations. Scientific consensus based on overwhelming evidence shows that greenhouse gasses like carbon dioxide are the main cause of current global warming, beyond reasonable doubt.”

CERES-Science's reply:

Dr. Bell elaborated on this claim with five subclaims each of which we will show in turn to be false or misleading in the following subsections. However, overall, his summary statement is also false and misleading.

Dr. Bell is repeating assertions that many scientists have made in various publications. But, as [Booker T. Washington \(1856-1915\)](#) observed, "A lie doesn't become truth, wrong doesn't become right, and evil doesn't become good, just because it's accepted by a majority."

As we will show in our response to Dr. Bell's Subclaims 2.1, 2.3 and 2.5, the hypothesis that the Sun is responsible for climate change is **NOT** "inconsistent with real-world observations". He claims that his view that greenhouse gases "are the main cause of current global warming" is "based on overwhelming evidence" and is "beyond reasonable doubt". As we will show, these assertions by Dr. Bell are all "Inaccurate" and "Unsupported"

INACCURATE

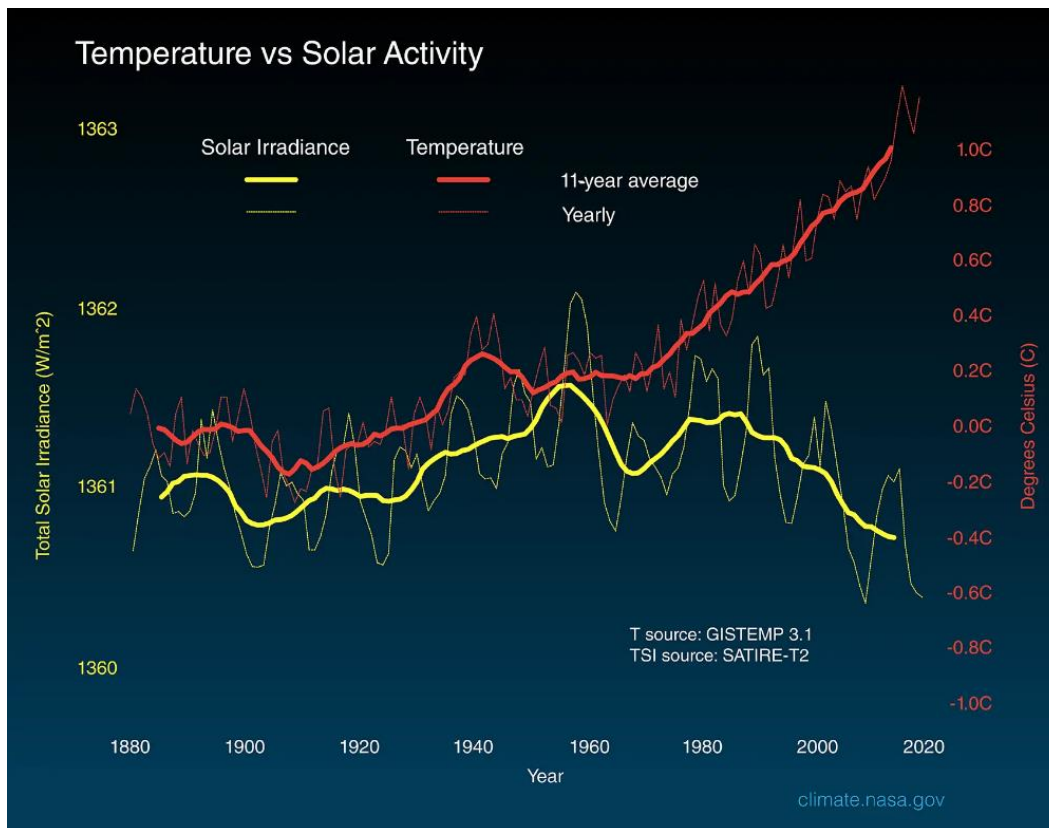
UNSUPPORTED

Subclaim 2.1: Solar activity cannot explain any global warming since the 1960s.

Climate Feedback's statement:

“Solar irradiance (the amount of power per unit area of solar energy reaching the Earth in the form of electromagnetic radiation, measured in watts per meter squared, $W\ m^{-2}$) and its influence on the climate are well-understood by scientists and the evidence shows clearly that solar variability cannot account for the recent warming[1]. The effect of rising rates of atmospheric greenhouse gasses, on the other hand, has been well established by decades of scientific research.

The Sun's activity has been monitored since the beginning of the 20th century, and although solar irradiance can have yearly fluctuations, there has not been a statistically significant increase in recent decades, as opposed to global temperatures (Fig. 1). Solar irradiance has decreased since the 1960's while global temperatures have increased. The warming influence of CO₂ has been much greater than that of the Sun over the past century.”



Dr. Bell's references:

- 1 – Lockwood (2008) Recent changes in solar outputs and the global mean surface temperature. III. Analysis of contributions to global mean air surface temperature rise. In Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences. <https://www.jstor.org/stable/pdf/20209476.pdf>

CERES-Science's reply:

We are very familiar with that specific climate.nasa.gov graph that Dr. Bell linked to, since that [particular website](#) is currently one of the top Google search results for terms such as “what are the causes of climate change?” As a result, many people who have only superficially researched the topic with a few internet searches, or through reading social media posts, have stumbled upon that initially impressive-looking graph.

But, more importantly, we are even more familiar with the two time series that are plotted in the graph, i.e., the GISTEMP global temperature estimate (red lines) labelled as “T source: GISTEMP 3.1” and the “Spectral And Total Irradiance REconstructions Telescope era version 2 (SATIRE-T2)” Total Solar Irradiance (TSI) reconstruction (yellow lines) labelled as “TSI source: SATIRE-T2”.

For details on the SATIRE-T2 solar reconstruction, see:

- N. A. Krivova, L. Balmaceda and S. K. Solanki (2007). “Reconstruction of solar total irradiance since 1700 from the surface magnetic flux”. *Astronomy and Astrophysics*, 467, 335-346. <https://doi.org/10.1051/0004-6361:20066725>.
- N. A. Krivova, L. E. A. Vieira, S. K. Solanki (2010). Reconstruction of solar spectral irradiance since the Maunder minimum. *Journal of Geophysical Research (Space Physics)*. 115, A12. <https://doi.org/10.1029/2010JA015431>.
- M. Dasi-Espuig, J. Jiang, N. A. Krivova, S. K. Solanki, Y. C. Unruh and K. L. Yeo (2016). Reconstruction of spectral solar irradiance since 1700 from simulated magnetograms. *Astronomy & Astrophysics*. 590, A63. <https://doi.org/10.1051/0004-6361/201527993>.

For details on the GISTEMP 3.1 global temperature estimate (last updated in 2019), see:

- J. Hansen, R. Ruedy, M. Sato, and K. Lo (2010). Global surface temperature change. *Reviews in Geophysics*, 48, RG4004, <https://doi.org/10.1029/2010RG000345>.
- https://data.giss.nasa.gov/gistemp/updates_v3/

We have published many peer-reviewed papers in which we have separately highlighted major flaws with **both** of these time series. The following list contains our most-relevant papers on these two topics of the last decade:

1. R. Connolly, **W. Soon**, M. Connolly, S. Baliunas, J. Berglund, C.J. Butler, R.G. Cionco, A.G. Elias, V. Fedorov, H. Harde, G.W. Henry, D.V. Hoyt, O. Humlum, D.R. Legates, N. Scafetta, J.-E. Solheim, L. Szarka, V.M. Velasco Herrera, H. Yan and W.J. Zhang (2023). “Challenges in the detection and attribution of Northern Hemisphere surface temperature trends since 1850”. *Research in Astronomy and Astrophysics*. <https://doi.org/10.1088/1674-4527/acf18e>.
2. **W. Soon**, R. Connolly, M. Connolly, S.-I. Akasofu, S. Baliunas, J. Berglund, A. Bianchini, W.M. Briggs, C.J. Butler, R.G. Cionco, M. Crok, A.G. Elias, V.M. Fedorov, F. Gervais, H. Harde, G.W. Henry, D.V. Hoyt, O. Humlum, D.R. Legates, A.R. Lupo, S. Maruyama, P. Moore, M. Ogurtsov, C. ÓhAiseadha, M.J. Oliveira, S.-S. Park, S. Qiu, G. Quinn, N. Scafetta, J.-E. Solheim, J. Steele, L. Szarka, H.L. Tanaka, M.K. Taylor, F. Vahrenholt, V.M. Velasco Herrera and W. Zhang (2023). “The Detection and Attribution of Northern Hemisphere Land Surface Warming (1850–2018) in Terms of Human and Natural Factors: Challenges of Inadequate Data”, *Climate*, 11(9), 179; <https://doi.org/10.3390/cli11090179>.

3. R. Connolly, **W. Soon**, M. Connolly, S. Baliunas, J. Berglund, C. J. Butler, R. G. Cionco, A. G. Elias, V. M. Fedorov, H. Harde, G. W. Henry, D. V. Hoyt, O. Humlum, D. R. Legates, S. Lüning, N. Scafetta, J.-E. Solheim, L. Szarka, H. van Loon, V. M. Velasco Herrera, R. C. Willson, H. Yan and W. Zhang (2021). “How much has the Sun influenced Northern Hemisphere temperature trends? An ongoing debate”. *Research in Astronomy and Astrophysics*, 21, 131. <https://doi.org/10.1088/1674-4527/21/6/131>.
4. P. O’Neill, R. Connolly, M. Connolly, **W. Soon**, B. Chimani, M. Crok, R. de Vos, H. Harde, P. Kajaba, P. Nojarov, R. Przybylak, D. Rasol, Oleg Skrynyk, Olesya Skrynyk, P. Štěpánek, A. Wypych and P. Zahradníček (2022). “Evaluation of the homogenization adjustments applied to European temperature records in the Global Historical Climatology Network dataset”. *Atmosphere*, 13(2), 285. <https://doi.org/10.3390/atmos13020285>.
5. R. Connolly, M. Connolly, R.M. Carter and **W. Soon** (2020). How much human-caused global warming should we expect with business-as-usual (BAU) climate policies? A semi-empirical assessment. *Energies*, 13, 1365. <https://doi.org/10.3390/en13061365>.
6. **W.W-H. Soon**, R. Connolly, M. Connolly, P. O’Neill, J. Zheng, Q. Ge, Z. Hao and H. Yan (2018). Comparing the current and early 20th century warm periods in China. *Earth-Science Reviews*, 185, 80-101. <https://doi.org/10.1016/j.earscirev.2018.05.013>.
7. **W. Soon**, Ronan Connolly and M. Connolly (2015). “Re-evaluating the role of solar variability on Northern Hemisphere temperature trends since the 19th century”. *Earth-Science Reviews*, 150, 409-452. <https://doi.org/10.1016/j.earscirev.2015.08.010>.

We also have replicated the simplistic analysis made by the climate.nasa.gov team for that figure and showed that if you use that particular TSI reconstruction and that particular global temperature record it is impossible to find a direct TSI-driven solar cause for the global warming implied by that particular temperature record. This particular claim and analysis is not news to those of us who have been actively researching scientific topic – and we have noted those claims in our own published work.

When he made his comments, Dr. Soon was well aware that this sloppy analysis by the creators of that figure was floating about on the internet. His comments were not referring to cherry-picked attempts at “science” like that figure. Instead, he was referring to genuine scientific opinion among scientists who are seriously looking at these problems from a scientific perspective instead of an ideological one.

In particular, he was referring to the latest findings from three of our recent papers – the first three in the list above, i.e., Connolly et al. (2023); Soon et al. (2023); and Connolly et al. (2021). These papers were multi-disciplinary international collaborations that collectively involved 40 researchers from 18 countries.

For those who do not have the time or expertise to study the technical scientific papers themselves, we have several posts summarizing in plain language the key findings of each of these three papers on the CERES-Science.com website:

- Aug 6th, 2021 (a short summary of Connolly et al., 2021): <https://www.ceres-science.com/post/how-much-has-the-sun-influenced-northern-hemisphere-temperature-trends-an-ongoing-debate>

- Sep 1st, 2023 (a short summary of Soon et al., 2023 with some discussion of Connolly et al., 2023): <https://www.ceres-science.com/post/new-study-suggests-global-warming-could-be-mostly-an-urban-problem>
- Oct 3rd, 2023 (a short summary of Connolly et al., 2023 with some discussion of Soon et al., 2023): <https://www.ceres-science.com/post/has-the-sun-s-true-role-in-global-warming-been-miscalculated>

Readers who want to learn more about these papers might also find some of our more detailed posts of interest:

- Jun 2nd, 2022 (a video interview that discusses some aspects of Connolly et al., 2021): <https://www.ceres-science.com/post/looking-at-the-sun-climate-discussion-nexus-interviews-ceres-co-team-leader-dr-ronan-connolly>
- Feb 19th, 2023 (a video presentation from a conference that summarizes Connolly et al., 2021 and other CERES research): <https://www.ceres-science.com/post/iccc15>
- Sep 8th, 2023 (a detailed response to some internet discussion on Connolly et al., 2023 and Soon et al., 2023): <https://www.ceres-science.com/post/reply-to-erroneous-claims-by-realclimate-org-on-our-research-into-the-sun-s-role-in-climate-change>
- Sep 18th, 2023 (an even more detailed follow-on response to more internet discussion on Connolly et al., 2023 and Soon et al., 2023): <https://www.ceres-science.com/post/the-orchestrated-disinformation-campaign-by-realclimate-org-to-falsely-discredit-and-censor-our-work>

In the meantime, below, we summarize why the climate.nasa.gov analysis is flawed. The main problems come down to two key issues with the data they considered:

1. As shown in our three papers mentioned above, the land component of the global temperature record that they considered (GISTEMP 3.1) is significantly contaminated by urban warming biases. This is despite failed attempts by the group in charge of GISTEMP ([NASA Goddard Institute for Space Studies](https://www.nasa.gov/goddard), NASA GISS for short) to try and correct for urban warming.
2. As shown in our three papers mentioned above, the TSI reconstruction that they considered (SATIRE-T2) is only one of many different competing TSI reconstructions available. It happens to be one that implies TSI has decreased since the 1960s. But, other TSI reconstructions disagree.

Let us consider each of these two points in more detail.

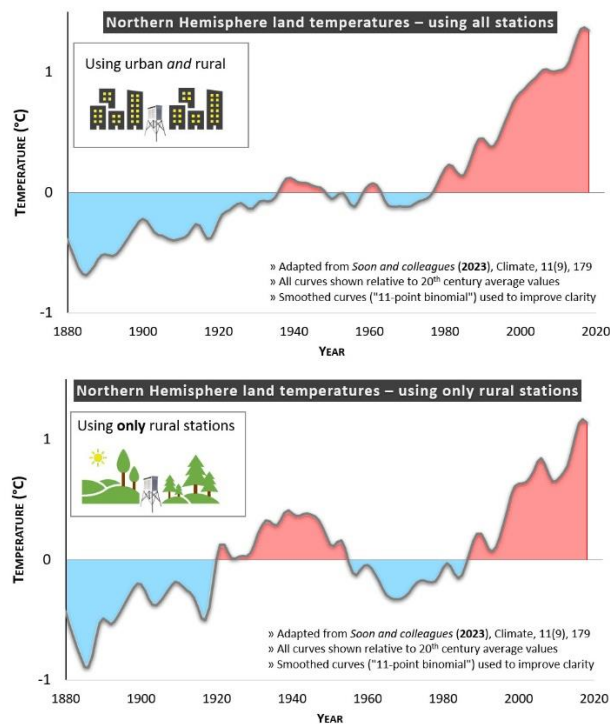
In Connolly et al. (2021), we developed a new rural-only temperature record for the Northern Hemisphere using the exact same dataset used by NASA GISS for generating GISTEMP 3.1, i.e., version 3 of the Global Historical Climatology Network (GHCN) dataset maintained by NOAA NCEI ([link here](#)).

NASA GISS believed that they could use all stations whether urban or rural, provided that they run the data through a computer program they developed to try and remove urbanization bias (see [Hansen et al. 2010](#)).

Two of the CERES-science team (Dr. Ronan Connolly and Dr. Michael Connolly) had published in 2014 as a working paper, a detailed analysis of the NASA GISS urbanization bias adjustments, and shown them to be woefully inadequate – see [Connolly & Connolly \(2014\)](#). In 2015, the Connollys met with the NASA GISS team in charge of the GISTEMP record and discussed the major methodological problems with the GISTEMP urbanization adjustments. The NASA GISS team admitted that they had not considered these problems and promised that they would consider them in the future. However, as of today (February 2024), none of the problems highlighted by Connolly & Connolly (2014) have been accounted for in the GISTEMP analysis.

Since the NASA GISS team still has not overcome the major flaws in their urbanization bias adjustments and none of the other groups currently developing global temperature records are even attempting to correct for urbanization biases, the CERES-Science team decided to develop their own rural-only temperature record. The latest version of this (which is confined to the Northern Hemisphere due to the severe shortage of long, rural records for the Southern Hemisphere) was published in Connolly et al. (2021).

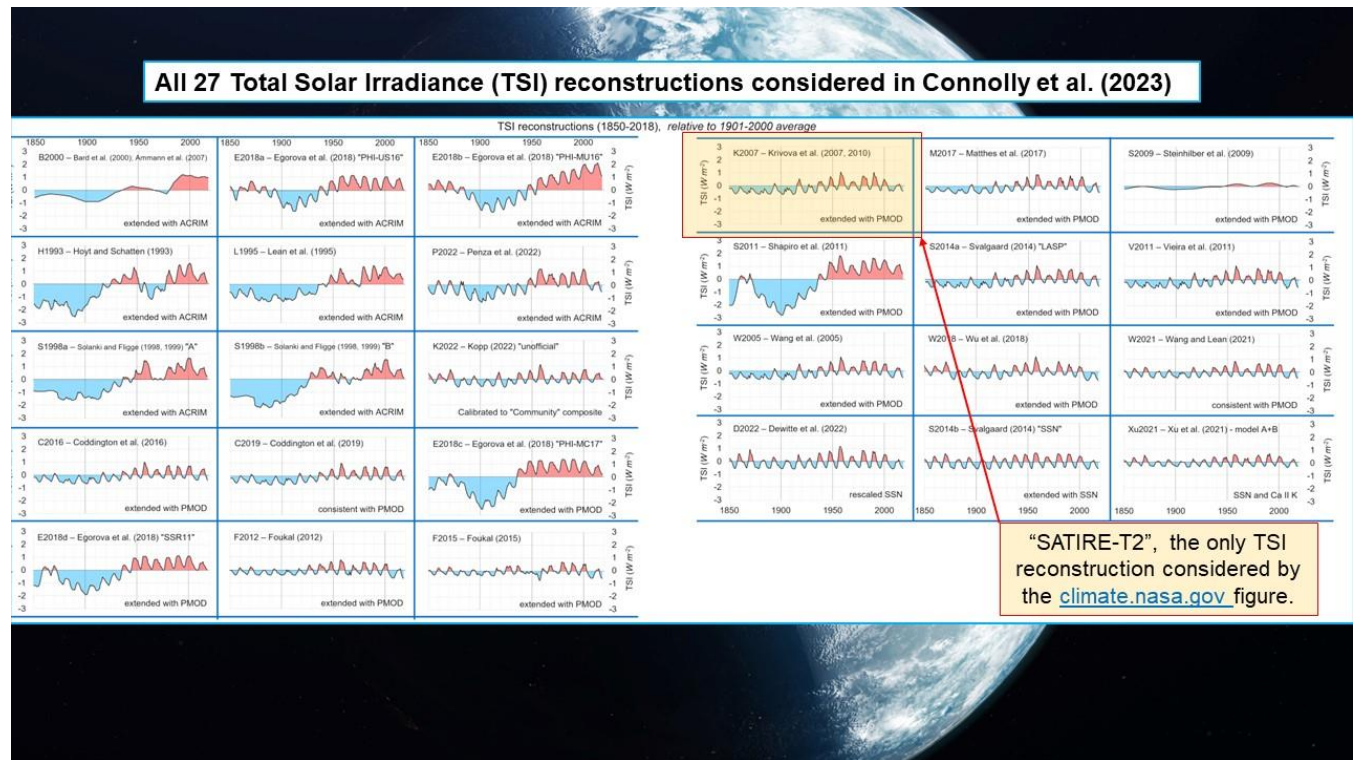
Below, we compare the standard estimates of Northern Hemisphere land temperatures using all stations (urban and rural) in the top panel to those using only rural stations in the bottom panel.



As discussed in Connolly et al. (2021), Soon et al. (2023) and Connolly et al. (2023), the GISTEMP curves for the Northern Hemisphere are almost identical to the “urban and rural” plot.

Indeed, it is also almost identical to the global GISTEMP 3.1 plot considered by the figure Climate Feedback used.

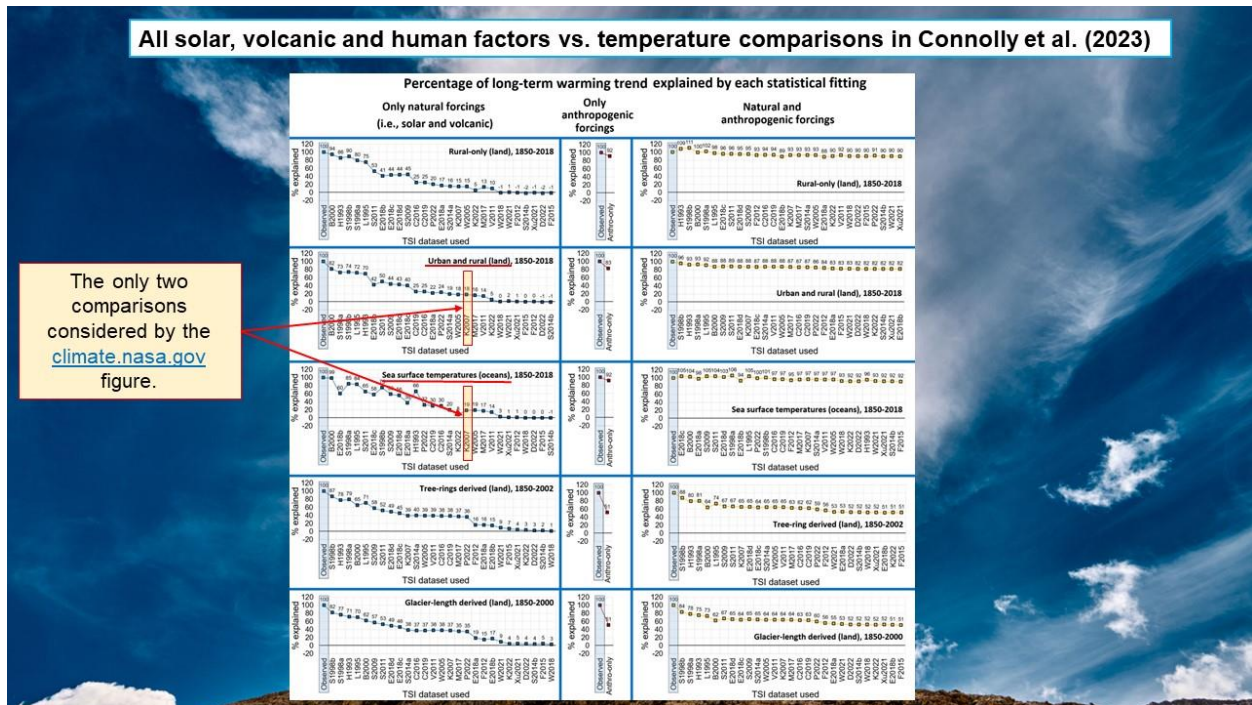
Meanwhile, in Connolly et al. (2023), we identified a total of 27 different TSI reconstructions that could be used for evaluating the changes in solar activity since the mid-19th century. As can be seen from the figure below (adapted from Connolly et al., 2023), SATIRE-T2 was just one of those 27:



Independently, a recent review of the available TSI reconstructions by the Max Planck Institute for Solar System Research (MPI SSR) team that developed the SATIRE-T2 reconstruction, has estimated the number of rival reconstructions to be 30 (Chatzistergos et al., 2023). 18 of the reconstructions identified by Chatzistergos et al. (2023) coincide with those we identified in Connolly et al. (2023). That means, that both independent reviews of the available TSI reconstructions have collectively identified 39 different estimates. The graph that Dr. Bell relied on, only considered one of these 39 estimates.

This is a major problem because – as we showed in Connolly et al. (2023) – depending on which TSI reconstruction you choose, you can explain anything from the long-term warming since 1850 being “mostly natural” to “mostly human-caused” or a mixture of both human-caused and natural factors. This finding is even more pronounced when you exclude the urban temperature data (that only represents 1-2% of the globe).

The wide range of different results you can get from varying either (a) TSI choice or (b) the use of urban temperature data can be seen from the detailed summary plots adapted from Connolly et al. (2023) shown below:



As we have highlighted in the above figure, the only two comparisons that were considered by the climate.nasa.gov figure used by Climate Feedback were the “urban and rural (land)” and “sea surface temperatures” records (i.e., the GISTEMP 3.1 land and seas curve) and the “K2007” TSI (i.e., the SATIRE-T curve).

According to Science Feedback, “A claim is characterized as “Neutral” if it leaves out important information or is made out of context (“Lacks Context”)”. Additionally, “If a claim contains an element of truth but leaves the reader with a false understanding of reality, for instance by omitting critical background context, it would be tagged as “Misleading”)”. Finally, “A claim is deemed of “Very Low” credibility when it is clearly wrong—for instance, if it makes a statement of fact in direct contradiction with available data (tagged as “Inaccurate”), or if it provides an explanation or a theory whose predictions have been invalidated (tagged as “Incorrect”).”

Therefore, their Subclaim 2.1 “Lacks context” and is “Misleading”, “Inaccurate” and “Incorrect”.

LACKS CONTEXT

MISLEADING

INACCURATE

INCORRECT

Subclaim 2.2: Eunice Foote discovered “the greenhouse effect” in 1856

Climate Feedback’s statement:

“Since the first experiments, like those of Eunice Newton Foote in 1856, countless more studies have tested and validated the warming effect of increased atmospheric-CO₂.”

(Their source: <https://www.scientificamerican.com/article/the-woman-who-demonstrated-the-greenhouse-effect/>)

CERES-Science’s reply:

In the early 19th century, several scientists began asking questions about why the surface of the Earth is much warmer than it should be based on its distance from the Sun. Fourier (1824) argued that the presence of an atmosphere between the ground and space was probably the key factor. At the time, the scientific community was investigating the transmission of energy via heat or “caloric rays” (what we now call “infrared radiation”). Pouillet (1838) built on Fourier’s ideas by investigating and measuring the radiation **and** absorption of heat by the air.

- J.B. Joseph Fourier (1824). "Remarques générales sur les températures du globe terrestre et des espaces planétaires" *Annales de Chimie et de Physique*, 27, 136–67 (in French). [Translation here](#).
- C.S.M. Pouillet (1838). “Memoir on the solar heat, on the radiating and absorbing powers of the atmospheric air, and on the temperature of space” (in French). *The Transactions of Foreign Academies of Science and Learned Societies*. [Translation here](#).

Later, Tyndall (1861) carried out a more detailed and systematic set of experiments to establish which specific atmospheric gases were most responsible for the absorption **and** radiation of heat by the atmosphere. He was particularly interested in trying to come up with an explanation for the starting and ending of ice ages that had been recently identified by geologists. He wondered if changes in the concentration of some atmospheric gases could be involved. He suggested that if this was the case, then water vapour would be the most likely candidate.

- John Tyndall (1861). I. The Bakerian Lecture.—On the absorption and radiation of heat by gases and vapours, and on the physical connexion of radiation, absorption, and conduction. *Philosophical Transactions of the Royal Society*. 151, 1–36. <http://doi.org/10.1098/rstl.1861.0001>

Tyndall had effectively discovered that the bulk atmospheric gases, oxygen, nitrogen and argon (although argon was not discovered until much later) are infrared inactive, whereas several of the trace gases are infrared-active. That is, they can absorb and re-emit infrared radiation. Of these infrared-active trace gases, water vapor (H₂O) is the most abundant (about 1%) by several orders of magnitude. Carbon dioxide, CO₂ (0.03% at the time and 0.04% today) is the 2nd most abundant of the infrared-active gases of the Earth’s atmosphere.

Tyndall quite explicitly emphasized that he was looking at the absorption and re-emission of “terrestrial” radiation as opposed to the absorption of “solar” radiation. Both Fourier and Pouillet (and others) had noted this distinction. Because the Sun is much hotter than the Earth, the incoming solar radiation has a very different wavelength distribution than the re-emission of heat

from the Earth and objects on the Earth. Specifically, the incoming solar radiation is mostly ultraviolet (UV), visible and some of the shorter-wave infrared bands. In contrast, the outgoing terrestrial radiation is mostly the longer-wave infrared bands ("long-wave IR" for short).

Tyndall had identified that water vapor (H₂O) followed by CO₂ and other trace gases (including methane and ozone) were responsible for most of the absorption and re-emission of terrestrial radiation, i.e., what we now call long-wave infrared radiation.

Although Tyndall proposed that changes in water vapor could potentially be a significant factor in climate change (specifically the starting and ending of ice ages), Arrhenius (1896) later argued that changes in CO₂ would be a more likely candidate. Arrhenius's theory was later disputed by other researchers, e.g., Ångström (1900); Simpson (1929):

- Ångström, K. (1900). "Ueber die Bedeutung des Wasserdampfes und der Kohlensäure bei der Absorption der Erdatmosphäre." (in German) (Translation: "About the importance of water vapor and carbon dioxide during the absorption of the Earth's atmosphere") *Annalen der Physik* 308(12): 720-732. [Translation here](#).
- Simpson, G. (1929). Past Climates. *Nature* 124, 988–991 (1929). <https://doi.org/10.1038/124988a0>

Others argued that changes in the Earth's orbit around the Sun would be a more plausible explanation for the ice ages. James Croll in the late 19th century speculated that this could be the case, as recently reviewed by Edwards (2022). In the early 20th century, Milutin Milankovitch calculated what these orbital changes would be, as summarized in a recent article co-authored by Dr. Soon:

- Kevin J. Edwards (2022). 'The most remarkable man': James Croll, Quaternary scientist. *Journal of Quaternary Science*. 37(3), 400-419. <https://doi.org/10.1002/jqs.3420>
- László Szarka, Willie W.-H. Soon, Rodolfo G. Cionco (2021). "How the astronomical aspects of climate science were settled? On the Milankovitch and Bacsák anniversaries, with lessons for today". *Advances in Space Research*, 67(1), 700-707. <https://doi.org/10.1016/j.asr.2020.09.020>

Indeed, currently, the main explanation for the climate changes associated with the beginnings and ends of ice ages is that they are orbitally-driven, as opposed to being due to changes in greenhouse gas concentrations as Arrhenius had argued.

That said, although Arrhenius's theory for the driver of the ice ages in terms of CO₂ has generally been discarded in favor of the orbital theory, current climate models still assume – on the basis of similar calculations to Arrhenius – that CO₂ is the major driver of climate change.

Arrhenius's calculations were explicitly building on Tyndall's studies. Therefore, this has led many to conclude that the current CO₂-driven theory for global warming was based on Tyndall's work, e.g., [Weart \(2008\)](#).

However, in 2010, a retired petroleum geologist, Ray Sorenson, was reading through an archive of 19th century presentations at AAAS meetings in the US. As explained in the [Scientific American article](#) cited by Dr. Bell and on various internet websites, e.g., [Thinkprogress](#), Sorenson believed

that an American female scientist, Eunice Newton Foote, had already discovered the same things as Tyndall several years earlier in 1856. Sorenson published his claim in a short [2011 article](#).

- Eunice Foote (1856). “Circumstances Affecting the Heat of Sun’s Rays”. American Journal of Art and Science, 2nd Series, v. XXII/no. LXVI, November 1856, p. 382-383. [Link here](#).

In the current political climate, it has become very popular to revisit the history of science to highlight the achievements of early female scientists. Indeed, up until the mid-20th century, the scientific community was very misogynistic and women scientists were both discouraged from carrying out research and found it extremely hard to get credit for their work.

Dr. Soon has personally tried to do his part to highlight and give proper credit to the achievements of women in science in the late-19th century and early 20th century. In particular, he emphasized the major scientific contributions of [Annie Maunder \(1868-1947\)](#) who had to publish most of her findings under her husband’s name due to the culture at the time:

- W. Soon and S. H. Yaskell, The Maunder Minimum and The Variable Sun-Earth Connection, World Scientific Publishing Company, 2004. [Amazon.com](#).

However, Sorenson does not seem to have a deep understanding of the greenhouse effect theory, or the history of its development. While Foote should be complemented for carrying out scientific experiments in a time when women were actively discouraged from doing science, her 1856 article is not of any relevance for the current generation of climate models or for the theory that CO₂ is a major climate change driver. That theory is based on the absorption and re-emission **of infrared radiation** by H₂O, CO₂ and other trace gases in the atmosphere, i.e., what Fourier, Pouillet, Tyndall, Arrhenius and others referred to as “terrestrial radiation” as opposed to “solar radiation”. Foote’s 1856 study was only considering “solar radiation”.

Unlike Tyndall, Foote’s study did not consider terrestrial radiation at all. Nor did she discuss the re-emission of infrared radiation that lies at the heart of current climate models. She was only investigating the relative absorption of incoming solar radiation by a few combinations of air samples that had been treated in different ways. She found that her samples containing carbonic acid (CO₂) absorbed more of the incoming solar radiation than dry or moist air.

So, when Dr. Bell claims that, “Since the first experiments, like those of Eunice Newton Foote in 1856, countless more studies have tested and validated the warming effect of increased atmospheric-CO₂”, he either doesn’t know what the greenhouse effect theory is, or he hasn’t bothered to read Foote’s article.

According to the Science Feedback framework, “A claim is deemed of “Low” credibility when it is made without backing from an adequate reference or if the available evidence does not support the statement (tagged as “Unsupported”)” and “A claim is deemed of “Very Low” credibility when it is clearly wrong—for instance, if it makes a statement of fact in direct contradiction with available data (tagged as “Inaccurate”)”. Therefore, Dr. Bell’s Subclaim 2.2 is rated as “Unsupported” and “Inaccurate”.

INACCURATE

UNSUPPORTED

Subclaim 2.3: A solar-driven global warming is contradicted by the observed stratospheric cooling.

Climate Feedback's statement:

“Soon claims the Sun is causing global warming, which means it is causing the recent warming observed at the surface of the Earth (i.e., the troposphere). If this was true, we should be able to observe warming at every layer of the atmosphere, especially at the top which receives the most radiation. Solar radiation reaching the surface on a clear day is around 1000 W m^{-2} , while at the top of the atmosphere it is 1361 W m^{-2} . However, the upper layers of the atmosphere (i.e., the stratosphere) have not increased in temperature in tandem with the surface layer. The temperature in the lower stratosphere (high altitude) has actually fallen while the temperature of the lower troposphere (low altitude) has risen, one of the main “human fingerprints on atmospheric temperature”[2]. This observation is consistent with the enhanced greenhouse effect, where heat-trapping gasses like CO_2 in the troposphere cause temperature to increase. This observation is inconsistent with Soon's claim.”

Dr. Bell's references:

2 – Santer et al. (2023) Exceptional stratospheric contribution to human fingerprints on atmospheric temperature. Proceedings of the National Academy of Sciences.

<https://www.pnas.org/doi/10.1073/pnas.2300758120>

CERES-Science's reply:

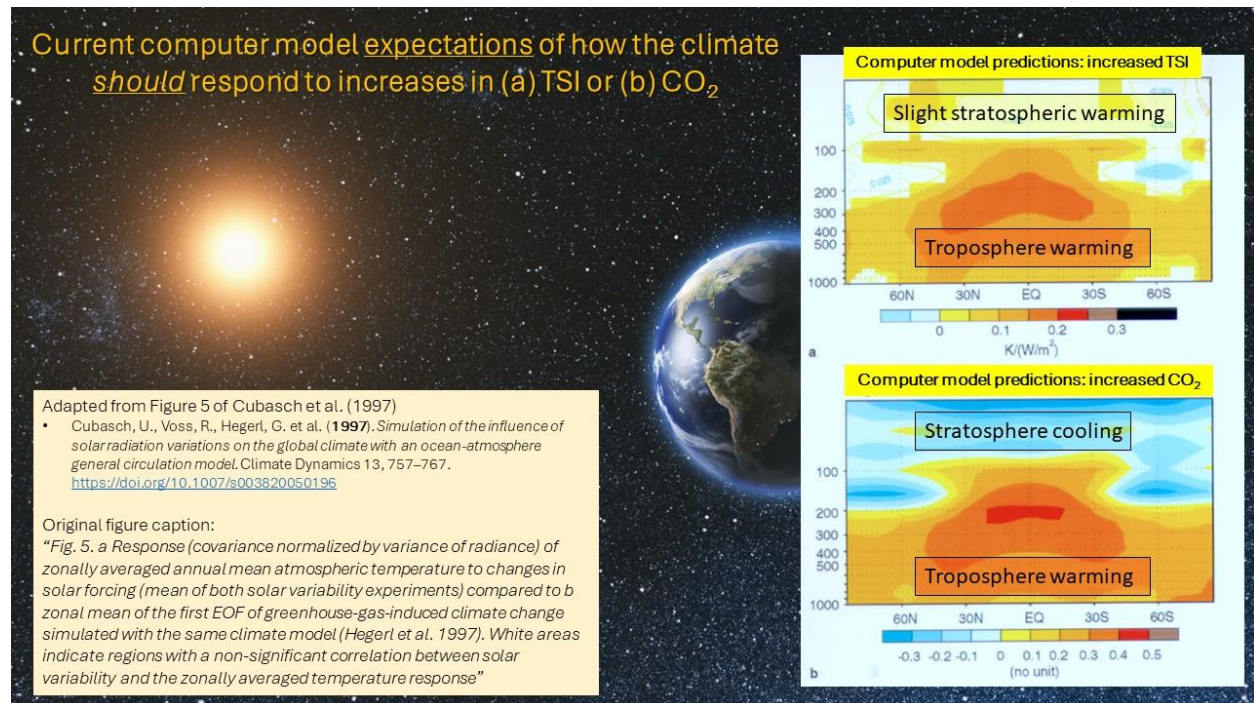
Dr. Bell is repeating a computer-model based claim and prediction that has been repeated many times over the years. However, it is a model prediction that has not ever been experimentally proven. In fact, while not widely known, it was actually contradicted by experimental observations as far back as 1919.

Specifically, since the 1960s, computer climate models have **assumed** that if the incoming total solar irradiance (TSI) reaching the Earth were to increase, this should cause a warming throughout the entire atmosphere – from the lower atmosphere (“troposphere”) to the middle atmosphere (tropopause and stratosphere) and higher.

One of the first systematic attempts to compare the model-expected responses of the atmosphere to either increased TSI or increased CO_2 was Cubasch et al. (1997):

- Cubasch, U., Voss, R., Hegerl, G. et al. Simulation of the influence of solar radiation variations on the global climate with an ocean-atmosphere general circulation model. *Climate Dynamics* 13, 757–767 (1997). <https://doi.org/10.1007/s003820050196>

Their key findings are summarized in the figure below that we have adapted from their Figure 5:



Other model-based studies have made similar predictions over the years. It is a prediction that directly arises from the way in which the climate models simulate how the climate should respond to a change in TSI or CO₂.

By explicitly relying on the assumption that these models accurately describe the climate’s response to these factors, several researchers have prematurely concluded that “a stratospheric cooling” and “tropospheric warming” is a “fingerprint” of a greenhouse gas-induced global warming, e.g., the Santer et al. (2023) paper that Dr. Bell cited. They also have prematurely concluded that a TSI-induced global warming must involve a warming of both the troposphere **and** the stratosphere.

But, were these model assumptions ever tested?

Actually, they were effectively tested and disproven in the early 20th century by the first scientists studying the troposphere and stratosphere using weather balloons. In particular, in 1919, [William Henry Dines](#) published a seminal work outlining how the temperature variability in the troposphere and stratosphere are related:

- Dines, W. H., The characteristics of the free atmosphere, Geophysical Memoir No. 13, Meteorological Office, London, 1919. [Pdf available from UK Met. Office here.](#)

Dines found that the temperature changes on a day-to-day basis in the stratosphere are anti-correlated to those at ground level. That is, when the troposphere warms, the stratosphere cools and vice versa. This “Dines relationship” was confirmed to still be valid more than 70 years later by Liu & Schuurmans (1990):

- Qing Liu, Cornelius J. E. Schuurmans (1990). The correlation of tropospheric and stratospheric temperatures and its effect on the detection of climate changes. *Geophysical Research Letters*. 17(8), 1085-1088. <https://doi.org/10.1029/GL017i008p01085>

As an aside, the CERES-Science team is continuing to investigate the relationship between tropospheric and stratospheric temperature changes and is currently preparing manuscripts for peer review on some important new insights since Liu & Schuurmans (1990).

In the meantime, the experimental data from weather balloon observations have shown since Dines, 1919 that the temperature variability in the stratosphere is anti-correlated to that in the troposphere. This contradicts the idea that “stratospheric cooling” is a “fingerprint” of a greenhouse gas induced warming. It also contradicts the idea that a solar-induced warming should lead to “stratospheric warming”.

As Liu & Schuurmans (1990) had already noted,

“We point out that the small warming trends in the troposphere and cooling trends in the lower stratosphere from the middle sixties to 1985 are not evidently caused by the greenhouse effect, as the internal fluctuations of the atmosphere-ocean system can also create the same trends.”

We appreciate that many scientists looking at the relationship between the temperature changes in the stratosphere and troposphere are unaware of these key experimental studies and are instead relying on computer model predictions. However, this doesn’t change the fact that Dr. Bell’s belief that a TSI induced warming must warm both the stratosphere and troposphere is contradicted by reality.

According to the Science Feedback framework, “A claim is deemed of “Low” credibility when it is made without backing from an adequate reference or if the available evidence does not support the statement (tagged as “Unsupported”)” and “A claim is deemed of “Very Low” credibility when it is clearly wrong—for instance, if it makes a statement of fact in direct contradiction with available data (tagged as “Inaccurate”)”. Therefore, Dr. Bell’s Subclaim 2.3 is rated as “Unsupported” and “Inaccurate”.

INACCURATE

UNSUPPORTED

Subclaim 2.4. Soon's arguments for a solar explanation are debunked by criticisms of Svensmark's "galactic cosmic ray" theory

Climate Feedback's statement:

"Estimates of the potential contribution of solar radiation to recent global warming further contradict Soon's claim. At the high end, a 2016 study concluded that "the contribution of changing solar activity either through cosmic rays or otherwise cannot have contributed more than 10% of the global warming seen in the twentieth century"[3]."

Dr. Bell's references:

- 3 – Sloan et al. (2016) [*sic.*, actually Sloan & Wolfendale (2013)]. Cosmic rays, solar activity and the climate. Environmental Research Letters.
<https://iopscience.iop.org/article/10.1088/1748-9326/8/4/045022>

CERES-Science's reply:

We are well aware of the Sloan & Wolfendale (2013, ERL) paper and it had nothing to do with what Dr. Soon was talking about. Sloan & Wolfendale (2013, ERL) were weighing in on a controversial scientific debate that has been ongoing since 1997. It refers to a specific hypothesis that there might be an indirect solar-driven climate change mechanism through the potential impacts of galactic cosmic rays (GCRs) on cloud formation. When solar activity decreases, the amount of GCRs reaching the Earth's lower atmosphere increases. Some researchers have suggested that these extra GCRs might lead to slight increases in cloud cover. This could potentially lead to a slight cooling. According to this theory, some warming trends since the 19th century might be partially due to decreasing cloud cover from increases in solar activity.

This has been a complex and controversial hypothesis. Part of the scientific problem is that even if GCRs are significantly involved in cloud formation, they are not the only factor. So, attempts to identify a GCR-driven contribution to cloud formation have been very tricky. Several scientists (including Dr. Soon) have been sceptical about how substantial a climate driver this potential mechanism has been.

Although Dr. Soon is open to the possibility that GCR-driven cloud formation can lead to subtle changes in cloud cover, he has been one of the first critics of the idea that it has been a major factor in the global warming since the end of the 19th century, e.g., see Soon et al. (2000):

- W. Soon, S. Baliunas, E.S. Posmentier, P. Okeke (2000). Variations of solar coronal hole area and terrestrial lower tropospheric air temperature from 1979 to mid-1998: astronomical forcings of change in earth's climate?. *New Astronomy*, 4(8), Pages 563-579.
[https://doi.org/10.1016/S1384-1076\(00\)00002-6](https://doi.org/10.1016/S1384-1076(00)00002-6)

Sloan & Wolfendale (2013, ERL) is another study that has been critical of the theory. Indeed, in our 2021 review of the role of the sun on climate, we included a 3.5 page detailed review of the literature on the cosmic ray debate (Section 2.6.4). And, in that discussion, we specifically cited Sloan & Wolfendale (2013, ERL) in the conclusions of that section as being one of the critics of the cosmic-ray hypothesis:

“Clearly, the evidence for and against a significant influence of GCRs on the climate has been controversial and equivocal, with many proponents (Svensmark 2007, 2019; Dragić et al. 2011; Shaviv et al. 2014; Maghrabi & Kudela 2019) and critics (**Sloan & Wolfendale 2013**; Laken et al. 2012; Pierce 2017; Lanci et al. 2020; Kulmala et al. 2010) of the theory, while others remain more neutral (Dima & Voiculescu 2016; Pallé & Butler 2001; Voiculescu et al. 2013; Harrison et al. 2013; Yu & Luo 2014).”

Indeed, Dr. Soon was the academic editor of a separate, but related, paper published by Sloan & Wolfendale in 2013 in a different journal – New Astronomy:

- T. Sloan & A.W. Wolfendale (2013). Cosmic rays and climate change over the past 1000 million years. *New Astronomy*, 25, Pages 45-49.
<https://doi.org/10.1016/j.newast.2013.03.008>

Therefore, the idea that either of Sloan & Wolfendale’s 2013 papers contradicted Dr. Soon’s views on the role of the Sun on climate is wrong.

Specifically, according to Science Feedback’s framework, “A claim is deemed of “Low” credibility when it is made without backing from an adequate reference or if the available evidence does not support the statement (tagged as “Unsupported”)” and “A claim is deemed of “Very Low” credibility when it is clearly wrong—for instance, if it makes a statement of fact in direct contradiction with available data (tagged as “Inaccurate”)”. So, Dr. Bell’s sub-claim 2.4 is “Unsupported” and “Inaccurate”.

INACCURATE

UNSUPPORTED

Subclaim 2.5 The IPCC (2021) reports’ estimates of the solar contribution to global warming have debunked Soon’s papers

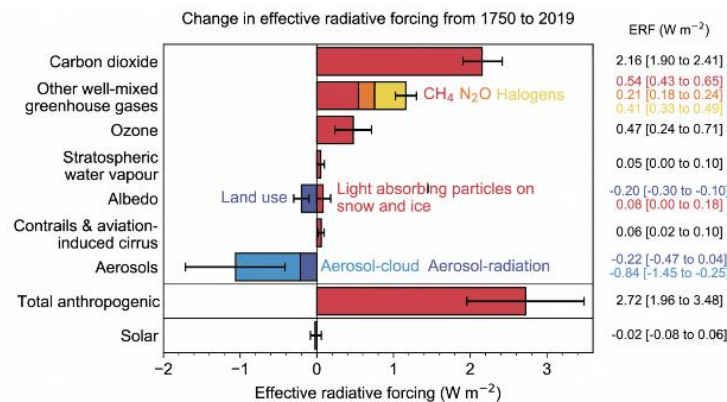
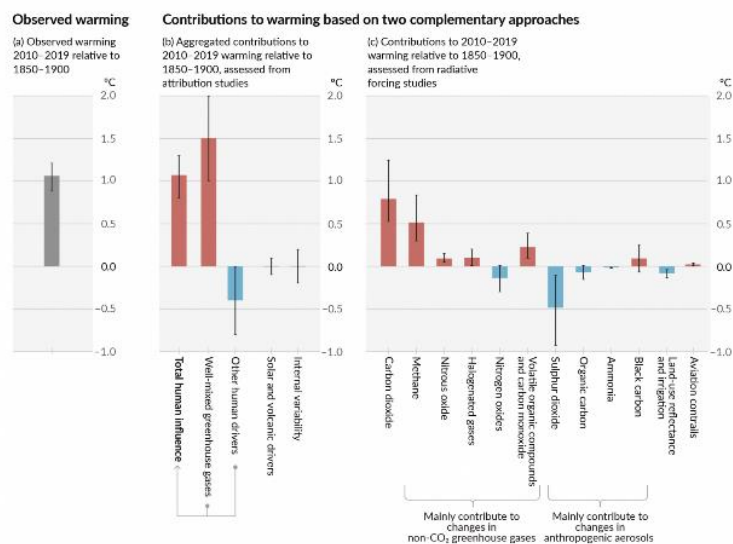
Climate Feedback’s statement:

“The IPCC has compiled robust estimates of all of the contributors to observed global warming, concluding that solar activity was a virtually non-existent factor in comparison to anthropogenic greenhouse gasses (Fig. 2). When comparing the effective radiative forcing (ERF, also [sic] measured in units of watts per meter squared ($W m^{-2}$)) of global warming contributors since 1750, CO₂ has an ERF of $2.16 W m^{-2}$, and methane is at $0.54 W m^{-2}$. Because these values are positive, they represent energy added to the Earth system, unlike the insignificant ERF for solar (indistinguishable from zero).”

Dr. Bell’s references:

- https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_AnnexVII.pdf

Observed warming is driven by emissions from human activities, with greenhouse gas warming partly masked by aerosol cooling



CERES-Science’s reply:

As Dr. Soon explained in his interview,

“We may not know exactly what is causing climate change, we suspect it’s the Sun. We have a lot of evidence to show that it’s probably the Sun. Very high percentage, you know like I would say 90% we are sure” (minute 12:47)

This short summary of Dr. Soon’s own scientific opinion on the probable causes of climate change was based on decades of his scientific research and published peer-reviewed papers. It was particularly based on a series of three recently published international collaborations collectively involving 40 researchers from 20 countries. These are the three papers we already discussed in our response to Subclaim 2.1, i.e.,

1. R. Connolly, **W. Soon**, M. Connolly, S. Baliunas, J. Berglund, C.J. Butler, R.G. Cionco, A.G. Elias, V. Fedorov, H. Harde, G.W. Henry, D.V. Hoyt, O. Humlum, D.R. Legates, N. Scafetta, J.-E. Solheim, L. Szarka, V.M. Velasco Herrera, H. Yan and W.J. Zhang (2023). “Challenges in the detection and attribution of Northern Hemisphere surface temperature trends since 1850”. *Research in Astronomy and Astrophysics*. <https://doi.org/10.1088/1674-4527/acf18e>.
2. **W. Soon**, R. Connolly, M. Connolly, S.-I. Akasofu, S. Baliunas, J. Berglund, A. Bianchini, W.M. Briggs, C.J. Butler, R.G. Cionco, M. Crok, A.G. Elias, V.M. Fedorov, F. Gervais, H. Harde, G.W. Henry, D.V. Hoyt, O. Humlum, D.R. Legates, A.R. Lupo, S. Maruyama, P. Moore, M. Ogurtsov, C. ÓhAiseadha, M.J. Oliveira, S.-S. Park, S. Qiu, G. Quinn, N. Scafetta, J.-E. Solheim, J. Steele, L. Szarka, H.L. Tanaka, M.K. Taylor, F. Vahrenholt, V.M. Velasco Herrera and W. Zhang (2023). “The Detection and Attribution of Northern Hemisphere Land Surface Warming (1850–2018) in Terms of Human and Natural Factors: Challenges of Inadequate Data”, *Climate*, 11(9), 179; <https://doi.org/10.3390/cli11090179>.
3. R. Connolly, **W. Soon**, M. Connolly, S. Baliunas, J. Berglund, C. J. Butler, R. G. Cionco, A. G. Elias, V. M. Fedorov, H. Harde, G. W. Henry, D. V. Hoyt, O. Humlum, D. R. Legates, S. Lüning, N. Scafetta, J.-E. Solheim, L. Szarka, H. van Loon, V. M. Velasco Herrera, R. C. Willson, H. Yan and W. Zhang (2021). “How much has the Sun influenced Northern Hemisphere temperature trends? An ongoing debate”. *Research in Astronomy and Astrophysics*, 21, 131. <https://doi.org/10.1088/1674-4527/21/6/131>.

Dr. Bell claims that the estimates by the [IPCC AR6 Working Group 1 \(2021\) reports](#) of the solar contribution to the climate changes since 1750 have debunked Dr. Soon’s scientific assessment. However, the IPCC AR6 reports were explicitly based only on the scientific literature that was accepted for publication before a specific cut-off date of January 31st, 2021.

Even though Connolly et al. (2021) was published before the IPCC AR6 reports, because it was accepted for publication on April 14th, 2021 (i.e., 10 weeks after the IPCC’s chosen cut-off date), it was automatically excluded from consideration in the IPCC AR6 reports. This includes the 2023 [IPCC AR6 Synthesis Reports](#) that were based on the three Working Group reports published in 2021-2022.

In August 2021, a journalist for the Epoch Times, Alex Newman, was struck by the contrast between the conclusions of Connolly et al. (2021) and IPCC AR6 Working Group 1, given that they were both published at around the same time. As part of his investigation, he asked the IPCC why their

Assessment Report did not even refer to Connolly et al. (2021). Apparently, the IPCC replied that “...[the new study had been accepted for publication after the deadline for consideration.](#)”

See the full article by Newman for more information and insights into the IPCC process:

- Alex Newman (2021). Study finds Sun – not CO₂ – may be behind global warming. The Epoch Times, August 16th, 2021 <https://www.theepochtimes.com/world/challenging-un-study-finds-sun-not-co2-may-be-behind-global-warming-3950089>

Climate Feedback is acutely aware of this article by Alex Newman and its contents since they explicitly published an alleged “fact-check” about it a few weeks later – [link here \(Archived version\)](#). As we have already explained in [our September 10th, 2021 open letter to Climate Feedback](#), their assessment of Alex Newman’s article makes multiple false and misleading claims and was completely erroneous. Nonetheless, the fact that Climate Feedback has written an (erroneous) “fact-check” article on the Epoch Times article is proof that Science Feedback is aware of this article. So, Dr. Bell should have familiarized himself with the previous claims that the website he works for has already made.

More recently, as mentioned above, in 2023, Dr. Soon co-authored a further two follow-on papers that looked specifically at the role of the Sun in global warming since 1850, i.e., Soon et al. (2023) and Connolly et al. (2023).

In all three papers, we found that there are major problems with at least two aspects of the analysis that the IPCC used to reach the conclusions Dr. Bell was quoting.

As we summarized above in our reply to Subclaim 2.1, in all three papers we showed that, depending on which TSI reconstruction and temperature estimate you choose, you can explain anything from the long-term warming since 1850 being “mostly natural” to “mostly human-caused” or a mixture of both human-caused and natural factors. This finding is even more pronounced when you exclude the urban temperature data (that only represents 1-2% of the globe).

Therefore, despite Dr. Bell’s erroneous evaluation, Dr. Soon’s statement in the interview accurately reflected the state of the science based on these two recent studies. Again, the IPCC admitted that they had not even considered Connolly et al. (2021) because it was past their somewhat arbitrary deadline for consideration. The two papers published after Connolly et al. (2021) and after IPCC AR6 Working Group 1 report in 2021 were obviously not considered by AR6 either.

So, according to Science Feedback’s framework, Dr. Bell’s subclaim 2.5 “provides an explanation... whose predictions have been invalidated” and therefore is “Incorrect”.

INCORRECT

Claim 3. CO₂ causes “multiple direct and indirect environmental impacts”

Climate Feedback’s statement:

“**Inaccurate:** Elevated atmospheric carbon dioxide causes the enhanced greenhouse effect which has multiple direct and indirect impacts on the hydrosphere and biosphere, including ocean acidification and the reduction of arctic sea ice, which affects polar bear populations.”

CERES-Science’s reply:

Dr. Bell elaborated on this claim with four subclaims each of which we will again show in turn to be false or misleading in the following subsections. However, as before, his overall claim is also false and misleading.

In our response to Subclaim 3.1, we will refer back to our responses to Subclaims 2.1, 2.3 and 2.5, where we showed that the claim that greenhouse gases are the primary driver of climate change is disputed by several peer-reviewed scientific papers including those of Dr. Soon. While Dr. Bell’s claim is also popular among many in the scientific community, it is a matter of ongoing scientific debate.

In our response to Subclaim 3.2, we will show that Dr. Bell has used “Flawed reasoning” to erroneously conflate evidence of “global warming” (that supports Dr. Soon’s statements) with “unusual human-caused global warming from increasing greenhouse gas emissions”.

For Subclaim 3.3, we show that Dr. Bell’s claims about “ocean acidification” are unsupported. Meanwhile, his Subclaim 3.4 about polar bear populations is completely inaccurate and incorrect.

INACCURATE

INCORRECT

FLAWED REASONING

UNSUPPORTED

Subclaim 3.1. Human-caused CO₂ and methane emissions have caused more than 1°C global warming since the mid-19th century

Climate Feedback’s statement:

“Relative to global concentrations in 1750, atmospheric CO₂ has increased by 47%^[4]. Methane, which breaks down into CO₂ after around a decade in the atmosphere, has increased by 156%. Through the enhanced greenhouse effect, human emissions of these gasses have resulted in an increase in average global temperature of more than 1°C since record keeping began in the second half of the 19th century. As temperature is pivotal to Earth’s climate system, Soon’s general claim that CO₂ “ain’t gonna cause nothing. It’s not gonna change much of the climatic system” is at odds with reality.”

Dr. Bell’s references:

- 4 – IPCC (2021) Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/report/ar6/wg1/>
- “more than 1°C”: <https://earthobservatory.nasa.gov/world-of-change/global-temperatures>
- “temperature is pivotal to Earth’s climate system”: <https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>

CERES-Science’s reply:

Subclaim 3.1 is essentially a rehash of Dr. Bell’s Subclaims 2.1, 2.3-2.5. We refer back to our detailed responses above for each of those Subclaims. But, as we explained in Subclaim 2.5, the IPCC Working Group 1’s 2021 6th Assessment Report (AR6) explicitly excluded from consideration the Connolly et al. (2021) paper that Dr. Soon co-authored because it was accepted for publication 10 weeks after the IPCC’s arbitrary chosen cut-off date of January 31st, 2021. Furthermore, Dr. Soon was also referring to two more of his recent papers that have been published subsequently.

Therefore, Dr. Soon’s comments in the interview were referring to published scientific research that **had not even been considered** in the report that Dr. Bell cited. As we explained in our response to Subclaim 2.5, Climate Feedback is well aware of this point. So, Dr. Bell’s decision to use an out-of-date report to evaluate Dr. Soon’s statement went against the stated methodology of Science Feedback.

According to Science Feedback’s framework, “A claim is deemed of “Low” credibility when it is made without backing from an adequate reference or if the available evidence does not support the statement (tagged as “Unsupported”)” and “A claim is deemed of “Very Low” credibility when it is clearly wrong—for instance, if it makes a statement of fact in direct contradiction with available data (tagged as “Inaccurate”)”.

So, since Dr. Bell was relying on out-of-date claims that have been contradicted by subsequent publications, his sub-claim 3.1 is “Unsupported” and “Inaccurate”.

INACCURATE

UNSUPPORTED

Subclaim 3.2. Human-caused CO₂ emissions have also caused 7 other forms of climate change (ocean warming, ice sheets shrinking, glaciers retreating, snow cover decreasing, sea level rising, Arctic sea ice decreasing, extreme weather increases).

Climate Feedback's statement:

“The direct and indirect environmental impacts of high anthropogenic-CO₂ emissions are not just related to temperature increases, but also other changes across different components of the Earth system. Aside from air temperature warming, climate change has been observed with the oceans getting warmer, ice sheets shrinking, glaciers retreating, snow cover decreasing, sea level rising, arctic sea ice decreasing, and extreme weather events increasing in frequency (see here for evidence provided by NASA).”

Dr. Bell's references:

- <https://earthobservatory.nasa.gov/features/CarbonCycle/page5.php> and <https://climate.nasa.gov/evidence/>

CERES-Science's reply:

As we explained in our response to Subclaim 2.1, one of the main problems with the analysis of both the IPCC and the climate.nasa.gov is that they severely underestimated the so-called “urbanization bias problem” in the land component of global temperature estimates.

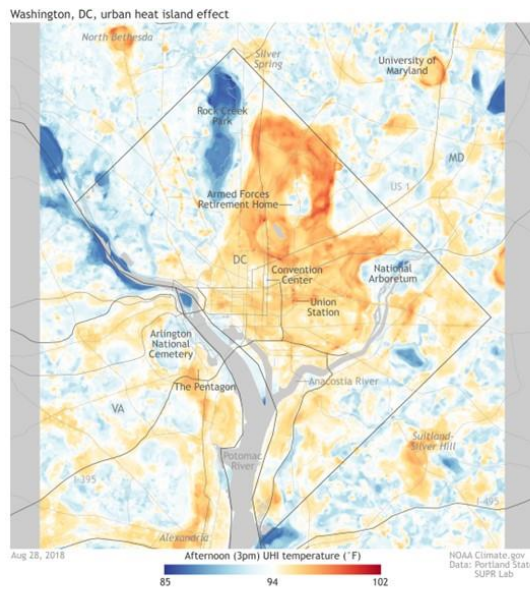
The instrumental global temperature records used by the IPCC to describe the global temperature changes since 1850 comprise two components:

- 1) A land component based on weather station records distributed around the world.
- 2) An ocean component based on sea surface temperature measurements made by ships travelling on shipping routes, and more recently using in situ and drifting weather buoys and satellite measurements.

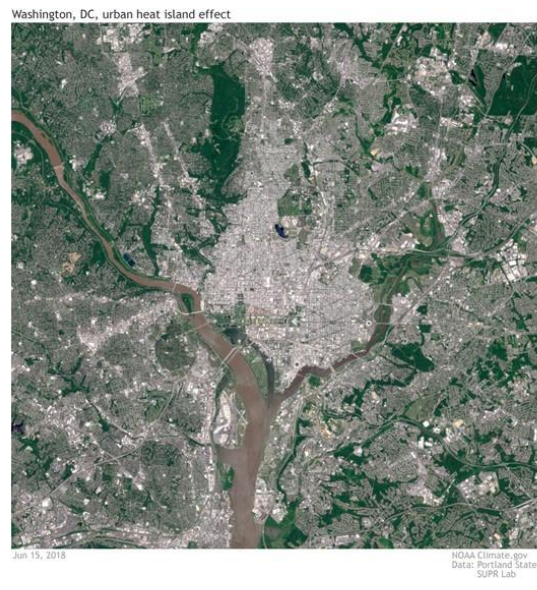
The land component represents 30% of the global surface area and 40% of the Northern Hemisphere. However, it is arguably the most data-complete component in that it is based on weather stations that remain in fixed locations for long periods of time.

That said, there is a major problem with the weather station records in that most of the weather stations with the longest and most complete records are located in or near urban areas. This is not surprising given that it is easier to find staff to maintain a continuous record of observations for multiple decades in a location that is near where people live.

This is a concern because urban areas are warmer than the surrounding countryside due to a phenomenon known as the “urban heat island” (UHI). This can be seen from the following infographic:



Urban heat map, August 28, 2018



Satellite image, June 15, 2018

Urban areas are known to be hotter than the surrounding countryside. The maps here illustrate an example – Washington D.C., USA. The hottest areas (red) correspond to high-density urban areas. The cold areas (blue) on the heat map correspond to green parkland and waterway areas within the city.

As a weather station becomes urbanized over the decades and centuries, it records a gradual increase in local temperature due to the growth of this urban heat island. The urban heat island is a form of human-caused climate change, but it is a localized effect that only affects the urbanized area and has nothing to do with greenhouse gas concentrations.

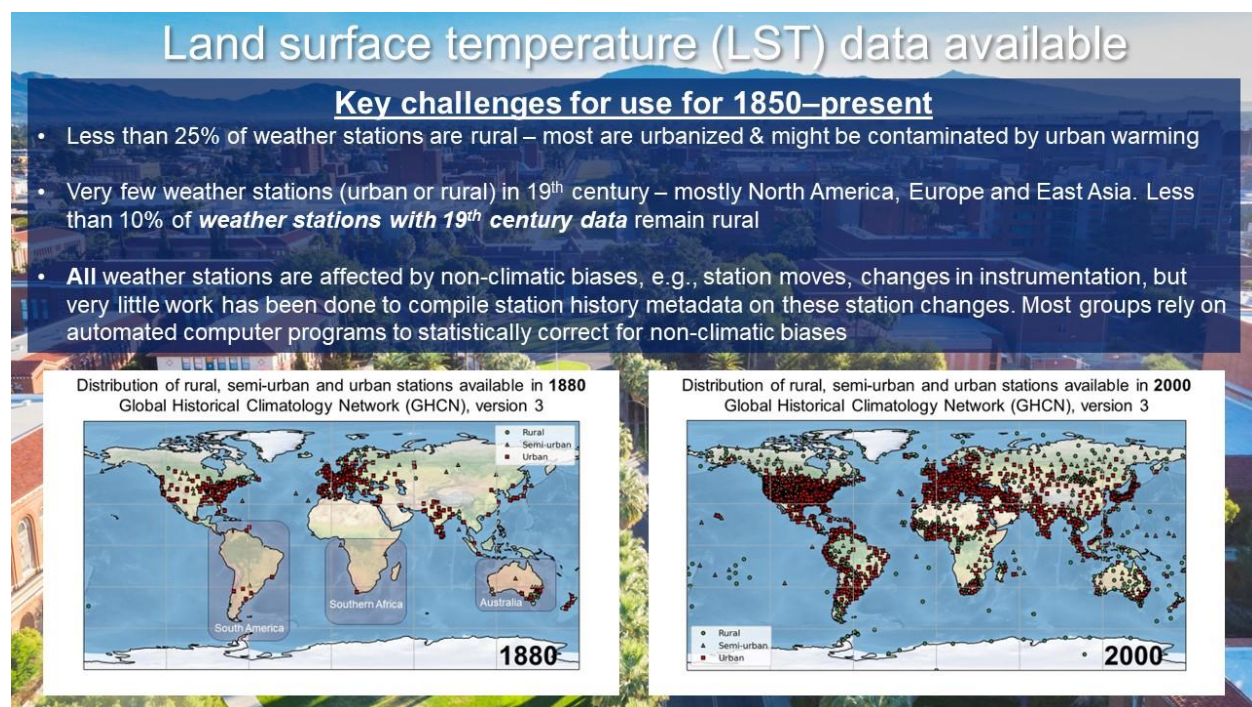
Therefore, when an urbanized weather station's temperature record is used to study global temperature trends, this urban warming can introduce an "urbanization bias". The IPCC claimed in its most recent 6th Assessment Report (AR6) that urbanization bias is "unlikely" to "have raised global Land Surface Air Temperature (LSAT) trends by more than 10%" (AR6, Chapter 2, pp. 43–44).

However, this assertion by the IPCC that urbanization bias is less than 10% is contradicted by multiple peer-reviewed papers, including several that Dr. Soon has co-authored, e.g.,

- R. Connolly, **W. Soon**, M. Connolly, S. Baliunas, J. Berglund, C.J. Butler, R.G. Cionco, A.G. Elias, V. Fedorov, H. Harde, G.W. Henry, D.V. Hoyt, O. Humlum, D.R. Legates, N. Scafetta, J.-E. Solheim, L. Szarka, V.M. Velasco Herrera, H. Yan and W.J. Zhang (2023). "Challenges in the detection and attribution of Northern Hemisphere surface temperature trends since 1850". *Research in Astronomy and Astrophysics*. <https://doi.org/10.1088/1674-4527/acf18e>.
- **W. Soon**, R. Connolly, M. Connolly, S.-I. Akasofu, S. Baliunas, J. Berglund, A. Bianchini, W.M. Briggs, C.J. Butler, R.G. Cionco, M. Crok, A.G. Elias, V.M. Fedorov, F. Gervais, H. Harde, G.W. Henry, D.V. Hoyt, O. Humlum, D.R. Legates, A.R. Lupo, S. Maruyama, P. Moore, M. Ogurtsov, C. ÓhAiseadha, M.J. Oliveira, S.-S. Park, S. Qiu, G. Quinn, N. Scafetta, J.-E. Solheim, J. Steele, L. Szarka, H.L. Tanaka, M.K. Taylor, F. Vahrenholt, V.M. Velasco Herrera and W. Zhang (2023). "The Detection and Attribution of Northern Hemisphere Land Surface Warming (1850–2018) in Terms of Human and Natural Factors: Challenges of Inadequate Data", *Climate*, 11(9), 179; <https://doi.org/10.3390/cli11090179>.

- G. Katata, R. Connolly and P. O’Neill (2023). Evidence of urban blending in homogenized temperature records in Japan and in the United States: implications for the reliability of global land surface air temperature data. *Journal of Applied Meteorology and Climatology*. <https://doi.org/10.1175/JAMC-D-22-0122.1>.
- R. Connolly, **W. Soon**, M. Connolly, S. Baliunas, J. Berglund, C. J. Butler, R. G. Cionco, A. G. Elias, V. M. Fedorov, H. Harde, G. W. Henry, D. V. Hoyt, O. Humlum, D. R. Legates, S. Lüning, N. Scafetta, J.-E. Solheim, L. Szarka, H. van Loon, V. M. Velasco Herrera, R. C. Willson, H. Yan and W. Zhang (2021). “How much has the Sun influenced Northern Hemisphere temperature trends? An ongoing debate”. *Research in Astronomy and Astrophysics*, 21, 131. <https://doi.org/10.1088/1674-4527/21/6/131>.
- Zhang, P.; Ren, G.; Qin, Y.; Zhai, Y.; Zhai, T.; Tysa, S.K.; Xue, X.; Yang, G.; Sun, X. Urbanization Effects on Estimates of Global Trends in Mean and Extreme Air Temperature. *J. Clim.* 2021, 34, 1923–1945. <https://doi.org/10.1175/JCLI-D-20-0389.1>
- Scafetta, N. Detection of Non-climatic Biases in Land Surface Temperature Records by Comparing Climatic Data and Their Model Simulations. *Clim. Dyn.* 2021, 56, 2959–2982. <https://doi.org/10.1007/s00382-021-05626-x>
- **W.W-H. Soon**, R. Connolly, M. Connolly, P. O’Neill, J. Zheng, Q. Ge, Z. Hao and H. Yan (2018). Comparing the current and early 20th century warm periods in China. *Earth-Science Reviews*, 185, 80-101. <https://doi.org/10.1016/j.earscirev.2018.05.013>.
- **W. Soon**, R. Connolly and M. Connolly, M. Re-Evaluating the Role of Solar Variability on Northern Hemisphere Temperature Trends since the 19th Century. *Earth-Sci. Rev.* 2015, 150, 409–452. <https://doi.org/10.1016/j.earscirev.2015.08.010>

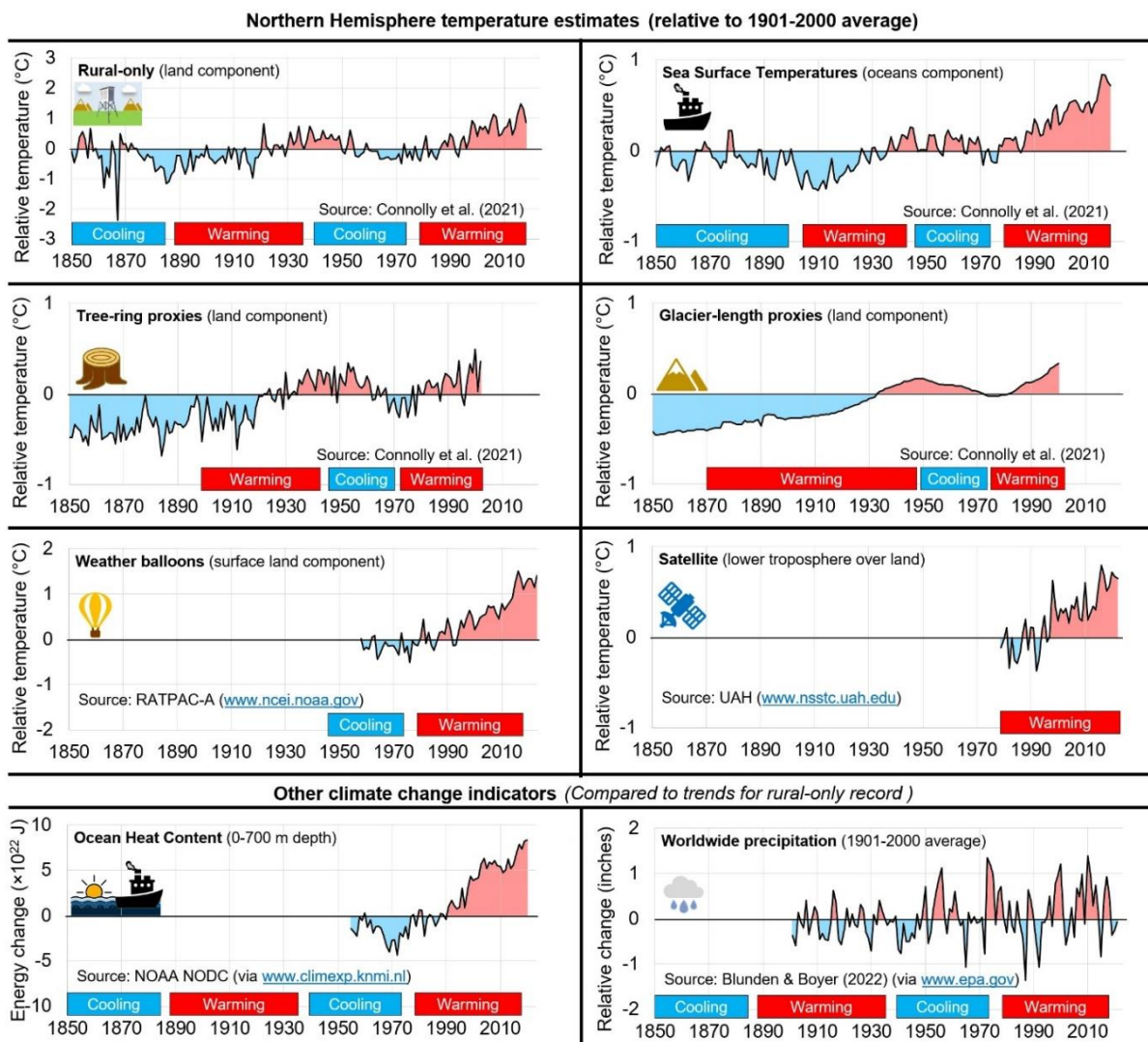
An idea of the major challenges involved in correcting for urbanization bias can be gotten by studying this comparison of the available rural vs. urban weather station records in version 3 of the Global Historical Climatology Network (GHCN) dataset. This is the dataset used by NASA GISS to generate the GISTEMP 3.1 temperature record considered by Dr. Bell in Subclaim 2.1:



As we explained in our response to Subclaim 2.1, in Connolly et al. (2021), we developed a new estimate of Northern Hemisphere land temperature changes since 1850 using only rural stations. We found that this rural record showed much less warming than the standard estimates using both urban and rural data. It also implied that the recent warming since the late 1970s, is not particularly unusual or dramatic. Rather, it suggests that global temperatures have been oscillating between periods of global warming and global cooling since the start of the record.

Therefore, by mistakenly treating evidence of “global warming” from other climatic data as alleged “proof” of human-caused global warming, Dr. Bell has fallen into the common trap of conflating “global warming” with “unusual global warming from human activity”. Our research has shown that it is only really with the urbanized temperature data that the observed climatic changes since the 19th century seem unusual or dramatic.

And since urban areas only account for 3-4% of the land surface area and 1-2% of the global surface area, we argue that the rural-based land estimates are more representative. Indeed, we find that the rural temperature trends are quite consistent with other climatic change indicators as can be seen below:



By conflating “global warming” with “human-caused global warming from increasing greenhouse gas emissions”, Dr. Bell has used “Flawed Reasoning”. By neglecting to consider the scientific literature that Dr. Soon was referring to during the interview, Dr. Bell’s Subclaim 3.2 is also “Inaccurate” according to Science Feedback’s framework.

FLAWED REASONING

INACCURATE

Subclaim 3.3. CO₂ is directly linked to ocean acidification.

Climate Feedback's statement:

“Contrary to what Soon claims, CO₂ is directly linked to ocean acidification. The ocean has absorbed between 20-30% of total anthropogenic CO₂ emissions in recent decades[5]. The excess carbon that is absorbed makes the oceans more acidic because when CO₂ dissolves in seawater, it forms carbonic acid, which lowers the pH of the ocean. Global surface ocean waters have increased in acidity by about 30% (because of a pH drop of 0.1) since the beginning of the Industrial Revolution, matching increases in atmospheric-CO₂ from human emissions (Fig. 3). Ocean acidification also causes a decline in carbonate ion concentrations and the calcium carbonate saturation state. When this lowers, carbonate minerals will dissolve, which can have implications for organisms with exposed calcium carbonate shells and skeletons, from corals to oysters, clams, and mussels. It has already been shown from experiments that the structure and function of marine species, particularly organisms with calcium carbonate shells or skeletons, are affected by ocean acidification[6].”

Dr. Bell's references:

- 5 – Friedlingstein et al. (2022) Global carbon budget 2022. Earth System Science Data Discussions. <https://essd.copernicus.org/articles/14/4811/2022/>
- 6 – Gazeau et al. (2007) Impact of elevated CO₂ on shellfish calcification. Geophysical Research Letters. <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2006GL028554>
- Figure taken from Doney et al. (2020). <https://doi.org/10.1146/annurev-environ-012320-083019>

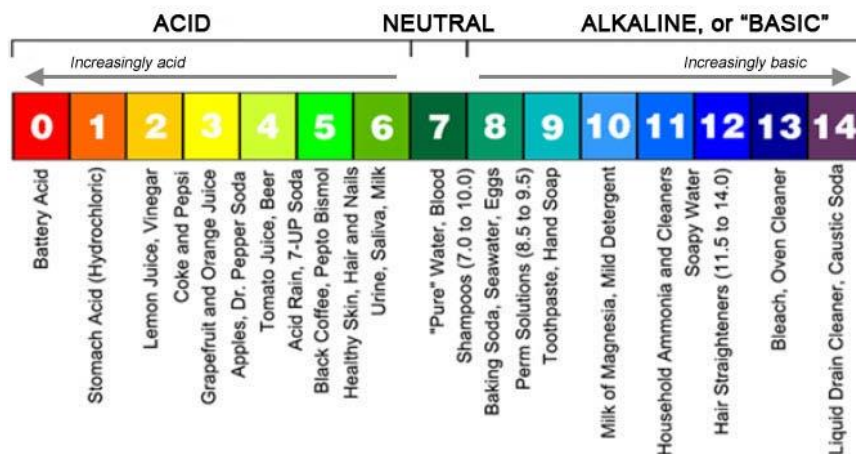
CERES-Science's reply:

Dr. Bell insists that,

“Contrary to what Soon claims, CO₂ is directly linked to ocean acidification.”

Dr. Bell's claim that, “CO₂ is directly linked to ocean acidification”, is not actually true, although it is widely believed by the public and many scientists.

First of all, for a solution to be “acidic”, it must (by definition) have a pH that is less than 7. This is a fundamental fact that is taught by most middle school-level chemistry classes. Below is a typical chart (source: US EPA) summarizing this which we have taken from the [U.S. Environmental Protection Agency \(EPA\)'s website](https://www.epa.gov/acidrain/understanding-acid-rain).



The average pH of seawater is typically estimated at between 8.1 and 8.3, e.g., Marion et al. (2011):

- G.M. Marion, F.J. Millero, M.F. Camões, P. Spitzer, R. Feistel, C.-T.A. Chen (2011). "pH of seawater". *Marine Chemistry*, 126, 89-96. <https://doi.org/10.1016/j.marchem.2011.04.002>

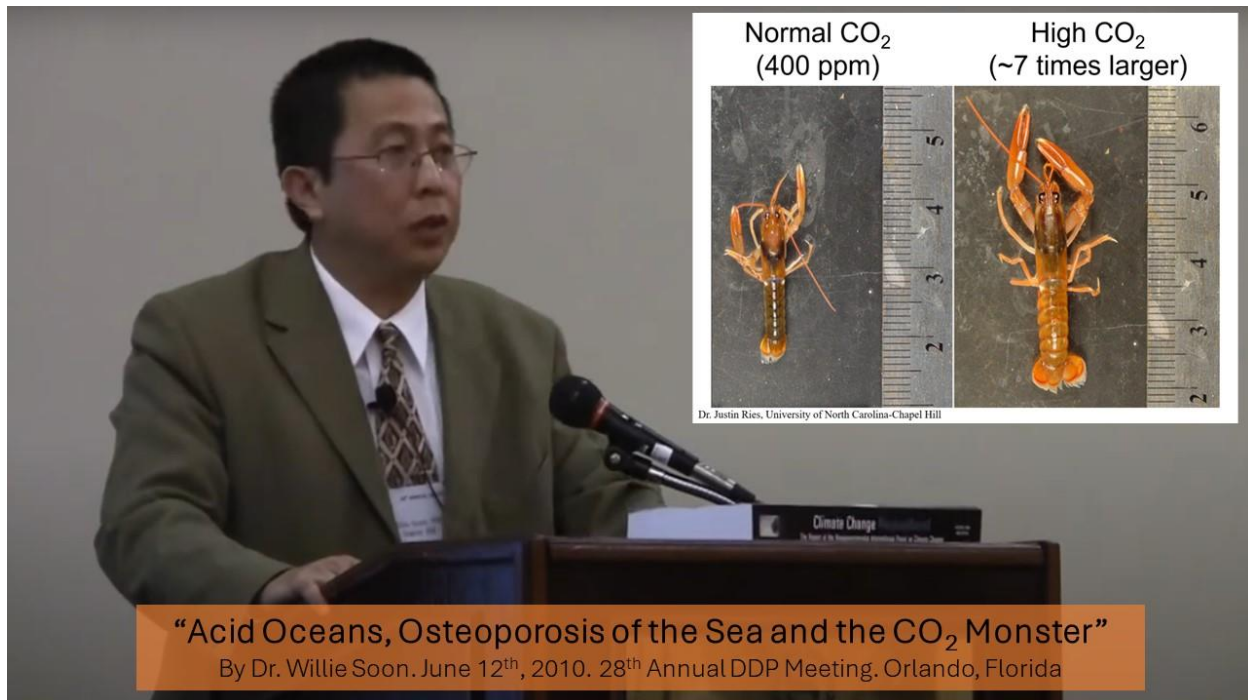
The pH is a measure of the concentration of hydrogen ions (H⁺) in a solution. It is a logarithmic scale. This means that a decrease of 1 pH unit is actually a factor of 10. To decrease 2 pH units, the concentration of H⁺ ions would need to be multiplied by a factor of 100. To decrease 3 pH units, the concentration would need to be multiplied by 1000, etc.

Therefore, for oceans to "acidify", i.e., to have an average pH less than 7, the change in H⁺ concentrations would be far beyond what even the scariest of models would predict. So, Dr. Bell's claim that "CO₂ is directly linked to ocean acidification" shows a fundamental lack of understanding of the pH scale and the definition of an acid.

Perhaps, he could argue that he meant "a reduction in the average alkalinity of the oceans" and that he misused the sensational pseudoscientific "ocean acidification" term through sloppiness or laziness.

However, even if he had been more precise and accurate in his terminology, he would still be wrong to say that CO₂ has been "directly linked" to a reduction in the average alkalinity of the oceans.

For a detailed discussion by Dr. Soon on the poor science behind the alleged "ocean acidification" claims, we recommend viewing [this 1 hour presentation](#) he gave in 2010:



But, essentially, Dr. Bell’s claim that a direct link between CO₂ and ocean pHs has been proven is wrong for two reasons:

- 1. Observations are based on extrapolation of very limited and often ambiguous datasets.** The pH of oceanwater is highly variable within the range particularly near the surface depending on temperature, the species and concentrations of organisms, the dissolved gases, amount of sunlight, etc. Moreover, as discussed in the Marion et al. (2011) paper above, measuring the exact pH of seawater is quite complex. As a result, attempts such as the figure that Dr. Bell used (originally from Doney et al., 2020) to try and measure the “average pH of the ocean” at any given time, let alone trying to evaluate long-term trends involve a lot of extrapolation of very limited samples.

That is, we still have not satisfactorily measured the “average pH of the ocean” either at the surface or at different depths in the ocean. So, claiming to have detected a change in this average pH is bad science.
- 2. The theory is ultimately based on unrealistic computer models.** Given how widely the claims of “ocean acidification” are repeated, many people might be surprised to learn that most of the alleged “evidence” for these claims can ultimately be traced back to theoretical models, such as those described in:

 - K. Caldeira and M. Wickett (2003) Anthropogenic carbon and ocean pH. *Nature* 425, 365 (2003). <https://doi.org/10.1038/425365a>
 - Raven et al. (2005). Ocean acidification due to increasing atmospheric carbon dioxide. Report for the Royal Society (UK). <https://royalsociety.org/topics-policy/publications/2005/ocean-acidification/>

It is correct that these theoretical computer models **predict** that if atmospheric CO₂ continues to rise, the corresponding uptake of some of this CO₂ by the surface oceans *should* slightly reduce the average alkalinity of the oceans – by perhaps 0.1 to 0.2 pH units over the next fifty to one hundred years.

However, it is very important to remember that those computer models neglect key mechanisms that operate in the real world:

- Biological interplays between photosynthesis and respiration of the living organisms in the ocean; and variability in the incoming sunlight.
- Chemical buffering mechanisms involving bicarbonates and other buffering mechanisms involving salt compounds.
- Physical effects due to changes in solubility based on: a) temperature variability; b) gas transfer rates and boundary effects; c) surface ice coverage; and various other physical aspects.

All of these mechanisms collectively act to dampen the hypothetical reductions in pH predicted by the models – within the pH ranges considered by the models. So, these models that predict that we should be seeing a very slight reduction in pH are physically, chemically and biologically unrealistic. And the claims to have observed such a reduction in the oceans are based on very limited and ambiguous samples.

Dr. Soon was not claiming that he has managed to satisfactorily resolve this complex scientific problem yet. However, Dr. Bell's claim that there is a "direct link" between CO₂ and "ocean acidification" is "Unsupported" according to the Science Feedback framework:

"A claim is deemed of "Low" credibility when it is made without backing from an adequate reference or if the available evidence does not support the statement (tagged as "Unsupported")."

UNSUPPORTED

Subclaim 3.4. Global warming has harmed and will continue to harm polar bear populations

Climate Feedback's statement:

“By driving global warming and reducing arctic sea ice extent, it is also well established that global warming has and will continue to negatively impact polar bear populations. A 2020 study estimated that, “with high greenhouse gas emissions, steeply declining reproduction and survival will jeopardize the persistence of all but a few high-Arctic subpopulations [of polar bears] by 2100”[7]. Because polar bears depend on sea ice for hunting, and because their main prey seals also depend on sea ice for breeding and making dens, arctic sea ice loss is making it more difficult for polar bears to hunt[8]. Studies correlating local losses in sea ice habitat with polar bear populations found that some subpopulations have already been negatively affected[9-10]. Loss of sea ice is occurring in almost all polar bear subpopulations, with arctic sea ice extent trending downwards since reliable satellite record keeping began in 1979 (Fig. 4). The downward linear trend in Arctic sea ice extent for December over the over four decades of satellite records is 43 400 square kilometers per year, or 3.4 percent per decade relative to the 1981 to 2010 average. Based on the linear trend, December has lost 1.97 million square kilometers of ice since 1979, equivalent to three times the size of Texas. Leading polar bear population experts Dr. Andrew Derocher and Dr. Ian Stirling told Science Feedback in a previous claim review that “Current [polar bear] declines are due to climate change associated loss of sea ice”, and “Several [polar bear] populations...declined significantly as a direct result of climate warming causing steady loss of sea ice”, respectively.”

Dr. Bell's references:

- 7 – Molnár et al. (2020) Fasting season length sets temporal limits for global polar bear persistence. Nature Climate Change. <https://www.nature.com/articles/s41558-020-0818-9>
- 8 – Stern et al. (2016) Sea-ice indicators of polar bear habitat. The Cryosphere. <https://tc.copernicus.org/articles/10/2027/2016/>
- 9 – Bromaghin et al. (2015) Polar bear population dynamics in the southern Beaufort Sea during a period of sea ice decline. Ecological Applications. <https://doi.org/10.1890/14-1129.1>
- 10 – Lunn et al. (2016) Demography of an apex predator at the edge of its range: impacts of changing sea ice on polar bears in Hudson Bay. Ecological Applications. <https://doi.org/10.1890/15-1256>

CERES-Science's reply:

Dr. Bell's analysis on polar bears uses “Flawed reasoning” and is “Misleading” and “Inaccurate”.

First, his decision to focus on the Arctic sea ice decline during the satellite era (1979-present) is “Misleading” because the satellite era coincidentally began at the end of three decades of Arctic cooling. The polar bears have been around for at least 100,000 years and some estimates suggest

that they might have been around for 600,000 years, e.g., see [here](#). So, basing your expectations of what should be happening to polar bears on the Arctic warming of the last four decades while ignoring the Arctic cooling of the preceding three decades is sloppy work at best.

Evaluating Arctic sea ice extents before the satellite era is challenging because the available data is indeed less comprehensive. Nonetheless, there is considerable ground and aerial-based records for much of the Arctic that allow reasonable estimates back to the early 20th century. Dr. Soon has co-authored one of these Arctic sea ice reconstructions:

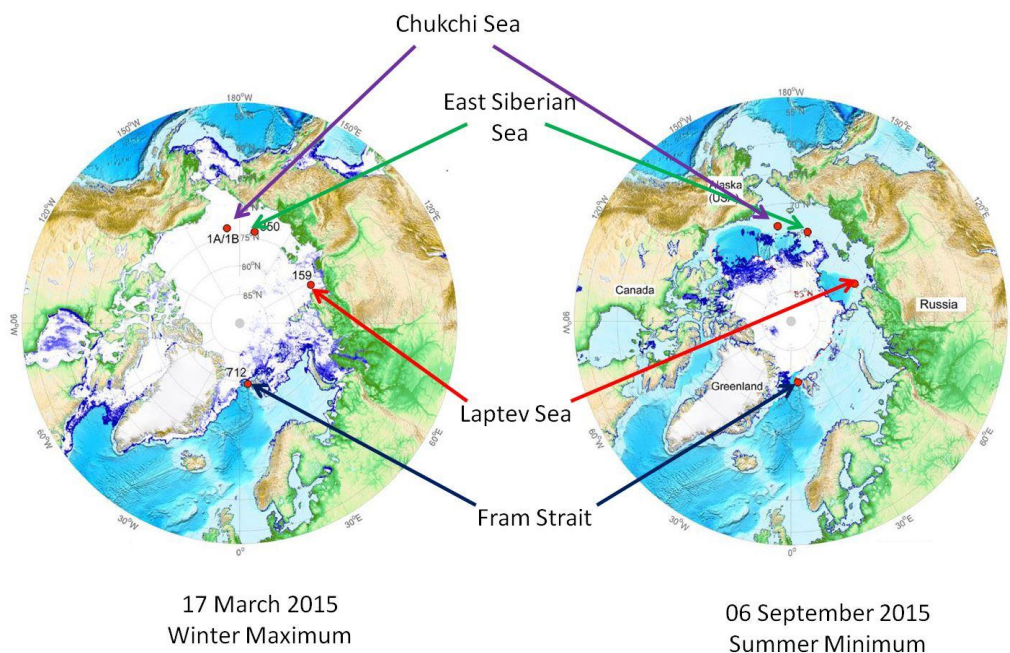
- Ronan Connolly, Michael Connolly & Willie Soon (2017). Re-calibration of Arctic sea ice extent datasets using Arctic surface air temperature records. *Hydrological Sciences Journal*. pp. 1317-1340. <https://doi.org/10.1080/02626667.2017.1324974>

It is also possible to reconstruct the Arctic sea ice variability in localized regions using various climate proxies. A very elegant example of this is the use of “PIP-25” combined ocean sediment core measurements that can identify when a particular site has been “permanently ice-covered”, “permanently ice-free” or subject to “seasonal ice cover” that melts in the summer.

Stein et al. (2017) was a particularly useful PIP-25 study in that they collected 4 ocean sediment cores from 4 Arctic sites that allow them to reconstruct the sea ice variability at those four locations for the last 10,000 years.

- Ruediger Stein, Kirsten Fahl, Inka Schade, Adelina Manerung, Saskia Wassmuth, Frank Niessen, Seung-Il Nam (2017). Holocene variability in sea ice cover, primary production, and Pacific-Water inflow and climate change in the Chukchi and East Siberian Seas (Arctic Ocean). *Journal of Quaternary Science*. 32(3), 362-379. <https://doi.org/10.1002/jqs.2929>

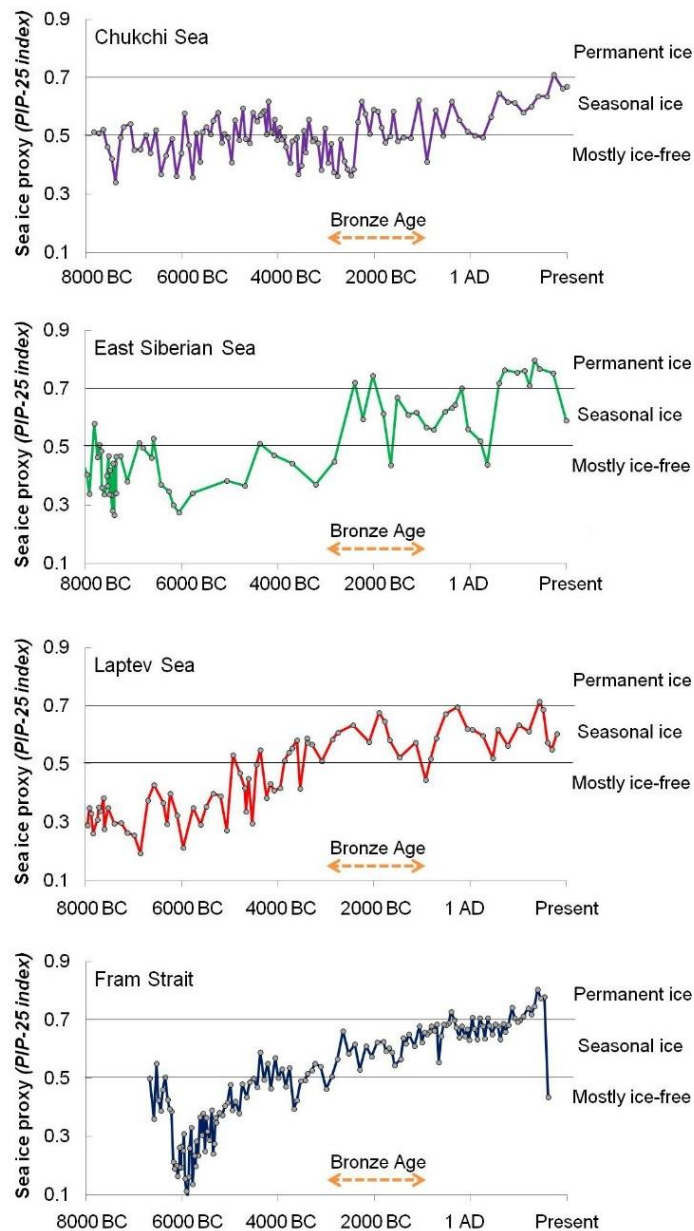
Below, we have adapted the maps from Figure 2 of Stein et al., 2017, with some editing to make the locations easier to see:



As can be seen from the maps, the four cores are quite well distributed throughout the Arctic and so should give us a good indication of how sea ice has varied throughout the Arctic over longer time scales than our instrumental record (1901-2015) or Dr. Bell’s favored satellite era (1979-present).

All four of Stein et al. (2017)’s locations were ice-free during the summer minimum (06 September 2015), but three of the locations (the Chukchi Sea, East Siberian Sea and Laptev Sea cores) were ice-covered during the winter maximum. That is, these three locations currently experience “seasonal sea ice cover” while the remaining location (the Fram Strait core) is “mostly ice-free”.

Has this always been the case? For the four plots below, we digitized the PIP-25 results for the four sediment cores from Figure 10 of Stein et al., 2017:



As can be seen from the four plots, all four locations seem to have experienced much less ice coverage 6,000-8,000 years ago (i.e., well before the Bronze Age) than they do today.

If Dr. Bell's logic about polar bear populations were correct, then presumably they would already have gone extinct well before the Bronze Age. Clearly, that is false.

So, then what is happening to polar bear populations and what are the key drivers in their population changes?

Dr. Bell quoted Dr. Andrew Derocher and Dr. Ian Stirling as his "leading polar bear population experts". He neglected to mention that both scientists have been involved in academic disputes with Dr. Soon and others going back to 2007, when Dr. Soon co-authored a paper that found flaws in some of Dr. Stirling and Dr. Derocher's early work. This led to multiple comments and replies in the peer-reviewed literature:

- M.G. Dyck, W. Soon, R.K. Baydack, D.R. Legates, S. Baliunas, T.F. Ball, L.O. Hancock (2007). Polar bears of western Hudson Bay and climate change: Are warming spring air temperatures the "ultimate" survival control factor? *Ecological Complexity*. 4(3), 73-84. <https://doi.org/10.1016/j.ecocom.2007.03.002>
- Ian Stirling, Andrew E. Derocher, William A. Gough, Karyn Rode (2008). Response to Dyck et al. (2007) on polar bears and climate change in western Hudson Bay. *Ecological Complexity*. 5(3), 193-201. <https://doi.org/10.1016/j.ecocom.2008.01.004>
- M.G. Dyck, W. Soon, R.K. Baydack, D.R. Legates, S. Baliunas, T.F. Ball, L.O. Hancock (2008). Reply to response to Dyck et al. (2007) on polar bears and climate change in western Hudson Bay by Stirling et al. (2008). *Ecological Complexity*. 5(4), 289-302. <https://doi.org/10.1016/j.ecocom.2008.05.004>

Dyck et al. (2007) was criticizing claims about polar bears that had been made by two studies co-authored by Stirling and Derocher:

- Ian Stirling, Nicholas J. Lunn and John Iacozza (1999). Long-Term Trends in the Population Ecology of Polar Bears in Western Hudson Bay in Relation to Climatic Change. *Arctic*. 52(3), 294-306. <http://www.jstor.org/stable/40511782>
- Andrew E. Derocher, Nicholas J. Lunn, Ian Stirling (2004). Polar Bears in a Warming Climate. *Integrative and Comparative Biology*. 44(2), 163-176. <https://doi.org/10.1093/icb/44.2.163>

Stirling et al. (1999) had claimed that the long-term trends in the population of polar bears in western Hudson Bay was largely a function of late spring (April-June) air temperatures in the area. Derocher et al. (2004) expanded the discussion to include the whole Arctic region. Dyck et al. (2007) noted that,

"...spring air temperatures around the Hudson Bay basin for the past 70 years (1932-2002) show no significant warming trend and are more likely identified with the large-amplitude, natural climatic variability that is characteristic of the Arctic. Any role of external forcing by anthropogenic greenhouse gases remains difficult to identify. We argue, therefore, that the extrapolation of polar bear disappearance is highly premature. Climate models are simply not skilful for the projection of regional sea-ice changes in Hudson Bay or the whole Arctic. Alternative factors, such as increased human-bear interaction, must be taken into account

in a more realistic study and explanation of the population ecology of WH polar bears. Both scientific papers and public discussion that continue to fail to recognize the inherent complexity in the adaptive interaction of polar bears with both human and nature will not likely offer any useful, science-based, preservation and management strategies for the species.”

Stirling et al. (2008) denied these empirical observations and insisted that their model-based predictions of what they believed **should** be happening to polar bears must be happening. Dyck et al. (2008) replied that we should be wary of relying on model-based predictions in general, but especially when they are contradicted by experimental observations. They concluded that,

“Polar bears of WH are exposed to a multitude of environmental perturbations including human interference and factors (e.g., unknown seal population size, possible competition with polar bears from other populations) such that isolation of any single variable as the certain root cause (i.e., climate change in the form of warming spring air temperatures), without recognizing confounding interactions, is imprudent, unjustified and of questionable scientific utility.”

Clearly Drs. Stirling and Derocher have different scientific opinions from Dr. Soon when comes to the ecological dynamics of polar bear populations in the Arctic region. As a “fact-checker organization”, Climate Feedback should be aware that, when differing scientific opinions are found, this is not a matter of “fact” vs. “non-fact”. It is more part of how science progresses.

To get another perspective, since Dr. Bell relied on repeating early comments provided to Science Feedback by Drs. Derocher and Stirling as “Leading polar bear population experts”, CERES-Science has reached out to two different polar bear population experts to see what they think of Dr. Bell’s assessment of the role of global warming on polar bear populations.

[Dr. Susan Crockford](#) is a zoologist who has specialized in the ecology of polar bears. When asked by CERES-Science what she thought of Dr. Bell’s analysis, she replied,

“Dr. Bell's analysis of polar bear populations is not only out of date but factually incorrect. The claims that global warming has already negatively impacted polar bear populations due to decreasing sea ice and that it will continue to do so, are based on two regions, Western Hudson Bay and the South Beaufort. However, according to the latest report by the IUCN Polar Bear Specialist Group, population counts in the Southern Beaufort have for decades been confounded by bears moving into and out of neighboring regions, calling into question the recent decline cited by Dr. Bell. In addition, the authors of a 2021 survey of the Western Hudson Bay subpopulation explained that all apparent declines since 2011 have been statistically insignificant (i.e., invalid) and in any case, were not associated with reduced sea ice conditions. Southern Hudson Bay, which experiences similar sea ice conditions, showed a marked polar bear population *increase* between 2017 and 2021. At least two other subpopulations in Canada have also increased significantly in recent years. And as of 2022, bears in the Svalbard portion of the Barents Sea have been in excellent condition and reproducing well since 2005 despite experiencing the greatest summer sea ice loss of any Arctic region. These results refute the simplistic notion that the size of polar bear subpopulations are determined by the amount of CO₂ in the atmosphere.”

References provided by Dr. Crockford to support her statement:

- Atkinson, S.N., Boulanger, J., Campbell, M., Trim, V. Ware, J., and Roberto-Charron, A. 2022. 2021 Aerial survey of the Western Hudson Bay polar bear subpopulation. Final report to the Government of Nunavut, 16 November 2022.
- Lippold, A., Bourgeon, S., Aars, J., et al. 2019. Temporal trends of persistent organic pollutants in Barents Sea polar bears (*Ursus maritimus*) in relation to changes in feeding habits and body condition. *Environmental Science and Technology* 53(2):984–995.
- Northrup, J.M., Howe, E., Lunn, N., Middel, K., Obbard, M.E., Ross, T., Szor, G., Walton, L., and Ware, J. 2022. Southern Hudson Bay polar bear subpopulation aerial survey report. Final report to Ontario Ministry of Natural Resources, 29 November.
- Norwegian Polar Institute (NPI). 2022a. Condition in adult polar bear males. *Environmental monitoring of Svalbard and Jan Mayen (MOSJ)*. <http://www.mosj.no/en/fauna/marine/polar-bear.html>
- Norwegian Polar Institute (NPI). 2022b. Polar bear cubs per litter. *Environmental monitoring of Svalbard and Jan Mayen (MOSJ)*. <http://www.mosj.no/en/fauna/marine/polar-bear.html>
- Norwegian Polar Institute (NPI). 2022c. Production of polar bear cubs. *Environmental monitoring of Svalbard and Jan Mayen (MOSJ)*. <http://www.mosj.no/en/fauna/marine/polar-bear.html>
- PBSG. 2023. ‘Status Report on the World’s Polar Bear Subpopulations’. *IUCN Polar Bear Specialist Group*, 17 October. <https://www.iucn-pbsg.org/>

[Adjunct Prof. Mitch Taylor](#), is a wildlife biologist currently based in Lakehead University, Ontario, Canada. He was formerly the polar bear biologist for the Northwest Territories and Nunavut for almost 25 years and has been studying polar bears since 1978. Dr. Taylor has published [many papers](#) on polar bear populations, including co-authoring papers with Dr. Stirling and Dr. Derocher, e.g., [Peacock et al. \(2015\)](#). When we asked him what he thought about Dr. Bell’s assessment, he said the following:

“Our research group at Lakehead addressed claims of a general decline in polar bears with a quantitative assessment of status in 2016 (York et al. 2016). That paper confirmed that both scientific studies and traditional ecological knowledge (TEK) agreed that polar bear subpopulations appeared to be stable or increasing. That perspective has by and large been substantiated even by subsequent studies that seemed desperate to find some evidence of polar bear decline.

Dr. Derocher was a graduate student of Dr. Stirling’s and neither of them have so far managed to conduct a single successful (accurate) polar bear subpopulation inventory (numbers and status). They are certainly among the world’s leading cheerleaders for the notion that polar bears can only respond to declining sea ice with a subsequent decline in populations numbers.

Dr. Susan Crockford recently published a paper showing that although these same “top scientists” predicted that if sea ice declined to levels common in the last decade total polar bear numbers would diminish by 70% and subpopulations in deciduous ice regions would

be extirpated ... however polar bears have actually increased in some areas and the evidence for decline in any area is ambiguous (unreliable).

These predictions by polar bear’s “top scientists” were the rationale for uplisting polar bears to “threatened” in 2006. The reality has been quite different. Currently the status of polar bears is best characterized as unknown because of a decline in the frequency and quality of field research programs. However, it should be obvious to all that polar bears as a species have a much greater capacity to adapt to new sea ice conditions than was previously expected. Readers should recognize that polar bear research has been compromised to some degree by activist “researchers”; and that problem extends to both the journals that publish their results and the agencies that use their “expert” models to justify draconian measures to reduce fossil fuel consumption. It’s political now, and that is a sad thing for polar bear conservation.”

Reference provided by Prof. Taylor to support his statement:

- York, J. Dowsley, M., Cornwall, A., Kuc, M., and Taylor. M. 2016. Demographic and traditional knowledge perspectives on the current status of Canadian polar bear subpopulations. *Ecology and Evolution*. 6(9): 2897–2924.
<https://doi.org/10.1002/ece3.2030>

In conclusion, Dr. Bell’s Subclaim 3.4 is “Misleading”, “Inaccurate” and “Incorrect”.

MISLEADING

INACCURATE

INCORRECT

Claim 4. Dr. Soon used flawed reasoning in his discussion of the relevance of Titan.

Climate Feedback's statement:

“Flawed reasoning: The fact that Saturn’s moon Titan is much colder than Earth despite having more methane does not mean that methane does not cause global warming on Earth as a greenhouse gas. In fact, methane causes the greenhouse effect on Titan just as it does on Earth.”

CERES-Science's reply:

Interestingly, in his assessment of Dr. Soon’s comments about Titan, Dr. Bell seems to agree substantively with most of Dr. Soon’s comments.

If the goal of Climate Feedback were genuinely to promote correct information over false information, we would expect them to have noted and emphasized these points of agreement. Therefore, it is remarkable that they neglected to provide any positive ratings for the points in which they agreed with Dr. Soon.

Science Feedback’s framework explicitly provides ratings for points of agreement for the assessor to us. So, Dr. Bell neglecting to use these positive ratings for the points of agreement seems to go against the principles of Science Feedback’s methodology.

Indeed, according to Science Feedback, “If a claim contains an element of truth but leaves the reader with a false understanding of reality, for instance by omitting critical background context, it would be tagged as “Misleading”.” So, by falsely assessing Dr. Soon’s statements on Titan as being “Flawed reasoning” despite Dr. Bell actually substantively agreeing on most of Dr. Soon’s statements, Dr. Bell is being “Misleading” in his Claim 4.

As we will see later, even on Dr. Bell’s sole point of disagreement with regards to the discussion of Titan, Dr. Bell’s subclaim 4.1 “Lacks context”.

MISLEADING

LACKS CONTEXT

Before we address the sole point on which Dr. Bell seems to be disputing the relevance of Dr. Soon’s comments on Titan, let us first discuss the three points of substantive agreement on Claim 4.

Point of agreement 1. The main factor in Titan’s colder temperature is its greater distance from the Sun.

Climate Feedback’s statement:

“Titan is much colder than Earth because it is far from the Sun”

CERES-Science’s reply:

According to their framework, “If the claim is an explanation of the causes of an observation (aka a “theory” or an “hypothesis” in science), it is deemed “Correct” when it has been well tested in scientific studies and generates expected observations that are confirmed by actual observations.”

Therefore, this claim by Dr. Soon that Dr. Bell agrees with is “Correct”.

CORRECT

Point of agreement 2. Titan’s atmosphere is very different from the Earth’s atmosphere.

Climate Feedback’s statement:

“Titan, on the other hand, has virtually no water vapor anywhere because it is so cold and it has no liquid water. Overall, Titan has a completely different atmospheric composition, pressure, and gravity than Earth.

Both Titan and Earth have a stratified atmosphere with a troposphere, stratosphere, mesosphere, and thermosphere, but Titan’s is much more extended because of its lower surface gravity (reaching heights of 15–50 km compared to Earth’s 5–8 km)[12]. Although Earth and Saturn’s moon Titan are the only two astronomical bodies with significant atmospheres and surface seas with stable liquids in the solar system, Titan’s climate cannot be directly compared to Earth’s.”

Dr. Bell’s references:

- 12 – MacKenzie et al. (2021). Titan: Earth-like on the outside, ocean world on the inside. The Planetary Science Journal.

CERES-Science’s reply:

As before, this claim by Dr. Soon that Dr. Bell agrees with is “Correct”.

CORRECT

Point of agreement 3. The term “fossil fuel” is misleading and possibly inappropriate because hydrocarbons are found in Titan and elsewhere.

Climate Feedback’s statement:

“There is no widely accepted answer for how so much methane appeared on Titan, but there is no mystery that hydrocarbons can exist without originating from organic lifeforms like fossil fuels from plants and animals. Methane exists off Earth as a gas, liquid, or as ice. It is found on Neptune, Uranus, and there’s so much on Titan that it rains methane and there are lakes and rivers of liquid methane (and ethane). It is one of the most abundant types of ice detected outside of our solar system too, and scientists have even managed to create methane in a laboratory under space-like conditions.”

CERES-Science’s reply:

Dr. Bell here is confirming that, “there is no mystery that hydrocarbons can exist without originating from organic lifeforms like fossil fuels from plants and animals”. That is, he agrees with Dr. Soon that the use of the term “fossil fuels” to describe hydrocarbons is possibly inappropriate and misleading.

As before, this claim by Dr. Soon that Dr. Bell agrees with is “Correct”.

CORRECT

Subclaim 4.1. The greenhouse effect on Titan is still substantial

Climate Feedback's statement:

“Titan is much colder than Earth because it is far from the Sun, but Soon uses flawed reasoning to claim this means methane does not cause global warming (on Titan or on Earth). Dr. Sarah Hörst, Associate Professor at John Hopkins University and one of the world's leading experts on Titan's atmosphere and climate[11], explained to Science Feedback that “Titan receives substantially less Sunlight than the Earth so it should be about 82 Kelvin (-191.15 °C) but the greenhouse effect provided by methane results in a surface temperature that is about 12 K warmer”. Titan orbits Saturn, which is 1.4 billion kilometers away from the Sun on average, compared to Earth's average distance of 150 million kilometers. Titan's average temperature is around -179 °C (-290 °F), compared to Earth's at around +15°C.

So, even though Titan is still very cold (-179°C) because it is so far from the Sun, it would be even colder (-191 °C) without methane causing the greenhouse effect like it does on Earth.”

Dr. Bell's references:

- 11 – Hörst (2017). Titan's atmosphere and climate. Journal of Geophysical Research: Planets. <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016JE005240>

CERES-Science's reply:

Dr. Sarah Hörst's review of what is currently known about Titan's atmosphere and climate is a reasonable review. She agrees with Dr. Soon and also with Dr. Bell that, as discussed above, a far bigger factor in why its temperature is so much colder than the Earth is because of its greater distance from the Sun.

Dr. Bell's main criticism of Dr. Soon's comments seems to be based solely on the fact that current climate models of Titan suggest that there is a modest “greenhouse effect” (and “antigreenhouse effect”).

Specifically, Hörst (2017), summarizes the current estimates as follows,

“Titan is therefore much colder than Earth, with an effective temperature of ~82 K. The combination of the greenhouse effect provided by CH₄ and collision-induced absorption (N₂-N₂, N₂-CH₄, N₂-H₂) and the antigreenhouse from the stratospheric haze layer [McKay et al., 1991] results in a surface temperature of approximately 94 K [Lindal et al., 1983; Fulchignoni et al., 2005; Schinder et al., 2011].”

The three papers she describes at the end are radio occultation based estimates of the surface temperature of Titan as being approximately 94 K (-179°C):

- G.F. Lindal et al. (1983). The atmosphere of Titan: An analysis of the Voyager 1 radio occultation measurements. Icarus. 53(2), 348-363. [https://doi.org/10.1016/0019-1035\(83\)90155-0](https://doi.org/10.1016/0019-1035(83)90155-0).

- M. Fulchignoni et al. (2005). In situ measurements of the physical characteristics of Titan's environment. *Nature*, 438, 785–791. <https://doi.org/10.1038/nature04314>
- J. Schinder et al. (2011). The structure of Titan's atmosphere from Cassini radio occultations. *Icarus*. 215(2), 460-474. <https://doi.org/10.1016/j.icarus.2011.07.030>.

Her estimates of the greenhouse effect/anti-greenhouse effect contributions come from a 1-dimensional climate model study by McKay et al. (1991):

- C. P. McKay, J. B. Pollack and R. Courtin (1991). The greenhouse and antigreenhouse effects on Titan. *Science*. 253, 1118-1121. <https://doi.org/10.1126/science.11538492>

Specifically, McKay et al. (1991)'s model predicted that in the absence of greenhouse/anti-greenhouse effect, Titan's surface temperature should be 82 K (-191 °C), but the observed surface temperature of 94 K (-179°C) is 12 K (12 °C) warmer. The average surface temperature of Earth is roughly 288 K (15°C). Therefore, the difference between the average surface temperature of Titan and Earth is roughly 194 K (194°C). But, Hörst (citing McKay et al., 1991) argues that without the (modelled) greenhouse/anti-greenhouse effects on Titan, the current difference between Earth and Titan would be roughly 206 K (206°C), i.e., 6.2% greater.

Dr. Soon has consistently noted in his research that current climate models place too high a weight on the influence of greenhouse gases on the climate of Earth (and other planets). He doesn't necessarily say that climate models should be abandoned. Indeed, he has even used climate models in some of his own research, e.g.,

- W. H. Soon, E. S. Posmentier and S. L. Baliunas (1996). Inference of solar irradiance variability from terrestrial temperature changes, 1880-1993: An astrophysical application of the sun-climate connection, *Astrophysical J.*, 472, 891. <https://doi.org/10.1086/178119>
- W. H. Soon, E. S. Posmentier and S. L. Baliunas (2000). Climate hypersensitivity to solar forcing? *Annales Geophysicae*, 18, 583. <https://doi.org/10.1007/s00585-000-0583-z>

However, while many climate scientists seem to have a deep unquestioning confidence in the current climate models, Dr. Soon is more cautious. He has been warning the scientific community for several decades that we should be wary of overreliance on these computer models, e.g.,

- W. Soon, S. Baliunas, S. B. Idso, K. Ya. Kondratyev, and E. S. Posmentier (2001). Modeling climatic effects of anthropogenic CO₂ emissions: Unknowns and uncertainties, *Climate Research*, 18, 259. <https://doi.org/10.3354/cr018259>

In particular, in his interview and in his research, Dr. Soon has consistently emphasized that – *in his scientific opinion* – the scientific evidence does **not** support the popular claim that greenhouse gases are the “principal control knob governing Earth's temperature”, as famously asserted by a 2010 NASA GISS climate model-based study:

- Andrew A. Lacis, Gavin A. Schmidt, David Rind & Reto A. Ruedy (2010). "Atmospheric CO₂: Principal Control Knob Governing Earth's Temperature". *Science*, 330(6002), 356-359. <https://doi.org/10.1126/science.1190653>

Dr. Soon argues that other factors, including the role of the Sun, are more important than the models imply.

Dr. Bell is implying that because computer model simulations, such as McKay et al. (1991), include a small greenhouse effect for Titan that this contradicts Dr. Soon's comments.

However, as discussed earlier, Dr. Hörst and Dr. Bell both actually agree with Dr. Soon that the biggest factor for the difference in temperature between Titan and Earth is not the greenhouse gas composition, but rather the much greater distance from the Sun. And Dr. Hörst's model-based estimate of the "extra warming" for Titan is only 6.2% of the observed difference between Earth and Titan. So, they largely agree with Dr. Soon.

According to Science Feedback, "A claim is characterized as "Neutral" if it leaves out important information or is made out of context ("Lacks Context")".

Therefore, this subclaim 4.1 "Lacks Context".

LACKS CONTEXT

Claim 5. The scientific community disagrees with Dr. Soon on the causes of climate change

Climate Feedback's statement:

"...Soon made multiple incorrect claims about the science of how greenhouse gasses like CO₂ and methane are driving global warming. In the video, Soon also claimed the scientific evidence for global warming driven by CO₂ is "all artificial" and dreamed up by the "tyranny of the few".

First, as we have shown, the science of climate change is actually built on real evidence that has been studied and compiled by tens of thousands of scientists over decades. Second, climate contrarians like Soon are, in fact, the extreme minority who have a disproportionately large influence over public opinion. Nearly all scientists agree greenhouse gas emissions are the cause of global warming."

CERES-Science's reply:

In this claim, Dr. Bell makes several subclaims asserting that Dr. Soon's scientific opinion is in "the extreme minority" among the scientific community and that "nearly all scientists agree greenhouse gas emissions are the cause of global warming".

Even if this were true, this would be a logical fallacy known as "[*argumentum ad populum*](#)", which is Flawed reasoning:

"an *argumentum ad populum* (Latin for "appeal to the people") is a fallacious argument which is based on claiming a truth or affirming something is good because many people think so." - [Wikipedia](#)

However, as we will discuss in our responses to Subclaims 5.1-5.3, Dr. Bell's claims that Dr. Soon's scientific opinion is in "the extreme minority" (Subclaim 5.1); debunked by the IPCC's 2021 report (Subclaim 5.2); and his published work on the role of the Sun in climate change is less comprehensive than the IPCC's (Subclaim 5.3) are all "in direct contradiction with available data (tagged as "Inaccurate")".

INACCURATE

FLAWED REASONING

Subclaim 5.1. Several studies have shown Dr. Soon's views on the causes of climate change to be fringe among the scientific community.

Climate Feedback's statement:

"... climate contrarians like Soon are, in fact, the extreme minority who have a disproportionately large influence over public opinion. Nearly all scientists agree greenhouse gas emissions are the cause of global warming. Among scientists with the most climate-related expertise, the consensus reaches 100%[13]. A recent peer-reviewed scientific study analyzing thousands of other peer-reviewed scientific studies found that 99% of the scientific literature confirms human greenhouse gas emissions cause global warming[14]."

Dr. Bell's references:

- 13 – Myers et al. (2021) Consensus revisited: quantifying scientific agreement on climate change and climate expertise among Earth scientists 10 years later. Environmental Research Letters
- 14 – Lynas et al. (2021) Greater than 99% consensus on human caused climate change in the peer-reviewed scientific literature. Environmental Research Letters
- <https://climate.nasa.gov/faq/17/do-scientists-agree-on-climate-change/>. This webpage in turn cites the following:
 - <https://climate.nasa.gov/scientific-consensus/>
 - N. Oreskes (2004). "The scientific consensus on climate change". Science, Vol. 306 no. 5702, p. 1686, <https://doi.org/10.1126/science.1103618>
 - J. Cook et al. (2013). "Quantifying the consensus on anthropogenic global warming in the scientific literature". Environ. Res. Lett., 8 024024. <https://doi.org/10.1088/1748-9326/8/2/024024>

CERES-Science's reply:

For a detailed response to the Oreskes (2004), Cook et al. (2013) and other attempts before 2019 to quantify how common different scientific opinions on the causes of climate change are, we recommend reading our summary analysis from 2019 below:

- <https://www.ceres-science.com/scientific-opinion-on-climate-change>

For a more detailed analysis, two of the CERES-Science members co-authored a longer blog post in March 2021 on one of their websites:

- <https://globalwarmingsolved.com/2021/03/09/95-of-scientists-including-us-agree-that-the-climate-is-changing/>

Dr. Soon has also co-authored a peer-reviewed paper (Legates et al., 2015) re-analyzing the claims of Cook et al. (2013) in which it was shown that Cook et al. (2013)'s actual "consensus agreement" referred to only 41 out of the 11,944 abstracts they analyzed. Therefore, their alleged "97.1% consensus" was dramatically reduced to 0.3% consensus – when re-analyzed scientifically!

- Legates, D.R., Soon, W., Briggs, W.M. et al. Climate Consensus and ‘Misinformation’: A Rejoinder to Agnotology, Scientific Consensus, and the Teaching and Learning of Climate Change. *Sci & Educ* 24, 299–318 (2015). <https://doi.org/10.1007/s11191-013-9647-9>

To clarify, Legates et al. (2015) was not claiming that only 0.3% of scientific papers agreed with Cook et al.’s views on climate change.

Instead, Legates et al. (2015) argued that the methodology used by Cook et al. (2013) was woefully unscientific and unsuitable for the type of analysis they were trying to do. Moreover, their 97.1% consensus claim was directly contradicted by their own data.

Our posts and articles linked above are very relevant for the two more recent papers cited by Dr. Bell. But, they were written before Myers et al. (2021) and Lynas et al. (2021). Therefore, let us now consider both of these studies in turn.

Myers et al. (2021)

Myers et al. (2021) was a rather crude attempt to update a very crude earlier survey of the scientific opinion on climate change ([Doran & Zimmerman, 2009](#)) among sectors within the scientific community. However, while Myers et al. (2021) extracted some apparently remarkable conclusions from their survey, a close inspection of their data reveals that the most striking “conclusions” involved considerable cherry-picking from their overall data.

Dr. Bell used a specific conclusion of “100% agreement” from Myers et al. (2021) that was based on a selected subsample of 47 out of the 2780 (1.69%). However, the full survey results showed that 7.9% of the 2780 respondents believed that the warming since 1950 was mostly natural and that 1% were unconvinced that there has been continuous warming since 1950.

Myers et al. (2021) did not allow the respondents to provide more nuanced answers such as the idea that the recent warming might have had multiple factors or that the recent warming is not unprecedented in terms of human history.

That is, it was a very crude attempt to survey the scientific community on their opinions on the causes of recent climate change. Nonetheless, Dr. Soon’s perspective was shared by 228 of the scientists who participated in the Myers et al. (2021) survey. In contrast, Dr. Bell’s chosen focus on the Myers et al. (2021) survey only considered a subsample of 47 of the participants.

According to Science Feedback, “A claim is characterized as “Neutral” if it leaves out important information or is made out of context (“Lacks Context”).”

Therefore, Dr. Bell’s reference to Myers et al. (2021)’s “100%” claim “Lacks Context”.

LACKS CONTEXT

Lynas et al. (2021)

Lynas et al. (2021) attempted to build on the earlier analysis of Cook et al. (2013), despite the fact that Cook et al. (2013)’s analysis has been proven to have been flawed by Legates et al. (2015), which as mentioned above Dr. Soon was a co-author of.

Lynas et al. summarize their analysis as follows:

“From a dataset of 88125 climate-related papers published since 2012, when this question was last addressed comprehensively, we examine a randomized subset of 3000 such publications. We also use a second sample-weighted approach that was specifically biased with keywords to help identify any sceptical peer-reviewed papers in the whole dataset. We identify four sceptical papers out of the sub-set of 3000, as evidenced by abstracts that were rated as implicitly or explicitly sceptical of human-caused global warming. In our sample utilizing pre-identified sceptical keywords we found 28 papers that were implicitly or explicitly sceptical. We conclude with high statistical confidence that the scientific consensus on human-caused contemporary climate change—expressed as a proportion of the total publications—exceeds 99% in the peer reviewed scientific literature.”

The findings of Lynas et al. (2021) might *initially* sound impressive and their conclusions initially sound quite compelling. But, a close inspection of their actual data reveals serious flaws in their analysis. The data from their analysis can be downloaded from the journal website here:

- <https://iopscience.iop.org/article/10.1088/1748-9326/ac2966/data>

There are many problems with the analysis of Lynas et al. (2021) and this could be illustrated in many ways.

But, one of the most relevant ways to illustrate how the claims of Lynas et al. (2021) are completely flawed with regards to Dr. Bell’s use of the study to try and discredit Dr. Soon is to do a search for Dr. Soon in the Lynas et al. (2021)’s dataset.

It turns out that, four of Dr. Soon’s papers were included in the full sample of 88125 abstracts:

- Paper 1. Yan, Soon & Wang (2015). “A composite sea surface temperature record of the northern South China Sea for the past 2500 years: A unique look into seasonality and seasonal climate changes during warm and cold periods”.
<https://www.sciencedirect.com/science/article/abs/pii/S0012825214002232>
- Paper 2. Monckton, Soon, Legates & Briggs (2015). “Keeping it simple: the value of an irreducibly simple climate model”.
<https://www.sciencedirect.com/science/article/pii/S2095927316303589>
- Paper 3. Legates, Soon & Briggs (2015). “Learning and Teaching Climate Science: The Perils of Consensus Knowledge Using Agnotology”.
<https://link.springer.com/article/10.1007/s11191-013-9588-3>
- Paper 4. Monckton, Soon, Legates & Briggs. “Why models run hot: results from an irreducibly simple climate model”.
<https://www.sciencedirect.com/science/article/pii/S2095927316305448>

In the first part of their analysis, Lynas et al. took a random sample of 3.4% of these 88125 abstracts, i.e., a random sample of 3000. Dr. Soon’s papers were in the other 96.6% of the abstracts and so were not considered for that part. Lynas et al. claimed that 99.53% of these 3000 papers explicitly or implicitly supported the view that “humans are the primary cause of recent global warming”.

However, in the second part of their analysis, they used a machine learning algorithm to rank all 88,125 abstracts based on the probability that they “might be sceptical” that human activity is the primary cause of recent global warming. Lynas et al. then took the top 1,000 abstracts from the list and evaluated them as well. Their algorithm only identified 28 of these 1,000 abstracts to be sceptical. That is, they concluded that 97.2% of the 1,000 abstracts explicitly or implicitly supported the view that “humans are the primary cause of recent global warming”.

All 4 of Dr. Soon’s papers in the full sample were indeed correctly identified as potentially being sceptical in that there were given the following “estimated probability of being sceptical”: Paper 1 = 99.999999999992%; Papers 2-4 = 85.6278355763182%. However, since they only analyzed the top 1.13% of the list, Papers 2-4 were not analyzed.

It is particularly ironic that Paper 3 was excluded from the analysis since this was the precursor paper to the Legates et al. (2015) paper that we mentioned earlier debunked Cook et al. (2013).

At any rate, Paper 1 was specifically analyzed by Lynas et al. (2021) since it was the 53rd most likely abstract to be sceptical. Their analysis however found that this paper offered “no position” (ranking 4a) and it was therefore included in the 97.2% “consensus”. In other words, Lynas et al. (2021) considered Dr. Soon to be part of “the consensus”.

So, Dr. Bell’s decision to cite Lynas et al. (2021) as part of his support for his claim that Dr. Soon’s views on climate change “are, in fact, the extreme minority” among the scientific community is “Incorrect” because Lynas et al. (2021) considered Dr. Soon to be part of their “97.2% consensus”!

Interestingly, Paper 1 was actually sceptical of the consensus. The paper was a paleoclimate study investigating the long-term sea temperatures in South China Sea over the last 2500 years using a new temperature proxy record. The study found that there had been two warm periods over the last 2500 years that were comparable to the current warm period: the Roman Warm Period (around 2000 years ago) and the Medieval Warm Period (around 1000 years ago). If the South China Sea was just as warm during those times long before the Industrial Revolution as now, then that would directly contradict Lynas et al. (2021)’s “consensus”. Yet, Lynas et al. included this paper co-authored by Dr. Soon as part of the consensus!

Another flaw in the Lynas et al. (2021) analysis is that the three other papers that their algorithm estimated had a 86% probability of being sceptical were indeed sceptical. But, Lynas et al. (2021)’s study design meant they never made the cut!

So, the conclusions of Lynas et al. (2021) are contradicted by a basic test of their analysis with regards to Dr. Soon’s own papers. But, Dr. Bell’s use of Lynas et al. (2021) for Subclaim 5.1, is ironically comical as well as simply Incorrect, given that Lynas et al. (2021) explicitly included Dr. Soon in their definition of their “97.2% consensus”.

INCORRECT

In conclusion, Subclaim 5.1 “Lacks context” and is “Incorrect”:

LACKS CONTEXT

INCORRECT

Subclaim 5.2. The IPCC’s latest report (AR6) “directly contradicts Soon” in their very first line.

Climate Feedback’s statement:

“In the most recent IPCC report (AR6), the very first text line (line A.1.) of the “Summary for Policymakers” directly contradicts Soon by stating “Human activities, principally through emissions of greenhouse gasses, have unequivocally caused global warming”[15]. The report confirms there has been 1.1°C of global warming since the period 1850-1900 and it explicitly identifies CO₂ from human emissions as the leading cause (Fig. 2).”

Dr. Bell’s references:

- 15 – IPCC (2023) Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change
https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf

CERES-Science’s reply:

As already explained in our response to Subclaims 2.4 and 2.5, the IPCC admitted to [The Epoch Times](#) that due to the IPCC’s chosen deadlines for consideration, they had excluded Connolly et al. (2021) from consideration in the IPCC AR6 reports. Their AR6 synthesis report published in 2023 was merely synthesizing the literature reviews of the three Working Group reports published in 2021/2022. So, this 2023 report also did not consider Connolly et al. (2021) or other more recent papers, including the two highly relevant papers Dr. Soon co-authored (Soon et al., 2023; Connolly et al., 2023).

Another oversight of IPCC AR6 was that they had neglected to consider a key paper that did meet the AR6 deadlines – Soon et al. (2015). In AR6, on the section concerning urbanization bias, the chapter co-authors claimed that “No recent literature has emerged to alter the AR5 finding that it is unlikely that any uncorrected effects from urbanization [. . .] have raised global Land Surface Air Temperature (LSAT) trends by more than 10%” ([AR6 Working Group 1, Chapter 2, pp. 43–44](#)). This statement by the co-authors of Chapter 2 of IPCC AR6 WG1 was simply incorrect. Several papers, including Soon et al. (2015), had been published before the AR6 deadline that had specifically disputed the AR5 estimate that urbanization bias was less than 10%:

- Soon,W.; Connolly, R.; Connolly, M. Re-Evaluating the Role of Solar Variability on Northern Hemisphere Temperature Trends since the 19th Century. *Earth-Sci. Rev.* 2015, 150, 409–452. <https://doi.org/10.1016/j.earscirev.2015.08.010>
- Zhang, P.; Ren, G.; Qin, Y.; Zhai, Y.; Zhai, T.; Tysa, S.K.; Xue, X.; Yang, G.; Sun, X. Urbanization Effects on Estimates of Global Trends in Mean and Extreme Air Temperature. *J. Clim.* 2021, 34, 1923–1945. <https://doi.org/10.1175/JCLI-D-20-0389.1>
- Scafetta, N. Detection of Non-climatic Biases in Land Surface Temperature Records by Comparing Climatic Data and Their Model Simulations. *Clim. Dyn.* 2021, 56, 2959–2982. <https://doi.org/10.1007/s00382-021-05626-x>

Bizarrely, while the chapter authors neglected to cite Soon et al. (2015) or several other relevant papers, the co-chair of IPCC AR6 WG1, Prof. Panmao Zhai, had explicitly highlighted the relevance and importance of Soon et al. (2015), in his own published work – see Chen & Zhai (2017).

- Chen, Y.; Zhai, P. Persisting and Strong Warming Hiatus over Eastern China during the Past Two Decades. *Environ. Res. Lett.* 2017, 12, 104010. <https://doi.org/10.1088/1748-9326/aa822b>

The Epoch Times asked the IPCC why they had failed to consider Soon et al. (2015) in their Chapter 2 given that one of their two co-chairs was aware of its relevance. The IPCC responded to say, “decisions on citations are up to the chapter team authors not the co-chairs.”

<https://www.theepochtimes.com/world/challenging-un-study-finds-sun-not-co2-may-be-behind-global-warming-3950089>

In other words, the authors of Chapter 2 were failing to properly review the scientific literature, and they were doing such a hasty job that they didn’t even check with their co-chairs who knew more about the topic than they did. This important case provides another example of how the summaries of the science in IPCC AR6 are neither comprehensive nor authoritative.

According to Science Feedback’s framework, “A claim is deemed of “Very Low” credibility when it is clearly wrong—for instance, if it makes a statement of fact in direct contradiction with available data (tagged as “Inaccurate”), or if it provides an explanation or a theory whose predictions have been invalidated (tagged as “Incorrect”).”

Therefore, Dr. Bell’s Subclaim 5.2 is both “Inaccurate” and “Incorrect”.

INACCURATE

INCORRECT

Subclaim 5.3. The IPCC’s AR6 report represented a more comprehensive review of the relevant scientific literature than Dr. Soon’s research.

Climate Feedback’s statement:

“As an indication of the scientific robustness of AR6, just the contribution from Working Group 1 alone was written by 234 of the world’s leading climate scientists coming from 66 countries. It included nearly 4 000 pages of research based on more than 14 000 scientific papers as supporting references and was critiqued and revised by over 1 500 expert reviewers.”

CERES-Science’s reply:

As described in our response to Subclaim 2.5, the IPCC’s 6th Assessment Report (AR6) did not consider Connolly et al. (2021) because it had apparently missed the IPCC’s somewhat arbitrary cut-off date for consideration by 10 weeks. The IPCC explicitly confirmed to The Epoch Times in August 2021 (shortly after AR6 Working Group 1 had been published) that AR6 had not considered Connolly et al. (2021) and that it would not be due for consideration until AR7 ([currently due for publication in 2028/2029](#)).

Soon et al. (2023) and Connolly et al. (2023) were published even later than this. Therefore, while the final synthesis report of the IPCC AR6 was only published in 2023, the scientific papers that were potentially considered in this 2023 report only include those accepted for publication before Jan 31st, 2021. This explicitly excluded the three papers that Dr. Soon was commenting on in his interview.

Therefore, Dr. Bell’s suggestion that the IPCC AR6 had even considered the three papers Dr. Soon was referring to in the interview is contradicted by the IPCC themselves.

INACCURATE

Moreover, Dr. Bell’s claim that the review of the scientific literature by IPCC AR6 was more comprehensive than Dr. Soon’s is based on flawed reasoning.

Dr. Bell assumes that because the IPCC AR6 Working Group 1 report was “based on more than 14 000 scientific papers as supporting references” that this was “an indication of the scientific robustness of AR6”. However, this is flawed reasoning. There are 100,000s of scientific papers that the IPCC could potentially have considered. Climate change is a multi-disciplinary subject that is currently one of the most widely published topics in science.

Carrying out a scientific literature review is not merely a matter of counting published papers that can be cited. It is more important to identify the papers that are most relevant and important for the specific research topics under investigation.

Connolly et al. (2021) included a scientific literature review of many of the key papers on the specific topics of:

- (a) The role of the Sun in climate change
- (b) The urbanization bias problem

The IPCC AR6 Working Group 1 also reviewed papers on these two topics.

In total, Connolly et al., (2021) cited 536 references, which is indeed a much smaller number than the “more than 14,000 scientific publications available by 31 January 2021” ([AR6 Working Group 1, preface, page vii](#)) that IPCC AR6 cited. However, only a small percentage of papers cited by AR6 were on either of these topics. Most were on other topics.

The total numbers of references cited by each assessment specifically with respect to each of these two topics are shown in the Table below:

Table 1. Total numbers of citations considered by both assessment reports specifically with respect to (i) the potential role of solar activity as a driver of recent climate change and (ii) the magnitude of the urbanization bias problem. Note that one reference was cited for both topics by Connolly et al. (2021) but is only counted once for the “Both topics” column.

Assessment report	Published	Solar activity as a climate driver	Urbanization bias problem	Both topics
IPCC AR6	pre-AR5	17	7	24
	post-AR5	51	21	72
	total	68	28	96
Connolly et al. (2021)	pre-AR5	261	15	276
	post-AR5	135	17	151
	total	396	32	428
Common citations	pre-AR5	7	1	8
	post-AR5	13	1	14
	total	20	2	22

Both assessments considered similar numbers of references for the urbanization bias problem – 28 by IPCC AR6 compared to 32 by Connolly et al., (2021). However, only 2 references were cited by both assessments on this topic. This could partially explain why the two reviews came to different conclusions on this issue.

On the role of solar activity as a climate driver, there was a bit more of an overlap in citations, with 20 references cited by both. However, while Connolly et al., (2021)’s assessment was based on 396 references, AR6’s assessment was only based on 68 references. Therefore, despite AR6 citing more than 14,000 references throughout the entire report, with regards to this specific topic, Connolly et al., (2021)’s assessment appears to have considered a much larger sample of the available scientific literature.

Dividing the totals in Table 1 by the total references considered by each report, these two topics together account for ~0.7% of AR6’s references (96/~14,000) but ~80% of Connolly et al., (2021)’s references (428/536).

So, contrary to Dr. Bell's assumption, in terms of "number of scientific papers cited", Connolly et al. (2021) actually was more comprehensive than IPCC AR6 on (a) ***the role of the Sun in climate change*** and at least as comprehensive on (b) ***the topic of urbanization bias***.

Dr. Bell also argued that the fact that AR6 Working Group 1 was "written by 234 of the world's leading climate scientists coming from 66 countries" was a further "indication of the scientific robustness of AR6". However, if we are playing counting games like that, it is worth noting that Connolly et al., (2021) alone was written by 23 scientists from 14 countries. Moreover, Dr. Soon (and the CERES-Science team) have in the last five years published scientific peer-reviewed papers with more than a hundred different scientists from more than 20 countries – see [here](#) for a list of Dr. Soon's most recent peer-reviewed publications and [here](#) for a list of all CERES-Science publications.

In our opinion, the number of scientists involved in a report and the number of countries they come from should **not** be treated as an "indication of the scientific robustness". But, if Dr. Bell insists that it is, then by this metric, Dr. Soon ***as an individual scientist*** would arguably be worth 30-40% of the ***entire*** AR6 Working Group 1 team in terms of "scientific robustness".

Is that really the metric that Dr. Bell wants to use?

At any rate, Dr. Bell was also using "Flawed reasoning" for Subclaim 5.3.

Therefore, Subclaim 5.3 is both "Inaccurate" and based on Flawed reasoning".

INACCURATE

FLAWED REASONING