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28 October 2020

Senator Malcolm Roberts
PO Box 6100
Senate
Parliament House
Canberra ACT 2600

Dear Senator Roberts

CSIRO acknowledges your letter received by email on 19 October 2020 regarding Senate Budget Estimates questions.

Your questions are addressed below.

1. Do you stand by CSIRO's implied claim that Marcott and Lecavalier are the best evidence CSIRO has for showing that the rate of temperature change today is unprecedented in the last 10,000 years?

The conclusion that the rate of temperature change today is unprecedented in the past 10,000 years is supported by many studies and multiple lines of evidence. There are no peer-reviewed published studies that contradict this conclusion, to our knowledge.

The most recent reconstruction of global temperatures during the Holocene (Kaufmann et al., Scientific Data, 2020) is consistent with that of Marcott et al. (2013) and provides further support to the conclusion that recent rates of temperature change are unprecedented in the past 10,000 years.

With regard to Marcott et al. (2013), we responded to your questions about this study in our reply of August 2017:

> *In relation to claims made in blog posts regarding the integrity of the Marcott study, and the questions raised regarding this research, it should be noted that there are currently 265 [>640, as of October 2020] published papers in the peer-reviewed literature citing Marcott et al (2013), and there is no published study that draws the temperature reconstruction into question for the period for which sufficient proxies are available (~11,300 BP to 1800 CE).*
>
> *We further note that reference [1] derives a 12,000-year record of Arctic temperatures that extends to the year 2009 CE, with 25-year resolution, and concludes that the recent rate of Arctic temperature change is unprecedented in the entire Holocene.*
>
> *CSIRO reaffirms the scientific rigour of the Marcott et al. (2013) study and the conclusion that the rate of recent warming of global mean temperature is unprecedented in the past 10,000 years.*
>
> *Studies published after Marcott et al. (2013), using a variety of data sets and analysis methods and covering various time periods, support the conclusion that recent rates of warming are unprecedented [e.g. 1-5].*

The conclusion drawn by CSIRO and by the Marcott study is based on a comparison of recent temperatures, as measured by instruments, to past temperatures inferred from proxy data. Neither Marcott, nor CSIRO, make any conclusions based on the "uptick" part of the proxy temperature record.

This approach is used because the best information we have about recent temperatures are those made by instruments measuring temperature (thermometers measure temperature more accurately than tree rings, ice cores, or plankton preserved in sediments).

There is no scientific evidence in any other climate variable to support the supposition that there may have been periods of rapid warming and cooling in the past that were missed by Marcott's reconstruction method, nor has a plausible physical mechanism been identified that could have driven such spikes in warming and cooling. In addition, it can be demonstrated that the Marcott method could have detected periods of rapid warming/cooling in the past, had they occurred.

2. What did CSIRO rely on before Marcott (2013), say in the 1980s, when Bob Hawke was the first Prime Minister to raise the issue of anthropogenic climate change said to be due to carbon dioxide from human activity?

The state of the science in an Australian context was provided by the volume **Greenhouse: Planning for the Future**, published by CSIRO in 1988 (https://ebooks.publish.csiro.au/content/greenhouse-planning-climate-change). It was already evident in the 1980s that anthropogenic emissions of carbon dioxide were altering the chemical composition of the atmosphere (e.g. increasing the concentration of carbon dioxide and other greenhouse gases). There was already substantial evidence that this increase in greenhouse gases would alter regional and global climate. The state of the science in the 1980s was summarised in the first global assessment of climate science, published by the IPCC in 1990.

3. At what stage did CSIRO start giving significant advice to governments on anthropogenic climate change?

CSIRO has always provided scientific advice to government on issues of national significance. That is part of our remit. For more than 60 years our scientists have been contributing to scientific knowledge about climate change and its impacts.

4. (sic) In senate estimates hearings on Thursday 24 October 2019, I asked Dr Mayfield to provide empirical scientific evidence that shows "statistically significant variation that proves there has been a process change, that is, variation that is beyond or outside natural, inherent, cyclical or seasonal variation, over the last 350 years?" In response, Dr Mayfield held aloft one of CSIRO's past slide show presentations to me and answered that CSIRO has already identified that in the previous presentation. I need Dr Mayfield to specify the slide(s) and specific data to which he refers and on which his answer relies, and to specify the statistical analysis techniques upon which he relies to deem statistically significant process change in climate and the relevant statistical levels of confidence from the analysis of the climate factor he identifies, and to specify the time interval of data for which the statistical analysis was applied.

As discussed at multiple briefings (September 2016, May 2017 and July 2017), numerous correspondence through Estimates Committee processes, as well as direct correspondence with your office there are many lines of evidence that show the recent changes in the climate system lie outside the range of natural variability. Further studies demonstrate that the observed record cannot be explained by natural factors alone. The statistical analyses used in the 1000s of published studies that provide this evidence cannot be summarised simply but are described in full in the peer-reviewed literature.

As stated in prior briefings, the direct empirical evidence that human activities are causing climate change includes:

a) Carbon dioxide is a greenhouse gas (i.e. absorbs and emits infrared radiation), as shown by direct measurement and the laws of physics.
b) Carbon dioxide concentrations in the atmosphere have increased by more than 45% since 1850, as shown by direct measurements of atmospheric samples and air trapped in ice cores.
c) The extra carbon dioxide in the atmosphere comes from human activities. Isotopic measurements show the source of the extra carbon dioxide is fossil fuel burning and land clearing.
d) The additional carbon dioxide added to the atmosphere by human activities has enhanced the greenhouse effect: measurements show that less energy is leaving the top of the atmosphere, and more energy is reaching the earth surface, in the wavelengths absorbed and emitted by carbon dioxide and other greenhouse gases.
e) The earth has warmed as a result of the enhanced greenhouse effect: surface and lower troposphere temperatures have increased, ocean heat content has increased, sea level has risen, and ice (sea ice, glaciers and ice sheets) has melted.
f) Observed changes in the climate system are consistent with an enhanced greenhouse effect. Other forcings (e.g. volcanoes, the sun, internal variability) cannot explain the magnitude, timing and distribution of observed trends. For example, enhanced greenhouse forcing causes warming of the lower atmosphere and cooling of the upper atmosphere, as observed.

We have previously provided you with published papers supporting each of these points.

5. If you disagree with this reasoning, please provide me with what you see as the alternative basis for policy.

Science provides a firm foundation for evidence-based policy.

6. Australia has already done much to destroy its energy grid, yet as an overseer of taxpayer resources, I need to know whether this has shown up in atmospheric carbon dioxide levels and if so, how and to what extent? Please provide evidence of the effect on atmospheric carbon dioxide levels and temperatures from Australia's cuts to human carbon dioxide output.

It is not possible to attribute changes in carbon dioxide concentrations to individual emitters. This is because carbon dioxide is a well-mixed gas in the atmosphere. The annual Global Carbon Project produces a comprehensive global analysis of sources and sinks of carbon dioxide. The research relies on the self-reported and global energy data stored by UN Statistics and more recently by the International Energy Agency (IEA), along with observations of greenhouse gas levels and carbon cycle models.

7. Have global attempts to cut human production of carbon dioxide shown up in atmospheric carbon dioxide levels and if so how and to what extent?

The relationship between emissions and carbon dioxide concentrations in the atmosphere can be evaluated using analyses from the Global Carbon Project. (see above).

In summary, the science - based on empirical evidence and physical understanding - provides a clear and compelling case that the climate has changed, and human activities are the principal driver.

Yours sincerely

Dr Larry Marshall
Chief Executive

References

[1] Lecavalier B. S., et al. High Arctic Holocene temperature record from the Agassiz ice cap and Greenland ice sheet evolution, Proceedings of the National Academy of Sciences (2017). DOI: 10.1073/pnas.1616287114.

[2] Masson-Delmotte, V., M. Schulz, A. Abe-Ouchi, J. Beer, A. Ganopolski, J.F. González Rouco, E. Jansen, K. Lambeck, J. Luterbacher, T. Naish, T. Osborn, B. Otto-Bliesner, T. Quinn, R. Ramesh, M. Rojas, X. Shao and A. Timmermann, 2013: Information from Paleoclimate Archives. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, US.

[3] PAGES 2k Consortium (2013). Continental-scale temperature variability during the past two millennia. Nature Geoscience, Vol. 6, pp. 339-346 (data publicly available at https://www.ncdc.noaa.gov/paleo-search/study/14188).

[4] North, G. R.; Biondi, F.; Bloomfield, P.; Christy, J. R.; Cuffey, K. M.; Dickinson, R. E.; Druffel, E. R. M.; Nychka, D.; Otto-Bliesner, B.; Roberts, N.; Turekian, K.; Wallace, J. (2006). Surface temperature reconstructions for the last 2,000 years, Washington, D.C.: National Academies Press, ISBN 0-309-10225-1. (data publicly available at https://www.ncdc.noaa.gov/paleo-search/study/14188).

[5] PAGES2k Consortium (2017). A global multiproxy database for temperature reconstructions of the Common Era, Scientific Data 4, Article number: 170088 (2017) doi:10.1038/sdata.2017.88.

[6] Kaufman, D., McKay, N., Routson, C. et al. Holocene global mean surface temperature, a multi-method reconstruction approach. Sci Data 7, 201 (2020). https://doi.org/10.1038/s41597-020-0530-7. (data publicly available at https://www.ncdc.noaa.gov/paleo/study/29712).

Senator Malcolm Roberts
One Nation Senator for Queensland

19 October 2020

Dr Larry Marshall
CSIRO
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Dear Dr Marshall

Re: Questions for Senate Budget Estimates

To make optimal use of your time, senators' time and taxpayers' resources, I ask that you and Dr Peter Mayfield prepare to answer the questions below in this month's Senate Budget Estimates.

Firstly, I remind you of the context. In 2017 prior to my second meeting with your CSIRO climate research team under the leadership of Dr Steve Rintoul, I asked that the CSIRO provide evidence of anything unprecedented in earth's last 10,000 years climate record and to provide empirical scientific evidence proving it was unprecedented.

CSIRO offered one paper on temperatures, being Marcott et al (2013). During our subsequent questions and discussions in our meeting on 10 May 2017 Dr Rintoul advised me emphatically that today's temperatures are not unprecedented and that instead he claimed that the rate of rise in twentieth century temperatures is unprecedented.

After we comprehensively proved, for many reasons, that Marcott does not provide valid scientific evidence, CSIRO replaced Marcott (2013) with Lecavalier (2017) and in our subsequent meeting on 26 July 2017 we showed Lecavalier does not provide valid scientific evidence.

Questions

1. Do you stand by CSIRO's implied claim that Marcott and Lecavalier are the best evidence CSIRO has for showing that the rate of temperature change today is unprecedented in the last 10,000 years?

2. What did CSIRO rely on before Marcott (2013), say in the 1980s, when Bob Hawke was the first Prime Minister to raise the issue of anthropogenic climate change said to be due to carbon dioxide from human activity?

3. At what stage did CSIRO start giving significant advice to governments on anthropogenic climate change?

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In senate estimates hearings on Thursday 24 October 2019, I asked Dr Mayfield to provide empirical scientific evidence that shows "statistically significant variation that proves there has been a process change, that is, variation that is beyond or outside natural, inherent, cyclical or seasonal variation, over the last 350 years?" In response, Dr Mayfield held aloft one of CSIRO's past slide show presentations to me and answered that CSIRO has already identified that in the previous presentation.

4. I need Dr Mayfield to specify the slide(s) and specific data to which he refers and on which his answer relies, and to specify the statistical analysis techniques upon which he relies to deem statistically significant process change in climate and the relevant statistical levels of confidence from the analysis of the climate factor he identifies, and to specify the time interval of data for which the statistical analysis was applied.

I take this opportunity to remind you that prominent politicians of the Greens, Labor, Liberal and Nationals parties directly or implicitly advocate policies that are costing Australia and Australians tens of billions of dollars and are having economic impacts costing trillions of dollars, destroying jobs and killing our nation's competitiveness.

I hope you agree that the only valid basis for such policies is specific empirical scientific evidence within a logic proving causation and quantifying the effect of carbon dioxide from human activity on climate factors such as atmospheric temperature. I hope you understand the need to justify such policies on solid scientific evidence quantifying cause and effect. Such quantified evidence is needed to implement such policies and to monitor the effect of such policies.

Without the specific quantified relationship between human carbon dioxide output and climate factors, it is not possible to do cost-benefit cases nor track progress.

5. If you disagree with this reasoning, please provide me with what you see as the alternative basis for policy.

6. Australia has already done much to destroy its energy grid, yet as an overseer of taxpayer resources, I need to know whether this has shown up in atmospheric carbon dioxide levels and if so, how and to what extent? Please provide evidence of the effect on atmospheric carbon dioxide levels and temperatures from Australia's cuts to human carbon dioxide output.

7. Have global attempts to cut human production of carbon dioxide shown up in atmospheric carbon dioxide levels and if so how and to what extent?

On this occasion we do not want your answers to the above simple and straightforward questions 1-7 to include alternatives to science such as appeals to authority that are internationally and scientifically accepted as not science.

We understand from your repeated claims that you believe that CSIRO is in the top one per cent of scientific agencies globally, yet your opinion is not what is wanted. That is a deviation from science and shows an unscientific approach and answer. In my experience here and overseas, people who rely on such distractions use such substitutes instead of science when they lack scientific evidence.

Nor do I want political rhetoric or buzzwords that mislead many politicians, journalists and members of the public. These are not science and only mislead people who do not understand science. Instead, we want to see CSIRO's science in the form of quantified scientific evidence of causation.

If your answer includes scientific papers or other scientific references, we can only see your references as valid if you specify the specific location—being publication title, page number, sentence, data table—of any claimed scientific data as evidence within a logical framework that proves and quantifies causation.

I take this opportunity to address an implied slur on me in your previous letter. I had enormous respect for CSIRO, yet sadly that respect has been eroded in part due to CSIRO's unscientific behaviours and claims about climate. I note that prominent and highly respected retired CSIRO researchers and managers have publicly expressed their concerns and it disturbs me that CSIRO's leadership apparently ignores these. I take this opportunity to express my support, in writing, for the overwhelming majority of CSIRO's people and to remind them and you that my concerns for CSIRO is what drives me to hold you and its climate divisions accountable in order to restore CSIRO's reputation.

Yours sincerely

Senator Malcolm Roberts
Senator for Queensland