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Mr L B Cummings
6 Molong Road
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26 November 2013

Dear Mr Cummings,

Thank you for your letter dated 17 September 2013 to the Hon Ian McFarlane MP, Minister for Industry. The Minister has asked me to respond on his behalf.

I trust the enclosed advice assists with your questions.

Yours sincerely

A handwritten signature in dark ink, appearing to be "A Johnson", with a long horizontal flourish extending to the right.

Dr Andrew Johnson
Group Executive

**CSIRO's response to questions to Minister MacFarlane by Mr L Cummings in
correspondence of 17 September 2013**

Question 1

"Is there, in the CSIRO's considered view, a credible published peer reviewed research paper in which the authors analyse observational data that shows evaporative cooling increases by only 2% to 3% in response to a 1-degree increase in surface temperature and, if so please provide a reference to that paper?"*

*"*It is a matter of fact that some published peer reviewed research papers, while they were approved for publication by a selected peer reviewed panel, are subsequently found to contain significant errors in fact or methodology, when subjected to scrutiny by the wide scientific community. A credible research paper, having been cited by for example the CSIRO as a significant paper, would be able to survive scrutiny by the wide scientific community."*

CSIRO response

CSIRO is not aware of a publication that uses globally-averaged observations to show evaporative cooling increasing by about 2% to 3% in response to a 1-degree increase in surface temperature.

CSIRO does not accept the view that "credible" means that if a CSIRO author cites a paper, then that paper will survive all scrutiny throughout the scientific community. This proposition is at odds with the scientific process of knowledge development, which hinges on rigorous challenge, hypothesis, debate, and on-going scientific testing as new knowledge is acquired.

Question 2

"Climate scientists are generally agreed that doubling the amount of carbon dioxide in the atmosphere would increase the amount of back radiation from the atmosphere to the surface by around 3.5 watts per square metre (excluding consequential changes.)

Does the CSIRO agree that the above estimate of 3.5 watts per square metre is substantially correct and if not, then what is the CSIRO's authoritative estimate?"

CSIRO response

CSIRO contributes to the IPCC assessments and regards the IPCC findings as an authoritative assessment of the climate science. The IPCC's Fourth Assessment Working Group 1 Report (Solomon *et al* 2007, Chapter 2, p. 140) states a doubling in the mixing ratio of atmospheric carbon dioxide leads to a global mean radiative forcing of 3.7 watts per metre squared.

Reference:

Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Contribution of Working Group I to the Fourth Assessment Report of the

Intergovernmental Panel on Climate Change, 2007. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Question 3

NASA estimates that the current flow of latent heat from the surface to the atmosphere due to evaporative cooling is around 85 watts per square metre.

Does the CSIRO agree that the above estimate of 85W/sqm is substantially correct and if not, then what is the CSIRO's authoritative estimate?"

CSIRO response

CSIRO contributes to the IPCC assessments and regards the IPCC findings as an authoritative assessment of the climate science. The IPCC AR5 Working Group 1 Report (IPCC 2013, Chapter 2 and Figure 2.11) provides a value of 84 Wm^{-2} for present-day conditions, with a range from 70 to 85 Wm^{-2} , based on the recent paper by Wild et al (2013). This is similar to other data quoted in the recent scientific literature (e.g. Trenberth et al, 2009).

References:

IPCC, 2013: 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.). Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, in press.

Trenberth, K. E., Fasullo, J. T. and J. T. Kiehl, 2009, Earth's Global Energy Budget, Am. Meteorol. Society, 90(3), 311 – 323. DOI <http://dx.doi.org/10.1175/2008BAMS2634.1>

Wild et al (2013) (Wild, M., Folini, D. Schär, C. Loeb, N. Dutton, E. G. and König-Langlo G., 2013, The global energy balance from a surface perspective. Climate Dynamics, doi:DOI 10.1007/s00382-012-1569-8).

Question 4

Climate scientists are generally agreed that the amount of water vapour in the atmosphere increases by around 7% for each 1-degree increase in surface temperature.

Does the CSIRO agree that the above estimate of 7% per degree is substantially correct and if not, then what is the CSIRO's authoritative estimate?"

CSIRO response

CSIRO agrees that the saturation water vapour pressure increases at a rate of about 7% per degree Celsius increase in air temperature. This is the well known Clausius-Clapeyron equation (see for example Iribarne, J. V., and W. L. Godson 1981. Atmospheric Thermodynamics. D. Reidel, p. 65) and so is an authoritative estimate.

Question 5

“Climate scientists are generally agreed that following a doubling of carbon dioxide and an increase in surface temperature of say 2-degrees the following changes in radiation energy flows at the surface would take place:-

Increase in back-radiation[#] from the atmosphere to the surface 16 W/sqm

Increase in (cooling) radiation emitted by the surface 11 W/sqm

Net increase in downward (warming) radiation 5 W/sqm

Does the CSIRO agree that the above estimate of 5 watts per square metre is substantially correct, and if not, then what is the CSIRO’s authoritative estimate?”

“# Includes the additional back-radiation due to the increase in atmospheric water vapour (often referred to as positive water vapour feedback).”

CSIRO response

To be able to provide an authoritative answer to this question, CSIRO requires more information about the underpinning assumptions that you have used in laying out this proposition. Such information for example, would include: Whether these figures are globally-averaged?; What atmospheric conditions are assumed (e.g. clear or cloudy skies)?; Is this an instantaneous change in CO₂ or a transient response?; and how are other greenhouse gases included in the calculation? In addition, it would be useful to know the source of Mr Cummings assertion.

CSIRO contributes to the IPCC assessments and regards the IPCC findings as an authoritative assessment of the climate science. The recent IPCC Fifth Assessment’s Working Group 1 Report Summary for Policy Makers (IPCC 2013, p.SPM-11) assessed that the equilibrium climate sensitivity (the amount of warming that would result from an almost instantaneous doubling of CO₂ concentrations in the atmosphere) is likely (with high confidence) to be in the range of 1.5°C to 4.5°C, and is extremely unlikely to be less than 1°C (with high confidence). This result is consistent with the IPCC’s conclusion that the water vapour feedback in the climate system is extremely likely to be positive and therefore amplifies changes in the climate. Similarly cloud feedbacks were also found likely to be positive.

Reference:

IPCC, 2013: Summary for Policymakers. 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, USA.