

Response to the reviewer's comments

We thank the reviewer for suggestive comments. Below is the point-by-point response for the reviewer's comments.

1) The use of Davies-Jones (2008). There are >50 equations in the Davies-Jones paper, with various different forms of calculating wet bulb temperatures with wide ranging accuracies. Only listing the manuscript as the method would leave any future researchers attempting to replicate results in confusion. I recommend either stating explicitly which equations that were used, or if using predesigned module, such as the HumanIndexMod (Buzan et al., 2015) that I previously recommended to use, should be cited. I believe it is important that the reader can follow the explicit methodology.

Thanks for pointing this out. We added a reference to clarify the method we used.

[L101] ... from which 2-meter relative humidity (rh) and wet-bulb temperature (w2m) are calculated using the methods of Davies-Jones (2008) with a predesigned module, HumanIndexMod (Buzan et al., 2015).

2) I listed a series of recommended citations in my previous review. As far as I can tell only one of them was used (Davies-Jones 2008). Contextualizing these results is an important component to this work. For example, why use wet bulb temperature? Wet bulb temperatures are not considered the best metric for heat stress (Liang et al., 2011 demonstrate this), however, there are clear linkages between moist thermodynamics of the atmosphere and heatwaves through wet bulb temperatures. Take the recent heatwave in the Pacific Northwest (last week of June 2021), for example. The diurnal measurement of dry bulb temperature and dew point temperature (29°C T and 19°C Td at midnight and peak 46°C T and 11°C Td at PDX airport) fluctuations slide along a constant wet bulb temperature (22°C Tw for the above PDX example), clearly showing that this moist thermodynamic process is dominating the heatwave. Readers need to be able to read your manuscript, see the methods, and connect them together within the wider context of heat stress, climate change, and most importantly, the robustness of climate model results. I encourage the authors to really consider the citations I recommended adding in my previous review. I think it would greatly enhance the discussion section and hammer the broader big picture of executing ensembles of General Circulation Models.

Thanks for suggesting valuable references. We have added suggested reference throughout the paper.

[L60-63] In addition, because the combined effect of temperature and humidity is known to affect human health by reducing the body's ability to cool itself through perspiration, wet-bulb temperature is frequently analyzed (Kang and Eltahir, 2018). Wet-bulb temperature is also closely associated with moist thermodynamics that drives the heatwave (Schwingshackl et al., 2021; Zhang et al., 2021), so we will analyze wet-bulb temperature also.

[L98-101] Our analysis will focus on 2-meter temperature (hereafter, t2m) and 2-meter dew point temperature (d2m), from which 2-meter relative humidity (rh) and wet-bulb temperature (w2m) are calculated using the methods of Davies-Jones (2008) with a

predesigned module, HumanIndexMod (Buzan et al., 2015).

[L190] We note that other values could be chosen (Liang et al., 2011), with higher values occurring less frequently but having more significant impacts.

3) Minor point: the manuscript focus on cities, but does not use urban models. Perhaps another sentence could expand upon this drawback and highlight that there are models available to take the climate data in this project and enable detailed analysis of the urban heat island. Such as the Community Land Model from the National Center for Atmospheric Research with its capacity to conduct decompositions of urban and rural environments. I want to make it clear: I don't expect the authors to conduct another modelling study but highlight an important aspect of heat stress research and that there are tools available to expand the study in the future, but they are not frequently used in global studies.

We have added a sentence to discuss the urbanization impact.

[L450-451] Statistical or dynamical downscaling could be used for a more detailed analysis (Dibike and Coulibaly, 2006;Wood et al., 2004). Also, land models with capacity to decompose urban and rural environment could be applied in same context (Bonan et al., 2002;Dickinson et al., 2006).

Minor points:

Rewrite sentence

line 69: for example: Previous studies have...

Revised

[L68-72] For example, previous studies have investigated tTemperature connections with El Niño Southern Oscillation (ENSO) (Thirumalai et al., 2017;Meehl et al., 2007), the Pacific Decadal Oscillation (PDO) (Birk et al., 2010) , the Atlantic Multidecadal Oscillation (AMO) (Zhang et al., 2020;Mann et al., 2021)

line 79: add de lima et. al 2021 on heat stress on agriculture labor and economic modeling interactions

Reference added.

[L72-75] The effect of climate extremes on different populations depends on numerous factors, including the level of economic development, with impacts of heat extremes being more severe in less economically developed countries (Diffenbaugh and Burke, 2019;Harrington et al., 2016;King and Harrington, 2018;de Lima et al., 2021).

line 111: error for citation

Corrected.

line 167: is there a citation for this assumption?

We simply assume that there is no change on geographical rank of economic ability in the future period.

line 178: this is also consistent with theory Buzan and Huber 2020.

The increase of global average temperature is nearly linear for both t2m and w2m, consistent with a linear ramping of the forcing (Buzan and Huber, 2020).