

Interactive comment on “Drastic shrinking of the Hadley circulation during the mid-Cretaceous supergreenhouse” by H. Hasegawa et al.

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This is a very important contribution to understanding climate change. The authors have done an excellent job of presenting the factual information and its interpretation. Their hypothesis that there is a threshold below which the Hadley Circulation spreads gradually poleward, the on crossing the threshold shrinks drastically is very plausible. The notion is widespread that as the Earth warms, the Hadley cells expand. But the heat transport of the Hadley cells is equatorward, not poleward, and because it carries so much latent heat to the ITCZ it helps to stabilize the present circulation system. However, if te Earth is to have a warmer and more equable climate more of the heat transport must b poleward. This requires that the Hadley cells must ultimately shrink. This important paper will be of interest to a very wide audience.

Editorial suggestions:

One special comment: $p\text{CO}_2$ versus $p\text{CO}_2$ versus $\text{PCO}_{2\text{atm}}$ The italic p indicates partial pressure in the atmosphere (Geologists often cite this in terms of ppmv although that is not an expression of pressure. This opens a real can of worms). As best I can tell, the regular p is used specifically for the partial pressure of blood CO_2 . The last variant is Paul Pearson's (2009) which he defined as being the concentration of CO_2 in the atmosphere in ppmv. Unfortunately, it looks so much like the other expressions it is sure to add to the confusion.

Geologists have taken the habit of referring to the concentration of CO_2 in the atmosphere in ppmv as $p\text{CO}_2$ or $p\text{CO}_2$. This expression appears a few times in the paper. This is incorrect, and will not be understood by the rest of the scientific community. As noted above, the expressions $p\text{CO}_2$ and $p\text{CO}_2$ refer to the partial pressure of CO_2 and would be in pressure terms of hectapascals (SI) or millibars (US), not ppmv. They change with altitude. In medicine or in discussions of hyperbaric conditions, as in deep sea diving, they are used in discussions of the pressure of CO_2 in the lungs. The proper expression in this and other papers concerning the concentration of CO_2 in the atmosphere in terms of ppmv or ppm is simply 'atmospheric CO_2 ' or 'atmospheric CO_2 concentration' or if 'atmospheric' is understood, simply ' CO_2 concentration' or ' CO_2 level.'

P.121, line 5: for 'peak' read 'maximum'

P.124, line 16: for 'are stemmed' read 'stem'

P.124, line 18: 'ence of each basins' read 'ences of each basin'

P.128 I suggest not using $p\text{CO}_2$ (lines 13, 20) but atmospheric CO_2

P.128, line 28: for 'westries' read 'westerlies'

P.129, lines 1-2: for 'several evidences support' read 'there is evidence to indicate that'

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- P.129, lines 10, 14: pCO₂ again.
- P.129, line 20: for 'can' read 'could'
- P.129, line 24: for 'by' read 'with'
- P.129, line 29: for 'Northern South Atlantic' read 'northern South Atlantic'
- P.130, line 11: pCO₂ again
- P.130, line 25: for mid-latitude' read 'mid-latitudes'
- P.131, lines 5, 7: delete 'wave'
- P.131, line 23: for 'latitude' read 'latitudes'
- P.131, line 24: for 'latitude' read 'latitudes'
- P.132, line 22: delete 'that'
- P. 133, lines 22, 23, 25, 27: pCO₂ again
- P.133, line 25: for 'shrink' read 'shrank'
- P.134, lines 2, 5: pCO₂ again
- P. 134, line 4: for 'predicting' read 'predicted'
- P.134, line 5: for 'predicting' read 'predicted'
- P.134, line 6: for 'will possibly reach' read 'may be reached'
- P.134, line 7: for 'possibility of presence' read 'possible presence'
- P.134, line 8: for 'as Pale-' read 'as the Pale-'
- P.148, line 4: for 'Skeleton' read 'Skelton'; for 'evidences' read 'evidence'
- P.150, line 2: for 'Gray" read 'Orange'
- P.150, line 3: for 'black-dotted' read 'red dotted'

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P.150, line 9: for 'evidences' read 'evidence'; delete ';' after '2008)

P.150, line 13: pCO₂ again

P.150, line 20: delete comma after 'modified after'

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