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Climate of the Past
Discussions

Interactive comment on "Elevated CO_2, increased leaf-level productivity and water-use efficiency during the early Miocene" *by* Tammo Reichgelt et al.

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This is a welcome contribution to CO2 paleobarometers and forest paleophysiology during a Miocene time of higher than current atmospheric CO2. The paper is thus relevant to understanding plant responses to currently rising atmospheric CO2.

This paper is well written and relatively free of errors, and presumably has been reviewed before. Nevertheless, three issues deserve further attention.

Earth System Sensitivity (l.242) is a very slippery concept in this context, because the temperature increase with CO2 doubling in any one part of the world will depend on

where it is. There are already numerous studies showing that midlatitude continental sites show little temperature change and thus muted sensitivity, but tropical and polar sites show marked changes in temperature. New Zealand is a temperate, site but also globally unusual in having a strongly marine-influenced climate now, and even more so in the Miocene when there was little land and few mountains. It is not clear how this even becomes relevant later (l.374) where elevated CO2 estimated is thought to relate to ESS of 4-7oC, because Miocene paleotemperature for New Zealand is not offered.

I fail to see the relevance of C4 grassland expansion (l. 388) because it postdated the age of these New Zealand leaves by some 10 million years.

Errors in estimated paleoatmospheric CO2 are asymmetric and very large (l. 307-8). Perhaps this is due to inadequate numbers of stomates counted: it should be hundreds in each image. Furthermore, Gaussian error propagation can be used to calculate symmetrical errors. Both issues are addressed in the following paper too recent to be included - Retallack, G.J. and Conde, G.D., 2020. Deep time perspective on rising atmospheric CO2. Global and Planetary Change, p.103177.

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