

***Interactive comment on “On the application and interpretation of Keeling plots in paleo climate research – deciphering  $\delta^{13}\text{C}$  of atmospheric  $\text{CO}_2$  measured in ice cores” by P. Köhler et al.***

**Anonymous Referee #2**

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General comments:

This paper discusses application of the Keeling plot approach to ice core records of  $\text{CO}_2$  and  $\text{d}^{13}\text{C}$ . The Keeling plot approach involves plotting  $\text{d}^{13}\text{CO}_2$  vs  $1/\text{CO}_2$ , fitting a straight line to the data and using the intercept with the y-axis to infer the isotopic signature of the flux that drives variations in both  $\text{CO}_2$  and  $\text{d}^{13}\text{C}$ . As the authors point out, this simple approach does not work on timescales that involve exchange with the ocean, and the authors explore a range of model simulations, to see whether (and when) the Keeling approach is useful.

The paper is very long and describes a large number of simulations in detail. Given

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that the conclusion is that Keeling plots are essentially not useful for interpreting paleo observations, this level of detail and number of examples is not necessary. A much shorter paper, with only a few examples would be much more useful. This paper is too long and the message is getting lost in the detail. The authors also continually fit straight lines to data that clearly should not be approximated by straight lines.

Detailed comments:

1. Abstract, line 9: "... can be interpreted with respect to the Keeling plot. However, only a maximum of approximately half of the signal can be explained by this method." The y-axis intercept does not reflect the isotopic signature of the flux, so is this actually useful? I think that the authors mean that a straight line is a reasonable representation of the plot  $d^{13}CO_2$  vs  $1/CO_2$ , but I think that this different to saying that the data can be interpreted with a Keeling plot.
2. page 517: equation (4) - is this equation exact or an approximation?
3. page 522, line 6 - explain "effective carbon signature of the isotopic change in the atmosphere". This quantity is discussed a great deal later in the paper, so should be explained more clearly when first introduced.
4. page 531, line 5: a straight line is clearly not a good way to represent these data.
5. page 531, line 28: the authors calculate lots of intercepts, but what use are they?

Specific comments:

1. page 515, line 3-6: This sentence could be improved for clarity.
2. page 515, line: 7: Prominent examples of what? (improving the previous sentence might fix this too).
3. page 515, line 9: define "end member"
4. page 529, line 2-3: fix grammar of sentence.

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5. page 534, line 24: define "end member analysis"
6. page 558, Fig 1: this figure might be clearer if the text was moved outside the axis. It is very cluttered.
7. page 561, Fig 4: paler background colors might help the model fluxes etc stand out better.
8. page 562, first line of fig caption: specify that this is pCO<sub>2</sub> "in the atmosphere".

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**BGD**

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