

Interactive comment on “Pliocene expansion of C₄ vegetation in the core monsoon zone on the Indian Peninsula” by Ann G. Dunlea et al.

Response to Anonymous Referee #1

Dunlea, Giosan and Huang use lipid plant wax biomarkers and their isotope composition to reconstruct the climate and vegetation of the eastern Indian peninsula over the last 6 million year. They find that C₄ vegetation was already present in the late Miocene and further expanded during the Pliocene. They argue that this expansion was likely caused by changing precipitation patterns during the studied time period as well as a decline in atmospheric CO₂ during the Pliocene. The results are consistent with previous reconstructions from the region that yielded similar results. The manuscript is overall well written. As outlined below there are however shortcomings regarding the description of the methodology that should be addressed prior to its publication and several points where the authors should expand the manuscript and provide further information.

- [We thank the anonymous referee for their comments and revisions.](#)

Major comments: The authors should consider moving the method description from the appendix to the main text to have it in chronological order. In the journal format of *Climate of the Past* there is no reason to put the methodology at the end.

- [The methods section has been moved from the appendix to the main text.](#)

Lines 82-85: As is, it is confusing to see sample pairs mentioned without proper explanation. I would suggest do give a detailed description of the core and the reasoning behind the sampling strategy beforehand to avoid any confusion.

- [A better description of the sampling pairs was added to the methods.](#)

In Fig. 2C and lines 113-115 it is mentioned that the δD values are corrected for physiological effects of C₃ and C₄ photosynthesis. Unfortunately, there is no description available of how this correction was conducted. This should be added in order to be able to reproduce the calculations and presented results.

- [We added the explanation of the correction to the methods section.](#)

In lines 147-153, the Pliocene C₄ expansion is explained by a lowering in atmospheric CO₂. It would be useful to show the CO₂ and C₄ vegetation trends together in a figure to illustrate this point.

- [Estimates of atmospheric CO₂ have been added to Figure 3.](#)

In the description of the compound-specific isotope analysis it is mentioned that the fatty acids were methylated prior to analysis (i.e. a methyl group added). Since this methyl group changes the isotope composition of the resulting fatty acid methyl esters, the measurements need to be corrected using the isotope composition of the methanol used in the reaction. Without the proper correction the absolute values and associated interpretations are incorrect.

- The correction was performed and we added a description of the correction to the methods section.

Minor comments: Line 27: Add some references backing up the sentence ending at the beginning of this line.

- The following references were added to support the statement: An et al., 2005; Behrensmeyer et al., 2007; Huang et al., 2007; Edwards et al., 2010; Zhou et al., 2014

Line 47: Specify what kind of model was used in the cited study.

- We added details about the type of model used to predict natural flora was added. The reference cited has additional information.

Lines 92-94: Why are the mid-Pliocene (3-5 Myr) and mid-Pleistocene (1.5 Myr) selected in this description. On the figure, the trend in dD seems to be pretty constant and the selection of these time points seems rather arbitrary.

- We selected those time intervals to be consistent with the time intervals we used for the $\delta^{13}\text{C}$ plots. We added text to emphasize the change in δD is gradually increasing and we only remark on the time interval to compare with the $\delta^{13}\text{C}$ record.

Lines 113-114: This sentence on physiological effects of C3 versus C4 plants on dD is not really connected to the previous sentence on air mass mixing. It is therefore confusing to see the word thus at the beginning of this sentence.

- The sentence was edited for better logical flow and includes reference to the methods section that explains the correction for plant physiology.

Line 182: The unit cm^3 already implies volume. The word volume after the unit is therefore redundant and can be deleted.

- The redundancy was removed.

Line 210: Provide the isotope composition of the methanol used.

- We have added the isotopic composition of the methanol used and the equations used to correct the data for the addition of methanol.

Lines 225: Specify the standard used. Was it an industry standard with known isotope values?

- Done. It was an in-house lab standard with known values.

Figures: In the text the abbreviation for million years is Myr, while in the figures Ma is used. This should be homogenized.

- We are using “Myr” for “million years”, and “Ma” for “million years ago”, as the USGS does. “Ma” thus stands for an event in the past whereas “Myr” indicates duration or time interval. The text was checked for consistency of this notation.

In the method description, alkenone and alkane measurements are described which are however not mentioned in the rest of the manuscript. Of course, it would be interesting to see these results. So, the authors should either remove reference to these measurements or include them in the manuscripts.

- We removed the reference to the alkenone and alkane measurements.

Supplementary tables S1-S3: In order to facilitate the use of data by other scientists, consider moving the data contained in the tables to a separate file that is in a machine- readable format.

- Yes, we will submit the final tables as .xls or .csv files.