

Response to Anonymous Referee #3.

We thank the referee for their valuable comments, which substantially improved the paper.

Referee comments are in *red italics*, our responses are in black text.

*In the paragraph starting on line 187, the authors relate the extraction of petroleum from the SoCAB to the production in the rest of the state. This seems likely to be a valid assumption, but it would be helpful here to provide some additional justification. Would the results of the analysis be substantially different if it is assumed that SoCAB petroleum extraction tracked regional or national trends? Lines 230-235 discuss how non-petroleum sources can close the methane budget. It would be helpful to discuss changes in these sources here to corroborate the conclusion that petroleum accounts for only half of the observed methane increase.*

We have obtained Los Angeles Basin oil and gas production values from the EIA, and have replaced the discussion with the more relevant numbers. This has simplified the interpretation and discussion as it now seems likely that basin oil and gas production can explain the early ethane record from the MkIV measurements.

*The panels on Figures 2 and 3 have “squashed” aspect ratios that make them slightly difficult to read. The bottom panel of Figure 2, for example, compresses much of the data into a small region of the graph.*

We have revised the plots.

*In Figure 3, the presence of four panels in a single figure makes it difficult to see the trends described in the caption. Could some of these panels be merged and their axes modified to make the graphs taller?*

Figure 3 has been reduced to three panels.

*The error bars on the atmospheric ratios in Figure 5 are quite large and imply a large uncertainty in the calculated slope. Indeed, this uncertainty is reflected in the text as well. A visualization of this uncertainty in the figure would be beneficial. Line 219 reports the ratio of slopes as  $54 \pm 20\%$ , which is thereafter referred to as “about half.” However, the large uncertainty in the slope means that the atmospheric increase could be anywhere from not well explained by the changing storage ratios (about 1/3), to very well explained (over 2/3). Do the authors have speculation as to whether the percentage is on the high or low end of this range?*

Error bars have been added to the slope. Since submitting this paper, we have recorded more Caltech measurements, which permitted more robust slopes to be computed. With the new data, we are now able report the mean slope (58%) with a smaller uncertainty (13%).

*Editorial comments In line 244, the slope of the ethane/methane correlation is  $4.28 \pm 0.07\%$ . This piece of information is in agreement with the storage “ratios exceeding 4%” in line 209. I suggest placing these pieces of information closer together to emphasize this connection, because it provides further evidence that the Aliso Canyon plume was detected.*

We have linked these two numbers better in the revised draft.

*The uncertainties are reported in an inconsistent manner in the text. Line 8 of the abstract contains the quantities  $13 \pm 4.5$  and  $25.8 \pm 3.9$ ; and line 234 of the text contains the quantity  $32 \pm 7$ . Some further discussion of how these different levels of uncertainty for these and other quantities reported in the text were chosen would be helpful.*

Uncertainties have been made more consistent and clearer in the revised draft.