Reply/reconciliation to Anonymous reviewer 2 (AR2)

Michael D. Lewan

This review is interesting in that it wanders around and requests major changes, but the specific major changes are not explicitly defined. Here is how I have broken down the AR2 review.

1. One obvious major change is the inclusion of Milkov's work, which has been done and he is now a coauthor of the revised Comment manuscript. It should be noted that the data in Milkov's paper (2020) was not publicly available at the time the original comment paper was written. As AR2 states, the Milkov data does not really change the conclusion of Lewan (2019) that the isotopic values used by Howarth (2019) are not representative. This is conveyed numerous times in the revised manuscript.

2. The inclusion of the Bruhwiler (2017) paper has not been included with the Lan reference as suggested. We simply used the most recent published NOAA report by Lan (2019).

3. There is no doubt that the Milkov data with weighted averages is a better data set than that proposed by Lewan (2019). Lewan (2019) better addresses the specific short comings of Howarth's data base and shows the resulting discrepancy that results in a more representative data base. This is also shown in the revised manuscript.

4. Regrettably, Towsend-Small atmospheric $\delta^{13}CH_4$ data has not demonstrated that the atmospheric methane originated from the gas production facilities. Until a connection is made, the difference of -5.5‰ between the produced and atmospheric methane (i.e., -46.5 and -41.0‰, respectively) needs to be established. The Keeling plots to correct the measured $\delta^{13}CH_4$ values show considerable scatter and as a result the corrections are questionable. It is interesting that the raw data presented in the supplemental data by Twonsend-Small show no significant difference among the up-wind (background) $\delta^{13}CH_4$ values (- 47.9± 0.2‰) and the downwind values (-47.8± 2.0‰) and the production pad values (-47.9± 2.0‰). A more unequivocal data set would take measurements from an established production leak with samples at various distances vertical and lateral from the leak. This type of data would establish the relationship between actual methane production leaks and what processes are operative as it becomes depleted in ^{13}C as it enters the atmosphere. Therefore, it does not appear to be necessary to side track the manuscript to content with Townsend-Smalls work. This further explanation of the problems with Town-send-Small's work is included in the revised manuscript and subsequent lines 60 will not be removed and can be defended.