

REFEREE #2

General comments:

Monteiro et al. present the core elements of a new in-situ network, which was established to monitor atmospheric CH₄, CO₂, H₂S and d¹³CH₄ in the Permian Basin. They detail: station design, instruments used, measurement and calibration procedures as well as data processing and flagging rules in detail. The dataset is made publicly available and the manuscript also includes a first order analysis of results, discussing relevant quantities such as diurnal cycles for each season, intra-network mixing ratio gradient changes over time as well as the relationship between site level CH₄ mixing ratios and meteorological conditions. Overall, the manuscript is well-written and sections are clearly structured. This manuscript fits well within the scope of ESSD and should be considered for publication after some minor and technical comments have been addressed.

We appreciate your comments and time to complete the review.

Specific and technical comments:

L14: change to 'species'

We changed to 'species'.

L17: suggest to change to: 'prior *to* deployment' or 'before deployment'

We changed to 'prior to deployment'.

L24: Which tower are you referring to here? There are multiple towers in this network.

There is only one tower with H₂S measurements (Hobbs, New Mexico). We added the specific location in the text for clarification.

L31: change to CO₂

We corrected the subscript.

L34: please consider clarifying this statement/ How much reduction would be considered 'dramatic' 50%, 80%? What does 'near-term' mean here? 1 year, 10 years, 50 years?

We clarified this statement in the text adding the following sentence: "According to Ocko et al (2021), full implementation of all methane abatement technologies that are already technically feasible could cut anticipated global methane emissions in 2030 by 57%, and global-mean average methane warming rates between 2030 and 2050 would consequently be reduced by 26%."

L47: consider clarifying what 'these basins' refers to here

We substitute the sentence for: “This expansion of O&G production has prompted an increasing interest in monitoring of methane emissions from O&G basins on regional scales for the purpose of possible regulations and commercial incentives for operators to prove low emissions.”

L72: This is a good summary of different O&G monitoring techniques. However, you only mention Lin et al. 2021 for in-situ monitoring, while Chan et al. 2020, preceded this work and demonstrated the ability of in-situ monitoring to be used to quantify CH₄ emissions for the Western Canadian Sedimentary Basin spanning Alberta and Saskatchewan:

Thank you for pointing out this omission. We edited the sentence to read, “Chan et al. (2020) used in-situ monitoring to quantify methane emissions for the Western Canadian Sedimentary O&G Basin and Lin et al. (2021) quantified methane emissions from the Uinta O&G Basin.”

L110, figure 1: please add a symbol indication the location of Lea County Regional Airport or give an indication of its distance from the HOBBS site. Please also update the labels of the 5 tower sites to match the manuscript (all uppercase letters). Furthermore, please consider adding information about the facility (e.g. O&G wells) locations or other CH₄ emission priors to sub-figure (a) or at least refer to figure 7 here. It is very hard to judge if the network locations is suitable without knowing where emissions are to be expected.

We added the airport location and updated the tower’s labels (uppercase). Changes can be seen in the updated Figure 1b. We referred to Figure 7 to indicate known O&G wells location (added in figure caption).

L125, table 1: please add the data of the move/re-install of CARL station in the Install data column.

We added the move/re-install date (Table 1).

L189: Presumably the $\delta^{13}\text{CH}_4$ data is reported on the VPDB scale or some equivalent?

The isotopic ratios were tied to the Vienna Pee Dee Belemnite (VPDB) scale. We added a phrase to this effect.

L268: Please elaborate, what are ‘hourly composites’? Are you referring to the average, median, mode of the measurement distribution gathered within one hour?

We changed this phrase to clarify. The text now says, “Composited means of hourly CH₄ and CO₂ mole fractions (averaged over summer and winter seasons)...”.

L299: Consider adding the information on local time (especially for non-US readers), i.e. what is 20 – 23 UTC in LT?

We added a sentence clarifying the conversion from UTC to local time within the text (Line 297 from the reviewed manuscript): “In Texas, the local time is UTC-5 and in New Mexico, UTC-6.”.