Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC1
https://doi.org/10.5194/acp-2021-734-RC1, 2021


# Comment on acp-2021-734

Anonymous Referee #1

---

Referee comment on "Quantifying fossil fuel methane emissions using observations of atmospheric ethane and an uncertain emission ratio" by Alice E. Ramsden et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-734-RC1, 2021

---

The paper by Alice E. Ramsden et al. describes a method for estimating fossil fuel methane emissions using airborne methane and ethane observations. The authors aim at reducing uncertainties in UK fossil fuel emission estimates by augmenting their inverse approach with an additional ethane-to-methane ratio parameter. They highlight the detrimental impact of an incorrect, fixed ethane-to-methane ratio on posterior emission estimates and the confidence level gain by the additional inversion parameter. In general, the paper is well written and the subject highly topical within the scope of ACP. I recommend publication after addressing some minor comments.

***Specific:***

p. 2, l. 21 Please indicate what “short atmospheric lifetimes” means for greenhouse gases. Methane does not have a short atmospheric lifetime.

p. 2, l. 46 Please indicate EDGAR version used in this study - v.4.3.2, v5? The reference indicates the use of EDGAR v5, however Chen et al., 2018 refer to EDGAR v4.2. Has the partitioning not improved since then?

p. 3, l. 77 Did Yacovitch et al., 2017 and Lowry et al., 2020 really make use of aircraft-observed plumes. To my understanding both of these studies are ground-based obs. Please remove “aircraft-observed” in that case.

p. 5, l. 120-123 Atmospheric transport is influenced by the molar mass of the simulated species. Simulated plumes can therefore significantly differ. I wonder if the authors checked this statement for ethane having almost twice the molar mass compared to methane. Furthermore, ethane has a limited lifetime in the atmosphere. How does this influence the inversion given the timescales of the simulations?

p. 5, l. 128 I wonder how exactly the model-measurement uncertainty has been estimated, as this is a very critical parameter for the inversion. On p. 9 l. 231 the uncertainty is described as the quadratic sum of measurements uncertainty and model uncertainty. Afterwards the measurement representation uncertainty is defined as 1 sigma from 1 minute of data. Is this also included in the quadratic sum? Model uncertainty is subsequently chosen with a uniform PDF between 10 and 50ppb ($CH_4$) and 20-50ppb ($C_2H_6$) without justification. This reviewer wonders how transport model error is included. In general, the description of uncertainty lacks some details, as this is a very crucial part of the study when claiming to narrow down uncertainties, especially if the posterior emission estimates show a dependence on the prior (p. 10, l.259). In the same context, what is the justification for prior uncertainties?

p. 6, l. 155 Adding gaussian noise is a very humble approach to simulating instrument noise. I wonder if the authors also considered the influence of added systematic noise and possibly a bias?

p. 6, l. 167 What kind of "basis functions" are referred to here?

p. 14, Fig. 5 Is b) showing "Posterior std dev"? Looks like it is showing posterior means. Unfortunate, that there is so few ratio observations to compare to.

***Spell & grammar:***

p. 12, l. 290 is there a word missing? "[...], so there … little [...]"

p. 13, l. 298 "[...] of the both [...]"

p. 16, l. 357 "[...] using using a […]"