Answers to reviewers for "Estimating CH4, CO2, and CO emissions from coal mining and industrial activities in the Upper Silesian Coal Basin using an aircraft-based mass balance approach"

We would like to thank the two reviewers for the suggestions to improve the manuscript. Below you find our answers to their comments. The reviewer's comments are written in normal font, our answers in italics.

Review 1 by Zachary Barkley

The authors describe 2 mass balance flights performed during a single day over a coal basin in Poland. Despite only having data for a single day, the analysis done is extremely thorough for this type of study, providing an extra layer of confidence to the overall solution, and serve as a sanity check for bottom-up inventory estimates of CH4 from coal in the region (and helpful guidance for other trace gases). Nothing about the results are particularly remarkable, but it's good, necessary science nonetheless, and well-written at that. In its current state, I have no objective with publishing this paper after some extremely minor revisions are addressed.

Minor comments

Line 110: "*Since the morning is not an ideal time for the in situ mass balance method because of the growing convective planetary boundary layer, we consider the estimate from the afternoon flight to be more reliable. However, we describe the morning flight as well and consider its results as additional information."* The later, afternoon loop tends to be more reliable for a number of reasons (morning blobs everywhere!). When I read this statement, I was bracing myself for crazy signals that cast doubt on the entire study. But such a thorough job regarding capturing the signal and meteorology from the first flight (as well as the period before it) that I would argue you're underselling your loop 1 results with this comment. To me, loop 1 and loop 2 together provide pretty good confidence in your calculated total for the day. I'd consider dropping these sentences entirely.
We have deleted these sentences.

Line 126: It would be helpful to mention here the local time relative to UTC time. – *Done.*

Line 207: The background downwind method also requires the assumption that there are no sources upwind of your area of interest that would create a complex concentration pattern flowing into your domain. With that said, you have an upwind here and it's pretty clean, so it's obviously not an issue here.
We added the following sentences: "The downwind method also requires that there are no sources upwind of the area of interest which would create a complex concentration pattern flowing into the domain. This is shown in our upwind flight transect."

Line 385: I just wanted to say I appreciate you mentioning the overnight winds, because so many mass balances neglect possible accumulation from stagnant winds in the overnight/dawn hours, leading to massive enhancement blobs scattered throughout the observations.
Thank you for this comment!

Minor comments bonus points:
This study does a remarkable job ensuring the validity of the mass balance technique by performing multiple vertical transects and even driving underneath the flight path to capture the signal at the surface layer. Many mass balance studies do not put in this level of effort, and it would be good to know how necessary these extra precautions are with regard to calculating the true emissions. Furthermore, if we're going to use mass balance techniques at any point to verify emissions from a policy enactment standpoint, we'd want to be as efficient as possible with resources. So what I'd be curious about is, if you took the central transect from each loop and calculated the emissions using the simple assumption of a perfectly mixed boundary layer, low different would your solution be compared to your kriging results? Such a simple comparison would be useful to have in your uncertainty analysis and increase the scientific impact of your findings.
We did this analysis and added it as Section 3.5.

3.5 Single transect emission estimates

"This detailed calculation of the emissions can help to understand uncertainties of a mass balance in cases where less information is available. We ensured the validity of the mass balance technique by performing multiple vertical transects and even driving underneath the flight path to capture the signal at the surface layer. Many mass balance studies do not put in this level of effort, but it would be good to know how necessary these extra precautions are with regard to calculating the true emissions. Furthermore, when using mass balance techniques at any point to verify emissions from a policy enactment standpoint, we need to be as efficient as possible with resources. So, using the single transects within the boundary layer from each flight we calculated the emissions under the simple assumption of a perfectly mixed boundary layer. The PBLH was kept constant for all transects. Figure 1 shows the results of the single transect mass balance calculations for the two flights on June 6, 2018. The average of the single transects (blue) is always well within the uncertainty range of the kriging mass balance results (red). Nevertheless, single transect emission estimates deviate up to 40% in both directions from the kriging estimate for CH_4. This deviation is much larger than the kriging estimate uncertainty. Deviations are largest for transects close to the PBLH when the concentration gradient between the boundary layer and free troposphere is also large, e.g. the highest CH_4 transects. Thus, when calculating emissions from single transects the flight altitude should be well below the PBLH to avoid sampling free tropospheric air masses. On the other hand, these results discourage single transect mass balance estimates anyway."

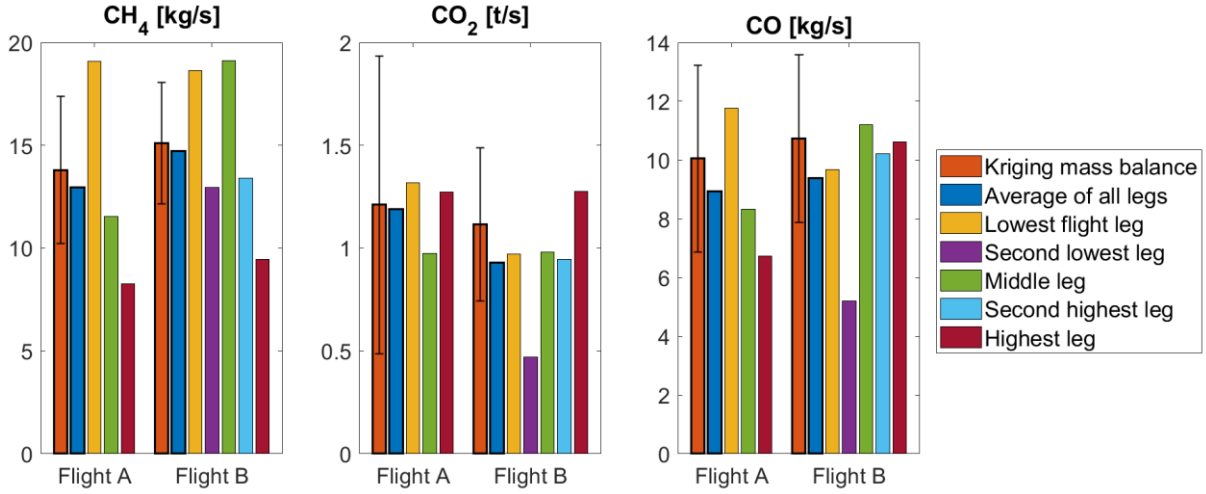

Figure 1: Mass balance results for single transects compared to the average of all single transects and the kriging mass balance result from Section 3.4.

We also added the following sentence to the Conclusion:
"The calculation of emission estimates from single flight transects is not advisable, because the single transect estimates showed deviations from their mean and the kriging method of more than 40% in both directions."

Grammar
Line 43: change "affect" to "affecting". – *Done.*
Line 473: "don't" to "do not". – *Done.*