AC to Editor comment,

We would like to thank the Editor's and Dr. Singh's comments regarding the uncertainty about the estimated emissions. AC reply (regular font) for the comment (bold font) is provided below.

I think one point that have to be addressed a bit more is based on the comments of Dr. Singh on the uncertainty related with the output (measurements/model). I think that in order to demonstrate the method usability for different applications some brief discussion on the at least the range of related uncertainties could be added in the conclusion section. I think this will enhance the paper value.

To quantify the uncertainty in our emission estimates, we applied a Monte Carlo error propagation approach. At each height level, we perturbed the lidar profile y_o by adding normally distributed noise, drawn from N $(0, \sigma^2)$, where σ is the standard error associated with each measurement. By repeating this process over multiple iterations, we obtained a set of emission profiles, allowing us to compute the mean and standard deviation at each height level. This method provides an estimate of the uncertainty in the retrieved emissions.

However, the results indicate that the inversion output remains highly stable, with minimal variation across Monte Carlo realizations. This suggests that, in the current setup, the available observational constraints based on a single lidar station do not introduce significant uncertainty into the retrieved emissions. This stability highlights the need for additional observational constraints to better validate the results.

Having multiple lidar stations would significantly improve the reliability of the retrieved emissions by offering a more comprehensive observational dataset. However, for this specific case study, additional ground-based observations were not available. For future research, we recommend incorporating multiple observation sites or complementary remote sensing techniques to enhance the sensitivity of the inversion framework and achieve a more thorough uncertainty assessment.

In the revised text of the Conclusions and Discussions section, we have added the following paragraph. The text now reads:

"To further assess the reliability of the retrieved emissions, a Monte Carlo error propagation analysis was conducted, introducing normally distributed perturbations to the lidar measurements. With this method the standard deviation of the retrieved emissions at each height level was estimated. The results indicate that the inversion output remained highly stable, with minimal variation across Monte Carlo realizations, suggesting that the single-station observational setup does not introduce significant uncertainty. To enhance the sensitivity of the inversion framework and provide a more comprehensive uncertainty assessment, multiple lidar stations or complementary remote sensing techniques are essential."