In this document we provide our answers to 'Anonymous Referee #1' for "**Intercomparison of detection and quantification methods for methane emissions from the natural gas distribution network in Hamburg, Germany**". We thank the referee for the comments. Please find our answers in blue texts.

In line 333, are the equation 3 taking into account the meteorological factors? If not, please evaluate the impact of meteorological data on the final results.

This equation was introduced by Weller et al. (2019) based on controlled release experiments. It uses only the mole fraction measurements (and in fact the observed maximum) to quantify leaks from individual mobile transects close to a gas leak. This equation does not include the meteorological information and it is based on statistical analysis. Von Fisher et al. (2017) stated that incorporation of meteorological information did not improve the emission rate estimate. It is acknowledged as a deficiency, still the same equation has been used in many different studies to derive comparable leak rate estimates.

Whether the large distribution of the maximum enhancement mentioned in lines 471-473 will affect the judgment of the threshold, and thus affect the results

The 10% threshold is a cutoff which excludes leaks smaller than ≈0.5 L min^{-1} emission rate. The rationale is that one should exclude transects in which the plume is almost "missed" due to unfavorable meteorological conditions. As we discuss in our manuscript, this threshold results in overestimation of the smaller leaks because then only the transects with the largest peaks are used for quantification, not the entire population. The 10% threshold has a minor impact on the bigger leaks.

Are the values of relative uncertainty mentioned in lines 479~486 too large and Whether they will affect the overall degree of confidence of the data

Uncertainties are indeed very large for individual passes. This has been investigated in detail by Luetschwager et al. (2021). According to their analysis the uncertainties in a quantification reduce to 10 % after about 8 transects.

What is the cause in lines 756-760 that the emission rates of the locations provided by the LDC were much lower than the locations detected by mobile measurements

These are the gas leak locations classified into the B and C categories. Indeed, emission from leaks in this category are lower compared to the A1 and A2 category. We do not know the causes, but we show that this can lead to a low bias of the gas leak emission rates reported in the German inventory. This is because leaks quantified with the suction method are most likely only from the B and C category, as the other leaks should be fixed either in one day or within a week.

About the two C_2H_6 signals mentioned in lines 789~794 that are not confirmed as the location of leakage by LDC, you suggest two reasons that they are related to the distant leakage and transmission, or surrounding emission sources. For the first reason, is it possible to compare the wind speed and direction when C_2H_6 signals are measured to find the location of leakage, For the latter reason, can you match the signal with the sources may produce both CH_4 and C_2H_6.

We have looked into that, but wind analysis is often not conclusive in cities. The wind conditions in the urban area are influenced significantly by the built-up environment (e.g., houses, trees) and traffic. Although the general wind direction can be determined if streets are aligned with the wind direction, this cannot be easily determined if this alignment does not exist. The determination of wind direction in narrower streets is also influenced by the street canyon effect.

References:

Luetschwager, E., von Fischer, J. C., Weller, Z. D., Characterizing detection probabilities of advanced mobile leak surveys: Implications for sampling effort and leak size estimation in natural gas distribution systems. Elementa: Science of the Anthropocene; 9 (1): 00143. https://doi.org/10.1525/elementa.2020.00143, 2021.

Von Fischer, J. C., Cooley, D., Chamberlain, S., Gaylord, A., Griebenow, C. J., Hamburg, S. P., Salo, J., Schumacher, R., Theobald, D., and Ham, J.: Rapid, Vehicle-Based Identification of Location and Magnitude of Urban Natural Gas Pipeline Leaks, Environ. Sci. Technol., 51, 4091-4099, https://doi.org/10.1021/acs.est.6b06095, 2017.

Weller, Z. D., Yang, D. K., and von Fischer, J. C.: An open source algorithm to detect natural gas leaks from mobile methane survey data, edited by: Mauder, M., PLoS One, 14, e0212287, https://doi.org/10.1371/journal.pone.0212287, 2019.