

Atmos. Chem. Phys. Discuss., author comment AC2  
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## Reply on RC2

Malika Menoud et al.

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Author comment on "Methane (CH<sub>4</sub>) sources in Krakow, Poland: insights from isotope analysis" by Malika Menoud et al., Atmos. Chem. Phys. Discuss.,  
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### General comments

RC: New measurements of methane and its two most abundant stable isotopes, <sup>13</sup>CH<sub>4</sub> and CH<sub>3</sub>D, are presented from a site in Krakow, Poland. Some new measurements of source isotopic signatures are also carried out. The measurements are analysed, using a chemical transport model. It was found that the observations are strongly influenced by a mixture of sources from the nearby urban area, and fossil fuel extraction emissions from the nearby Upper Silesian Coal Basin.

The paper is well written, and the analysis of the data is thorough and sound, as far as I can see. The main weaknesses of the paper are that only a relatively short measurement record was obtained, and the site, being situated in a densely populated urban area, doesn't appear to be ideally suited to understanding regional emissions (e.g., I presume the relatively poor fit of the data and model are due, at least in part, to the proximity of unresolved sources in the model). However, the authors have done a good job of extracting as much information as possible from this dataset. I recommend the paper for publication in ACP, following some relatively minor changes.

AC: Thank you for your comments. In the conclusion, we've emphasised the difficulty of distinguishing the different sources in the urban context. This is indeed a limitation, but the analysis of the wind data still allows to conclude on the USCB influence, as our site was west of Krakow, just downwind of Silesia.

### Specific comments

RC: L1 – 2. I think the first two lines could be cut as they are quite general, and there would be too much to unpack in the assertion that methane emissions are a threat to the adherence to the Paris Agreement "goals".

AC: We think it is still useful to remind the reader of the motivation behind studying the methane budget. The importance of reducing CH<sub>4</sub> emissions in order to follow the Paris agreement goals was not only mentioned in several other studies, but also demonstrated in Nisbet et al. 2019. We've added the reference to this paper. Because it is indeed not our main point here, we moved the reference to the Paris Agreement goals from the abstract to the introduction.

RC: L16: "The X(CH<sub>4</sub>) are generally under-estimated in the model". This should be more

specific. Do you mean the magnitude of the pollution events are under-estimated? (I assume so, as this is the only part that's relevant to the regional emissions covered here. We don't really care if the model gets the background component correct).

AC: Indeed, it is the magnitude of the pollution events that is under-estimated, and it is what we wanted to emphasised. We've changed the text accordingly.

There are several potential causes of the over-estimation of CH<sub>4</sub> mole fractions in the model, and they are discussed P8L216-227. It is indeed most likely that the magnitude of emissions is too low in the inventory, but it is not something we investigated, quantified and verified in this study. We still specified this statement as you suggested.

RC: L17: "... would lead to better agreement". Need to say what the better agreement is with respect to (I.e. the data).

AC: This was changed accordingly.

RC: L29: "only 3% THOSE OF CO<sub>2</sub>..." (instead of "of the ones of")

AC: This was changed accordingly.

RC: L65: I suggest "consists of", rather than "gathers"

AC: This was changed accordingly.

RC: L93-94: "..., as described in..." (delete "the one")

AC: This was changed accordingly.

RC: L180: "This is due to a lowering of the boundary layer when the temperature decreases in the evening". This isn't technically correct. It's the temperature gradient in the lower atmosphere that leads to a lowering of the boundary layer height, rather than the temperature itself. I.e. the atmosphere tends to become more stable at night time.

AC: This was rephrased.

RC: L182: "emission peaks". Need to be careful with terminology here. You aren't describing "emission" peaks, but "concentration"/"mole fraction" peaks.

AC: This was changed accordingly.

RC: L216: I don't think the authors mean that pollution events are "less predictable" here. This implies that meteorological forecasting is less skilful in winter, which I don't think is the point they are trying to make.

AC: This was reformulated.

RC: L240 and elsewhere: I'm not actually sure what "manholes" means in this context. Perhaps this is a technical term, but, to me, a manhole is one of the many holes you see in the street that give access to the sewer system, etc. Is there a more descriptive term that can be used? If not, a line clarifying what this means would be helpful.

AC: We don't come up with any better term, but what the word "manhole" refers to was now introduced (Table 2). We don't want to use a more descriptive term because based on our isotopic measurements, the emissions from these holes were not clearly associated with one type of source.

RC: L347: "westerly", rather than "western" winds.

AC: This was changed accordingly.

RC: L434: I think you need to be clearer that this statement comparing the source mixture in the Netherlands and Poland only applies to these two parts of the two countries. I.e., you can't be sure (as far as I'm aware) that there are regions of the Netherlands that are more strongly influenced by fossil fuels, or vice versa.

AC: This was adjusted accordingly.

RC: L440: "which confirms the source attribution". It's not clear from this sentences what is being confirmed.

AC: This was reformulated.

RC: L444: "But the emissions within the Krakow urban area, where multiple CH<sub>4</sub> sources are detected at the study site, are affected in a particular way." I don't know what this sentence means. In what way are they affected?

AC: The sentence was replaced by: "When multiple CH<sub>4</sub> sources contribute to the total x(CH<sub>4</sub>), as it was the case for the Krakow urban area, the uncertainties in the isotopic characterisation increase further."