

Atmos. Chem. Phys. Discuss., referee comment RC2  
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## Comment on acp-2021-114

Anonymous Referee #2

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Referee comment on "Shipborne measurements of methane and carbon dioxide in the Middle East and Mediterranean areas and the contribution from oil and gas emissions" by Jean-Daniel Paris et al., Atmos. Chem. Phys. Discuss.,  
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Important study presenting CH<sub>4</sub> and CO<sub>2</sub> data for a key oil and gas production region – where there exists limited measurement-based characterization of emissions.

The authors present a thorough characterization of CH<sub>4</sub> and CO<sub>2</sub> enhancements, and simulate potential sources of emissions. The paper would benefit from a discussion on what would be needed as next steps in terms of fully quantifying emission rates (not only characterizing the mixing ratios), this is important as towards the end the authors ask if they can verify inventories.

Line 3: change the term 'atmospheric distribution' or expand description of this term.

Introduction

Line 25: Highlight short-term potency of methane. Importance to illustrate the difference in their climate impact.

Lines 40-43: Important to highlight that the fossil fuel sector has key mitigation opportunities, likely more cost-effective than the other sectors (e.g. waste or ag). You could cite IEA methane tracker work and opportunity to reduce a significant fraction of emissions at net zero cost. I would suggest the IEA data instead of the MARCOGAZ report.

Line 46. Alvarez et al is relevant here but this is only for the US. Similarly, I would suggest rephrasing that methane emissions occur throughout the oil and gas supply chain.

Alvarez et al. also shows that in the US majority of emissions are for upstream sector.

Line 55. Any reason for not mentioning Hmiel et al. here?

Suggest revising consistent use of significant figures throughout the manuscript.

Line 69. For fields discovered in Levantine Sea, are they already producing? If so, is production significant?

Line 70. I assume that these emissions estimates are from EDGAR, please mention explicitly. Can you also include estimate from UNFCCC. For this, you can use Scarpelli et al.

Line 95. In terms of referencing Yacovitch et al. Can you expand on why you do not attempt to estimate emission rates?

Lines 160-170 I suggest that you also compare your inventory results to the Scarpelli et al. gridded inventory, as this is based on UNFCCC data.

Also, do you adjust EDGAR to any changes in production during the time of the study?

Figure 4- Include units of radiative heat.

Line 220 – I would caution (or request expanding) discussion on using flaring as proxy for extraction and production sites. While this can be true, gas production fields tend to have less flaring. At the same time, oil production fields could be venting gas instead of flaring.

Line 239 – Emissions could also be related to venting, not necessarily fugitive emissions. Also, what about the correlation between CH<sub>4</sub> and CO<sub>2</sub> to check for combustion sources (not only correlation with NMHCs).

Line 255: methane to ethane ratio depends on gas composition, but also on source of emissions. Ratio would be different if emissions are happening at the wellhead, at a storage tank, or after a processing plant.

Line 260: For natural gas the ratio is expected to be 0.86 (indicated as horizontal line in Fig. 6). Can you expand on why is this expected for natural gas? Is this for natural gas production stage? What about other stages of the supply chain? And different gas compositions?

Line 320; Can you expand on known source locations? Is this only based on EDGAR? I would expect high density of oil and gas infrastructure relative to granularity of EDGAR inventory. Also, can you expand on how episodic emissions could be impacting your simulations (i.e. impact of super-emitters)?

Lines 340-345: It would be useful to expand on potential differences in methane emissions between oil vs gas production (or combined production). It could be hypothesized that gas fields (where natural gas is main product) could have lower emissions than oil fields (where associated gas is a co-product, often not captured).

Can you also expand on influence of onshore infrastructure (processing gas from the offshore platforms) vs emissions from offshore infrastructure?