

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-114

Anonymous Referee #1

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.,
<https://doi.org/10.5194/acp-2021-114-RC1>, 2021

Overall Evaluation

This manuscript utilizes an excellent dataset and derives many conclusions, particularly highlighting the discrepancies between measurements and poorly constrained inventories in these regions.

The measurements section requires some extra detail for clarity, and the derivation of the time-averaged CO₂ and CH₄ data for direct correlation with NMHC GC data needs explanation.

For the modelling some more consideration needs to be given to the predominance of the waste and agricultural sources along a narrow coastal strip of the Arabian Peninsula and closer to the ship track, while many O & G emissions, particularly oil extraction activities, are further inland.

Specific Comments

2.2 Measurements Line 125 – water vapour contents were corrected – up to what % was recorded at the sub-tropical latitudes? Is the correction linear to this level?

2.2 Line 129 – Where do these calibration gases come from and which instrument is capable of measuring CH₄ and CO in ppb to 3 decimal places? Don't give these to more decimal places than the specified instrument precision.

2.2 Line 132 - Precisions for G2401 are based on temperature-controlled lab conditions, not a moving platform at different temps. What was the precision for the on-ship calibration runs.

Line 190 – Is this each region as defined in Fig. 1?

Section 3.2 – Through to the title of this section the only mention is of alkanes, then in this paragraph it suddenly switches to NMHC. Please be consistent, or clarify that you are referring to the same dataset for these measurements.

Fig. 5 – 4 main categories, but only 3 trend lines that don't necessarily seem to relate to the data. Which category is the lime-green trend line referring to? Needs more explanation in the caption. This figure compares ethane from GC measurements of NMHC with CH₄, presumably from Picarro measurements. How were the values of CH₄ derived to make these direct correlations?

Fig.6 – Same comment as above. How are the averaged CO₂ and CH₄ values derived for comparison with the NMHC measurements?

3.4 Were ship engines turned off for the whole time in the harbours as no obvious evidence for filtered data?

Line 339 – Kuwait city has no natural gas network, but numerous large landfill sites. Inventory emissions from O & G activity are far-removed from the coastal region. Is being so close to big sources a good comparison with modelled inventory data? These sources would potentially be within the same 01 x 0.1° model box as the receptor point.

3.5 What about photochemical ages for the times spent in harbours? Does this suggest an even smaller source footprint than 38 km? Harbours are often in industrial areas, potentially with storage of fossil fuels and very local generation of emissions that strongly influence the observed peaks.

Line 425 – As pointed out the wind fields are at approximately 100 x 100 km scale. The winds in the north part of the Arabian Gulf are highly variable. On land the winds are

dominantly from the NW. In the Gulf they often blow from the SE and these sea breezes lead to unpredictable emission dispersion along the coastal strip that may be difficult for model simulation. Less than 5 km inland the wind can be 180° different to along the coastal strip. HySplit simulations, for example, are unable to pick up these sea breezes.

Technical Corrections

Fig. 8 – Need to reposition geographic labels that don't fit into the boxes. Lot of detail so probably better as a full-page figure.

Line 354 – should be naphtha.

Line 405 – paragraph is about CH₄, but refers to Fig. 9 that is about CO₂