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## Comment on acp-2022-679

Anonymous Referee #1

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Referee comment on "Flaring efficiencies and NO<sub>x</sub> emission ratios measured for offshore oil and gas facilities in the North Sea" by Jacob T. Shaw et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-679-RC1>, 2022

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### Flaring efficiencies and NO<sub>x</sub> emission ratios measured for offshore oil and gas flaring facilities in the North Sea – Review

#### Summary of Paper

The authors present analysis of emissions efficiencies and ratios for four different gases from North Sea oil and gas flaring. They have used data from two flight campaigns and measured 58 flaring plumes using the FAAM aircraft between 2018 and 2019. By using combustion efficiency and destruction removal efficiency calculations the authors show that previous assumptions of emissions from this sector broadly agree with field measurements. The calculated combustion efficiencies are between 94 – 100% and the authors demonstrate that including ethane in combustion efficiency calculations has a very small impact on the final result. They also show no statistical correlation between wind speed and combustion efficiency but higher combustion efficiencies were measured in the Norwegian sector of the region. Comparisons with two emission datasets show their calculated emission ratios to be 30 times greater than that of the ECLIPSE inventory resulting in 30 times less methane emissions when compared to the emission dataset. They conclude the paper by extrapolating their results to a global scale, based on coarse assumptions.

#### Comments

I think this is generally a good paper and is worth publication. The results presented are not ground breaking or particularly controversial but are non the less important to back up assumptions of emissions from flaring. Below are some comments:

Line 37 – This would be more readable as 142 billion rather than  $149 \times 10^9$

Line 73 – I think 'shipborne-based' should either be shipborne, or ship-based

Line 74 – I do not understand why the sentence about isotopic ratios is important here as there is nothing about it in the rest of the paper. What is the context of this statement?

Figure 1 – Lat/lon grid lines would be useful on this map to be able to get a sense of scale when comparing to the model resolution

Section 2.3 – It is unclear how you decide what/where a plume is in the data. It seems as if you decide a plume if its elevated from the background, and decide the background if its not a plume which seems a bit circular. 50 neighbouring measurements either side of a plume seems ok but clarification on if there is a measurement limit for when the plume starts and stops is needed here.

Lines 210 - 216 – What is the variation of fuel composition data you do have? Is the median value representative or is there a large spread of values and do you have an indication on whether this value would impact the results in major way or not?

Section 3.4 –It need to be clearer as to why the large disparity between ECLIPSE inventory and the observations is not a resolution problem. One the face of it would seem that a few pinpoint measurements in a 0.5 x 0.5 degree inventory is never going to match but I think (after a bit of head scratching) that it shouldn't matter. But it would be useful to have more explanation so the reader doesn't have to work this out themselves. Are your measurements going to be representative of the large grid square?

Appendix figure D1, D2 & D3 – I don't think these maps are useful. The regional ones are but the global ones don't provide any useful information for this particular study

Appendix E – I may have missed this but where is this VIIRS data referred to in the text? Is this data used at all?