

## ***Interactive comment on “Speciation of VOC emissions related to offshore North Sea oil and gas production” by Shona E. Wilde et al.***

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The authors present a thorough analysis of airborne measurements of VOCs and other trace gases over four different regions of oil and natural gas production in the North Sea. Offshore measurements of routine oil and natural gas operations are relatively few making these observations highly valuable to the scientific and regulatory communities. The authors use the iso- to n-pentane and the benzene to toluene ratios to differentiate oil and natural gas sources from urban fossil fuel sources, a minor source for the South UK sector. Tight correlations of nearly all hydrocarbons with propane (a common component of natural gas) over acetylene (a combustion tracer) further indicate the prevalence of oil and natural gas operations as the source of the light alkanes and aromatics in these regions. The authors also calculate the ethane to methane

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ratios and the excess mole fraction to differentiate the VOC composition in the different source regions and to investigate the VOC composition as a function of type of product produced (oil, gas, condensate, or mix) and water depth. Additional analysis includes calculation of the OH reactivity to identify important contributors to potential ozone formation as well as comparisons to emission inventories.

The measurements are of high quality, the analysis is thorough, and the paper is very well written. I suggest publication with only a few minor technical corrections.

Corrections to be addressed:

- Impressively, I only found one typo. Page 15, Line 24. Change “representative” to “represent.”
- Figure 8b: It would be best to change these to colored lines rather than the “fill to zero” as you can’t see what is beneath the orange-colored oil curve.

Suggestions for the authors to consider:

- It would be helpful if Figures 1 and 5 were combined.
- It would be helpful if the colors on Figures 1b and 5 were consistent. Additionally, the orange and yellow colors used throughout were often hard to differentiate. Perhaps a darker saturation on the orange color or changing one to a different color would help the reader tell the colors apart more easily.

General comments for discussion (mainly my own curiosity):

- Did the authors measure cycloalkanes? These are often prevalent in crude oil and raw natural gas.
- Figure 4b and Line 13. I agree that either case could be true, but the slope is more suggestive of an additional benzene source as the mixing ratios for benzene are the largest for nearly all regions studied. Chemical aging would also occur along with dilution but these samples look fairly concentrated by comparison. Were any other

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VOCs enhanced in the samples with enhanced benzene? It could help point to a more specific source. Benzene is used in glycol dehydrators, a common piece of equipment in US gas fields. I wonder if similar equipment is used in these fields and could be the source of benzene-only emissions other than solvent usage.

- Are the authors planning to calculate emission fluxes of methane and VOCs using these measurements in a future analysis? It would be great if so.

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