

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2022-416

Anonymous Referee #2

Referee comment on "Airborne glyoxal measurements in the marine and continental atmosphere: comparison with TROPOMI observations and EMAC simulations" by Flora Kluge et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-416-RC1>, 2022

General Comments:

Kluge *et al.* present a comprehensive set of airborne glyoxal measurements from a miniature DOAS instrument flown on the HALO aircraft across 8 missions. These missions span a wide gradient in latitude from the southern to northern hemisphere and sample a range of different environments, including pristine marine and continental air, and biogenic, anthropogenic and pyrogenic influenced air. Data are presented in both nadir and limb viewing geometry, with the latter providing vertically resolved measurements. Comparisons are made to the TROPOMI remote sensing instrument as well as to a chemical transport model.

The paper is largely descriptive in terms of defining the spatial distribution and abundances of the observed glyoxal. The latter sections of the paper, especially those pertaining to model comparisons, describe some findings that interpret the measurements in terms of glyoxal sources and sinks and potential implications for factors such as secondary organic aerosol formation.

Overall the paper is clear and well written. It provides a novel data set for glyoxal observations at global scale that is not present in any other literature. It is of strong interest to the readers of ACP and should be published after attention to the following minor comments.

Specific comments:

Abstract, line 16: remove "over days"

Abstract, line 28: suggest "mixture" rather than "cocktail", which is colloquial

Lines 60-62: Please add the Washenfelder *et al.* reference for measurements in Los Angeles. Washenfelder, R.A., *et al.*, *The glyoxal budget and its contribution to organic aerosol for Los Angeles, California during CalNex 2010*. J. Geophys. Res., 2011. **116**: p. D00V02.

Line 133: "or briefly" appears to be out of place and likely not intended

Line 191 and following paragraph: Specify the integration time associated with the LOD for the glyoxal dSCD or mixing ratio.

Line 204: Remove extra parentheses

Line 320: Should biogenic influenced air be on this list? Is this part of pristine continental?

Line 348: Is the nature of the empirical correction of CHOCHO at high NO₂ explained in Lerot 2021? Is it possible to summarize briefly here?

Line 394: Why are direct emissions of glyoxal from biomass burning excluded?

Table 3: Values are listed as median with standard deviation – should this read mean and standard deviation? Is there a reason for using a median rather than a mean in combination with a standard deviation. Would percentiles be more appropriate, and if so, is the glyoxal in each region normally distributed?

Line 488: The large emission of isoprene is associated with the data from South East Asia but not the Amazon basin?

Line 562-564: Min *et al.* also report airborne glyoxal over the Eastern U.S. that can be listed here. Min, K.E., et al, *A broadband cavity enhanced absorption spectrometer for aircraft measurements of glyoxal, methylglyoxal, nitrous acid, nitrogen dioxide, and water vapor.* Atmos. Meas. Tech., 2016. **9**(2): p. 423-440.

Figure 8: Figure is rather difficult to read and would benefit from an overview map identifying the locations of each of the different examples. The insets in the individual figures do not have sufficient reference to understand where each images it taken easily. The lables, (a), (c), (e) and (f) are quite difficult to see.

Line 686-688: Measurement noise that leads to negative glyoxal values implies that there is also noise that leads to larger positive values than are actually present in the atmosphere. Inclusion of the positive noise with omission of the negative noise then biases the model – measurement subtraction in Figure 10. Does the one-sided omission of noise bias this comparison? If so, by how much? If not, the authors should justify.

Line 705: Should this read overestimated (not underestimated) emissions of long lived precursors?

Line 800: Glyoxal may also be a product of multi-generation biomass burning oxidation rather than simply long-lived precursors.

Line 805-809: The biomass burning source is a potential explanation for the tropical oceanic glyoxal, but it would have a very different vertical distribution than a surface glyoxal source. To what extent are the vertically resolved data from this analysis consistent with either source?