

Review of Hamryszczak et al., AMTD (2023):

The manuscript presents instrumental details for HYPHOP, a dual-enzyme fluorescence spectroscopy-based measurement of hydrogen peroxide and organic peroxides from aircraft. Chemical and environmental challenges to the measurement are discussed and quantified in the context of a 2022-2023 field campaign in Brazil, and data from that campaign are presented in very general terms. Considering that the instrument has flown on multiple field campaigns since 2015, describing it in the literature is valuable exercise. The manuscript needs some revisions before it is ready for publication.

One major concern relates to instrument precision, accuracy, and how best to convey those values. I have a few related comments:

1. When you report data for a field project, do you share 1 Hz data or 120 s data? I found the intermixing of the two time bases to be confusing. Instrument precision, etc., should be presented for the time basis of the mixing ratio data that you provide for field projects.
2. Instrument precision (in the abstract and section 2.4) is presented for values near 6 ppbv. These values are much too high to convey instrument precision relevant to your field measurements when median mixing ratios observed during CAFE-Brazil were 170 pptv and 280 pptv for H₂O₂ and organic peroxides, respectively, and maximum values were 1.94 ppbv and 1.73 ppbv.
3. The “precision” mentioned in comment 2 seems more appropriately described as a component of measurement accuracy because it largely consists of the reproducibility of laboratory calibration experiments. Consider reevaluating how you describe these attributes.

Throughout the manuscript text and Figure 4, I suggest using pptv instead of ppbv for values such as 0.020 ppbv to improve readability.

How do the measurement performance characteristics (e.g., limit of detection, precision, accuracy, time resolution) of your instrument compare with the other aircraft instruments you mention in the introduction? A bit of comparison would help provide context for your reader.

In the introduction where you first mention details such as “...a compact V25 control unit...” and “...a constant pressure inlet unit (CPI)...”, the reader really has no context to make this information useful. Consider adding text that refers the reader to the appropriate section later in the paper where these terms are better described, e.g., “...as described in Section 2.1...”

Lines 101-102: What is a “manually cooled liquid container department”?

Line 106: You mention constant pressure here but don't mention a value until line 125 "...approximately ambient pressure..." — consider giving a value for the pressure control at line 106.

Line 112: With a forward-facing inlet, how do particles and cloud droplets impact your measurement? Do you remove data affected by condensed phase material?

Line 117: What airflow does the pump provide at maximum altitude (150 hPa ambient)?

Line 126: I assume that the "reaction coil" mentioned here is the "stripping coil" shown in Figure 2. Making the body text match the figure text would be helpful.

Line 127 and elsewhere: You mention precooled solutions but nowhere in the manuscript do you give details on how the temperature control of the cooling is performed and how the temperatures of the solutions are monitored. Considering how important temperature is to your assumed sampling efficiencies, these details seem very important to the performance of your instrument and are critical to include in this manuscript.

In Figures 3, 4, 5, and 7: consider changing the altitude unit from m to km to get rid of the " $\times 10^3$."

Lines 159-161: Calibrating with a liquid H_2O_2 standard calibrates the measurement to a certain extent, but it misses important stages of your instrument. Have you ever calibrated with gas phase peroxides? At multiple mixing ratios (or at least multiple H_2O_2 solution concentrations) to verify linearity?

Lines 162-163: Why is the HCl wash needed to precede the calibrations but not the ambient measurements?

Lines 170-190 and related parts of the Supplement: All variables need to be defined and units given for each.

Lines 180-184: What are typical values for the destruction efficiency?

Line 190 through the end of Section 2.2: It would be good to introduce this section by naming the individual corrections and giving typical values (in pptv) for them.

Lines 191-193: How much does the background typically vary, in terms of pptv of peroxide, between background measurements? Over the course of a flight?

Lines 199-200: Do you expect the inlet transmission efficiency to be temperature and pressure invariant?

Line 200: Regarding flow rates, 30 slm and 10 slm at all altitudes or is there a range of flow rates?

Line 205: Using MHP instead of PAA for your inlet and CPI pump transmission tests would seem preferred, since MHP is your assumed organic peroxide.

Line 221: Is the temperature of the sampling solution measured just prior to the reaction coil? Have you measured these sampling efficiencies with your instrument? And what would the sampling efficiencies be for PAA or HMHP?

Lines 228-229: The transmission efficiency values would fit better at the end of the previous paragraph. Are these for the inlet + CPI pump or without the pump? It would be valuable to state both sets of values.

Lines 239-241: have you experimentally confirmed that these additions do indeed eliminate all of the interferences?

Lines 253-254: Delete "...but also cabin..." and replace with "and"

Lines 255-263: This test is valuable but really only evaluates changes in background, not changes in instrument sensitivity, since no calibration standard was added. Are the flight maneuver effects expected to only affect background levels, not instrument sensitivity?

Line 275-280: 5 ppbv does not seem to be the appropriate reference here—shouldn't it be the signal levels of typical ambient mixing ratios since that's where the temperature variations are relevant (not during calibrations)? Using 5 ppbv badly underestimates the uncertainty caused by temperature-dependent noise, unless I'm missing something.

Lines 323-325: Are the valves mounted vertically or horizontally? Some researchers have found improved immunity to aircraft motion by mounting valves horizontally.

Line 335: Change "...mixing ratio, which can be..." to "...mixing ratio that can be..."

Lines 249-352: As mentioned earlier, reproducibility of calibrations is more appropriately considered as part of instrument accuracy rather than precision. Precision itself will presumably be a function of mixing ratio and would be best quoted at a value much closer to ambient mixing ratios than the calibration standard value. Regarding accuracy and total measurement uncertainty, how well do you know the absolute value of your calibration standard?

Line 468: Considering the significant ozone interference and assumption of zero H₂O₂ in the LS to determine the interference value, a qualifier might be appropriate for the claim of measurements into the lower stratosphere.