Manuscript Review - Smit et. al, 2025

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Title: Intercomparison of IAGOS-CORE, IAGOS-CARIBIC and WMO/GAW-WCCOS Ozone Instruments at the Environmental Simulation Facility at Julich, German

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Summary:

This paper provides a summary of a number of experiments conducted at the Forschungszentrum Julich (FZJ) atmospheric profile simulation chamber designed to connect the ozone measurements profile measurements made as part of the In-service Aircraft for a Global Observation System (IAGOS) to those made on balloon sondes using the common, world-standard UV calibration instrument of Proffitt et al. (1982). As such this paper is an important contribution to the literature and will allow a harmonization of in situ ozone profiles across these measurement platforms.

In particular, the experiments conducted examined the performance of two versions of the aircraft O3 instruments (P1-O3 and CAR-O3) against the dual-beam UV-Ozone Photometer (OPM) of the World Calibration Center of Ozone Sondes (WCCOS) at FZJ. The instruments generally showed agreement to within 5-6% over the range of pressures studied. Interestingly, the P1-O3 instrument showed a consistent trend in offset from the OPM, starting at ~+2% at 1000 hPa and changing linearly to ~ -3% by 400 hPa. The paper was uncertain as to the cause, which does need to be identified and reconciled. It mentions that the performance of this instrument might be an artifact of the experimental set-up. That question should be resolved.

Recommendation:

Publish with relatively minor revisions – see my detailed comments below.

While it would be good to have the question of the drift in the offset of the P1-O3 instrument from the WPM resolved, it is worth getting these results into the literature sooner than later. If it is not resolved by the time of publication of this manuscript, a follow-up “note” should be submitted with an answer to the question.

Detailed comments:

Line 28: How often do you recommend that these comparisons be performed? Is it possible that the offsets historically might have looked different if these comparisons had been done before? How stable are the instruments?

Line 36: I might say, "anthropogenically influenced"

Line 38: delete “and its impact on life on Earth.”

Line 39: “Beside**s** the traditional” (change first word and delete “of”)

Line 45: “long**-**term”

Line 47: “operation**,**”

Line 47: “(9-12 km)” should match later reference of 10-12.5 km cruise altitude (line 78) – one or the other.

Line 47-48: “and **provides profiles of ozone from the surface to cruise altitude** during take-off and landing**. S**ince August 1994 more than 70,000…”

Line 53: swap “instruments” in for “devices”

Line 66: “chamber**,**”

Line 68: “...that is **approved as** EASA…”

Line 78: “(Z=10-12.5 km)” should match earlier reference of 9-12 km cruise altitude (line 47) - one or the other.

Line 114: “considered**,** too, **and that** is also dependent…”

Line 118: “...serves as **the** reference **instrument**.”

Line 124: Delete the phrase, “It is to mentioned that”

Line 137: What are the flow rates and cell volumes? I think this question is answered in the text below – just curious about the “flush” time for the cells when they are switched into zero air sampling mode.

Line 148: swap “evaluate” for “prove”

Line 149: “...is responding linearly to ozone to within…” instead of “...that its linearity is…”

Line 150: “...comparison with **an instrument with measurements** traceable to the National Institute…”

Line 151: Confused about the word “above” at the end of this sentence.

Line 152: “...IAGOS-CORE **is** compared…”

Line 209: swap “supply equivalent air samples to” in for “provide”

Line 224: “CAR-O3 uses a 2 m tube (ID = 4 mm), while the P1-O3 inlet line goes…”

Line 242-243: “...the manifold **was** monitored…”

Line 246: “...when P1-O3 **was** directly connected…”

Line 251-252: “...of the aircraft**. O**n IAGOS-CARIBIC…”

Line 253: “...about 12.5 km**,** the lowest…”

Line 255: “...thus to **a value of the** lowest total…”

Line 256: “Note**,** however, as P1-O3…”

Line 258: “...both instruments **span** the relevant…”

Line 262: “...usually **falls in the range** 800-850…” Question: By your argument in the text above this point, if you are determining the maximum difference, should you not be using 250 hPa here instead of 280 hPa? That would result in a 600 hPa difference instead of 570 hPa. Maybe I misunderstood the goal?

Line 268: “...instrument **does not** use a pump…”

Line 279: “...simulation experiments**,** number**ed** 3 to 7, which…”

Line 295: For Figure 2, it might be helpful to include the 0% difference line across the top plot.

Line 304: “...underlying cause**. In** a subsequent test (May 2024), KIT found an issue…” What is “KIT”?

Line 307: “...after the **repair** of the AD-converter…”

Line 310-311: “...compared to the OPM. We only will present the pressure corrected…”

Line 315: Figure 3 – the panels seems somewhat blurry. Do you have higher resolution versions for inclusion in the final publication?

Line 320: "...and the **cruise altitude** section at 400 hPa **(Figure 4b)**."

Line 321: "...during ascent and descent**,** and no indication…"

Line 354 and elsewhere: It would be good to formulaically define what you mean by relative difference.

Line 363: Figure 6 – what are the spikes that appear in the red trace at the step changes in ozone concentration? Are those real or artifacts of the processing/measurement system?

Line 380: "**..to within +/- 3%.**"

Line 392: "...at discrete values **typically found at** the corresponding…"

Line 398: "...again (as in **Exp #3** and #4) **around** -(1-2)% and is constant…"

Line 399: "...400 - 1000 hPa **with** ozone volume mixing ratios…"

Line 399-400: "...follow the **changes in** ozone levels below 100 ppbv**,** only relative…"

Line 401-402: "...CAR-O3 in more detail**. Figure 10 shows** the three ozone VMR…"

Line 418-420: The lines-of-best-fit in Figure 10 are forced through the origin. Is that the right approach?

Line 420: "...P1-O3 and CAR-O3" space added between "O3" and "and"

Line 424: replace "for" with "of"

Line 427-428: Should the formula be: "100% X (P1-O3 - OPM)/OPM? Same for the CAR-O3 calculation…

Line 443: "**(i.e., the** pressure under real flight conditions, see section 2.3.2)."

Line 446: "...10 minutes**, the difference** declined to…"

Line 448: "...the OPS and ESC**;** however, no indication of any **malfunction** of any…"

Line 448-449: Delete "Although"..."The cause is **still** not understood**;** it is **a** subject for…"

Line 455-456: "**unrealistically** high and most likely **impacted by the** high temperatures of the electronics of the instrument." Is there a way to check this hypothesis?

Line 468: "P1-O3 showed a good performance…" Should the consistent slope and the 5% change from bottom to top worry users? Can this be corrected?

Line 473-475: Comment – if you had swapped the positions of the instruments in the chamber set-up, could you have possibly seen different results?

Line 477-478: "...of the OPM as a standard, in combination…"

Line 478-479: "...set up, to within about +/- 1%. A primary standard for O3-UV photometer measuring only exists at Earth surface conditions (at the Bureau…"

Line 480: delete "respectively"

Line 483: "...**reference** instrument." delete "to refer to"

Line 487: "...complementary, their records do not typically cover the same **time** period."

Line 497: "...has only a small, **in any,** impact of less…"

Line 499: "...**have** been flown…"

Line 502: "...stratosphere, be efficient **enough** that the impact…"

Line 503: "...essential, **and** could be…"

Line 538: LIDAR = "Light Detection and Ranging"

Line 548: I believe UTC = "Coordinated Universal Time"