



EGUsphere, referee comment RC2
<https://doi.org/10.5194/egusphere-2022-565-RC2>, 2022
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Comment on egusphere-2022-565

Anonymous Referee #2

Referee comment on "Development of an automated pump-efficiency measuring system for ozonesondes utilizing an airbag-type flowmeter" by Tatsumi Nakano and Takashi Morofuji, EGU sphere, <https://doi.org/10.5194/egusphere-2022-565-RC2>, 2022

This paper is an overview and summary of the long-term JMA ozonesonde pump flow efficiency measurements of individual ozonesondes launched at three JMA field sites. The standard ozonesonde procedure (SOP) includes several steps, including measuring flow rate of the ozonesonde at the surface during the day-of-flight preparation. The additional measurement of pump efficiency is not included in the SOP due to the complicated and very time-consuming nature of these flow rate measurements done at a range of low pressures from surface to 3hPa in a vacuum chamber. Thus, essentially all ozonesonde operations (except for JMA) around the globe use an average pump efficiency to calculate the ozone profile. The average pump efficiencies are based on measurements and tests performed many years to decades ago. The ozonesonde equation (converting current to ozone concentration) includes a term for the pressure-dependent pump efficiency or the drop off in the surface measured flow rate during ozonesonde preparation. The authors also make an excellent point in the conclusions on the importance of long-term monitoring of pump efficiency of ozonesonde pumps from the two ECC ozonesonde manufacturers.

The JMA designers of this ozonesonde flow rate calibration/efficiency method have done an excellent job in developing the pump flow measurement system and addressing and reducing errors and offsets related to making low pressure flow measurements. This includes automation of the key steps, measuring pump motor speed (tachometer), checking temperature effects and back pressure (cell solution) effects, and focusing on the plastic deflation/inflation bag to reduce restrictions by using a polyethylene bag with a thin fluoroplastic film placed inside the bag to prevent wrinkles during inflation and deflation. They also simulated head pressure of the 3cc of sensor solution (the normal KI salt sensor water solution would evaporate and boil during testing) by first testing silicon oil (no evaporation) and then using sonde flow tubing that was made longer and narrower to create a restriction that matched the head pressure of actual solution in the cells.

The paper finishes with showing (based on JMA long-term individual pump efficiency measurements) how sites using an average pump efficiency may have been calculating total column ozone too low by 2-4% around 2014 or specifically when the EnSci serial

numbers within the 24000 series were used.

Editing Suggestions/Comments/ and Questions:

Line 25: Replace- "flew up" with "flown"

Line 27: Replace- "chemical" with "electrochemical"

Line 27: Replace- "The downlink of the data is taken care of by the radiosonde - also providing pressure, temperature, humidity and position measurements - the ozonesonde is coupled with.

with

"The downlink of the data, through the coupled radiosonde transmission, also provides pressure, temperature, humidity and position measurements.

Lines 33-34: Reference - If available, please add a publication reference on the KI Carbon electrode type (KC) ozonesonde.

Line 37: Replace- " with take the ambient air into" with " with bubble the ambient air into"

Line 39: Replace- "sampling air" with "sampled ambient air"

Line 39: The flow rate is also needed to calculate concentration of ozone. Please add this in the last sentence to make it: "The ozone concentration is calculated from this electric current and the volumetric flow rate of the piston pump."

Line 46: Replace "(4). Then again, the force of the piston takes the ambient air into the pump." with "(4). The piston draws in a fresh sample of ambient air."

Line 46: Replace "During the ozonesonde observation, this cycle is repeated" with "The cycle is repeated for each pump rotation. The steady pump speeds typically range from 2400-2600 rotations per minute (RPM)."

Lines 47-48: I am having difficulty in understanding the first part of this sentence. I believe this is saying the back pressure is always the same from ground level to low pressure while ambient pressure is decreasing.

Line 63: Replace "silicone membrane" with "bubble" contraction

Line 67: Replace "airbag contraction" with "airbag evacuation"

Line 67: Remove this part of the sentence "and a gear pump with high pump efficiency" The gear pump (nearly 100% pump efficiency) was only used at NOAA to confirm the accuracy of the oil bubble flow meter.

Line 70: Replace "The system was designed to perform the entire series of measurement automatically, in order to be able to obtain pump efficiency with uniform quality." with "The system was automated in order to obtain pump efficiency measurements with uniform quality."

Line 73: Replace " we could build up a" with " we accrued a"

Line 104: Replace "exhaust limit" with "minimum pressure"

Line 117: Replace "Flowmeter controller" with "The flowmeter controller"

Line 118: Replace "flow values of them" with "flow data"

Line 121: Just a question on what is time-dense control?

Lines 130-133: Figure 6 text: Replace "The bag is made of polyethylene in a volume of 140 ml." with "The 140 ml. bag is made of polyethylene."

Replace "in thermometers with "by thermometers"

Replace "measured in optical instrument" with "measured by an optical instrument"

Line 202: replace "back pressure" with "back pressure (load)". This is a suggestion since back pressure and load are both used in the next sections. I assume they refer to the same thing so it would be good to include both in the title of section 3.3.

Lines 227-229: Figure 8 text: Suggest replacing "reaction solution" with "silicon oil" to be consistent with the text that notes silicon oil was used to represent the head pressure instead of actual sensor solution – which would create very large errors due to boiling of the KI/water solution.

Line 245: Replace "(sucked out)" with "pushed out"

Line 245: Please add the typical pump temperature observed during a test. For example, it would be helpful to know what the typical pump temperature at surface (beginning of test) and at the lowest pressure (3 hPa).

Lines 335-336: It appears that "reaction solution" is being used for referring to more than one thing. It is used early in the paper when referring to the actual sensor solution (the KI salt water solution) and then in line 335 it looks like in this text "reaction solution" is referring to head pressure simulation of the sensor solution for NOAA/CMDL pump efficiency measurements, when NOAA/CMDL actually used non-evaporative oil to replace the reaction solution. Then in Line 336, I believe JMA is using extra tubing length to create a simulated back pressure of the 3cc of reaction solution. It would be helpful to be clear where "reaction solution" is actually back pressure or

simulated head pressure of the 3cc of reaction solution.

Figure 12: Replace "UMYO 2002" with "UWYO 2002" within the graph for Univ of Wyoming (blue line).

Figure 16: The figure text letters (a) (b) and (c) should be in front of the data being described. For example: (a) Variation over time of pump flow rate.