Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2022-66

Anonymous Referee #2

Referee comment on "Development and testing of a novel sulfur dioxide sonde" by Subin Yoon et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-66-RC2, 2022

The manuscript presents a balloon-borne instrument measuring SO2, based on the well-known ozonesonde. The technique is really promising, definitely a step forward to the dual-sonde method, and the manuscript reads very well. It provides a good background on atmospheric SO2, the ozonesonde technique, the dual-sonde method, and the measurement principle of the new technique is well described and illustrated. Tests done with the SO2 sonde underline the potential of this new technique.

The manuscript can be therefore accepted after some **minor revisions**:

- The structure of the manuscript, and in particular the description of the tests (field deployments), could be possibly improved. Now, those sections follow a rather chronological order, like the reader is taking part in the development phase of the instrument, and this might not be the best way to present it. In the paper, you should present the state-of-the art SO2 sonde, and a reader might be less interested in intermediate versions of the instrument (e.g. without sample dryer). Therefore, alternatively, you might present the final instrument and its different components, and illustrate the importance of every component by means of those field deployments (e.g. the importance of the sample dryer).
- In studies about ECC-ozonesonde measuring ozone, quite often the formula to convert the current to ozone partial pressure is included, illustrating which factors (e.g. background current, temperature of the pump, pump flow rate, pump efficiency, conversion efficiency) impact the measurement of the ozone concentration. Would it be feasible to come up with a modified version for the SO2 sonde as well? This would, to my opinion, nicely demonstrate which factors contribute to the SO2 measurement, and to which extent (in some sense).
- The weak point of the study is the lack of validation/comparison of the SO2 tropospheric profile measurements of the SO2 sonde by another reference instrument. Does such a reference instrument exist? Could the SO2 total column data of the SO2 sonde be compared with TROPOMI overpass data? Please comment in the manuscript on possible (future) validation/intercomparison studies.

- On page 10, line 285, you mention a descent profile of the SO2 sonde, which triggers my curiosity. Have you gathered all the descent profile data of your SO2 sonde launches? And if yes, what could be learned from the comparison of the ascent and descent profiles (taking the trajectories of the volcanic SO2 plumes and the balloon into account)?
- I follow the other reviewer in his/her comment that the magnitude of the bias current is in some sense the hocus pocus of the technique and deserves more attention. How can you prevent a profile like in Fig. 7(d), where the SO2 sonde saturates? What is the price of imposing a very high default magnitude of the bias current for every SO2 sonde?

Technical comments (other than from the other reviewer):

- Page 6, lines 157-158: shouldn't "white background" and "grey background" be reversed?
- Page 7, line 196: is it really necessary to mention which team conducted the free release flight?
- Page 8, line 215: additional laboratory testing on the dual-sonde?