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Atmospheric Measurement Techniques Discussions

Interactive comment on "A fully Automated Dobson Sun Spectrophotometer for total column ozone and Umkehr measurements" *by* René Stübi et al.

René Stübi et al.

rene.stubi@meteoswiss.ch

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Reply to RC2 comments, AMT-2020-391 manuscript, "A fully Automated Dobson Sun Spectrophotometer for total column ozone and Umkehr measurements" by René Stübi et al."

The authors thank referee#2 for the critical reading and the valuable comments. Also, the numerous suggestions were very helpful to improve our manuscript.

Initial Comments: This submitted manuscript would fit in the category of a commentary, as it describes the modernization of an existing measurement program. I recommend

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Discussion paper

publication after the issues below are addressed.

Specific Comments/Questions:

I am not commenting on the details of the automation and electronics, as I am not currently experienced in this field.

Introduction:

A reference to the history of the discovery of ozone depletion by chlorofluorocarbons (CFCs) is expected. The discovery of the Antarctic ozone hole by Dr. Solomon is a good source for the history. Suggest a lead-in sentence similar to: The history of the detection of the ozone layer depletion is one of the most important scientific stories of the 20th century (Solomon, 2019).

=> this is a good suggestion that we have adopted

Line 20: The term “calibrate” is not correct. This paragraph should be re-written. The various ground-based and space-based networks have independent calibration methods. Data results from the various instruments and networks are inspected and intercompared to detect problems within networks. I believe that authors are also saying that the algorithms used to convert data to total ozone values are evolving with increased understanding of the instrument characteristics, and the assumptions used in the measurement and data reduction algorithms.

=> We agree that the term calibrate is not adequate. The paragraph has been rewritten

Line 25: There should be some mention of the development of the instrument for the early 1900s’ studies in Stratospheric Circulation.

=> The early circulation studies have been added

2 Dobson measurement principle and instrument design:

Table 1: Why is there no A-pair wavelength values for D 062 or FWHM values for D 062 or D 051 ?

=> The intensity of TUpS light source were too low to measure correctly the A-pair of D062. The FWHM of the D062 and D051 are similar to those of D101. A remark is added in the table header.

3.4 Automation of instrument tests

There are other processes in the operation of a Dobson observing program. One of which is determining the attenuation curve of the optical attenuator. Has there been an attempt to automate this process?

=> the calibration of the wedges is carried out as part of the regular intercomparison organized by the regional Dobson calibration center (Hohenpeissenberg for EU). There was no attempt to develop an automated wedge calibration system at MeteoSwiss.

Page 14, line 10: Larger changes are normally a sign of either an aging lamp or a change in the instrument response and are corrected by an update of the attenuator calibration curve. A better explanation is required. The data reduction algorithm incorporates the changes in the standard lamp test values from the lamp values determined at the time of the instrument's calibration by comparison to a reference instrument. The attenuator calibration curve is determined by a different procedure. The standard lamps are actually reference lamps, with measured values for a certain Dobson instrument on a specific date. The change in the measured values with time indicates aging of the instrument. Use of multiple lamps on varying time schedules allows for detection of aging lamps.

=> A rephrasing of the sentence were done

Technical Corrections/Comments/Suggestions

Abstract:

Line 3: Suggest: However, the Dobson sun spectrophotometer requires manual operation which has led to the discontinuation of its use at many stations, thus disrupting long term records of observation.

=> suggestion adopted

Line 8, Suggest: Compared to manual operation, the automation results in a higher number of daily measurements with lower random error and additional housekeeping information to understand the measuring conditions.

=> suggestion adopted

Introduction:

Line 9: Suggest: Moreover, the uncertainties associated with climate change feedback on the ozone recovery process require dedicated ground-based measurement networks for sustained monitoring .

=> suggestion adopted

Line 14: Suggest: The principle of the instrument developed by G. M. B. Dobson in the early 1920s is based on measurements of the intensity of ozone-attenuated radiation in a number of narrow spectral bands. This was first done by analyzing spectra recorded on photographic plates, later directly on spectra within the instrument with photoelectric detectors and nowadays with photo-multipliers (PM) detectors.

=> suggestion adopted

Page 2, Line 32: Suggest: After the discovery of ozone layer depletion by CFCs, the measurement program continued as part of the global effort to verify that the Montreal Protocol was working. The more recent automation of the Dobson operation allows for continuation and improvement of this observation program, with reduced operational cost.

=> the suggestion is included and the paragraph rearranged.

3 Automation of the LKO Dobson instruments

Suggest starting with a sentence similar to: The instrument and observation facilities have had numerous improvements over the years.

=> suggestion is included and the paragraph rearranged.

3.1 Instrument Control

Page 7, Line 7: the local horizon

=> corrected

Page 7, Line 11: Suggest: The sun's image must fall on the entrance window of the instrument, thus the sun's azimuth and elevation must be tracked.

=> suggestion adopted

3.3 Measurements results Page 12, line 12: suggest: has not yet been automated .

=> suggestion adopted

3.4 Automation of instrument tests

Page 14, Line 2, Suggest: Once the measurement procedure had been developed, the data acquisition (DAQ) system could then be programmed to perform other specific tasks .

=> suggestion adopted

Page 14, Line 12: Suggest: A Hg lamp is used to verify the wavelength settings and to check the optical alignment of the Dobson instrument.

=> suggestion adopted

Discussion Page 18. Line 6 : Komhyr not Koomhyr

=> corrected

Page 18, Line 10: Suggest: The Swiss automation system is unique in that the instruments...

=> suggestion adopted

References:

Page 20, Line 20 Komhyr, not Komyhr – references in text (Page2, line 19; Page 4, Line 2) have to be corrected

=> corrected

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