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Atmospheric Measurement Techniques Discussions

Interactive comment on "Early results and Validation of SAGE III-ISS Ozone Profile Measurements from Onboard the International Space Station" *by* Michael P. McCormick et al.

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Interactive comment on "Early results and Validation of SAGE III-ISS Ozone Profile Measurements from Onboard the International Space Station" by Michael P. McCormick et al.

Anonymous Referee #1 Received and published: 7 November 2019

General comments: This work provides the first validation results of the SAGE III-ISS ozone profile observations with respect to ozonesonde, lidar, and ACE-FTS measurements. Although results are usually presented in a clear way, the validation method-

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ology and its description (mainly Section 2.4, see below) should be improved before publication in AMT.

We want to thank the referee for taking the time to review our paper and provide us with valuable comments and suggestions for its improvement.

Specific reviewer comments and author responses:

1. Abstract, line 20 (and throughout the text): The meaning of the term 'accuracy' is unclear as it is sometimes differently used in different contexts. In fact, 'accuracy' should not be used as a synonym of total uncertainty; see VIM, GUM, or Loew et al. (2017) for their application to satellite validation practices. It is recommended to just use 'total uncertainty' instead.

Response: We agree with the reviewer and have changed the text to reflect this throughout the revised manuscript.

2. Lines 66-70: The 'CompositeO3' product is not explained in the last paragraph of Section 2.1.

Response: The 'CompositeO3' product, which was included in v5.0 of the SAGE III-ISS data, was an attempt by the SAGE III team to combine the other three ozone profile products into a single profile. This product was removed from v5.1 of the SAGE III-ISS data and is not used in the comparisons, therefore, the statement that mentions the 'CompositeO3' profile has been deleted in the revised manuscript.

3. Section 2.2: Information on the ozonesonde launch frequency and lidar observation frequency is missing, while this is of importance in considering the reference data coverage (temporal representativeness). Typical uncertainties of these measurements, with references to the appropriate literature, should be mentioned as well for proper interpretation of the comparison statistics later on.

Response: Information on the ozonesonde launch frequency and lidar observation frequency for the June 2017 to May 2018 time period, as well as typical uncertainties

of the measurements with references, have been added in two extra paragraphs at the end of Section 2.2.

4. Section 2.4 is rather poorly written in terms of English language quality (e.g. lines 91- 92), contains duplicate information, and the comparison statistics can be significantly improved. Regarding the latter, three important issues have been detected: 1. The coincidence criteria are not motivated, except for the mentioning of the need for larger values to compensate for the fewer comparisons in the southern hemisphere. The coincidence criteria should be motivated, ideally in terms of the (estimated) spatial extent of the measurements, including references. 2. Using a linear interpolation (line 105) for vertical sampling to a common grid is presently considered to leave important vertical profile information out of the resampling. Improved methods given in Calisesi et al. (2005) or Langerock et al. (2015) (or see Keppens et al. (2019) for an overview) could be implemented. 3. Calculating relative differences by using the averaged observation as a reference (lines 115-117) is not appropriate for satellite validation exercises (it is rather used for model comparisons as the average model is typically closer to the truth than each individual model): The reference averaging process corrupts the independency of the reference and smooths the effects that you want to detect (the unknown satellite errors), making their quantification flawed. If one wants to normalize the satellite deviation, the normalization should be done independently from the satellite data, i.e. using the reference data only.

Response: Section 2.4 has been rewritten to improve the grammar and clarify the coincidence criteria. -1. A reference has been added to explain the motivation for selecting coincident measurements. -2. Although beyond the scope of this initial investigation, other techniques of resampling to a common grid, including the use of averaging kernels, will be considered for future validation efforts. -3. The ozonesonde/lidar comparisons have been recomputed using the ozonesonde/lidar data as the reference in the denominator (instead of the average between the instruments). A statement was added to Section 2.4 after Eq. (2) to clarify this point. The ozonesonde/lidar com-

parison figures (3-6 and 11) and associated text were modified according to the new results.

5. Section 3: In order to properly address the satellite uncertainty budget, the spatiotemporal sampling difference errors and vertical smoothing difference errors that result from the inexact coincidences should be discussed as part of the uncertainties. E.g. one expects an effect of the larger coincidence criteria in the southern hemisphere.

Response: We agree with the reviewer and added a statement indicating that larger errors are expected using an expanded coincidence criteria. A sentence at the end of 2.4 has been added. A more detailed quantitative analyses would require a larger data record than available in this early validation manuscript.

6. Line 237: Please provide a reference for the statement that the tropical tropopause area “is most likely impacted by cirrus clouds”.

Response: A reference was added to support the statement that cirrus clouds occur more frequently in the tropical tropopause region: Nazaryan et al., 2008.

7. The conclusions should contain quantitative results (as the abstract).

Response: Several sentences have been added to the conclusions that supply quantitative results similar to what was presented in the abstract.

Technical corrections: 8. Abstract, line 14: “the average difference of ozone concentration measured by SAGE III-ISS” is a confusing phrasing (as if average differences are measured). Please rephrase.

Response: The sentence in the abstract has been replaced with “Average differences in ozone concentration between SAGE III-ISS and Hohenpeissenberg lidar observations for one year are less than 10% between 16 and 42 km and less than 5% between 20 and 40 km.”

9. Line 43: Explain the acronym ‘CFC’.

Response: The acronym ‘CFC’ has been replaced with “Chlorofluorocarbons (CFC)” in the text.

10. Line 103: Provide links or references to the product user guides.

Response: A link to the SAGE III-ISS Data Products User’s Guide has been added.

11. Line 190: Explain three-monthly acronyms.

Response: Parenthetical text has been added to explain the three-monthly acronyms.

12. Conclusions, line 258: “This paper represents an early effort to provide validation of ozone to the broad science-user community.” is a too broad statement. Which ozone, and measured by what?

Response: For clarification, the sentence has been replaced by “This paper represents an early effort to provide validation of upper tropospheric and stratospheric ozone measurements from SAGE III-ISS to the broad science-user community”.

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