

Interactive comment on “Residual Temperature Bias Effects in LIMS Stratospheric Ozone and Water Vapor” by Ellis Remsberg et al.

Anonymous Referee #2

Received and published: 4 December 2020

This paper deals with biases in the distributions of ozone, water vapour and nitric acid from observations of the LIMS satellite instrument and derived within the V6 retrieval version. The trace gas biases are due to biases in the temperature profiles $T(p)$ that are caused by horizontal gradients in temperature that are not fully accounted for in the retrievals. The approach chosen compares the retrieved profiles from the descending and ascending orbit branches that are, at the same time, day and night observations. However, the assessment of biases in the trace gas fields is complicated by the fact that either real diurnal variations occur, or the retrievals are further biased by neglected Non-LTE effects.

General comment: The paper provides a theoretical assessment based on assumed horizontal temperature gradients along the light path through the atmosphere, and con-

C1

fronts these numbers with observed A-D differences. Comparisons to reference measurements are presented in order to validate the bias assessments. Over all, the paper is clearly written, concise and to the point. It fits very well into the scope of AMT. I recommend publication after some minor revisions.

Specific comments: As already said, the paper is clearly written. The only overarching issue I could not resolve is the quantitative assessment of the temperature bias caused by not fully accounted horizontal gradients (second row in Table 1). The authors state in the introduction (l67 - 69): "While the LIMS algorithm makes first order corrections for $T(p)$ gradients, residual bias effects are still apparent in the V6 species distributions.", and in section 2.2 they state (l146 - 147): "Estimates of a bias in V6 $T(p)$ are in Table 1 (row 2), according to the error simulations of Remsberg et al. (2004)". I have checked this paper, but I could not identify the numbers in Table 1 of this manuscript in the Remsberg et al. (2004) paper. I suggest that a short outline of the assessment of the temperature bias due to horizontal gradients should be included in this manuscript.

Abstract, l38 - 40: The authors state here: "We recommend that researchers use the average V6 Level 3 data for their science studies of stratospheric ozone and water vapor wherever diurnal variations of them are unexpected." However, pseudo-diurnal variations appear for ozone, and, to a lesser degree, to water vapour, due to the neglect of NLTE effects (l57 - 59 and l120 - 123). A simple averaging of day and night values does not help here. I suggest that a more careful wording is used in the abstract.

L161 - 163: "The sharply increasing H₂O near the tropical tropopause is due, in part, to residual emissions from cirrus cloud tops that were not screened completely from the bottom of the LIMS H₂O radiance profiles prior to retrieval." Is this just a presumption, or have you demonstrated this within an other publication? In the first case you should indicate that you assume this, in the latter case you should provide the reference.

L341 - 342: I do not understand the following argument: "... the residual biases in the $T(p)$ distributions are related to seasonal changes for the Brewer-Dobson circulation

C2

...". Some clarification would be helpful.

L345 ff: HNO₃ does not appear in the title, abstract or any section heading. I suggest to give HNO₃ the appropriate place in the manuscript.

L 404: "... due to uncorrected NLTE emissions from CO₂ and ozone ...": has this been assessed quantitatively? If so, please provide the reference.

L407 - 408: Is it reasonable to assume a negative T(p) bias? Is the comparison with ROCOZ ozone sondes the only indication for that? Could it be that this result is caused by an over- or underestimation of the Non-LTE effect?

L435 - 436: For me, having scientifically "grown up under the ozone hole" the statement in the first sentence of this para is a bit strange - although it might have been true (at least within some limits) at the time of the LIMS measurements. Maybe a link to the pre-ozone hole area of the LIMS observations should be made here.

L483 - 486: Similar to the abstract, the neglected non-LTE effects in ozone and water vapour retrievals should be kept in mind, and the statement about averaging the A and D observations needs a bit more caution.

Technical comments:

L 183: ... temperatures for (or in) March.

References: several dois are incorrect.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-322, 2020.