

***Interactive comment on* “Comparison of VLT/X-shooter OH and O₂ rotational temperatures with consideration of TIMED/SABER emission and temperature profiles” by S. Noll et al.**

Anonymous Referee #2

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Review

This manuscript is an interesting study dealing with the comparison of ground-based measurements of OH and O₂ rotational temperatures – based on VLT/X-shooter observations – complemented by kinetic temperature and OH emission profile observations carried with the SABER instrument on the TIMED spacecraft. The manuscript deals with several issues important for ground-based rotational temperature measurements and is therefore worth publishing.

However, the paper contains quite a number of misleading or unclear statements that should be adjusted before the paper should be accepted, in my opinion. I think I am

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well familiar with the overall topic of the manuscript, but I had a hard time understanding many of the sentences. In many cases I think I know what the intended meaning of the statements is, but the sentence actually states something else. Particularly section 3.3 is difficult to follow. I ask the authors to go through the paper carefully and make the statements as clear as possible.

Again, I think this paper is very relevant, but some of its messages should be conveyed more clearly.

Specific comments:

Page 30794, line 5: “ .. has to be achieved”

I find this phrase somewhat misleading, because it suggests that a Boltzmann distribution can be “achieved” by some means. I suggest something like., e.g.: “To measure realistic temperatures, the rotational population has to be in LTE”.

Page 30795, line27: “and makes the initial T_{rot} higher for lower ν ”

This is certainly a valid point, but I suggest removing it here. It may confuse the inexperienced reader, because this sentence is the argument for higher T_{rot} at higher (not lower) ν as stated in the previous sentence.

Page 30798, line 7: this is only a minor point, but I thought that $\lambda/\Delta\lambda$ is the “resolving power”, while $\Delta\lambda$ is the “resolution”. But perhaps the latter term is also used for $\lambda/\Delta\lambda$.

Page 30800, line 7: resolving power vs. resolution (see point above)

Page 30800, line 21: “We retrieved VER profiles”

I suggest writing “We used VER profiles”, because in satellite remote sensing “retrieval” usually refers to applying a numerical scheme to the raw data to infer the parameter wanted. For a satellite person your statement suggests, that you actually performed this retrieval, which is not the case.

Page 30800, line 22: “We took the “unfiltered” VERs, which are corrected for the emission of the targeted molecular band(s) outside the filter”

I’m not sure I really understand this statement. The statement doesn’t clearly say, whether this correction was performed by you or whether it has already been applied to the data you use. Does the correction mean, that, e.g., the parts of the OH(4-2) and OH(5-3) bands not covered by the SABER 1.6 micron channel are added to the measured radiances?

Page 30803, lines 21 -26: I read these sentences several times, but I don’t really get the intended meaning, particularly of “Taking the most reliable bands with at least five measurements, the T_{rot} were converted to a reference line set consisting of the three . . .” What conversion is meant here? I think I know what’s done, but I think this is not well explained.

Page 30804, line 25: resolving power vs. resolution

Page 30806, line 27: “Taking the resulting temperatures as reference, we decreased the T_{rot} of the whole sample by 0.4 K”

Again, I don’t understand the reasoning or logic behind this and the previous sentence. My understanding is that you determined the temperature difference between two cases with difference continuum windows and obtained 0.4 K. Then the temperatures were corrected by 0.4 K. I’m sorry if I appear somewhat picky, but in my opinion the text does not clearly describe what was actually done.

Page 30807, line 8: resolving power vs. resolution

Page 30810, line 14: “see Baker et al.”

I think it’s more appropriate to cite “Russell et al. (1999)” here

Page 30812, line 23: “a ppears” -> “appears”

Page 30813, line 18/19: “which shows the best agreement”

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Agreement in terms of what? Probably the mean emission altitude?

Page 30813, line 20: “(4.6 vs. 2.3 km for the first and the last period in comparison)”

These values do certainly not correspond to the emission profile widths, as the sentence suggests.

Page 30814, section 3.3, Temperature corrections: This is in my opinion the section of the paper which is most difficult to understand and which required some text adjustments.

Page 30814, line 21: Suggest to replace “of 2 to 3 K, i.e. 2.5 K” to simply “of 2.5 K”

Page 30814, line 23: “The old T_{kin} show deviations between ..”

This statement is not entirely precise. I assume the deviations refer to differences in T_{kin} between the two SABER data versions? This is, however, not explicitly stated.

Page 30815, line 2: “With the band-dependent T_{eff} , the emission profile correction can be performed by calculating a temperature shift from the T_{eff} for a given band and the desired reference profile”

I read this statement many times, but I still don't fully understand its intended meaning. Please rephrase to make it easier to understand.

Page 30815, line 15: “In particular, the yaw cycle of the TIMED satellite lasting about 60 days .. results in a very narrow range of times for a certain DOY”

I don't think the logic of this sentence is correct. It's not the specific yaw cycle of TIMED that causes these problems. A yaw cycle of 50 or 40 days would be essentially associated with the same problem, and so would a sun-synchronous orbit, right?

Page 30816, line 4: “Within the $1-\sigma$ radius around ..”

What exactly do you mean by “ $1-\sigma$ radius” ?

Page 30816, line 23: I'm not sure, what “interval-specific” refers to here? The five

nighttime periods?

Page 30816, line 26: “The resulting errors”

Perhaps better “differences” rather than “errors”?

Page 30817: I find many statements on this page difficult to follow. I always have a rough idea what the intended meaning is, but this is in many cases not what the sentences state. I would like to ask you to go through this page again carefully and explain things as plainly as possible. For example line 26: “For the correction to the reference profile, we find average errors of 1.2 ...” What do you mean by “For the correction TO the reference profile”?

Page 30818, line 6: “It is possible to check the reliability of these data by comparing the sample means of h_{eff} differences with correlation coefficients r for the selected bands derived from the T_{rot} data of the same data set”

I’m sorry, but I have no clue what this statement means. What correlation coefficients are these. What’s correlated with what? Please clarify.

Page 30819, line 1: “There is an almost perfect linear relation of h_{eff} and r for these data, which confirms the found equidistance of the OH layers and ...”

I can see that the equidistance and the linear relation of h_{eff} and r are not entirely unrelated, but I don’t see such a clear connection that justifies the conclusions that the one confirms the other. Perhaps I’m missing a point?

Page 30820, line 27: “By calculating the T_{eff} differences involving the reference profiles”

Please explain better what you mean here.

Page 30822, line 18: “Nevertheless, values of more than 10K for $\nu = 8$ are plausible”

It’s not clear what “values” refers to here. Please clarify.

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Page 30823, line 19: “based on OH($\nu=2$) instead of O2 ..“

Please mention that the corresponding emission profiles are meant here (right?)

Page 30824, line 28: “, it is not clear how this distribution is modified by collisional quenching”

I’m not sure what the intended meaning of this statement is. There are several OH modelling studies taking collisional quenching into account (based on the best or plausible knowledge of the relevant rate constants). Does the statement refer to the issue that some of this rate constants are highly uncertain?

Page 30827, line 22: “LTE dynamics”

This is not a frequently used term, please specify

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