Replies to referee Report 1

We thank the reviewer for careful reading of the manuscript and several helpful suggestions that lead to an improvement of the text. Here we reproduce referee's comments in full and show our replies in blue font. Similarly, in the manuscript we use bold font to clearly denote the changed text.

Abstract, l2: 150km: tangent altitude? - please specify what this distance refers to.

Done

p3, l24: an "a" is missing before "series" and
p3, l26: "the" Martian atmosphere...

Both done

p4,l17: why was the altitude of 100km chosen for this comparison while the data discussed before refers to 115km? It would be more consistent to show this for the situation discussed before.

We added one new curve in left panel, and two in right panel of Figure 2 for the altitude of 120 km and SZA=69 deg., which exactly correspond to the conditions of simulated spectra in Figure 1. We also modified the discussion of this figure in the text.

p4,l28: split infinitive "significantly better reproduces..." -> "reproduces ... significantly better compared to..."

Done

p4, sec 3.1: While the model does a very good job reproducing the observed feature, it seems that the ratio of the peaks is slightly shifted toward the left peak compared to the observed spectrum. Is there an obvious explanation for this (admittedly small) discrepancy? What is the estimated uncertainty in the modeled spectrum (e.g., arising from input data) also with respect to the absolute values of the derived radiances?

In order to clarify the "uncertainty in the modeled spectrum (e.g., arising from input data) also with respect to the absolute values of the derived radiances" let us consider left branches of spectra presented in Fig.1, which are mostly formed by the P-branches of 626 SH 4.3 bands considered. The latter are less influenced by a self-absorption in the cores compared to to the right branches of spectra associated with stronger R-branches of these bands.

Generally, the position of the peak for each of 27 single spectra used to obtain the measured mean distribution depends on (a) the temperature and pressure distributions in the atmosphere at the time of each particular scan, and (b) on the degree of self absorption of the radiation in the most intensive lines of branch core along the limb line-of-sight (LOS). This is also true for our simulated spectrum. For this case, the model temperature used in calculations is increasing from 136K at 120 km up to 225K at 150 km (and also higher for higher altitudes). This temperature increase causes the shift of the rotational distribution maximum along the LOS to higher j from j_max=11 at 120 km to j_max=13 at 150 km. The simulated spectrum is a resulting integral over the LOS, which also accounts for the self-absorption of lines.
It seems that one finally may find the model temperature/pressure distribution, which will provide

complete match of absolute values and shapes of measured (mean) and calculated (single) spectra, however, this was no the goal of this study.

p5, fig 1: assuming the figure will be smaller in the final layout if might be good to choose a different color or line width for the yellow line.

We increased the width of orange line.

p6, fig 2: typo in the x-axis label in the right panel see previous comment above: why is an altitude of 100km chosen here?

Typo is corrected, the curves for altitude of 120 km are added, see also reply above.

p6, l2: ... "the" first of these...

Corrected

p6/p7: The last paragraph of sec 3.2 requires some language improvements, especially with regard to missing articles and word order. Maybe some of the long sentences could be split.

We have rewrote the paragraph for clarity and easier reading.

p7, l20: ...does "an" excellent job...

Corrected

p7, l28: "...need of significant additional study..." - please rephrase this sentence to clarify.

Done

p8, l7: ...influence "the" main results...

Done