Atmos. Meas. Tech. Discuss., 3, C2560–C2563, 2011
www.atmos-meas-tech-discuss.net/3/C2560/2011/

Atmospheric Measurement Techniques Discussions

Interactive comment on "

Retrieval of temperature and pressure using broadband solar occultation: SOFIE approach and results" *by* B. T. Marshall et al.

Anonymous Referee #2

Received and published: 28 January 2011

This paper describes a number of general considerations for temperature retrievals from broadband solar occultation, describes the retrieval approach used for the latest version of the SOFIE instrument, and presents comparisons of SOFIE results with the results from other satellite instruments. Overall, the paper is well written and clearly presented. Any concerns I have are relatively minor.

Contributions to the errors from various sources (detector noise, pointing errors, errors

in CO2 VMR profile, and errors in values of P and T at the lower boundary) are investigated. I feel there are a couple of other contributions one might expect in "real world" applications that should have been at least mentioned.

When measuring in broadband, the filter regions are presumably chosen such that the signal is dominated by the target molecule. However, I expect there could be contributions to the signal from other molecules, and limits on your knowledge of the concentration profiles of these interferers will contribute to the errors. Also, the interferers need not be different molecules, they could be different isotopologues of CO2 (which will in general have different VMR profiles than the main isotopologue), or you could have CO2 lines with different lower state vibrations within your filter having different effective vibrational temperatures due to non-LTE effects. Is it possible to choose your filters to avoid all such complications (i.e., encompassing a spectral region that contain only CO2 main isotopologue lines with a common lower state vibration and negligible absorption from other molecules) over the entire altitude range of interest? I'm certain I read that SOFIE temperature retrievals suffered from non-LTE effects. Are non-LTE effects being modeled in the retrievals now? If so, do you really expect the residual errors from non-LTE effects are completely negligible? If not, then you might want a paragraph at the end of Section 4 that lists additional potential sources of error not considered in your study.

Because SOFIE often measures PMCs, it is perhaps worth mentioning why you do not expect significant contributions to the error in retrieved temperatures from have ice in the field of view (ice is a minor interferer near 4.3 microns). Can you get enhanced errors in T for very "bright" PMCs (i.e., due to a significant contribution to the spectrum at 4.3 microns from ice when there is a lot of ice along the line of sight)? If so, this should be mentioned.

Later in the manuscript, you mention that retrievals were improved by including line mixing effects in the 4.3 micron band but did not previously mention line mixing as a potential source of error. Again, for completeness I think you need a paragraph or

so, probably at the end of Section 4, where you discuss potential sources of error not estimated in your study.

It wouldn't hurt to mention some of the SOFIE instrument characteristics, particularly details (like bandwidth, perhaps) on the filters used to measure the 2.7 and 4.3 CO2 bands.

On page 5753, line 11, you state that CO2 is known to 1% in the stratosphere. Do you have a reference available for that statement? If not, you may want to say instead that it is "assumed known to 1%" rather than stating it as an unsubstantiated fact.

On page 5753, line 20, you say "With proper selection of spectral band-pass for the 2.7 and 4.3 micron channels, it is possible to retrieve a CO2 mixing ratio profile simultaneously with T (P)." No guidance is provided as to what constitutes "proper selection," so this statement felt a bit vague to me. You should probably mention what filter regions you used for your retrievals with synthetic measurements.

On page 5756, line 9, you mention line mixing effects in the 4.3 micron band. Ideally you should provide a reference to measurements of line mixing in this band, particularly because not everyone will know what is meant by line mixing.

If I understand correctly, CO2 VMR is not retrieved in v1.03 processing. What is the source of the CO2 VMR profile employed in your retrievals? If it is from a model, you should mention the model.

Minor comments/ technical corrections:

On page 5748, lines 8-9, you mention that R_air varies with altitude, but the parameter is not explicitly shown as being a function of z in Equation 4. I assume this means that it is fixed to a constant value, and the altitude dependence of the average molecular mass is ignored. This is not clear from the text.

On page 5756, line 1, "This data is" should be "These data are"

On page 5761, line 2, you say "differences above 0.01 mb" when you really mean "differences for pressures below 0.01mb"

In Figures 8 and 10, you show differences in retrieved pressure below 34 km (the altitude used as zo), when I thought pressure and temperature were supposed to be fixed in that altitude region.

In the caption to Figure 17, you say ". . .overcome lower boundary error of 2% in pressure and 5 K." You should probably have "in temperature" at the end of that sentence.

In Figure 20, you label the CO2 VMR profile as "simulated retrieval," but the VMR profile is not actually retrieved. It is an erroneous profile you have introduced to investigate the sensitivity of the temperature retrieval to errors in assumed CO2 VMR.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 5743, 2010.