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Atmospheric Measurement Techniques Discussions

Interactive comment on "IMK/IAA MIPAS temperature retrieval version 8: nominal measurements" *by* Michael Kiefer et al.

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This article describes a new temperature retrieval from Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) measurements, employing an updated set of radiance spectra along with upgrades to the processing scheme compared to previous processing versions. The paper is well-written, well-organized, clear, and comprehensive. I just have a few minor comments.

I would have liked to see a few more words on how pressure is handled. The comment on page 8 ["Between 43 and 53 km, a smooth transition between ECMWF and bias-corrected WACCM temperatures is obtained by linear interpolation along with hydrostatic correction of pressures at the given geometric altitudes."] seems to imply that

pressure is fixed to a priori information in the analysis and makes me wonder if perhaps the source of pressure information is different below 43 km versus above 53 km. The significance of this question comes from the following comment:

Page 24, line 553: V8 engineering tangent altitudes are, on average, lower than the retrieved ones by about 200 m below 40 km and by about 50 m above

I can imagine that the onset of refraction effects below 40 km might contribute to larger discrepancies in this altitude region, but I would perhaps naively expect such errors to increase with decreasing altitude. As described here, the errors seem to be more of a step function, possibly suggesting something in the analysis that generates a $\sim$150 m discrepancy below 40 versus above 40 km. Obvious candidates would be pressure (from page 8, the described hydrostatic correction of pressures between 43 and 53 km), or from Table 2, there is a set of three microwindows containing strong CO2 lines where the lower altitude limit is 42 km. Discrepancies between these microwindows and other microwindows used in the analysis below 42 km could give rise to an apparent step in pointing. The latter possibility could be tested by adjusting the lower altitude limit of the three microwindows in question from 42 km up to 55 or 60 km and see if the discrepancy from engineering information changes for the region just above 40 km.

It would be good to say a few words on the determination of instrument pointing (tangent heights). I assume it basically amounts to ensuring hydrostatic equilibrium is maintained for the combination of assumed pressure profile and retrieved temperature profile, but it is not clear from the text.

The apparent step function in the discrepancy from engineering information below 40 km versus above 40 km is not reflected in the error estimates. If the source of the step function is a problem in the assumed pressure profile, the retrieved tangent height will mostly compensate, but there might be a 'second order' contribution to the retrieved temperature error, along with a 150 m altitude registration offset in the two altitude regions.

Even if there is a 150 m step, though, things are still better off than the previous processing version. I am not advocating further investigations at this time or significant changes to the paper. Just a few words on how pressure is handled and a brief description of the nature of the tangent height determination (e.g., ensuring hydrostatic equilibrium) would suffice.

>Page 10, line 248: The cause of the continuum signal from high altitudes is presumably meteoric dust

I do not know what magnitude of continuum levels are being discussed, but it would surprise me if that were the case. I can see there being measureable scattering effects for lidars operating in the visible, but we are talking about the thermal infrared here. Contributions to the spectrum from background sulfate aerosols could extend up to about 40 km. However, my first inclination would be far wing contributions from the nearby strong CO2 Q-branch that are missing in the calculation (assuming your calculation does not extend that far in wavenumber), or the shape of the far wing contribution isn't quite right (e.g., it should be sub-Lorentzian or line mixing contributions are missing or not quite right). The shape (as a function of wavenumber) for the retrieved continuum parameters might give a clue. If the far wing lines are missing in the calculation for a set of microwindows, if the apparent continuum is larger for microwindows closer to the CO2 Q-branch, that could suggest far wing effects are the source.

Note that I cannot say with certainty that the continuum is not associated with meteoric dust. Perhaps it is, but it would surprise me.

>Page 10, line 266: the offset can vary independently between microwindows

The sources of offsets that I can imagine would all at least vary smoothly with wavenumber. Self-emission of the instrument, which would provide an offset with a blackbody curve appropriate to the instrument temperature. Deficiencies in the detector non-linearity correction. Hard to say what the shape might be, but would it be random? Channeling artifacts, which would have a sinusoidal variation with wavenum-

ber (or a superposition of sine waves if there are multiple contributions), but if your microwindows sample the sine pattern (or the beating pattern from multiple overlapping sine waves) at various locations, I suppose it might look vaguely random.

Is there typically a lot a scatter as a function of wavenumber in the retrieved offset values? Is there a physical explanation attributed to the offsets?

>Page 17: Random errors are errors which explain the standard deviation of the differences between measurements of the same state variable by two different instruments

I know what you are saying, but the wording implies a narrower definition of random error than I would like. How about the following:

When comparing measurements of the same state variable by two different instruments, random errors are errors that contribute to the intrinsic variability (standard deviation) of the differences.

———— Minor edits and wording suggestions: ————

>Page 3, line 56: exemplary results

'Exemplary' means perfect, flawless, the best of its kind. While it is possible you were suggesting your results are perfect, I wonder if you meant 'example results.'

>Page 4, line 91: MIPAS spectra are analyzed with constrained nonlinear least squares fit

. . .with a constrained. . .

>Page 4, line 110: but are least interfered of gases of unknown abundancy

Awkward phrasing. Suggest something like 'with minimal contributions from gases of unknown abundancy'

>Page 6, line 154: for the RR measurements)

delete the ')'

>Page 6, line 163: following implementation of the altitude dependence

. . .the following implementation. . .

>Page 20, line 480: and we investigate, to which degree MIPAS provides

delete the ‘,’

>Page 21, line 500: it is obvious, that the differences

delete the ‘,’

>Page 24, line 534: The example shown in the lower panel demonstrates, that MIPAS is

delete the ‘,’

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