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Atmospheric Measurement Techniques Discussions

Interactive comment on "Potential for the measurement of MLT wind, temperature, density and geomagnetic field with Superconducting Submillimeter-Wave Limb-Emission Sounder-2 (SMILES-2)" *by* Philippe Baron et al.

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General remarks

This paper assesses the ability of a proposed sub-mm-wave limb sounding instrument to measure some dynamic properties of the mesosphere and lower thermosphere (MLT). No such instrument with the ability to measure both vector components of the wind has been flown before. Furthermore, at least some of the spectral regions which

the new instrument will use (including the spectral region described in this paper) have not been used by previous instruments. The paper therefore represents an advance in understanding and should be published.

The standard of written English in the paper is very good. Only a few mis-placed or missing "the"s and "a"s hint that it was not written by a native speaker. I note a few such corrections below. I do not claim to have found all of them, but in any case they should not prevent publication of the paper. The figures are mostly of an adequate quality for publication; I make a few suggestions for improvements below.

I am not a fan of sentences of the form "British (French) people prefer beer (wine)". There are several such sentences in the paper, e.g Page 1 lines 11–12, Page 13, line 22, and the caption of figure 8. I can not find any guidance in AMT's instructions as to whether such sentences are recommended or not, but I seem to recall dealing with another journal recently which told authors to avoid this construction. I do not insist that these sentences be re-written, but I suggest to the authors that they consider doing so. To write "British people prefer beer, while the French prefer wine" is a little more wordy, but far less confusing to the reader.

The one scientific/technical issue I have with the paper is that the explanation of how the quantities of temperature, pressure, density and height are connected seems inadequate. These quantites are linked via the hydrostatic equation and the ideal gas equation. Limb sounder data is typically used to estimate quantities as a function of some vertical co-ordinate.

- If that co-ordinate is pressure (as with MLS), then temperature is determined as a function of pressure, and the geopotential height of a single pressure surface is also estimated. The geopotential height of any other pressure surface is then obtained using the hydrostatic equation.
- If the vertical co-ordinate is geometric or geopotential height, the limb sounder

measures pressure and temperature as a function of height.

In both cases, density can be obtained from the pressure and temperature using the ideal gas equation. One could choose to use density instead of pressure as a vertical co-ordinate. Or, with height as a vertical co-ordinate, one could estimate the density directly from the measurements and obtain the pressure from the ideal gas equation. This appears to be the approach taken by the authors of this paper; I think they should explain it in a little more detail and state why they chose it over other possible approaches. They should in particular explain if, and if so, how, the hydrostatic equation is used to constrain their estimates.

Specific comments

- Page 2 line 31: MLS only measures one of the two vector components of the wind: it is perhaps worth reminding the reader here that the proposed instrument (with its two antennae) can measure both components.
- Page 3 lines 5-10 and table 1: This section should perhaps also reference Wang et al. (https://doi.org/10.5194/amt-2019-212), who describe the TALIS mission proposed by China. (TALIS, if built, will be very similar to Aura MLS.)
- Page 7 figure 3: The caption gives a magnetic field in Gauss, while Figure 10 shows magnetic fields in Tesla. The paper should present all magnetic fields in consistent units (preferably in Tesla as it is the SI unit.)
- Page 13, Line 10 and Page 14, Figure 7. The text states that the left panel shows "atmospheric density", while the label on the figure itself says "O_2/Density (%)". The figure appears to show neither of these things — rather, it shows the mixing ratio of O_2. It is quite confusing that this figure combines errors in % of the

quantity measured with profiles of the quantity itself. For O_2, the label "ppmv $\times$ 10" is wrong as the quantity shown is the mixing ratio itself. For NO, it is unclear how the scale should be interpreted for the climatological profile — maybe that panel is missing a label along the lines of "ppmv $\times 10^x$" for some x.

- Page 17, figure 10: many of the curves go off the top of the figures. It would be preferable to add an extra log decade at the top of each panel, while making the entire figure taller so that the same level of detail is visible as at present.

Technical corrections

- page 4 line 15: "Tables 2" should be "Table 2"
- Page 4 line 17: "with 7 min" should be "with a 7 min"
- Page 5 Line 3: "oxyde" should be "oxide"
- Page 5 line 8: "under the local" should be "under local"
- Page 6 Line 4: "The molecular" should just be "Molecular". Also, "so-call" should be "so-called", but actually I would remove it entirely — to a native English speaker "so-called" implies that people call it that, but that they are wrong to do so.
- Page 8 line 9: "They dependent" should be "they are dependent". Also, remove "such as" from this sentence.
- Page 10 lines 20 and 23: First mentions of figures in the text should be in numerical order. Here, Figure 6 is mentioned before figure 5.

- Page 12 Line 20: “a1” and “a2” should be in italics and should not have “” round them ($a1$ and $a2$), in order to match their appearance in the equations.
- Page 15 line 5. “likely” should be “probably”. Despite ending in “-ly”, likely is an adjective and is synonymous with “probable”. It is not an adverb synonymous with “probably”. You could re-word the sentence to read “It is likely that this impact occurs . . . ”. (Americans never get this right, and I recognise that I am fighting a losing battle with them.)