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Interactive comment on "The evolution of AMULSE (Atmospheric Measurements by Ultra-Light Spectrometer) and its interest in atmospheric applications. Results of the Atmospheric Profiles Of GreenhousE gasEs (APOGEE) weather balloon release campaign for satellite retrieval validation" *by* Lilian Joly et al.

Anonymous Referee #1

Received and published: 15 November 2019

OVERVIEW: This paper describes the ongoing development of a novel new greenhouse gas (GHG) measurement system designed for deployment on standard meteorological balloons using an ultralight (< 3 kg) mid-IR spectrometer. Because in situ trace gas profile measurements are of high value for atmospheric chemistry, transport models, climate change studies, and satellite validation, this topic is of interest to, and

suitable for, publication in AMT.

RECOMMENDATIONS:

Reconsidered after major revisions.

GENERAL COMMENTS

1) While the paper's topic is of high interest for reasons cited above, major revisions will be needed to bring the manuscript to publication quality.

2) Certain sections (detailed more below) would benefit from additional expository, where other sections are questionable as to the scope of a single paper. Additional content will be necessary to link the work with the large quantity of current and previous related work.

3) Linkage to current/previous work (e.g., other trace gas measurement systems and satellite validation) is essential as the paper seeks to identify itself as of something of "interest in atmospheric applications," but then falls woefully short of pointing out specific applications with appropriate citations to existing/previous work (some given below). Previous work includes retrieval algorithm validation work from the AIRS and CrIS instruments and other in situ greenhouse gas measurements. The AIRS instrument isn't even mentioned in the submitted paper, nor campaigns such as HIPPO or ATom, nor well-established networks such as TCCON, which is a glaring oversight given the paper's original stated goal of "interest in atmospheric applications and satellite validation." This needs to be corrected in the revision.

4) There are numerous issues with grammar throughout (e.g., spelling errors, problems with singular/plural usage, etc.); I have identified out some corrections below, but not all of them.

SPECIFIC COMMENTS

1) Title: IMO the title could be shortened (the entire second part could be deleted) and

modified. A suggestion is as follows: "The development of the Atmospheric Measurements by Ultra-Light Spectrometer (AMULSE) greenhouse gas profiling system and its interest in atmospheric applications"

2) P. 1

a) Line 5: Rewrite "under weather and tethered balloons" as "via standard weather and tethered balloons"

b) Line 8: replace "tethered balloon campaign and for a balloon campaign" with "two experiments" 3) P. 2

a) Line 7-8: rewrite as "During the last decades, evidence has been accumulated that this climate change is directly related to the human activates" and include the 2019 IPCC Report and 2019 AMS State of the Climate citations.

b) Line 21: Here and elsewhere, plural/singular usage needs to be corrected. I do not have time point out every occurrence here in a formal review – it is systematic throughout the document and needs to be corrected. In this case, "many informations" should be replaced simply with "information" – "information" is already both singular and plural – there is no such word as "informations". 4) P. 4

a) Line 26: "meters' " should be simply "meters".

b) Line 27: Pertaining to plural usage, replace "lots of preparations" with "a lot of preparation"

5) P. 5

a) Line 2: "The specificity of the balloons, to be able to access the profiles" – meaning not clear.

b) Line 11: "resolution of few meters" – needs to be more quantitative, e.g., "1-5 meters" (or something like that)

c) Line 21: "atmospheric sensing" is much too vague – rewrite as "measuring atmospheric gas concentrations"

d) Line 28: "Lambert Beer's law" is usually referred to either as "Beer-Lambert law" or "Beer's Law"

6) P. 6

a) Line 13: What is meant by "meteorological fields"? Such terminology usually refers to an analysis or model of a particular set of state parameters, but I don't think that's what you're talking about with an Iridium module.

b) Line 14: "computer fixed at 400 m" – what does that mean or how is it relevant?

c) Line 16: Capitalize acronym "AMULSE"

d) Line 18, Table Caption: Delete "This table illustrates" and begin simply with "Evolution (between 2015 and 2018. . .)

7) P. 7

a) Lines 1-2: Please give the fractional differences (%) as well.

b) Figure 1 Caption: capitalize AMULSE and don't refer to the insets as (a), (b), (c), which usually simply refer to the panels of a multi-panel figure. Instead simply refer to them as "insets".

8) P. 8

a) Line 5: Here and elsewhere, replace "captive balloon" with "tethered balloon" – "captive balloon" is not a standard terminology.

b) Line 8: Here and elsewhere, I suggest replacing the word "campaign" with "experiment", based upon the descriptions of said experiments. A "campaign" usually refers to a dedicated mission that deploys single or multiple moving platform aircraft (e.g., ATom or CalWater), ships, or a dedicated observing network spread over an area and

working in coordination with one another over an intensive observing period. Perhaps the Authors haven't fully described their mission or I have misunderstood, but what they describe otherwise sounds more a like an experiment.

c) Line 9: replace "spatial" with "vertical" – spatial resolution refers to horizontal resolution.

d) Line 10: to what point spacing are the data interpolated?

e) Lines 10-13: Need to comment/discuss the boundary layer evolution shown on the figure, or otherwise delete the figure.

f) Figure 2: The H2O is given in %, but % what? I presume it's not RH.

9) P. 9

a) Line 1: Reiterate what APOGEE stands for, and more details on where and when it was conducted.

b) Line 9: What does "GSMA" stand for?

c) Line 10: sentence needs period.

10) P. 10

a) Figure 3 caption: Rewrite "connected in order to send" with "connected which measures and transmits"

b) Figure 4: Is this the "GSMA" site? More details are needed in the caption.

11) P. 11

a) Table 2: Either insert commas "," in the altitude numbers (e.g., 19,121) or rewrite in km (e.g., 19.121).

b) Line 3: "photosynthesis phenomenon"? How does photosynthesis "enrich" CO2?

c) Line 6: insert "the year" before 2020 for clarity.

12) P. 12

a) Section 5.1.2 Radiative Transfer Model: To my knowledge, greenhouse gases (or greenhouse gas channels) are minimally assimilated into NWP models – these models assimilate thermodynamic sounder channels (e.g., temperature/moisture) for forecasting. So it is not clear to me what the ultimate relevance of this section is to the paper, which ought to be more focused on the new (and novel) in situ gas sampling system.

b) Line 6: "a prior" should be "a priori"

c) Line 11: "The differences between observations and simulations are called innovations." – I am unfamiliar with the terminology "innovations".

d) Line 15: Capitalize TIROS.

13) P. 13

a) Line 14: insert "near the surface" between "high sensitivity" and "to window channels"

b) Line 15: Here and elsewhere: Use decimal points to separate the unit and tenth decimal places – at first I was completely confused when I saw 1.080 to 1.150 cm-1, thinking these were near-IR to microwave channels when talking about an IR instrument. Please rewrite simply as "1080 to 1150 cm-1")

14) P. 14

a) Last line: What does "ARPEGE" stand for?

15) P. 15

a) Last line: It should also be noted that there is a temporal difference in the overpass times between IASI and CrIS. Also, the Author should always be explicit as to what satellites they're talking about. For IASI is it Metop-A, -B or –C? For CrIS is it Suomi NPP or NOAA-20?

C6

16) P. 16

a) Equation 1: These equations could be expressed better. Why "EXP"? Is it possible to simplify the subscripts by abbreviating them to a simply letter (e.g., replace "simul" with "s", "REF" with "r" or "b" for background, "AMULSE" with "o" for "obs", etc.) Also, why are three variables in boldface?

17) P. 17

a) Figure 9 caption: What does ",rp" mean?

b) Lines 5-6: Please explain the relevance to the current paper.

18) P. 18

a) Lines 8-10: It is not clear what relevance this has. Are simulations usually "validated" in this manner? Usually what is done is that radiative transfer model (RTM) "obs minus calc" are subjected to empirical bias correction "tuning" using observations such as this (where the RTM is then later used in retrieval algorithms), but that's not "validation."

19) P. 19: nothing

20) P. 20:

a) Line 14: include "AIRS, CrIS" along with IASI; Combine sentence fragments by replacing "." with "," before "which".

b) Line 17: insert "level" after "pixel" and insert "or from cloud-cleared spectra as done by the AIRS and NUCAPS systems (Susskind et al., 2003; Smith and Barnet, 2019)." (References provided below)

c) Line 20: Replace "ozone analyses" with "ozone retrievals"

d) Line 23: Insert citation "(Nalli et al. 2018)" for the ozone retrieval validation connection.

e) Line 26: What does "restitutions" mean?

21) P. 21

a) Line 2: What radiosondes?

22) P. 22: The Authors should provide a bit more information on their 1-D VAR retrieval algorithm and then should relate their results using this algorithm with results from established operational algorithms such as NUCAPS (as in the Nalli et al. reference) and/or AIRS.

23) P. 23

a) Figure 12: Because the Authors aren't even showing AMULSE measurements in these figures, it's important that they related it to their AMULSE work and also tie it back to other work on the subject of ozone validation using ozonesondes.

b) Figure 12d: Fix typo "Radiosondge" should be "Radiosonde"

24) P. 24

a) Figure 13 Caption: Simplify by rewriting as "As Figure 12, except for IASI..."

b) How is "validating the quality of our simulations essential for NWP models"?

25) P. 26

a) Line 13: Please provide full citation.

REFERENCES (not all-inclusive – please feel free to include more if you have them, including specifically references to other in situ measurements such as HIPPO, ATom)

Blunden, J. and D. S. Arndt, Eds., 2019: State of the Climate in 2018. Bull. Amer. Meteor. Soc., 100 (9), Si–S305, doi:10.1175/2019BAMSStateoftheClimate.1.

Chahine et al., 2006: AIRS: Improving weather forecasting and providing new data on greenhouse gases, Bull. Amer. Meteorol. Soc, 87, 911-926.

IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups

I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Nalli, N. R., et al., 2018: Validation of atmospheric profile retrievals from the SNPP NOAA-Unique Combined Atmospheric Processing System. Part 2: Ozone, IEEE Trans. Geosci. Remote Sens., 56(1), 598-607, doi:10.1109/TGRS.2017.2762600.

Smith, N. and C.D. Barnet, 2019: Uncertainty characterization and propagation in the community long-term infrared Microwave Product System (CLIMCAPS), Remote Sens., 11, 1227, doi:10.3390/rs11101227.

Susskind, J., C.D. Barnet, and J.M. Blaisdell, 2003: Retrieval of atmospheric and surface parameters from AIRS/AMSU/HSB data in the presence of clouds, IEEE. Trans. Geosci. Remote Sens., 41, 390-409.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-335, 2019.