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Interactive comment on "Understanding nighttime methane signals at the Amazon Tall Tower Observatory (ATTO)" *by* Santiago Botía B. et al.

Anonymous Referee #1

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This is a generally well-written manuscript about understanding the reason why methane concentrations are occasionally strongly positive at nighttime in the Amazon forest. The authors describe that the positive gradients occur when the atmosphere is stable, with wind speed and direction in a certain range. They eliminate local sources, forest fires as potential explanations and conclude that the most probable explanation is remote sources from wet forest areas, where the methane is brought into the air by meso-scale type atmospheric circulations. As a plain observations driven analysis, this is a welcome and original scientific contribution. At the end the authors suggest that further research by modelling could strengthen the conclusions, and I agree, although the modelling will be challenging.

The manuscript is clearly written, most arguments are sound. I have two concerns,

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Discussion paper

however. The first is: the paper is overly long. The results section is a mixture of results and discussion and even hypotheses. It takes a long time to read and this will scare off potentially interested readers. I suggest a general reduction in the order of 35% for all sections, which I think is feasible. My second concern is that there are a lot of hypotheses (as indicated by 'could', 'probably', 'potential', etc.). These hypotheses are mixed with real results. I suggest a better separation of the text in 'Results' into a section containing data-driven evidence and a section containing discussion (including hypotheses). In this way it will be easier for the audience to know what the data-analysis contribution of the authors is, and which part is still open for interpretation, further experiments, modelling, etc.. I think such a separation is more conform the journal's standard too. After these two concerns are addressed, I would advise publication of the manuscript in Atmos-Phys-Chem.

Specific comments:

P2, l31: 'Vertical CH4 profiles . . . to decrease': the concentrations decrease or the profile has a negative gradient, but a decreasing profile is not semantically correct.

P4, l 28: Rototronic → Rotronic.

Section 2.5: include units in the comparisons (e.g. CH4_grad < 0 ppb).

Section 3, all subsections: the text is too long, there is a lot of speculation, as a consequence the readers doesn't know what is fact and what is thinking.

P7, l12: 'This directly affects. . .': this is not true per se. It depends on the gradient and the source. If the free atmospheric concentrations are higher than the PBL concentrations (positive gradient), more mixing will lead to higher concentrations near the ground, not lower.

P7, l 21: I don't think 4 m above the soil would be too high to measure the contribution from soil CH4 emission at night, particularly because many forest atmospheres are slightly unstable at night because the canopy top is cooling faster than the soil.

P7, l30: you derive a WFPS of 57%, which is interesting information. But on the basis of what do you deduct that CH4 production is enhanced? Could you show evidence of the variation of WFPS and from which level is methane production enhanced?

P8, section 3.1.1: I wonder if it would be useful to give these examples earlier in the paper. I would have appreciated it.

P8, section 3.1.1, first paragraph: this is a verbal description of what can be easily seen in the figure. Please shorten and only highlight the aspects of importance.

P8, l28: ... the profile decreases. The gradient decreases or the temperature decreases, but not the profile itself.

P16, l 28: At this point I was wondering how you imagine the CH4 to reach the higher levels. It would make sense to tell the reader that section 3.3.2 is dedicated to explaining this transport mechanism.

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