

## ***Interactive comment on “Study of the main processes driving atmospheric CH<sub>4</sub> variability in a rural Spanish region” by Claudia Grossi et al.***

### **Anonymous Referee #1**

Received and published: 2 February 2018

#### General comments

The article reports three years of atmospheric methane (CH<sub>4</sub>) and radon (<sup>222</sup>Rn) measurements at a measurement site in central Spain, and presents an analysis of the variability of these two parameters for the period of three years (2013-2015), including also modelled <sup>222</sup>Rn fluxes and planetary boundary layer heights. Furthermore, nocturnal CH<sub>4</sub> fluxes were estimated using the radon tracer method (RTM) as well as a bottom-up emission inventory.

The text is written clearly enough, but should be further improved - best revised by a native speaker/writer (e.g. to improve the structure of sentences). Figures 1 to 3 are too small and the legends as well as labels of Figs. 1 to 2 are not legible. Figure 2S is much too crowded with labels and not well legible. I am not convinced by the color

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scale used in figures 5 to 7; is this safe for color-blind readers? Particularly in Fig. 5, the colors for hours 5 to 8 look practically the same.

I agree with the comment by Referee #2 regarding the disagreement of  $^{222}\text{Rn}$ -based  $\text{CH}_4$  flux estimates with the EDGAR inventory-based ones. While it might well be that livestock is responsible at least for a part of the  $\text{CH}_4$  signal, I failed to see a proof in this work. Moreover, EDGAR should be sensitive to livestock emissions (as they are non-natural), but the opposite seems to be the case. This seems to indicate that the main processes driving  $\text{CH}_4$  variability at GIC3 area are natural ones or that EDGAR is performing poorly at least when livestock is concerned. In my opinion, the focus, discussion and conclusions of the article should be more on the method and less trying to link the  $\text{CH}_4$  variability mostly to livestock as it is the case in the current version. In this context, I also find the title of the article a bit ill chosen.

The section 2.2 is very minimalistic. I acknowledge that concise descriptions of measurement systems is not in the scope of articles in ACP, but as there is no other reference to direct the reader to, at least a schematic of the measurement setup could be added in the Supplement. In my opinion, the paper is suitable for publication in ACP, but only if the comments have been addressed properly.

Specific comments and technical corrections

Note on Technical corrections: in some cases, I have marked a word or formatting only once, but make sure to apply the corrections throughout the text where relevant.

Line 17 (L 17): instead of “concentration” use rather “(dry air) mixing ratio”. Sentence is too long and difficult to read/understand.

L 21: delete “previous”

L 27: delete “of” in “is of 0.32”

L 36: reported by whom?

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L 49: “. . .data and data products. . .”

L 51: “In some European regions. . .”

L 52: what do you mean by “remote”? Please define this more clearly.

L 64: “In this study, we analyzed the time series. . .and December 2015.”

L 68: delete “Particularly,”

L 69: delete “such as Extremadura” – you mention it in L 72 again.

L 75: delete “further”; better replace “mobile” with “ephemeral” or “transient” (without the quotes in the text)

L 83-85: are the durations of the cold and warm seasons defined anywhere in the text?

L 91: “The GNP is located in a granitic basement;”? Rather: “The GNP has a (predominantly) granitic basement and is thus covered by granitic soils with high . . .”

Fig. 1: missing unit in the legend, add reference for CORINE/the map (. . ., 2007)

L 98: delete “Particularly,”

L 100: “In Figure 2, a map . . .”

Fig. 2: instead of “Source”, use “Modified from”

L 120: the reference “Crosson, 2008” is not well chosen here – it would be better to leave it out. Change to “. . . measured with a frequency . . .using a. . .”

L 125: a target gas is, more precisely, used for “checking the stability and quality of the instrument calibration”. Please define better what you mean by “according to the definitions of the World Meteorological Organization (WMO).”; add a reference.

L 131: “. . .of both ARMON and G2301 analyzer are. . .”

L 134: Sample air drying system

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L 144: "...area is quite hilly." is not very explicit, please elaborate on this. A figure showing the terrain would be helpful for understanding to what extent it is justified to apply a method as RTM at GIC3 (c.f. assumptions in Lines 160 to 175).

L 149: how representative are the ECMWF PBLH data for the GIC3 site? This question also relates to previous comment (L 144) – is the variability of the terrain captured well enough in the ECMWF model?

L 185: please explain the acronym UHU

L 195: "...country on a spatial grid."

L 196: provides global annual CH<sub>4</sub> emissions on a 0.1 degree resolution

L 225: "...sample system 11 % of the..." How are the data gaps distributed; evenly or was there a concentration of data gaps in some periods /in which ones?

Fig. 3 I presume "Hour of the day" is in UTC? Please add. Also, better use nmol/mol instead of concentration, which should only be used in communicating with the general public (see e.g. GAW Report No. 229)

L 245: I cannot follow this sentence "A light increase of methane concentrations seems to be observed between the first and the second semester of the year." – please clarify

L 305: delete "Indeed,"

Fig. 9: correct the month name abbreviations to English language; green circles are poorly visible

L 392: if CH<sub>4</sub>-enhanced air masses were transported in the afternoon, would we not see the same pattern for R<sub>n</sub> as well? Please elaborate on this in more detail. It would be interesting to actually see a typical footprint for such events.

L410: There was not much said on the landscape, precipitation patterns, water (bodies), etc. in the region – it is a reasonable guess that livestock has something to do

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with it, but there might be other reasons for this increase in CH<sub>4</sub> fluxes - this should be discussed.

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