

Interactive comment on “Validation of farm-scale methane emissions using nocturnal boundary layer budgets” by J. Stieger et al.

Anonymous Referee #2

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The manuscript describes tower- and balloon-based observations, and the application of a boundary layer budgeting method to determine farm scale emissions of CH₄ at the research farm Chamau in Switzerland. Resulting estimates are compared to inventory based estimates. The manuscript is well written, with well-prepared figures and a clear structure. I recommend publication after the following comments have been addressed.

General comments:

1) Advection seems to be a major issue as with many studies. This is discussed fairly detailed in the paper, however I would recommend the following additions:

- When neglecting F_a in section 2.3, it should be mentioned that this will be discussed in more detail in the discussion section. Otherwise the reader wonders how one can

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characterize the Chamau area as “horizontally sufficiently large and flat terrain with a homogeneous source distribution”

- The fetch of the different profile measurements should be assessed a bit more quantitatively, e.g. by making use of the wind profiles (velocities and directions). Also changing wind direction can cause changes in fetch, and can lead to inclusion or exclusion of emission locations from upwind areas.

- The selection of the wind sector is not very consistent: Section 2.3 mentions the SSE-SW sector, i.e. a wind direction between 202.5 and 225 degrees; the wind direction limits shown in Fig. 3 are at 90 and 270 degrees, and the wind direction observed during the different soundings varies much stronger than the narrow SSE-SW sector. Given the dimension of the farm (buildings cover about a 200 m x 200 m area, estimated using Google Earth), the distance of 150m of the measurement to the nearest farm building seems relatively small. A sketch showing the main farm buildings and the location of the balloon and tower measurements sites would be helpful to the reader to better grasp the geometry.

2) It remains unclear whether the limitation of the vertical integration to the level where $\Delta\theta/\Delta z$ approaches zero really avoids influence on the NBL budget from sources further upwind than the Chamau farmstead. This seems especially problematic for the 2012 observations, where profiles show no clear top of the NBL, and where CH₄ shows no vertical gradient. This should be explained in more details, as also the various references cited in the manuscript do not really provide this information.

3) Usually a budget estimate cannot be given from a single profile as done in Table 1, as a change in the mixing ratio needs to be determined (see Eq. 1). It should be made more clear in the manuscript that this is only possible due to the use of Kriging in time and space and by taking the local derivative. Furthermore, ordinary Kriging algorithms usually also provide an estimate of the uncertainty in the interpolated variable. Have those been used in error propagation to determine the resulting contribution to the

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uncertainty in estimated NBL budget fluxes?

Specific comments:

P21771 L10: Are there any tube effects on CH₄ when using 220 m tube for tethered balloon measurements?

P21778 L20, Fig. 2a: It is unclear how the observations from the different soundings listed in Table 1 support the Kriging results shown in Fig. 2a. The text mentions a maximum around 3:00 LT, while the last sounding was made around 00:48-01:47. It would be helpful if the measurement locations (height vs. time) supporting the Kriging results could be shown as thin black lines in Fig. 2a.

P21780 L25: I suggest replacing "gradient" with "difference"

Caption Fig. 5: "The circles (A) show the NBL budget flux that was achieved if no interpolation was done beyond the height range" I suggest using "extrapolation" rather than "interpolation"

P21782 L25: Also here I suggest using "extrapolation" rather than "interpolation"

P21785 L10-12: This seems like circular reasoning: If the good agreement between NBL budget fluxes with the CHAI estimates is used to validate the experimental approach, the NBL budget fluxes cannot be used to then validate the inventory estimates.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 21765, 2015.