Anonymous Referee #2

We thank reviewer #2 for the review and the thoughts on how to improve the manuscript. In order to address all points mentioned, we reproduce the original statements in blue, and we reply in black; additional text for the revised manuscript is given in red.

General comments:

The paper provides unique CO2 and CH4 biosphere-atmosphere exchange estimation for a region from where such data have been hardly available while the region plays a crucial role in the global atmospheric CO2 and CH4 budget. The study presented in the paper uses the available tall tower concentration measurements to estimate the net CO2 and CH4 exchange. It is a pity, that only nighttime surface-atmosphere flux data can be estimated with acceptable uncertainty yet, therefore, the use of the results in budget studies is limited. The paper is well written and may be accepted for publication after revision. I have only a few comments, partly concerning certain scientific questions, partly of technical character.

Comments:

Page 15346-15347, Section 2.3: Footprint of the measurements depends on the elevation above the ground. A few words would be desirable on how big the difference may be and how much this difference may influence the results of the calculations.

Indeed, the footprint depends on the elevation above ground. Previous runs with the STILT model demonstrated the reduced coverage of a footprint from close to the ground compared to the 300 m tower top qualitatively well, especially during night. However, the main driver for the night-time calculations is the (unknown) boundary layer height and the (limited) mixing therein. It is difficult to reproduce the concentration profile close to the ground with transport models quantitatively correctly; models perform much better at ~300 m height and above. During day, the differences of the footprints between different tower levels shrink; however, the quantitative analysis becomes more difficult, because the well-mixed atmosphere causes only tiny differences in the tower gradient. While some contributing air parcels may originate from even further away than the 300 m night-time values, the turbulent flux component will dominate the total flux, the adequate footprint may concentrate on the nearer few kilometers only (at 300 m height).

For our manuscript, we added the following text on p15347/L6:

"The size of the night-time footprint of the tower will decrease for lower tower levels."

The calculation of the flux footprints is only important for the data interpretation. They do not influence the flux calculations (e.g., in Figure 7 and 9).

Please see also our discussion on footprints with Reviewer #1.

Page 15346, line 23: What kind of 'ECMWF meteorology' was used? (Although the meaning of the abbreviation 'ECMWF' is well known among the professionals, the full name of the organization may be given in the paper for completeness.)

We agree and add the following information to the revised manuscript on p.15346/L23:

"We use the Lagrangian transport model STILT (Lin et al., 2003), which is driven by three-hourly short-term forecast fields from the operational archive of the European Centre for Medium-Range Weather Forecasts (ECMWF, http://www.ecmwf.int/), to get an overview of the origin of air parcels arriving at ZOTTO."

Page 15347, line 12-16: The second sentence lists the fetch areas of the towers in the opposite order than the first sentence lists their heights. It would be more logical to use the same order.

We shifted the text phrases in the revised manuscript.

Page 15349, line 24-29: The method applied systematically underestimates the CO2 sink capacity of the region in the afternoon hours. The reason is understandable but this bias also distorts the monthly and annual integrated NEE frequently used in budget calculations, which is not good news. Could the magnitude of the bias be estimated using the new CO2 eddy covariance measurements? Could the shape of the mean diurnal variation of NEE measured by the eddy covariance system used retrospectively for the correction of the afternoon NEE values calculated from storage? (If the noontime minimum NEE and the evening NEE are reproduced more or less correctly by the storage method, the afternoon values might be interpolated using the mean diurnal variation as the interpolation function.)

We like the suggestion. To validate this method, we would rely on a season, when the Eddy covariance towers and the storage run in parallel without the huge disturbance by forest fires in 2012. Currently, we do not have more recent data points available to compare with (due to a rigid data regulations). We rather see that as an ideal starting point for future investigations.

Page 15350, line 12-13: variing -> varying, widly -> widely

Corrected in the revised manuscript.

Figure 3: legend is missing

Added in the revised manuscript.

Figure 5: ...and years (to be consequent with the captions of Figs 3 and 4)

Added in the revised manuscript.

Figure 10: Why are the data for 16:00-6:00 missing? I would expect a figure similar to Figure 1.

The data was dismissed for better visibility. The process on which we are focusing is taking place in the early morning hours. As it seems confusing, we will add the completed figure to the revised manuscript.