

Interactive comment on “Seasonal trends and environmental controls of methane emissions in a rice paddy field in Northern Italy” by A. Meijide et al.

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We thank the referee for the comments provided, which will improve the quality of the manuscript. The main request of the referee is that we should be more critical in relation to our data evaluation and interpretation. We will follow this suggestion in the revised version of the manuscript, improving the description of the methods and the interpretation of results for both measurement techniques, and expanding the discussion of the literature on the subject.

The detailed replies to each of the comments are provided below:

In relation to the experimental set-up (position of chambers in relation to EC), all chambers were placed within the footprint of the eddy covariance tower. Chambers were placed in two groups of four at different sides of a small dike (1-2 m wide) where the eddy covariance tower was installed, and each group was on average at 25 and 45 m from the EC tower, in the direction where the flux contribution is maximized. This information will be included in the text.

We agree with the reviewer on the use of flux data according to wind direction, and for this reason we will include in the reviewed version an analysis of the dependence of the methane fluxes on wind direction.

The impact of spatial heterogeneity on the uncertainties of chamber measurements has been taken into account. Measurements are computed as average of 8 chambers, which were distributed along the field in the two different sides of the dike with a distance of 2-3 m between chambers and of 20 m between groups. No significant differences (tested by ANOVA) were found between chambers placed at different sides of the dike. All this information will be reported in the manuscript.

For most sampling events chambers were closed for less than 1 hour. The interval reported in the manuscript (90 min) has to be considered as the longest closure time used during periods with low fluxes (beginning of the season). In addition, as chambers were sampled every 15-30 min (30 min at the beginning of the season, 15 during the growing season), 4 concentration measurements were taken for each chamber and sampling event. When the last point was not linear with the previous 3 (because of having closed the chambers for a too long period) the last value was not used for the calculation of the fluxes and the effective closure time was therefore 45-60 min. These details of the measurement protocol will be included in the revised version of the manuscript.

We agree with the referee that chamber estimates would have been more accurate with more than one measurement per day. On the other hand this is the most common protocol in studies carried with chambers, and our intention was to compare the two

techniques as they are commonly applied. We would also like to clarify that samples were taken at midday (12 am), which is a common approach in chamber studies, and not at 12 pm as it is said in the discussion version of the manuscript.

To improve the robustness of the inter-comparison of the two techniques and in accordance to the suggestion of the first referee, we have decided that in the revised version of the manuscript, we will limit the comparisons of the cumulative fluxes to the intervals when both measurements were running properly (removing periods when there were no EC data because of instrumental failure). Moreover, we will revise the wording along the manuscript taking into account data uncertainties.

We would like to thank the referee for the suggestions in relation to the discussion on the diurnal variations and the indications of references, some of which we were not aware of. We will consider the suggested references for the discussion, giving greater importance to other studies where diurnal variations on rice paddies have been found, comparing our results with those from other rice paddies in Italy, especially those done with EC such as the suggested study from Werle and Korman (2002). It is worth notice that also in that study chamber estimated higher fluxes and significant relationships were found between CH₄ fluxes and temperature.

We did carry out simultaneous measurements of CO₂. However, as the paper from McMillan et al. (2007) states, it is recommended to carry out full year round measurements to obtain reliable estimates of the CH₄/CO₂ exchange stoichiometry. In our study, CH₄ measurements started in April, even if CO₂ measurements had already been running for a few years. Therefore, it would only be possible to do this kind of comparisons for the growing season, but not for the whole season. During the growing season, NEE was very high and so were CH₄ emissions, so we thought that even if it can provide some information, it will not be representative of the whole year. For this reason we have considered that it would be more convenient not to include this information in this manuscript.

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We agree with the referee that the method used to estimate the emissions does not differentiate between the processes responsible of these emissions. However, the high temporal resolution of aerodynamic flux measurements provides insights on the role of environmental drivers on ecosystem methane fluxes. Following the suggestion of the reviewer, we will carefully interpret our findings in the discussion and conclusions, differentiating those directly derived from our research from those based on previous studies.

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