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Biogeosciences Discussions

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 reviewer for the comments provided, which have helped us to improve the manuscript. We respond in detail to each of the comments below (the comments were numbered so we have provided our reply just after each of the comments):

1. Reviewer: My major concern is about the overestimation with the chamber procedure followed in this study (Section 2.2 and page 9017 lines18-22): First, sampling time around 12 pm is not representative of the daily average for CH4 flux. Second, the Plexiglass chamber is not isolated for sunshine and heat thus the temperature inside the chamber would increase obviously during gas sampling. The chamber closure duration

lasts for 60 to 90 minutes which is long enough for the rapid temperature increase.

Authors: We would like to clarify that chamber samplings did not take place at around 12 pm but around 12 am (midday). This was a typing error in the original manuscript. This information will be modified in the text, indicating that sampling time was around midday to avoid possible confusions. We decided to sample during the central hours of the day since our goal was to replicate the common sampling protocol followed in many other chamber studies. In relation to the chambers, we decided to use transparent chambers (made of Plexiglas) to minimize the impact on the light regime and on plant physiology during the closure of the chambers. Even if it is known that CH4 is not released through stomata, as pointed out in the discussion, there are some studies indicating that a reduction in solar radiation decreases CH4 emissions (Sass and Cicerone, 2002). In order to cope with the unavoidable changes in the chamber microclimate, during sampling time the chamber temperature was registered and fluxes were corrected for temperature variation. Chamber closure was longer than 1 hour only at the beginning of the season when fluxes and temperatures were extremely low. During the growing season chamber closure was systematically shorter than 1 hour. In addition, as 4 samples were taken form each of the chambers for each sampling event (every 15 min when fluxes were high, every 30 min at the beginning of the season), if the concentration trend was not linear, only 3 points were used. To summarize, when there was a significant increase in temperature during the last period of chamber closure (if it was greater than 1h) and this forced an increase in the emissions, the sampling point has been rejected if not linear with the previous 3. This information will be clarified in the text.

2. Reviewer: Two major measurement gaps for eddy covariance methods (Fig. 3, Page 9011 lines16-20) (each lasted 2 weeks when the chamber-derived CH4 fluxes are not small) prevented robust calculation for the seasonal CH4 emissions. Therefore, comparison between the two methods is not sound.

Authors: We agree with the referee's comment saying that the two two-weeks gaps

in the eddy covariance measurements might make the comparison of seasonal estimations not very robust. Therefore, in the revised manuscript the comparisons of integrated fluxes will be performed exclusively for the periods when both methods were running properly.

3. Reviewer: Similarly, the water table management strategies are not applicable in this study since there are not enough measurements when the water table is around 0-10 cm due to instrument interruption (Figures 2 and 3).

Authors: Looking at Figure 4 we can see that there are 7 measurements when the water table was between 0 and 10 cm. We agree that this is not a large number of observations and that it is actually slightly lower than when the water table was below the soil surface. On the other hand, all measurements taken during this range of the water table depth consistently showed very low fluxes and, from our point of view, are sufficiently informative and robust to be discussed together with similar evidences emerging from the literature.

4. Reviewer: Environmental factors such as water table are associated with seasonal trends and rice plant development in this study. Thus, separate effects of environmental factors and conclusion of environmental drivers can not be obtained.

Authors: The type of experiment presented in the manuscript does not allow the separation of the effects of single environmental factors, giving that ecosystem fluxes estimated with aerodynamic techniques have a large footprint that do not allow factorial experimental design. However, the high temporal frequency and spatial representativity of turbulent flux data allows the evaluation of a combination of environmental variables on the temporal flux series, and this was indeed the aim of our experimental approach. In addition, some of the changes in environmental drivers (such as water table depth) occur at different stages of the development of rice plants, and so effectively provides valuable information in order to evaluate their effect on methane fluxes. However, we fully understand and share the concern of the reviewer and therefore in

the revised version of the manuscript we will address more carefully the interpretation of environmental drivers. In relation to your other minor corrections:

1. Reviewer: CH4 fluxes are composed of CH4 production, oxidation, transportation, and finally emitted out as flux. Both methods used in this study can only detect the flux, not distinguish the underlying processes. CH4 production process can not be studied following this procedure. Authors should carefully differentiate using words “emission” and “production”, such as Page 9000 line 10, Page 9001 line 29, Page 9015 line 28, and Page 9020 line 7.

Authors: We agree that the methods we are using to estimate the fluxes do not differentiate between the processes responsible of the emissions. Indeed, in the indicated sentences the word “production” had been used when it should have been “emissions”. This has been corrected in the text and the whole manuscript will be revised to check that the correct terms are used along the text.

2. Reviewer: Soil water content was at about 60% when water logged in this study (Page 9009 line 24). How can the soil humidity in Figure 2 increased when soil was dried around day 350?

Authors: There was a rainfall event taking place on day 350, which might have slightly contributed to the increase of soil water content on that day. However, the values above 60% at the surface (0-15 cm) in a period when, even if the soil might have been waterlogged, it was not fully covered by a water table, might be caused by instrument failure, so we have decided not to consider them and to remove them from the figure and from any other analysis.

3. Reviewer: Mismatch between text and figure results; Page 9010line 9-10 and Figure 3. Rewrite as “The highest half-hourly emissions were measured in July and August, in the reproductive (not vegetative) and ripening periods”.

Authors: Both points with highest half-hourly emissions took place during the repro-

ductive period. This has been corrected in the manuscript.

4. Reviewer: There is no need for inclusion and discussion of the seasonal integrals of CH4 fluxes measured with chambers without correction for chamber temperature. Figure 6 and page 9012 line 20-24.

Authors: Seasonal integrals of CH4 fluxes measured with chambers without correction for temperature increases inside the chamber will be removed both from figure 6 and from the results.

5. Reviewer: Check the language grammar and expression for concision throughout the whole manuscript.

Authors: The language will be checked in all the manuscript and the specific corrections indicated have already been made.

Interactive comment on Biogeosciences Discuss., 8, 8999, 2011.