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Atmospheric Measurement Techniques Discussions

Interactive comment on "The "Lung": a software-controlled air accumulator for quasi-continuous multi-point measurement of agricultural greenhouse gases" *by* R. J. Martin et al.

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Thank you for your helpful comments. I have considered and incorporated these as appropriate and the result I feels will be an improved paper. My comments are inserted in between your text. RJM 14 June 2011

Anonymous Referee #2 Received and published: 3 May 2011 This manuscript presents an interesting system for measuring N2O and other greenhouse gas (GHG) fluxes. The Lung system, which automatically collects and sends samples for analysis, can be connected either to a mast to perform micrometeorological measurements, or to a set of automatic chambers. The gas chromatographic (GC) technique used to determine the N2O concentrations is up to now, the most common method used to measure N2O fluxes. In this paper the performance of the system in a micrometeorological setting for measuring N2O fluxes is evaluated, and its results compared with those obtained with another technique, the TDL. The paper is therefore methodological and falls within the scope of the journal, as it presents an improvement to an existing method which will allow for the collection of more continuous data and/or decreasing the alteration produced in the environment by using the gradient technique instead of chambers. The introduction is well organized, the method used to evaluate the technique is valid, the related work is generally well considered and the references are adequate. However, some of the explanations should be clarified and separate between the results of this work and further possibilities of the system. The conclusions need to be rewritten avoiding making a resume of the paper and presenting the conclusions of the work carried out.

Some rearrangement of the conclusions has been done.

Specific comments P1936 L2. Even if the results show that the system is more reliable when measuring emissive fluxes than sinks, it does also detect the sinks. Therefore, it would be more correct to remove the word "emissive". Moreover, for other GHG different of N2O, the system should also detect the sinks.

Agreed. Removed "emissive" and revised sentence to: ... capable of measuring surface-atmosphere greenhouse gas exchange fluxes in a wide range of environmental / agricultural settings.

P1936 L9-10 and L11-12. In this paper no results are presented of the use of the

system for flux chambers (even if other uses of the system apart from the micrometeorological setting are discussed). This should be removed.

I have left this in as it illustrates another use for the system. I have clarified that the system has been used with sheep housed in metabolic crates and not soil flux chambers.

P1938 L28-29. Eddy covariance measurements for N2O are already possible and some studies have been carried out, please include some references.

References added.

P 1939 L6-22. This paragraph is too descriptive. Some of this information could be moved to the following section (design and operation) and leave just the information relevant for the introduction.

Some detail moved to the following section to improve readability.

P1940 L 17. Is the flow filling the bags measured?

P 1940 L 9-11. Are bags completely evacuated? Sampling lines are flushed but what about the lines from the bags to send the samples for analysis? Have you checked if there is no memory effect between one sample and the following? This could be the cause of some of the uncertainties in the measurement.

Rewritten paragraph to adequately explain how the flow to the bags is controlled. Yes, the transfer lines as well as the bags are evacuated. There of course must be some carry over from one sample and the following. This was checked early on and it was found to be undetectable.

P1942 L1-8. The previous paragraph explains the gas GC method and the following (already in section 2.3) its calibration. The sequence control presented here, is it specific for the field deployment in the micrometeorological setting with 2 sampling points or would it have 3 sets of bags in case of 3 sampling points? This should be clarified

and in case this is the particular case for the field deployment, move it to the correspondent section, where you have already explained that you are measuring from 2 heights. As the system allows for measures at 3 different heights, if you put it in the description of the system then Fig. 2 should explain the sequence between 3 sets of bags.

This is a typical sequence control for 3 inlets. In this experiment only the 2 inlets in common with the TDL are used in the comparison. The wording has been changed to make this clear.

P1944 L19-23. The failure of the Teflon bags and how they were reinforced with polyethylene tube has already been explained in Page 1941.

Removed the duplicate first reference to the failure of the Teflon bags and how they were reinforced on Page 1941.

P1946 L 12. You are not comparing two detectors but two techniques, as the comparison with the GC includes the whole Lung system, which may lead to some errors apart from those caused by the GC itself. Please clarify.

Agree. Wording changed to make this clear.

P1947 L6-14. You claim that you do not focus on understanding the emission processes but in Table 2 you are separating the results between the periods before and after grazing and you do a small discussion about them. Even if this is not the aim of the paper, as you present the fluxes together with information about grazing and rainfall, it would be interesting to make a short discussion in a separate paragraph, including some references. In Table 2, as standard deviations are very high, could you please indicate if there are significant differences between the instruments and between the pre and post graze periods?

Clarification added to the text. The TDL does better at flux estimate during pre and post grazing due to its higher precision compared to the lung system.

Fig 6. Some of the error bars are out the graph. As the secondary “y axis” is for both irrigation and rainfall, its legend should not be precipitation but a word adequate for both rainfall and irrigated water.

Fixed error bars. Legend changed to “rainfall + irrigation”

Fig 7. It is not very easy to see the time series for TDL-20min, please modify the lines/colors.

I have modified lines and colours to make them clearer.

P1947 L14-15, when you talk about Fig 7, it is said that it describes a 2 day pre-grazing period (days 291 to 293), but then in the figure there are data from 3 days (291 to 294). Please correct.

Corrected.

P1947 L 19. Is it the GC which has lower precision or the Lung? The GC, adequately modified could be very precise. L21 “in the 20 min data” is repeated twice in the same sentence. Please rewrite the sentence in a clearer way. L22 “reversal in flux” is not the adequate term, rather say negative flux or sink.

Used the term negative flux to replace reversal in flux.

Table 1: The instrument specifications for the GC, are they for the GC or for the system of GC connected to the Lung? GCs could be very precise (if adequately set), but lower precision might be caused by problems with the sample transfer of the Lung, leaks or proper evacuation between cycles. In general, the differences between the precision of the Lung coupled to the GC and GC itself should be made clearer. In this paper you are evaluating the Lung coupled to a GC, and its performance against a micrometeorological setting with a TDL, this should be made clearer.

Actually it is the Lung-GC combination that has lower precision. Although the GC itself is very precise, only one determination can be made on each 20 minute sample.

Reworded the paragraph to clarify this.

P1949 L6-10. The analysis has only been performed for N2O fluxes, but a proper setting of the GC could allow for determination of fluxes of CH4 and CO2 (it is said that the GC is already set for CO2 analysis). Please distinguish between what you have observed in this experiment and the possibilities of the system.

Reworded this paragraph to distinguish between what was observed in this experiment and other possibilities of the system.

P1949 L1-4. You chose to build a system with 3 inlets but the results presented are only from a 2 inlet experiment, please clarify.

In this experiment only the 2 inlets in common with the TDL are used in the comparison. The wording has been changed to make this clear.

P1949. Conclusions: the Lung coupled to a GC does allow for simultaneous measurements of several GHGs, but in this paper you have only presented its performance for measuring N2O. You should distinguish between the possibilities of the system and the use you have tested and presented in this paper. A resume of the paper is not needed in this section, just clearly present the conclusions of the experiment. The discussion about the problems of using chambers for this kind of systems should be moved to the discussion.

I have added the following to the conclusions to make this clearer: “This paper demonstrates the capability for N2O but simultaneous measurements of CH4, N2O and CO2 would be possible using standard chromatographic equipment that is readily available in most gas analysis laboratories.”

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 1935, 2011.