**Comments from D. Murphy :**

Introduction :

-the introduction would benefit from careful editing.

→ We propose to do it for the revised version of the manuscript.

-the authors should check if the IPCC method is based entirely on an emission factor applied to fertiliser N alone as implied in lines 23-25 p9291 (I'm not certain myself so I suggest they chek this)

→ we agree that the total emission is not calculated from fertilizer N alone, depending on the crop or soil type (e.g. histosoils) and the crop cycle period (e/g. residues. We will change the text accordingly.

The potential sources of nitrous oxide in the context of rotation with legumes in them are not clearly described as a background to the research. The paper covers the various potential sources, but a clearer description for non-specialists readers would be very useful perhaps by describing a nitrogen supply and use cycle : fixation (synthetic and biological), soil processes priori to and lead to root uptake, and residue decomposition.

→ A few lines have been added in order to describe the different potential sources : biological fixation, nitrogen transformation into the soil including N from rhizodeposition,, residues decomposition

Methods :

There is some repetition between this section and the subsequent section on treatments.

→ The sections have been revised and repetitions have been suppressed, when possible!

The description of the soil is confused –confusing loam with silt

→ the description of the soil has been changed, as required by the reviewer : « The soil was a clay loam with 25.7 % clay, 66.6 % silt and 7.7 % sand »

I think this section should describe the site and the management of plots. How many plots, plot dimensions, measures to prevent inter-plot effects

→It was written in the submitted version that the whole trial size was 0.46 ha. We will precise the size of individual plots in the revised manuscript: each plot was 3.50m * 16.5m for the non-fertilized plots and 5.25m * 16.6m for the fertilized plots (144.4 $m^2$). To prevent inter-plot effects, the chambers were placed in the middle of each plot, and the plants were sampled outside the two border rows. The chambers were placed on the various treatments all over the trial.

we propose to include a plan of the trial in the revised paper.

The description of the treatments could be tightened. In particular it is not clear if the N0 treatments are embedded in the relevant rotation plot which is otherwise fertilised or if the N0 treatments have their own plots.

→ The description of the treatments was simplified in the text. And we will precise that the N0 treatments were at the same place during the three years of the trial.

The treatments and their application to plots in blocks could be presented in a much more straight-forward way.

→ Done.

Results :
Fig 1 is practically impossible to read because the data points and text elements are so small.
→ Done (see figure at the end of this document).

The graphs are a useful summary of key elements of the data. The authors might consider presenting a table of total cropping year emissions data for each year and each of the treatments set out in tables 1 and 2, along with the N0 data. This would make the overall data resource more transparent for readers. The same could be done for soil mineral N after harvest.
→ A table (Table 3) has been added with the same structure as Table 2, but with the data of cumulated emissions during two periods (sowing-harvest ; harvest-sowing of the following crop) and the data of soil mineral N after harvest.

Discussion :
It would be useful if the reader was provided with some orientation of the structure of the discussion.
→ A few sentences have been added at the beginning of the discussion in order to explain the structure of this part. The structure has been changed as the content was not always consistent with the heading! We proposed three parts: (1) discussion on the processes explaining the measurements, (2) discussion on the comparison between the pea crop and the other crops, (3) discussion on the GHG budget.

4.1: the heading is unclear. What is the section about: the effect of crop species or the effect of rotations ? The early sections do not deal with the effect of crops, rather the characteristics of the site.
→ The heading has been changed, and the content was partly modified in order to be more consistent.

Section 4.2 is a very important section and is well written. The last paragraph however belongs in another part of the discussion
→ This paragraph has been moved to a new « conclusion » part.

Section 4.3 is confused and confusing – it draws on existing LCA models to attribute a crop rotation saving peas arising from a combination of reduced fertiliser manufacture, use, and reduced diesel use in application etc. The problem is the research presented does not support the analysis directly. This section needs rewriting to more clearly set out the discussion based on the research results presented supported separately by consideration of other effects (e.g. manufacture savings) presented separately and clearly.
→ We agree that the discussion on this point could be improved. The analysis will be presented into more detail, though remaining short, with a table giving the main values which the GHG budget is based on, as well as the primary references (mainly from LCA databases). This will make it possible for the reader to reconstruct the steps and values of the assessment.

The section also uses IPCC data for emissions even though the research provided high quality data from the measurements. So there seems to be little need to use the IPCC emission factors to estimate the rotational effects of reduced fertiliser application in

crops after peas in this case. The LCA effects of the rotations could be estimated on the basis of the data presented supported by assumptions for fertiliser manufacturing and application emissions. This would link LCA approach (which is useful) better to the research presented
→ As agreed by the second reviewer, we think that the comparison with IPCC emission factors is interesting. Thus, we propose to clarify the discussion on this part to include a specific discussion on comparing our data with IPCC estimates and to add a Table comparing the emissions measured with emissions estimated from emission factors.

Section 4.4
This section seems rather hastily completed and is worth expanding.
→ this section has been developed.

Language and text editing generally
The text would benefit from a thorough revision and editing for language purposes. It reeds as a paper which is not quite finished and I think the authors would do themselves a justice by revising it thoroughly for structure, the logical flow of the arguments presents, and some language aspects.
→ The revised version will be revised by an English-native scientist.

**Comments from R.Rees:**
General : the manuscript provides a valuable account of the emissions of nitrous oxide associated with crops of cereals and peas. The authors correctly identify the scarcity of literature that compares emissions from these crops within the European context, and for that reason the manuscript provides a very valuable scientific contribution to our understanding of the behaviour of these crops within European context. The study has been carefully undertaken, and observations have been recorded over a period of three years, which provides useful assessment of inter)annual variability. The observed lack of carryover in relation to the effects of the crop residues on subsequent emissions is of considerable interest.

Suggested changes : I recommend mostly minor changes to the manuscript prior to publication. This includes the following :
I would suggest that where crops receive synthetic fertiliser nitrogen, that emisions factors are calculated, and added to the table which is subsequently discussed in the manuscript. I expect emission factors from this experiment the lower than default IPCC values.
→ As proposed previously, we added a table comparing the measured emissions with the emission factors from the IPCC method.

Emissions are consistently expresses unit area basis. I would suggest that a table is included that also express emissions per unit product. Such intensity based emissions are becoming increasingly important in literature, and would highlight further the distinction between leguminous and non leguminous crops. Again this should be discussed within the mauscript.

→ We propose not to add this information in the Result part (emissions expressed per unit product), as it corresponds to another question that we do not address in our paper. Nevertheless, we propose to complete the discussion on these aspects.

2.1 Experimental site : Please specify the previous land use for the site, and comment on the drainage status of the soil.

→ the previous crops were barley (blocks 1 and 2) and wheat (blocks 3 and 4). The soil is not artificially drained but it is a deep soil (> 2 m) with a good natural drainage functioning and no evidences of hydromorphy.

2.2 You state that the pea crop was not fertilised, but do you know if it had a sufficient P and K ?

→ The soil contents of P and K were analysed and the level was above the recommended agronomic references. This information has been added in the text.

2.3 Measurements : State the molarity of the KCl extract (line 18)

→ The molarity was 1mol.$l^{-1}$ (added in the text).

Fig1. The figure is far too smal to read without magnification. Could the text size and symbols be increased ?

→ See figure at the end of the document

Section 3.1. Could you confirm that the results in this section report N2O and not N2O-N.

→ All the figures correspond to g N-N2O.$ha^{-1}$. Sorry for the errors in the figure legends.

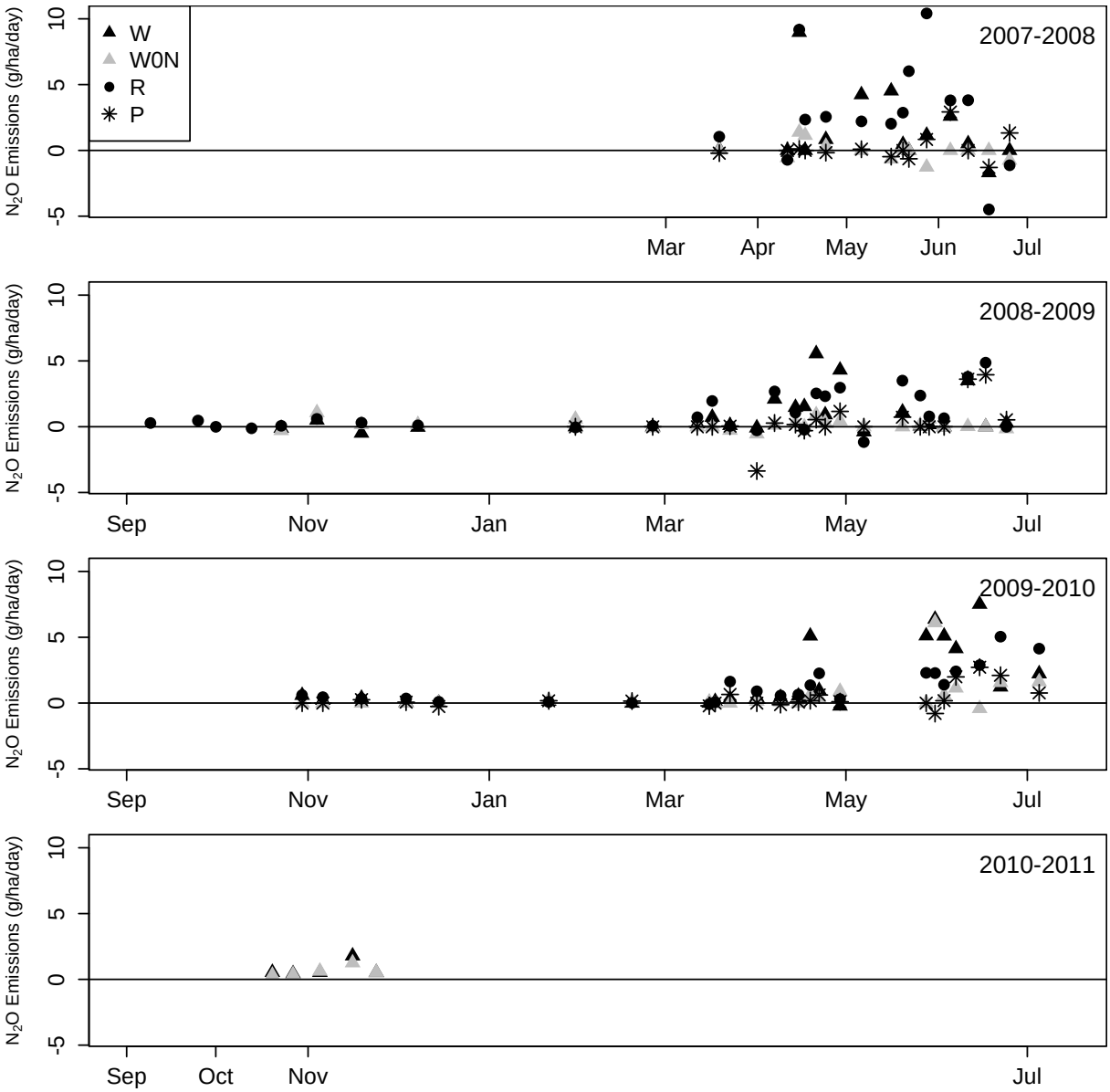
Section 3.1. The magnitude to the emissions and the timing of N2O Peaks would have been strongly influenced by temperature and rainfall. Could it be possible for this data to be presented in some form either as a table or graph ?

→ Prior to the submitted version, we analysed the data of emissions regarding temperature and rainfall: we observed a general agreement with the well-known effects of these two factors but could not derive a specific trend on the whole dataset. Consequently we chose not to present those results which do not add to the analysis nor to the general topic of the influence of climatic factors on N2O emission. We propose to add comments on this topic in the text but not add a figure.

Presentation. The standard of English could be improved. Here are some suggestions, but some further polishing would be helpful

→ The revised version will be revised by an English-native scientist.

Figure 1 :


W
W0N
R
P
2007-2008
2008-2009
2009-2010
2010-2011
N2O Emissions (g/ha/day)
-5
0
5
10
Mar
Apr
May
Jun
Jul
Sep
Nov
Jan
Oct