

## ***Interactive comment on “Quantifying nitrogen losses in oil palm plantations: models and challenges” by Lénaïc Pardon et al.***

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Referee: General comments This is a very useful paper. Nitrogen losses have a large economic cost, in addition to any environmental aspects, so the subject should be relevant to all concerned with the crop. Reply: Thank you very much for your comments. They notably invited us to step back on our results and discussion, and they improved the clarity of the figures.

Referee: I think they could be more critical in the comparison of models, discarding those which clearly do not give useful output. From my reading of the results, the Schmidt model is clearly the best, and I think they could identify that as the basis for further model development. Reply: We understand that clearer recommendations about models to be used or not could add a value to this study. However, on the

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contrary, our other referee proposed a cautious approach regarding recommendations: “It may be good to include some further words of caution to use of the ‘portfolio of models’ rather than a single one – in the absence of further empirical studies.” Indeed, we could not have access to a comprehensive dataset of measured N losses in one specific site. Therefore, we rather chose to keep a cautious approach, adding this sentence in the discussion (L 468): “Therefore, our results call for caution with regard to the choice of a single model to simulate N losses in oil palm. In absence of further empirical studies available to test these models, we would recommend to use several models to perform N losses predictions.” Please, see below for specific comments and replies about Schmidt model.

Referee: Specific comments Line 30 - The comparison with field measurements is the only useful test of the model’s validity. Reply: Yes, we agree. This led us to favour a cautious approach in the discussion concerning a potential ranking of models, because the only available measurements data to assess the models were overall ranges mentioned in Pardon et al. (2016), which summarised a great variety of conditions.

Referee: Section 3.3 - Sensitivity analysis: Combined results for all models, as set out here, seem rather irrelevant. Given that some of the models give poor results in comparison with actual measurements, it would be better to first identify models which might be useful (Banabas and Schmidt look best - see line 452), and then assess the sensitivity of those models only. Reply: Thank you, we understand your advice. However, two points led us to consider still all models in the sensitivity analysis: first, it provides a more comprehensive comparison of the models throughout the paper; second, as the sensitivity analysis is done at the level of the sub-models (each one being potentially used by several comprehensive models), the link between performances of comprehensive models and performances of their sub-models is not always obvious, which means that the selection of the sub-models for the sensitivity analysis would not be straightforward and subject to discussion.

Referee: Lines 495-500 - I agree, and thus conclude that the Schmidt model is better

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than Banabas. However, Schmidt still combines leaching, run-off and erosion, so could be improved. Reply: Ok, thank you for your suggestion. In order to be more explicit, we hence added this sentence at the end of the paragraph (L518): “Regarding these criteria, Schmidt model is the most comprehensive and detailed model, but could be improved by modelling separately losses through erosion, runoff and leaching.”

Referee: Line 562 - It is probably correct that leaching is the main loss pathway, and also probably correct that losses are particularly high during the immature stage, but I do not believe there are sufficient published data to support quite such a definite statement as here. Reply: Yes, we agree, and we moderated the statement replacing “is particularly high” by “is likely to be high”.

Referee: Line 563 - Losses from legume cover crop presumably only become significant when the crop starts to be shaded out and to decay. Reply: Yes, we agree, and we replaced “immature phase” by “young phase” in order to refer to a longer period.

Referee: Figure 2 - Only the pattern from the Schmidt model is similar to that shown by Pardon et al. (2016). Reply: Yes, however we cannot really use the pattern shown in Pardon et al. (2016) to assess these models as it is in itself another model. Moreover, the similarity mainly comes from the fact that the pattern in Pardon et al. (2016) is modelled using a N budget approach accounting for most of the N fluxes, which is the same approach than Schmidt.

Referee: Figure 12 - a logarithmic scale on the Y-axis would allow differences between the smaller values to be seen Reply: Thank you for the idea, we changed the Y-axis to a logarithmic scale, which improves greatly the clarity of the figure.

Referee: Technical comments and corrections Line 39 - Corley Tinker should be 2003, not 2008 Reply: Thank you, we corrected the date.

Referee: Line 58 - I think this should read "...the delay between inflorescence meristem initiation..." Reply: Yes, we agree, and we modified the sentence.

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Referee: Figure 1, etc - These figures might be improved by including an additional line showing the range of published data found by Pardon et al. (2016). Reply: Thank you for the idea, we added the ranges of measured data to Figure 3, 5 and 7. We did not add ranges of measured data to Figure 1 to avoid misinterpretations, as the measured values do not include N<sub>2</sub> whereas modelled values do.

Referee: Figure 1, etc - The emission factors in the figures are almost illegible. Greater contrast between the text and the coloured boxes is needed Reply: Ok, we increased the contrasts.

Please, see the last comment for the revised version of the manuscript.

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