

## ***Interactive comment on “Farm nitrogen balances in six European agricultural landscapes – a method for farming system assessment, emission hotspot identification, and mitigation measure evaluation” by T. Dalgaard et al.***

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This paper presents a method to produce nitrogen balances on a farm level in six European landscapes. Such studies are extremely important with regard to the efficient use of fertilizers and also for generating knowledge bases for nutrient emission mitigation strategies under different conditions. The manuscript is with a few exceptions clearly written and (also with a few exceptions) structure, conditions, management, databases as well as lacks and shortcomings are comprehensively described.

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Due to the complexity of the topic, the authors touch several subtopics of which I think that some have to be described more deeply and others can be shortened or left out. Before I will list some suggestions for potential modifications, I would like to congratulate the authors for their great work and efforts that authors put in this study. I suggest moderate revision of the manuscript. Overall, I think this paper would make a very valuable contribution to the journal "Biogeosciences".

General comment: Reduce the number of the word "however" ;o)

Title: In my opinion, the title is too long. A potential alternative could be: "Farm nitrogen balances in six European landscapes as indicator for N losses and basis to improving N management."

Abstract: I would start with one sentence about the importance of N studies / "the N problem" for the environment. The next sentence could be on what currently is lacking, then present your method. Currently, there is no explanation about your method in the abstract. I would split the (current) first sentence. Mention that N balances on this scale (or as you have done it) are special and innovative (link to other scales!). Add a sentence on uncertainties (important for future studies to filling research gaps). - line 17: "We conclude..". How can you conclude that here? This sentence stands a bit alone here (after the last section). - line 22: "However, no significant..". Short time factor might be one reason, but the other question is if you could cover the different conditions such as soils, weather, denitrification potentials, location, dimension and hydrology of rivers with your monitoring strategies. I am not sure if your correlations make sense in this regard.

1 Introduction: page 8863, lines 1 to 21: I think you should give also some examples for modelling / monitoring studies on different scales (see at least some papers in a special issue of Agriculture, Ecosystems & Environment 142 (guest editors Volk & Ewert, 2011) which deal with data and models (and with related problems) on regional to continental scales). There is also (beside many others) some nice work by Hewett

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et al. (2009) on multiscale management of diffuse pollution (Env. Modell. & Software 24, 74-85), other related studies have been done by Louise Heathwaite, H. Jarvie, I.G. Littlewood or Ullrich and Volk (2010, Env. Monitoring & Assessment 171, 513-527) as well as Volk et al. (2009, Land Use Policy 26, 580-588). Of course you do not have to cite all these studies, but it would be good to give some more background about agriculture- and WFD-(and nitrate directive) related nitrogen measuring, modelling and monitoring on different scales.

2 Materials and Methods page 8864, ff

2.1 Study landscapes - It is not clear to me how you came to the selection /choice of the farms. Could you give an explanation?

- I think it would be useful to have a bit more information on the river networks (see my previous comment), for instance on location, dimension, hydrology, connection to fields, etc.

- Perhaps you could shorten the text a bit if you would add a table including information on size, management, live stock, etc., for the farms.

2.2 Farm N balance and surplus - It would be good to have a flow chart of the method including the data sources / data flow. Perhaps you could extend Fig. 3 (add inputs and outputs to the figure) and do another one with the data? I mean you use interviews, assumptions, measurements at different years, statistics, different other databases (which becomes obvious also in chapter 2.3). I would visualize that, which also could help to point out better the gaps that we have to work on in the future (and perhaps to quantify uncertainties). As you know, alone the atmospheric N deposition rates are discussed in a very wide range.

2.3 Farm data collection page 8873, line 2 to 10: What do these "exceptions" mean for your results?

2.5 Verification measurements - Great and important procedure - did you use a com-

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mon measurement / monitoring design for all you study areas? Nitrate concentrations were measured once a month? This is not much to cover variabilities - see on impact of sampling strategies Ullrich and Volk (2010, Env. Monit. & Assessm.)

3.2 Comparison with independent N measurements line 23 to 28 and following 3 lines on the next page 8876: As mentioned before - you have different locations, soils, weather conditions, denitrification potentials, hydrological conditions, management schemes. What monitoring design did you use to investigate these complex relationships in such a short time?

3.4 N surplus variation and hotspots farms page 8877 line 5-9, Split / simplify sentence. line 16: "in Fig. 6"

3.5 Example on the effect of N mitigation measures in the Danish landscape page 8878 This is a very nice example, but it is not clear how it is related to the other studies / farms. I would bring this either section more into context to the other farm studies or remove it. Right now, this section stands a bit alone here. Maybe write a another paper on mitigation strategies based on your studies ;o)

4 Discussion page 8879 For me the greatest value of your study is to highlight the hotspots, N balances on the farm level in different landscapes as well as to show the different databases, methods and assumptions used to perform the procedure in these different regions with different conditions. This is a great basis for scale- and region-specific development of measures for N emission reduction. So, for me it is not most important to compare the farms amongst each other but more to point out the specifics of conditions, vulnerabilities, tradeoffs which all is good to show environmental problems but also gaps and lacks in data, methods, etc.

4.4 Landscape-scale measurements and sustainable farm N management design - add hyphen between "landscape" and "scale" page 8885-86

- As mentioned before, I think it is difficult to adjust the monitoring design to the different

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conditions of all these different landscapes and farms in order to cover all the relevant processes. - You describe in this chapter only the Danish (nice) example - so what N mitigation strategies would you suggest for the other landscapes of your studies?

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