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Biogeosciences Discussions



# *Interactive comment on* "Significant non-linearity in nitrous oxide chamber data and its effect on calculated annual emissions" *by* P. C. Stolk et al.

**P. C. Stolk et al.**

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Non-linearity in chamber data has since long been recognized as a potential problem for chamber flux measurements: linear regression does underestimate the flux in these cases. Various non-linear regression methods are available that give a more reliable flux if non-linearity occurs. Referee #2 mentions that uncertainties with regard to the non-linear regression models are the "strongest limitation to their use".

Our analysis revealed that these uncertainties for the exponential regression method were too large in our opinion to further use the exponential fluxes. The referee #2 mentions that this decision seems contradictory to the good fit shown by the exponential regression. To get better insight in the uncertainties with regard to the exponential regression, we compared the exponential fluxes with the (linear) flux based on the concentration change in the first five minutes only. As expected from the shape of the



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exponential model, the exponential flux is generally larger than this initial flux. But in some occasions the exponential flux has no relation with the initial flux (see Figure 2 in the revised manuscript). This occurs when the concentration change in the first five minutes compared to the total concentration change is either very small (< 9%) or very large (> 87%). This is the case for 26% (n = 684) of the chamber data. Rather than rejecting over a quarter of the calculated fluxes, we excluded the exponential method for further analysis of significant non-linearity and its influence on the annual fluxes. In support of this decision, we added the results of this analysis as Figure 2 and commented upon this in the text. It appears that all chamber data where the exponential regression method results in extreme *k*-values > 2 (n = 52) were within this 26%. However, from the rest of the data still 8% gives a *k*-value above the physical plausible maximum of 0.286 $min^{-1}$. Apparently this is not an erroneous regression result. This implies that in these cases the theory behind the exponential is not valid and non-linearity must have another cause here. The Referee #2 posted a question about our hypothesis that leakage by macropores caused non-linearity in our dataset. A closer look at the timing of the non-linearity revealed that non-linearity is not bounded to defined periods in the year. No complementary information was available to check the environmental conditions related to non-linearity. Therefore we agree with the referee #2 that also other causes may have contributed to the non-linearity in the chamber data, but we do not have the possibility to further analyze this. We changed the text in the revised manuscript in line with this insight.

The Referee #2 suggested changing the denumerator in the equation for adjusted r-square *($r^2{}_a$)* and use *n-p-1* in stead of *n-p*. Both forms are used in literature. As changing the denumerator would lead to division by zero, we did not do this. However, the median values for $r^2{}_a$ of the various regression methods appeared to be wrong. The corrected values show that the quadratic regression method has a better performance than the linear regression method, also based on $r^2{}_a$. The corrected values are taken up in the revised manuscript.



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A further comment was made by Referee #2 about the overlap in the years used for calculation of the annual fluxes. To more reliably check the impact of different calculation methods for different years, we now limited our analysis to the two years only, with an overlap of 45 days.

Other specific textual comments and comments about the references made by Referee #2 were changed in the revised manuscript.

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Interactive comment on Biogeosciences Discuss., 6, 115, 2009.