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Interactive comment on "Estimating the soil N_2O emission intensity of croplands in northwest Europe" *by* Vasileios Myrgiotis et al.

Vasileios Myrgiotis et al.

v.myrgiotis@gmail.com

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Thank you very much for taking the time to review our article and for your comments/suggestions. Below, we respond to the main points of your review.

The first comment refers to the fact that potentially important elements of an agroecosystem's N budget (e.g. NO, N2, soil NO3/NO4/organic-N) are not covered in this study. It is true that presenting model outputs for all the N-based outflows from the plant-soil-atmosphere-water system would have made the study even more useful. We decided to consider the minimum number of N-based system variables that could provide a good (yet not complete) picture of the N budget of arable ecosystems in Eastern Scotland. The three main aspects behind our decision to consider only plant N and

NO3 leaching, in addition to N2O emissions, were : (1) the lack of field measured datasets or sufficient locally-relevant literature on any other N-based variable (e.g. N2) meant that we would have nothing to compare our outputs with (2) any additional model output considered would have increased the size of the raw regional-scale model outputs that need to be processed for final analysis/presentation âĂŤthat would have had a considerable computational cost (3) discussing and presenting any additional N-based gases or soil elements would have required more text space What weighted more was the fact that both NO and N2 are very difficult to measure on the field [1,2], that measured data for NO/N2 are generally rare and, mainly, that no relevant dataset was available to us. Similarly, and while we had some field measured data for soil NO3/NO4 from UK sites (i.e. sites used in Myrgiotis et al 2018b), we believe that presenting soil NO3/NO4 model outputs would have complicated things significantly. This is mainly (but not exclusively) due to the fact that the Landscape-DNDC model calculates and outputs soil NO3/NO4 on a soil layer-by-layer format, which, in turn, means that for just a single model run at a single point/location multiple values would have had to be read andprocessed âĂŤand this would have had a prohibitive computational cost.

The second comment refers to how representative of Eastern Scotland's climate was the weather in the area during 2013. Mean annual temperature across the region was not different from the 1981-2010 mean but 2013 was quite dry when compared to the 1981-2010 mean (https://www.metoffice.gov.uk/climate/uk/summaries/2013/annual - for climate anomaly maps). However, the total precipitation during spring was similar to the 30-years mean. One could argue that drier conditions might lead to emission factors that are lower than what is "normal" for this area. Nevertheless, as we show in Figure 9, no single factor/variable affects soil N2O emissions so strongly that such a statement could be made without hesitation. In conclusion, we believe that adding some text on the climatic representativeness of 2013 would be useful and will be done in the final revision.

The third comment refers to the 9 model parameters that were identified as being crucial for N2O prediction in previous publications (Myrgiotis et al, 2018a,b) and were used in this study. Table 1 presents, for each parameter, the value used to perform the regional simulations and the "realistic" margins that were used in the uncertainty analysis. Thank you for noticing our omission to state that the samples were drawn from the posterior distributions (presented in Myrgiotis et al, 2018b) âĂŤwe will add a statement about this at the materials and methods section in the final revision. Regarding the uncertainty range that is produced for each output variable (N2O, N uptake, NO3); the uncertainty analysis runs produced 300 values (per output variable and per point/location). We considered different ways to visualise the results of the pseudo-regional uncertainty analysis and concluded that using the relative standard deviation is the best way to present the results for all 3 output variables in a single figure in which readers can see/understand how "sensitive" the regional estimates were to soil inputs and model parameters. Essentially, at each point/location, which was randomly selected and used in the analysis, we divided the standard deviation by the mean of the 300 values produced.

Finally, another issue that was raised regarded the validity/appropriateness of the parameter ranges used in quantifying model output uncertainty. Indeed, according to the results presented in Myrgiotis et al, 2018b, under certain conditions the model might fail to estimate N2O emission peaks when measurements show them occuring. In regards to this, we argue that (1) some of these missed emission peaks were single points with considerable uncertainty attached (i.e. large variability across measured N2O samples) and (2) we identified those "missed-peak" instances as caused by Landscape-DNDC's very detailed soil discretisation method according to which N2O produced at a certain soil layer travels through the soil profile before being released to the atmosphere and can be transformed to other N-gases during this travel; we would like to note that having no or very low emission peaks after fertiliser application is a possibility according to field studies and especially under protracted wet soil conditons. We cannot exclude the possibility that in some of the thousands of point-runs performed, this no/low emission peak phenomenon has occurred. However, plots of time series of the

mean (all grid cells) daily N2O emissions (per crop type) showed the peaks/troughs that one generally expects before/after fertiser application, which means that any no/low peak instances, if present in the our results, were very rare (e.g. no/low peak instances cause mean daily N2O to become an elevated flat line with no peaks/troughs). Overall, we believe that Myrgiotis et al, 2018b provided a field-data-based "constraining" of the theoretical/default parameter ranges and that this constraining was as good as the data themselves (and bayesian calibration and model structure) allowed.

1. Menidets et al, 2015 - A review of soil NO transformation: Associated processes and possible physiological significance on organisms 2. Butterbach-Bahl et al, 2013 - Nitrous oxide emissions from soils: how well do we understand the processes and their controls?

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