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Interactive comment on "Spatial variability and hotspots of soil N_2O fluxes from intensively grazed grassland" *by* N. J. Cowan et al.

Anonymous Referee #2

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The manuscript by Cowan et al. addresses the issue of spatial variability of N2O fluxes caused by the spatial variability of driving factors by interaction of topography, land use pattern and live stock behavior. Cowan et al. demonstrate that a major share of N2O fluxes (>50%) originate from just a small area of a test field (<2%). This indicates that the common procedure to determine field scale fluxes by chamber measurements at locations that represent the majority of soil properties and land use can cause unobserved uncertainties or even systematic errors. The manuscript highlights the need for a spatial distribution of measurement facilities that meet the characteristics of the field conditions. Cowan et al argue that emission factors used to quantify field scale, regional and national emission budgets are often based on insufficient measurement designs. These budgets might therefore systematically underestimate real N2O fluxes at these scales. The manuscript is suggested for publication after addressing following

comments. Page 15344 L12: There are many publications on the relationship between soil properties and N2O fluxes that could be discussed before highlighting the need for more research and better measurement approaches. Page 15344 L24: I understand that the confidence interval (table 3) for aggregated fluxes was derived from the range of N2O fluxes what would represent uncertainty if aggregated fluxes would be based on just one sample otherwise the uncertainty of aggregated fluxes would be smaller. Page 15346 L25: It is mentioned that not covering the full variability of a field could cause an underestimation of derived emission factors and related N2O budgets. In fact, N2O emission budgets are derived from the amount of reactive N multiplied with an emission factor. So far, reactive nitrogen is uneven distributed at the test site and therefore also N2O fluxes are uneven distributed. However, it is not (clear enough) shown that the response of N2O fluxes on reactive N (nitrate) differ between measured features. The number of soil property measurements on soil features (shaded area, manure heap perimeter,..) is probably too small, but it could be interesting to see how the slope of N2O versus NO3 differs between soil features and grazed area and how this relationships can be explained by difference in wfps, soil porosity and ph between features and grazed grassland.

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