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Interactive comment on "N_2O and N_2 losses from simulated injection of biogas digestate depend mainly on soil texture, moisture and temperature" *by* Sebastian Rainer Fiedler et al.

Anonymous Referee #3

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This paper reports on a laboratory incubation experiment to determine potential losses of N2O and N2 after amendments of biogas digestate (BD) by injection. This kind of investigations are important to judge the risk of the use of BD and to evaluate potential trade offs between mitigation of NH3 emissions and increases of N2O in the context of nitrogen use efficiency.

I doubt that the chosen laboratory design allows a sound evaluation of the risk of injection of BD on field scale N2O and N2 losses. The setup of the treatment as given in Figure 1 is far away from a realistic scenario and flux measurements are at best a few snapshots of a complex process leading to emissions of N2O and N2. I have difficul-

ties to follow the rationale behind the chosen conditions. N2O emissions of fertilized agricultural systems are mostly related to trigger events in case rain or irrigations follow application of fertilizer. The production is then concentrated to the few cm of the top soil where WFPS are high and easily reaches values close to 100% in conjunction with the water input. The chosen WFPS of 35%, 55%, 75% seems rater on the low side. I also have my reservation that in this range the effect of WFPS on the gas diffusivity is that great. The soil samples are first well mixed with the BD and the repacked into the soil samples. This is given by the chosen laboratory setup, but drastically differs from a real situation where a small slit in the soil is filled with the digestate that on the soil surface extents to the side depending on the technical approach of the injection. The soil WFPS during the application and the amount of precipitation and irrigation later on will then have a key influence on the timing of subsequent emissions. And as enough water is mandatory for the growth of the plant it is very likely that sooner or later conditions in the top soil (few first mm) with WFPS exceeding 75% will be present. The gathered results are certainly valid from a laboratory experiment point of view and I don't see drawbacks, even though they are counterintuitive as the presented fluxes seems not to be depend on the amount of N-substrate. The given explanation with an inhibitory effect of the high concentration of NH4+ seems plausible for the specific situation of the measurement. Sooner or later an important fraction of this NH4+ will be nitrified and can lead to further N2O an N2 emissions when WFPS increases again.

I recommend that this paper is scaled down to a short communication reporting the laboratory experiment. Any further up-scaling to recommendations for field application of BD especially dependence on the application amount and/or spacing can hardly be justified by the presented results.

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