We thank you for thoroughly reading our manuscript and the detailed and constructive comments to improve the quality of our paper. In the following, we will reply to each remark in detail:

It is a thoroughly conducted study and a well written manuscript, that warrants publication. I have several only minor questions and requests for some clarifications: 1) My biggest confusion when reading the manuscript was the regression analyses between the emissions and the amounts of added litter. Were not the same amounts of litter with the same properties added to each treatment? If that is correct, with only two treatments, how is it possible to do a regression? If that is not correct, better explanations are needed in the Methods.

We used data of all 24 pots for the regression analyses. The amounts of litter added differed between the three litter treatments as described in Table 1. We agree that having only three litter levels does not allow to draw general conclusions. However, for the soil and litter used in our study, the regressions summarize the relationship between litter quality, mineralization, and N_2O and CO_2 emissions.

We will include the missing information in L. 221-223:

For cumulative CO_2 emissions, regression models included the factors total C input, water-extractable C input, hemicellulose fraction, cellulose fraction, and lignin fraction from all litter treatments (-Cn, -Rt, -RS, n=24).

2) There is a need to describe the reasoning for some of the experimental choices and decisions that the authors made. a. What was the purpose of growing plants at two different N rates? I presumed that since you had plants grown at two different N levels you would use their litter separately. If the point was that the plants grown at two different rates will generate different N levels in the soil, would it not be just easier to add N to the soil prior to the incubation?

The main purpose of growing plants at two N rates was to obtain soils with different background mineral N levels for the incubation experiment. We did not add any fresh mineral N immediately before onset of the incubation because we wanted to simulate conditions comparable to agricultural practice in Europe where in most countries farmers are not allowed to add mineral N with crop residues/catch crops. In addition, soil microorganisms adapt to different N availability during plant growth phase.

We will specify this information in the introduction (L. 81 ff):

Maize plants were grown in a greenhouse to produce root and shoot litter. As farmers in most European countries are not allowed to add mineral N with incorporation of crop residues or catch crops, we applied two N fertilizer regimes (low vs. high) to realize differences in soil N_{min}

concentration at harvest. We then set up a laboratory incubation experiment with fresh maize root or root and shoot litter under fully controlled conditions and determined hourly CO_2 and N_2O fluxes for 22 days.

We decided to use a two-factorial design for the incubation experiment. Thus, we used the same litter types for both soil N levels to be able to compare the litter treatments over soil conditions. We will clarify this in Material and Methods section 2.2 (see improved section 2.2 below).

We agree that the information given in L. 132 ff is misleading and will be corrected:
The samples were covered with PVC lids, to minimize evaporation from the soil and to incubate samples in the dark.

We improved this section according to your suggestions starting with a general description of the experimental design and explanation of the experimental choices. Then, we describe preparations of treatments and setting up of the experiment:

L. 115-135

2.2 Incubation experiment

The incubation experiment consisted of a two-factorial setup comprising two N levels (N1 and N2) and three litter levels (Control = Cn, Root = Rt, Root+Shoot = RS) (see Table 1 and Figure 1 for details). To allow comparison of litter treatments over soil conditions, the same litter types for both soil N levels were used. As N2 plants had produced greater and healthier biomass during pre-experimental growth phase, only N2 shoots were used for both soils. Roots from N1 and N2 plants were mixed to ensure sufficient amounts for all replicates. Control soils (N1-Cn and N2-Cn) did not receive plant biomass, yet they contained C input from rhizodeposition of the previous maize growth. C remaining from rhizodeposition, root hairs and small root fragments was calculated as the difference in soil C concentration before and after maize growth. For the root treatment, 100 g fresh root biomass was added per kg dry soil (N1-Rt and N2-Rt), and in the root and shoot treatment, 100 g fresh root and 100 g fresh shoot biomass was added per kg dry soil (N1-RS, N2-RS). Each treatment was replicated four times.

Within each N level, soil was homogenized to ensure similar starting conditions. Subsamples of both soils were taken for analysis of mineral N, water extractable C_{org} concentration, and total

soil C. Soil mineral N concentrations were 0.93 and 1.97 mg N kg^{-1} for N1 and N2, respectively. Plant litter was cut to a size of 2 cm and homogeneously mixed with the soil, simulating residue incorporation and tillage. PVC pots with a diameter of 20 cm and a total volume of 6.8 L were filled with fresh soil equivalent to 3.5 kg dry weight previously mixed with plant litter. Soil was compacted in a stepwise mode by filling a 2 cm-layer of soil in pots and compacting it with a plunger. To ensure continuity between soil layers, the surface of the compacted layer was gently scratched before adding the next soil layer. Due to high litter input, target bulk density was 1.1 g cm^{-3}. Actual bulk density was determined by measuring headspace height, and these values were used for calculations.

To adjust soil moisture of all pots to 70% WHC, equivalent to 49% WFPS, water was dripped on the soil surface through hollow needles (outer diameter 0.9 mm). Pots were covered with PVC lids to minimize evaporation from the soil surface and to incubate samples in the dark. The incubation experiment was carried out under controlled temperature (16 h day at 25°C, 8 h night at 19°C) for 22 days. Volumetric water content (VWC) sensors (EC-5, Decagon Devices, Pullman, USA) were used to monitor soil water content.

4) Minor suggestions: a. L.273-274 – this information will be more visible when reported in a table, instead of being buried in the text.

Data on soil NO_3^- and NH_4^+ concentrations are shown in Figures 4 a and b. We will add a table showing mineralization during the incubation period.

b. In some places you talk about statistical significance and provide p-values, in others you say how things are different but without mentioning the statistical significance. I suggest being consistent and either only talk about statistically significant differences or specify what is being regarded as numeric and what as statistically significant difference.

We will add p-values for differences between cumulative CO_2 and N_2O emission in the text (L. 255 ff.). Currently, these values are depicted in Table 3. In all other cases, p-values are given in the text and in the respective tables. We did not conduct statistics on hourly N_2O and CO_2 fluxes or soil NO_3^-, NH_4^+, and WEOC concentrations. Thus, we do not provide p-values for these.

L. 254-259

To account for different C inputs in treatments, cumulative CO_2 and N_2O emissions were standardized against the C input per treatment (Table 1). Still, cumulative CO_2 emissions were almost twice as high in -Rt and about four times higher in -RS compared to -Cn (p<0.05), indicating that differences between litter treatments cannot simply be explained by differences in

C input. Addition of maize root and shoot litter increased cumulative N_2O emissions by roughly 100-times compared to control treatments (p<0.05). In contrast, root litter increased cumulative N_2O emissions only by a factor of 5.4 (N1-Rt) and 7 (N2-Rt) compared to the respective controls (p<0.05).

c. L. 351-354 and l. 368-370 – I don' believe that just the correlation results can warrant the conclusions that are stated in these two cases.

We improved these paragraphs as following:

L. 351-354

Denitrification in soil is largely controlled by the supply of readily decomposable organic matter (Azam et al., 2002; Burford and Bremner, 1975; Loecke and Robertson, 2009), leading to significant correlations between both hourly and cumulative N_2O and CO_2 emissions (Azam et al., 2002; Fiedler et al., 2017; Frimpong and Baggs, 2010; Huang et al., 2004; Millar and Baggs, 2004, 2005). Hourly CO_2 fluxes increased directly with onset of incubation and started to decline after day 10, thus mostly C compounds with a short turnover time, i.e. sugars, proteins, starch, and hemicellulose were decomposed and contributed to CO_2 fluxes. Availability of easily degradable C compounds stimulates microbial respiration, limiting O_2 at the microsite level and thus increasing N_2O emissions from denitrification (Azam et al., 2002; Chen et al., 2013; Miller et al., 2008). Accordingly, hourly N_2O fluxes increased after a lag phase of two days. The strong positive correlation ($R^2=0.9362$, $p \leq 7.632\ e^{-15}$) between cumulative CO_2 and N_2O emissions (Table 6) further supports our hypothesis that litter quality, in particular degradability of C compounds, affects N_2O fluxes from denitrification by creating plant litter associated microsites with low O_2 concentrations.

L. 368-371

High correlation of cumulative N_2O emissions and mineralized N during the incubation period ($R^2=0.5791$, $p<9.551\ e^{-06}$) indicates that, in addition to denitrification, heterotrophic nitrification may have contributed to N_2O production in our study. However, to further differentiate between processes contributing to N_2O production, stable isotope methods need to be used (Baggs, 2008; Butterbach-Bahl et al., 370 2013; Van Groenigen et al., 2015; Wrage-Mönnig et al., 2018).