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Interactive comment on "Autotrophic component of soil respiration is repressed by drought more than the heterotrophic one in a dry grassland" *by* J. Balogh et al.

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Dear Referee #1, Please let me reply quickly to your major concerns. I put my answers into your text for the easier follow-up.

Your major concerns:

1. While the topic is very timely, and the findings would be of high interest to the scientific readership, unfortunately this work fails to comply with minimum scientific standards in its core measurements. While total soil respiration was determined with six chambers, and the corresponding isotopic signatures with at least three chambers,

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the two component fluxes (heterotrophic only and heterotrophic plus fungal respiration) were determined only with two chambers, and the corresponding isotopic ratios even with ONE chamber only! Given the fact that the isotopic data and the conclusions drawn from them play a key role in this paper, this is by far not an acceptable methodology.

Reply: We used 5 small chambers in this study for the isotopic measurements. No permanent positions were used, each chamber were moved to a different position in every two weeks (see answers below). Most of the chamber-based isotopic studies – providing valuable results and new insights into the soil-plant system - used limited number of larger chambers (n=2 to 6 replicates with d=10 to 30 cm) and shorter measuring periods due to the limitations of the measuring systems (e.g. Bloemen et al., 2014; Burri et al., 2014; Kodama et al., 2008; Moyes et al., 2010). In addition these systems are often static ones – and do not provide continuous measurements. We think we collected a large number of data (1980 measurement cycle) during the study period (182 days) and I hope – after the rewrite of the description – it could be acceptable.

2. Furthermore, the chambers used for the measurements were extremely small (19.6 cm2 surface area) and can thus by no means be regarded as representative for the grassland, in particular as a comparison was made with EC measurements of a footprint which was several orders of magnitude higher than the area covered by the chambers.

Reply: These chambers were really small, but this size allowed less disturbance of the vegetation than that of larger chambers. They have been designed considering the limitations arising from the structure of closed (small gaps) grass vegetation. The usual size of soil respiration chambers (d>10 cm) necessitates the removal of aboveground plant biomass before measurements, especially in a grassland with relatively high plant cover. Cutting disrupts the photosynthate supply to roots and rhizospheric microbes, which is an extremely important effect in this case! Therefore it should be avoided during long-term unattended measurements. But even under high vegetation cover

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small gaps could be found between the plants, where the small chambers can be placed. Therefore we used these small chambers to avoid the negative effects of cutting. This system has been used for several years and provided valuable information on soil CO2 efflux of this site (Balogh et al., 2014; Nagy et al., 2011). This size of soil respiration chambers is not unexemplified. Other studies (Nickerson et al., 2013; Risk et al., 2011) also used this size arguing - as we also did - that these chambers can be placed between the plants in grasslands, while larger chambers might create a nonrepresentative surface.

3. Thirdly, at least according to what can be extracted from the Materials and Methods section, the chambers were permanently placed at the same spot for at least half a year, without changing regularly between at least two alternating positions, which should be standard for long-term measurements with chambers.

Reply: Your major concern was that we measured only one position permanently in the experimental plots (root/root- and mycorrhizal fungi exclusions). But this was not the case. It was my fault that this description disappeared somehow from the final text, but the remaining information – we established 5-5 plots for root/root- and mycorrhizal fungi exclusions – at least supports that we changed the measured positions. The position of each chamber was changed in every two weeks to have a better spatial coverage and to ensure the maximal spatial variability possible within the experimental area. I am not sure that larger chambers would be much more representative for the whole grassland considering the spatial scales of the EC and chamber measurements and the spatial variability of soil CO2 efflux. In addition, larger chamber size would cause larger uncertainty of the measured values due to the disturbances.

4. In addition, the chambers had vent holes with a total area of barely 1 cm2, which "allowed precipitation to drip into the chambers". If there was no funnel on top of the chambers with the same basal area as the chambers, directing the precipitation into the chamber, this would mean that 95% of the precipitation would have been excluded from the chamber and by this also from the soil below.

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Reply: Since the system had been already published, we put less effort to describe it in more details. The top of the chamber walls exceeded the chamber top by 3 mm where the holes were drilled, serving as a funnel for the precipitation. Moreover, runoff water could flow through between the chamber wall and the metal cylinder covering it and water transport is supposed to be adequate over this 2. 5 cm distance (radius).

5. Finally, there might have been an unspecified contribution of a C4 grass between 5-10%, which might have biased the isotopic data to a degree which might make any statement on isotopic signatures of the different component fluxes invalid.

Reply: Uncertainty calculations included this possible contribution of the C4 grass, as we mentioned it in the text.

Specific comments:

p. 16888, l. 3-13: This paragraph about isotopic signatures does not provide enough insight into the potentials and limits of the isotopic approach. This should be described in more detail, especially for sites with no or only very small isotopic disequilibrium between plants and SOM.

Reply: We can give more details on this topic here, if necessary.

p. 16888, l. 12: Here it should be described HOW this restriction of heterotrophic respiration to deeper soil layers could change d13C of soil CO2 efflux. A kinetic diffusional effect would only be transient, until a new equilibrium between CO2 formation at the deeper soil layer and CO2 efflux at the surface has been established.

Reply: Yes, the diffusive fractionation could be an important effect during soil drying, we can shortly describe it here. In our results, neither the δ13CRrme value (heterotrophic respiration), nor the δ13CRre value (heterotrophic+mycorrhizal respiration) showed correlation with SWC, but δ13CRsoil (total respiration) showed significant negative correlation. We can assume that if the changes of δ13C were governed by the soil drying, we could see this response in all measured effluxes. These data were not

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presented in the paper, but could be considered.

p. 16888, l. 21-22: The reasoning for using an isotopic approach is not sufficiently clear at this stage.

Reply: There were serious changes in soil structure caused by the excavation of the soil cores (experimental plots: root-/root- and mycorrhizal exclusion). We used the isotopic approach to identify the component's contributions to the total CO2 efflux measured in the undisturbed soil. We can clarify it here.

p. 16889, l. 8: The dimensions of the tubes are missing.

Reply: The tubes had the same dimensions as the soil cores (160 mm in diameter and 800 mm in depth).

p. 16889, l. 12: Until this point it is not known that there is an EC tower at the site.

Reply: Yes, we can change the order of the study site description.

p. 16889, l. 22: CRDS needs to be defined here.

Reply: Yes, this abbreviation needs definition (cavity ring-down spectroscopy).

p. 16889, l. 22-23: It is not clear whether the EC footprint included the area covered by the SRS.

Reply: The area covered by SRS was included in EC footprint (10 m from the eddy covariance tower in south direction, l. 12).

p. 16889, l. 24-25: Here it sounds as if the area covered by the SRS is not included in the EC footprint, but was only similar in soil characteristics and vegetation composition and cover. Furthermore it is not clear which methodology was used to make sure that the soil characteristics and vegetation composition were comparable between the two locations.

Reply: Yes, this sentence could be confusing, we can rewrite it. Coenological investi-

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gations of the different parts of the site were not aimed in this study, but they have been regularly done since the establishment of the EC measurements for providing data for the different ongoing projects (eg. (Koncz et al., 2014). Soil organic carbon content was also measured at the site in a 90 m x 70 m grid - including the experimental area - at every 10 m and at additional random positions. These data were not published yet, but we can provide an average value for the site and for the experimental area.

p. 16891, l. 2-3: A diameter of the chambers of 5 cm, i.e. a surface area of 19.6 cm2, is extremely small and by far not representative for a larger area, given the very limited number of chambers. p. 16891, l. 8-14: Again unclear: In the first part it says that the chambers can be applied without cutting the plants, so that there is no disruption of transport processes within the plants, and then later it says that the respiration chambers did not contain standing aboveground plant material. Were the plants then cut within the chamber area, or were the chambers placed at vegetation-free spots? And if so, how far away were the next plants?

Reply: Please see answers above.

p. 16891, l. 6-8: If the chambers cover an area of about 20 cm2, but if the vent holes only have an total opening of about 1 cm2, that means that precipitation reaching the soil surface inside the chamber will be reduced by 95%!

Reply: Please see answers above.

p. 16891, l. 16-18: Two chambers for soil CO2 efflux measurements, and only one chamber for isotope measurements for each soil respiration component is clearly not enough to make any scientifically sound statement on differences between the different components.

Reply: Please see answers above.

p. 16893, l. 19: Of which linear correlation? More information and R2 values are needed here.

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Reply: We can present the results of the linear fits between δ13CRsoil and Rre/Rsoil (y intercept is δ13CRrhizo): y = 3.54x - 28.6, R^2 = 0.0921, P<0.0001 δ13CRsoil and Rrme/Rsoil (y intercept is δ13CRmycrhiz): y = 2.9x - 28.9, R^2 = 0.0683, P<0.0001 δ13CRre and Rrme/Rre (y intercept is δ13CRmyc): y = 1.79x - 27. 2, R^2 = 0.0137, P=0.0032 δ13CRmycrhiz and δ13CRrhizo were used then in mixing models to calculate the ratio of the different components.

p. 16893, l. 19-20: The derivation of the relationship is unclear. Shouldn't d13CRre be plotted against Rrme/Rsoil?

Reply: Rrme does not contain the mycorrhizal fungi component. We look for the value when – hypothetically – only mycorrhizal fungi component is present (Rrme/Rre is zero).

p. 16893, l. 22: How were these daily contributions estimated?

Reply: Contributions estimated by the mixing models were calculated both for daily scale and for the periods.

p. 16893, l. 23-24: Unclear what this cross-correlation should reveal.

Reply: We tried to find correlations between the photosynthetic CO2 uptake and the component respirations, considering that these correlations could be lagged.

p. 16894, l. 2-4: This means that the microbial analyses were only done half a year after the end of the measurement period. How representative are those data?

Reply: It was not possible to take soil samples from the experimental area without serious disturbance of the measurements, so we decided to hold over the sampling after the end of the measurements. We decided to do it at the peak of the next vegetation period (May) before the dry summer period when soil drying could change the microbial community These data served as reference, we wanted to know whether the mycorrhizal filaments were able to penetrate through the mesh and the only heterotrophic soil could sustain a microbial activity.

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p. 16894, l. 24-25: How could the Keeling approach give similar results as the chamber-based measurement, given that the ecosystem respiration contains also the aboveground part, which the chambers do not.

Reply: The major part of the ecosystem respiration is the soil CO2 efflux, especially in grasslands. Therefore changes in δ13C value of Rsoil are supposed to be seen in δ13C value of Reco.

p. 16894, l. 26-27: Unclear why this should be an advantage

Reply: The two systems worked independently, so the results were supported by different measuring systems.

p. 16895, l. 5-8: Unclear, which d13C value for the C4 respiration component was used for this uncertainty estimate.

Reply: We used δ13CC4= -14 value for the calculation.

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Interactive comment on Biogeosciences Discuss., 12, 16885, 2015.