Answer to the first short comment

Dear Richard Wehr,

Thank you very much for your comment to our manuscript! It drew our attention to an unfavorable arrangement of two of our equations and to few sentences that may be misinterpreted. We apologize for that and optimize those parts of our manuscript according to the following explanations:

Modified part in the manuscript 1:

δ_A, the isotope ratio of assimilated CO_2, was derived by subtracting the ecosystem discrimination of ^{13}C (Δ_e) from the isotope ratio of the CO_2, leaving the respective air column (i.e., the signature of the air between ground surface and REA sample inlet) that is affected by the assimilating biosphere (Wichura, 2009). Equation (8) is based on the mass balance equations of Lloyd et al. (1996; see also Bowling et al., 2001 and Bowling et al., 2003) and represents the tool to determine δ_A that can not be measured directly:

$$\delta_A = \overline{\delta^{13}C_\uparrow} - \Delta_e \tag{8}$$

Equation (9) is based on a definition of Δ by Farquhar et al. (1989). In Buchmann et al. (1997), see also Buchmann et al., 1998), this definition was utilized to derive the ecosystem discrimination Δ_e as used in this manuscript and e.g. in Ruppert (2008) and Wichura (2009).

$$\Delta_e = \frac{\overline{\delta^{13}C_\downarrow} - \overline{\delta^{13}C_\uparrow}}{1 + \overline{\delta^{13}C_\uparrow}} \tag{9}$$

Annotation 1:

The former arrangement of equation (8) and (9) directly after each other might have suggested a direct connection, e.g. that both equations originate from the same derivation in the same publication. However, the only connection is that the unknown quantity Δ_e is contained in both equations and that both are part of our calculations.

As you mentioned, the definition of Δ related to the discrimination of heavier isotopes in Equation (9) is based on Farquhar et al. (1989). In Buchmann et al. (1997; see also Buchmann et al., 1998), this definition was utilized to derive the ecosystem discrimination Δ_e as used in this manuscript and e.g. in Ruppert (2008) and Wichura (2009).

Equation (8) is based on the mass balance equations of Lloyd et al. (1996; see also Bowling et al., 2001 and Bowling et al., 2003). Equation (8) is the tool to determine δ_A that can not be measured directly. We will separate equation (8) and (9) locally and point out the different origin as explained above.

Modified part in the manuscript 2:

Relaxed eddy accumulation is still applied in ecosystem sciences for measuring trace gas fluxes. On managed grasslands…

… Resulting $^{13}CO_2$ isofluxes can be determined with the flux-gradient method (Flanagan et al., 1996), by modeling approaches (Ogée et al., 2003; Lloyd et al., 1996), by hyperbolic relaxed eddy accumulation (HREA, Bowling et al., 2001; Bowling et al., 2003a; Wichura, 2009; Wichura et al., 2004), the hybrid eddy covariance / flask gradient method (Bowling et al., 1999a; Griffis et al., 2004) and direct isotopic eddy covariance (Griffis et al., 2008; Sturm et al., 2012; Wehr et al., 2013). This study examines…

… REA application in general is expensive and time consuming and is therefore only applicable for short term and special investigations. Its versatility and the information about NEE component flux variability gained through its use justify its application in ecosystem sciences. However, in the future it will be more and more replaced by e.g. direct isotopic eddy covariance measurements that are also adapted for long term experiments (Wehr et al., 2013).

Annotation 2:

The first sentence of the abstract should suggest that REA is still useful today. And there are trace gases worth to investigate without fast sensors available. But you are right that in the context of the whole manuscript this can be misrelated to $^{13}CO_2$ measurements.
Thus, we shifted the sentence to the introduction and reformulated it to put that right.

The point of our manuscript is REA application on managed grassland, but in the last sentence of the first paragraph other related methods applied in ecosystem sciences should be presented. As you suggested, this sentence was completed by considering latest literature about direct eddy covariance measurements of the $^{13}CO_2$ isoflux using laser spectroscopy.

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