

Interactive comment on “Seasonal and vertical variations in soil CO₂ production in a beech forest: an isotopic flux-gradient approach” by Emilie Delogu et al.

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Our manuscript addresses the contribution of different soil layers to CO₂ production and to its isotopic signature. We used the flux – gradient approach to analyze and understand the constraints on vertical and seasonal variations in production and its isotopic signature from the measurement of the [CO₂] vertical profile and its isotopic composition. As recommended by Referee#1, the comparison between the surface effluxes (Fs) measured and obtained with the empirical model based on soil moisture and temperature will be shown graphically. The satisfactory agreement can then be visualized. We also investigate for a hysteresis effect with temperature that can appear when autotrophic respiration is the major component of Fs but we couldn't find any.

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This last point will put in perspective in the discussion with the absence of clear infra-day oscillations in the isotopic signal. Referee#2 found the manuscript lacks context and explanation. We obviously will try hard to unfold the text in a somewhat better way with longer and stronger description of context, objectives and perspectives. The main motivation of a study like ours is a better disentangling of the influences of the environmental drivers on the different processes composing soil CO₂ efflux for a better prediction. Indeed, the behavior analysis of the CO₂ sources vertical distribution, explaining the patterns in the successive soil layers, goes towards some predictive outputs standing out from the usual one (soil considered as only one entity) when climatic change will impact soil through its surface in first. The understanding of the temporal variability of the isotopic signature is a fundamental input for the carbon propagation delay through the different ecosystem components. Achieving a high degree of precision into soil efflux and production description will allow the results to be compared to other sites. In addition, we will present the reasons for using Hesse site. They lies in the pertinence, complementarity, quantity and quality of the data which are continuously collected on this site since years and the strong knowledge of the ecosystem functioning (notably on the soil respiration) that ensued from the many past studies. This beech forest is also representative of the European temperate ecosystems. Its deciduous nature allows the existence of periods with only heterotrophic and both autotrophic and heterotrophic contributions to CO₂ production among the seasons. This is an advantage for disentangle the influences of the environmental factors on the different processes composing soil CO₂ efflux We hope that the modifications contextualization and explanations that we will add will ensure a better understanding of our manuscript. Furthermore, we found an error in our computations of the soil CO₂ production after the manuscript was submitted to Biogeosciences. This error led to substantial changes in our result. The new analyses (based on these corrected results) in addition to a better contextualisation (see above) and complements responding to the referees advices (time series analysis, propagation of error analysis) will improve the discussion beyond the speculation written in the text. Furthermore, some conclusions will somewhat change along

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the way. For all these reasons, the new version of the MS (that we will produce in a close future) will be appreciably different from this one and will be presented as a new submission.

We thank the reviewers for their useful contributions and recommendations to improve our manuscript and we hope that the redevelopment will suit the standards needed. Sincerely yours, On behalf of all co-authors, Emilie Delogu

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