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Interactive comment on "Rainfall intensification increases the contribution of rewetting pulses to soil respiration" *by* Stefano Manzoni et al.

Anonymous Referee #2

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In this manuscript, the authors present an analysis of the role of variability in rainfall (amount and frequency) on average heterotrophic respiration for dry ecosystems. It is an attempt to provide a mechanistic explanation of the 'Birch' effect, showing that respiration pulses are more relevant under low precipitation frequency and to a lesser extent to low rainfall amounts. The analysis relies on a very simple stochastic model that links a stochastic representation of rainfall to changes in moisture and subsequent changes in heterotrophic respiration. The resulting probability density functions (PDFs) are then expressed in terms of their first and second moments. I appreciate the effort of the authors in highlighting the limitations of the model ,because due to its simplicity, it excludes a number of process commonly integrated in soil respiration models. However, I agree with the authors in that the minimal model presented here is enough to

capture the main dominant processes that capture the stochastic nature of respiration pulses. This is enough to provide a general understanding of the problem, but these results should be used with caution when attempting to represent other type of systems; e.g. systems with high seasonality in litter inputs or water-logged. I have only very minor comments, and can recommend the manuscript for publication after small modifications.

Minor comments:

- Line 100. The parameter γ is an important parameter because it controls the exponential decay in both terms of equation (3). Please give a more intuitive explanation of this parameter.
- Line 105. I think the term 'stochastic steady-state' is not appropriate. A steady-state refers to a fixed point in the phase plane, which is not the case for the stochastic case here. I suggest using the term 'stationary' instead.
- Eq. (8). I think it would be helpful for the reader to split this equation in two lines, with the first line using an inverse function notation, so it is clear that your aim is to find the inverse of equation (7). Also, I think it's important to explicitly mention that finding this inverse implies that you can only use this approach for bijective functions, and not for non-bijective functions. There are many functions in the literature that show that respiration as a function of soil moisture has a maximum at an intermediate level, after which respiration declines with moisture (e.g. Skopp 1990, SSSAJ 54:1619). These functions are non-bijective and therefore have no inverse over their entire domain. A consequence of this, which I think is partially addressed by the authors, is that you can only use this approach when predicting the behavior of respiration at low soil moisture levels.