Global quantification of the eco-hydrological co-benefits of soil carbon sequestration

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Abstract

This response letter contains numbered figures and references to these figures. To prevent confusion, the figures embedded within this response letter are called illustrations. Finally, the following convention is applied to denote modification in the original manuscript: new text.

1 Reviewer 1

Reviewer 1 Comment 1

I appreciate the improvements and feedback from the authors, which satisfied most of the points I have previously raised.

Response We thank the reviewer for the careful re-assessment of our manuscript and appreciate that the revisions have satisfactorily addressed most of the previously raised comments.

Reviewer 1 Comment 2

Yet, one last issue covers the water stress analysis and the definition of the water stress indicator. The authors have proposed the use of 50% water content at FC as it represents "onset of plant water limitation more realistically than the wilting point". Indeed, I would indicate more specifically that the water stress emerge as soil water content reaches intermediate level of plant available water capacity (theta_fc – theta_wp). In specific soils, like clay soils, water retention from soil particles can emerge quite strong, and 50% of the Water content at Field Capacity may yet be proximal, or even lower that water content at wilting point. Could you specify how/if water content below wilting point is accounted in plant available water capacity, and verify if water content at 0.5 FC is above that at wilting point to represent onset of plant water limitation. Or else, adjust description accordingly.

Response We thank the reviewer for pointing this out. We indeed calculate plant water availability as $\theta_{fc} - \theta_{wp}$, as stated in L217. In the calculation of water stress, the wilting point was included as a lower bound in addition to the threshold of $0.5 \cdot \theta_{fc}$. This was not clearly stated in the original manuscript. We have therefore revised the text to explicitly clarify this assumption as follows:

> Soil water stress conditions are defined based on a threshold relative to field capacity and the wilting point. Water stress occurs when the volumetric soil water content (θ) falls below 50% of the water content at field capacity (θ_{fc}), provided that this threshold remains above the wilting point (θ_{wp}). In cases where $0.5 \cdot \theta_{fc} < \theta_{wp}$, the wilting point is used as the stress threshold instead. The annual water stress is then quantified as the cumulative deficit between the applicable stress threshold and the actual soil water content (θ), accumulated over the year and summed across the first seven soil layers ($d = 0.68$ m), representing the upper 60 cm of the soil profile corresponding to the depth affected by irrigation (Eq. 2).

$$\theta_{\text{stress},i} = \max\left(0.5 \cdot \theta_{fc,i}, \theta_{wp,i}\right) \tag{1}$$

$$\text{water stress} = \sum_{i=1}^{7} \sum_{month=1}^{12} \left(\theta_{\text{stress},i} - \theta_{month,i}\right) \cdot d \quad \text{for} \quad \theta_{month,i} < \theta_{\text{stress},i} \tag{2}$$