

Interactive comment on “How well can we predict soil respiration with climate indicators, now and in the future?” by C. T. Berridge et al.

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Berridge et al. have analysed a global set of heterotrophic respiration (R_h) measurements, and claim to show that the prevailing approach to modelling the climate dependency of this process is wrong. In particular, they find that R_h does not increase with mean annual temperature. They describe this as "a finding that runs counter to the well-documented site-scale dependency of respiration on temperature".

However, the total heterotrophic respiration at any site depends not only on the rate constant, but also on the size of the respiring pool of organic matter. This in turn must depend on inputs (net primary production, NPP) as well as outputs. The authors seem to have neglected this dimension, but it is crucial to the interpretation of the data.

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In the simplest possible 'box model' of the process, the pool size tends towards a stable value that is the product of NPP and residence time. The residence time in turn is inversely proportional to the rate constant. The outcome is that NPP and Rh approximately balance, and the expected temperature dependence of Rh is thus not the temperature dependence of the rate constant, but rather the (weaker) temperature dependence of NPP. This logic also very simply explains both the reported increase of Rh with precipitation, and the 25% enhancement of Rh with elevated CO₂.

Models vary in the complexity with which they represent below-ground processes but this basic logic is common to them all. In other words, there is no model that actually works in the way the authors say that models work.

A first avenue of further exploration might be to compare the observed Rh with the Rh output by a real model, as opposed to the 'straw man' of the authors' imagination.

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