

Publication

Plant respiration: Controlled by photosynthesis or biomass?

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Two simplifying hypotheses have been proposed for whole-plant respiration. One links respiration to photosynthesis; the other to biomass. Using a first-principles carbon balance model with a prescribed live woody biomass turnover, applied at a forest research site where multidecadal measurements are available for comparison, we show that if turnover is fast the accumulation of respiring biomass is low and respiration depends primarily on photosynthesis; while if turnover is slow the accumulation of respiring biomass is high and respiration depends primarily on biomass. But the first scenario is inconsistent with evidence for substantial carry-over of fixed carbon between years, while the second implies far too great an increase in respiration during stand development-leading to depleted carbohydrate reserves and an unrealistically high mortality risk. These two mutually incompatible hypotheses are thus both incorrect. Respiration is not linearly related either to photosynthesis or to biomass, but it is more strongly controlled by recent photosynthates (and reserve availability) than by total biomass.

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