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Effects of seasonality and girdling on the age of stem CO_2 in mature tropical lowland forest trees (*Scleronema micranthum*)

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Little is known about the use of carbon (C) that was assimilated more than 1 year previously in trees. As a tree's lifetime is measured in decades to centuries, and trees are known to be able to build up essential nonstructural C reserves, it is possible that years elapse between fixation and later metabolic return of C to the atmosphere. We will refer to this elapsed time here as the "age" of CO_2, and we measure it by comparing the radiocarbon (^{14}C) signature of CO_2 emitted by trees with the observed rate of decline in atmospheric ^{14}C-CO_2.

Here, we report data from *Scleronema micranthum* trees from a tropical lowland forest near Manaus, Brazil. Starting with 7 trees in 2012, we looked for seasonal changes in the age of CO_2 emitted from the tree stem surface into the surrounding atmosphere as well as CO_2 extracted from several depths (4, 8, and 12 cm) within the tree stem. We found no clear seasonality, but instead found that almost all samples were influenced by CO_2 originating from sources fixed up to several years previously, suggesting that trees make use of storage C pools on a regular basis. There was a clear pattern of CO_2 samples getting older the deeper from the stem they were extracted. The oldest samples, extracted from 12 cm depth, were made up of C fixed up to 30 years previously in some cases. The CO_2 that is emitted into the atmosphere at the stem surface presumably represents a mixture of CO_2 produced at various depths within the stem, and hence on average was substantially younger than these old samples, but still had an average age between 0-6 years. These findings of trees regularly using previously fixed C contradict the widespread assumption that trees mainly rely on recent assimilates for respiration unless forced to mobilize C from older pools due to environmental conditions limiting assimilation rates.

In April 2013, we increased the number of investigated trees from 7 to 12. Initially, we kept the original sampling design, measuring seasonal CO_2 ages twice for all trees, before – in October 2013 – we finally girdled half of the trees to investigate how completely cutting off the supply of recently assimilated C from the leaves to the stem affects the age of respired CO_2 in the girdled trees compared to the ungirdled control. Initially, we hypothesize an increase of the age of respired CO_2 in the beginning, due to a mobilization of older storage C. It is unclear however, how long this increase can be observed, or what the maximum age of observed emissions could be, as such an experiment has not yet been carried out to our knowledge.