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Contribution of stored carbon pools to leaf level biosynthesis and respiration as revealed by ^{13}C labeling experiments

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To assess how turnover rates of plant carbon pools affect the temporal coupling between photosynthesis and the isotopic signatures of respiration and biosynthetic products (leaf soluble carbohydrates and waxes), we grew slash pine (*Pinus elliottii*), sweetgum (*Liquidambar styraciflua*) and corn (*Zea mays*) plants in isotopically enriched $^{13}CO_2$ environments to label the plants, and then removed them to ambient conditions where we monitored the loss of ^{13}C label in night-time respiration (δC_F),leaf bulk organic matter (δC_{OM}), soluble carbohydrates (δC_{SC}) and waxes (δC_{LW})over a several month period. Pine saplings were grown under label ($\delta^{13}CO_2$ $\sim$-26 $\pm$ 2 per mil) for an entire year before the start of the experiment. Small sweetgum trees were placed under label just prior to leaf out and for three months afterwards. Corn was grown from seed under label for three months. Controls were subject to similar conditions without the CO_2 treatment.

TheδC_F label was rapidly lost within the first week with the rate (corn>pine>sweetgum) inversely correlated with the total plant carbon stock. The label then slowly approached the control value, but after two months labeled sweetgum and pine δC_F still remained depleted by $\sim$5 per mil, indicating continuing respiration of unlabelled, stored carbon pool(s). In contrast, δC_F of labeled corn

reached that of the control after one month, indicating complete turnover of pools. For δC_{SC}, $<$5% of the pine and $<$35% of the sweetgum label was lost after two and three months, respectively. In labeled corn, δC_{SC}geturned to control values within two weeks. For $\delta C_{LW}$and δC_{OM}, $<$5% of the pine and sweetgum labels were lost after two and three months, respectively. In labeled corn, $\delta C_{LW}$and δC_{OM} slowly approached control values although both remained depleted by 5 per mil even after one month. These results indicate a strong, continuing influence of plant stored carbon pools on the isotopic composition of respiration and biosynthetic products. Signal damping and temporal offset arising from the influence of stored carbon pools requires consideration when relating plant respired $^{13}CO_2$ and the ^{13}C of foliage products to environmental variables.