The role of non-structural carbohydrates in simulations of ecosystem carbon fluxes.

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Accurately representing the response of ecosystems to environmental change in land surface models (LSM) is crucial to making accurate predictions of future climate. Many LSMS do not correctly capture plant respiration and growth fluxes, particularly in response to extreme climatic events. This is in part due to the unrealistic assumption that total plant carbon expenditure (PCE) is always equal to gross carbon accumulation by photosynthesis. We present and evaluate a simple model of labile carbon storage and utilisation (SUGAR), designed to be integrated into an LSM, that allows simulated plant respiration and growth to vary independently of photosynthesis. SUGAR buffers simulated PCE against seasonal variation in photosynthesis, producing more constant (less variable) predictions of plant growth and respiration relative to an LSM that does not represent labile carbon storage. This allows the model to more accurately capture observed carbon fluxes at a large-scale drought experiment in a tropical moist forest in the Amazon, relative to the Joint UK Land Environment Simulator LSM (JULES). SUGAR is designed to improve the representation of carbon storage in LSMS and provides a simple framework that allows new processes to be integrated as the empirical understanding of carbon storage in plants improves. The study highlights the need for future research into carbon storage and allocation in plants, particularly in response to extreme climate events such as drought.