2H-fractionations during the biosynthesis of carbohydrates and lipids imprint a metabolic signal on the δ2 H values of plant organic compounds.

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Hydrogen (H) isotope ratio (δ; 2; H) analyses of plant organic compounds have been applied to assess ecohydrological processes in the environment despite a large part of the δ; 2; H variability observed in plant compounds not being fully elucidated. We present a conceptual biochemical model based on empirical H isotope data that we generated in two complementary experiments that clarifies a large part of the unexplained variability in the δ; 2; H values of plant organic compounds. The experiments demonstrate that information recorded in the δ; 2; H values of plant organic compounds goes beyond hydrological signals and can also contain important information on the carbon and energy metabolism of plants. Our model explains where; 2; H-fractionations occur in the biosynthesis of plant organic compounds and how these; 2; H-fractionations are tightly coupled to a plant's carbon and energy metabolism. Our model also provides a mechanistic basis to introduce H isotopes in plant organic compounds as a new metabolic proxy for the carbon and energy metabolism of plants and ecosystems. Such a new metabolic proxy has the potential to be applied in a broad range of disciplines, including plant and ecosystem physiology, biogeochemistry and palaeoecology.
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