

# Estimating canopy gross primary production by combining phloem stable isotopes with canopy and mesophyll conductances

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## Abstract

Gross primary production (GPP) is a key component of the forest carbon cycle. However, our knowledge of GPP at the stand scale remains uncertain because estimates derived from eddy covariance (EC) rely on semi-empirical modeling and the assumptions of the EC technique are sometimes not fully met. We propose using the sap flux/isotope method as an alternative way to estimate canopy GPP, termed GPPiso/SF, at the stand scale and at daily resolution. It is based on canopy conductance inferred from sap flux and intrinsic water-use efficiency estimated from the stable carbon isotope composition of phloem contents. The GPPiso/SF estimate was further corrected for seasonal variations in photosynthetic capacity and mesophyll conductance. We compared our estimate of GPPiso/SF to the GPP derived from PRELES, a model parameterised with EC data. The comparisons were performed in a highly instrumented, boreal Scots pine forest in northern Sweden, including a nitrogen fertilised and a reference plot. The resulting annual and daily GPPiso/SF estimates agreed well with PRELES, in the fertilised plot and the reference plot. We discuss the GPPiso/SF method as an alternative which can be widely applied without terrain restrictions, where the assumptions of EC are not met.

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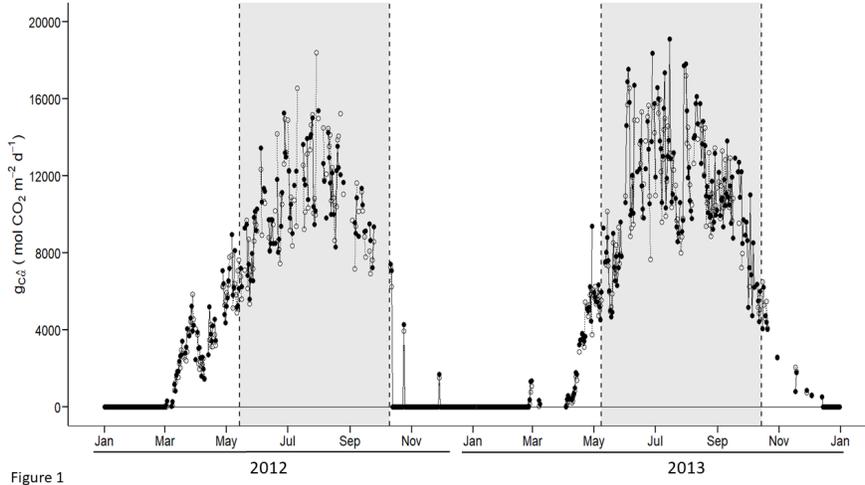


Figure 1

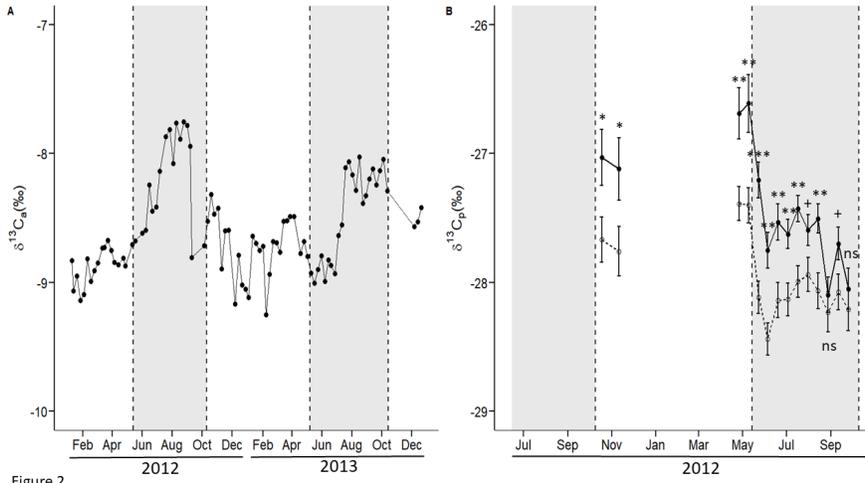


Figure 2

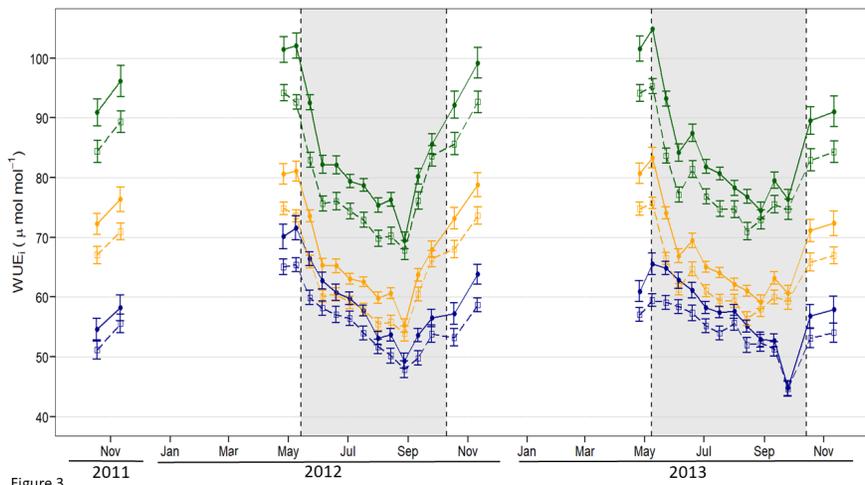


Figure 3

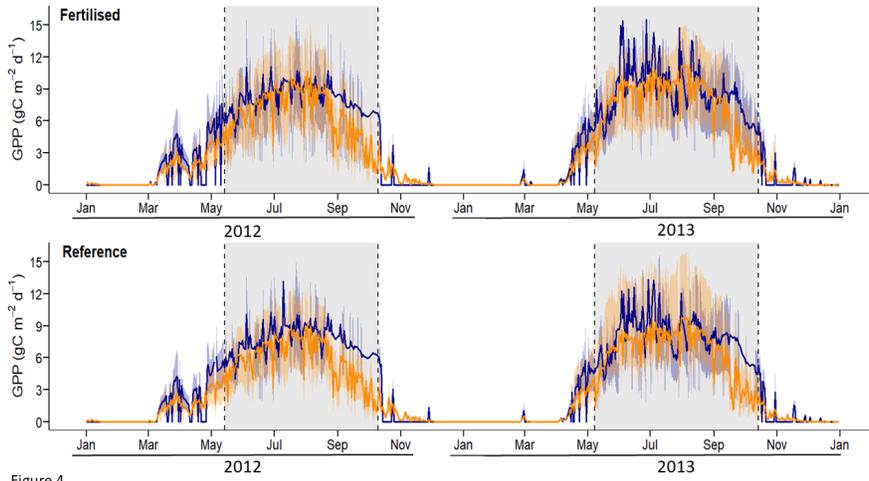


Figure 4

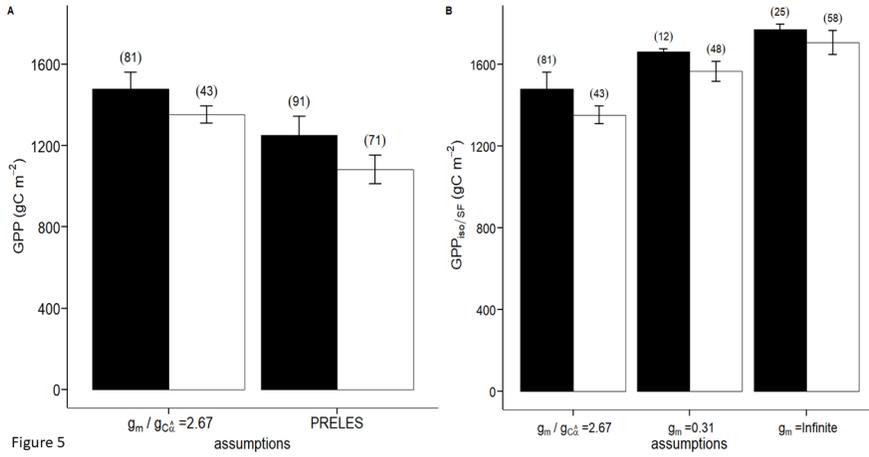


Figure 5