Strong seasonal 18O disequilibrium between leaf and soil CO2 fluxes

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P2.09 Strong seasonal disequilibrium measured between the oxygen isotope signals of leaf and soil CO_2 exchange

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The oxygen isotope composition of atmospheric CO_2 is among a very limited number of tools available to constrain estimates of the biospheric gross CO_2 fluxes, photosynthesis and respiration at large scales. However, the accuracy of the partitioning strongly depends on the extent of isotopic disequilibrium between the signals carried by these two gross fluxes. Chamber-based field measurements of total CO_2 and $CO^{18}O$ fluxes from foliage and soil can help evaluate and refine our models of isotopic fractionation by plants and soils and validate the extent and pattern of isotopic disequilibrium within terrestrial ecosystems. Due to sampling limitations in the past, such measurements have been very rare and covered only a few days. In this study, we coupled automated branch and soil chambers with tuneable diode laser absorption spectroscopy techniques to continuously capture the oxygen isotope signals of foliage and soil CO_2 exchange in a Pinus pinaster Aït. forest in France. Over the growing season we observed a seasonally persistent isotopic disequilibrium between the oxygen isotope signatures of net CO_2 fluxes from leaves and soils, except during rain events when the isotopic imbalance became temporarily weaker. Variations in the oxygen isotope composition of CO_2 exchanged between leaves, soil and the atmosphere were also modelled following theory describing changes in the oxygen isotope composition of ecosystem water pools in response to changes in leaf transpiration and soil evaporation. These results of this modelling and the implications for larger scale partitioning studies will be discussed in this presentation.