Measuring and modelling the evaporative enrichment of water pools in maritime pine trees over daily and seasonal time-frames

Lisa Wingate, Jérôme Ogée, Kadmiel Maseyk, Régis R. Burlett, Ulrike Seibt, Alexandre Bosc, Patricia Richard, Thierry Bariac

MEASURING AND MODELLING THE EVAPORATIVE ENRICHMENT OF WATER POOLS IN MARITIME PINE TREES OVER DAILY AND SEASONAL TIME-FRAMES.

Lisa Wingate[1], Jerome Ogee[1], Kadmiel Maseyk[2], Regis Burlett[1], Ulli Seibt[2], Alexandre Bosc[1], Patricia Richard[2] and Thierry Bariac[2]

[1] *INRA UR1263 EPHYSE, 33130 Villenave d'Ornon, France*
[2] *UMR 7618 BIOEMCO, 78850 Thiverval-Grignon, France*

Variations in the $^{18}O/^{16}O$ ratio of atmospheric CO_2 are strongly influenced by plant function. This is because the water contained in leaves becomes enriched in the heavy isotopes of oxygen (^{18}O) in response to fluctuating evaporative conditions and transpiration rates. This same oxygen isotope signal of leaf water is also transferred to the portion of gaseous CO_2 that, having entered into leaves via stomata, then diffuses back to the atmosphere without being fixed by photosynthetic enzymes. Continuous measurements of the oxygen isotope composition of foliage CO_2 exchange collected using a tunable diode laser spectrometer set-up in a Maritime pine forest in France are presented in this paper. These data were then used to estimate the diurnal and seasonal dynamics in leaf water oxygen isotope signals. Leaf water signals estimated from the $\delta^{18}O$ of CO_2 were compared against direct measurements obtained from the destructive harvesting of foliage during multiple diurnal field campaigns. We found good agreement between the direct and indirect estimates of the oxygen isotope composition of leaf water. Using these seasonal datasets we demonstrate that a non-steady-state model of leaf water enrichment reproduces the diurnal and seasonal changes in the ^{18}O of leaf water well most of the time, whereas the commonly used Craig-Gordon steady-state model has problems reproducing the observed dynamics.

Communication orale
colloque Xylème - eau - croissance,
23-25 novembre 2009, Bordeaux.