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Investigating diurnal ecosystem scale H2O and CO2 isotope fluxes in an irrigated semi-arid environment during the LIAISE 2021 field campaign

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Validation of gas exchange fluxes in models has been challenging due to the lack of ecosystem scale exchange fluxes partitioned into soil, plant and atmospheric components. One promising method to partition turbulent fluxes uses the exchange process dependent fractionation of molecules like CO2 and H2O. When applying this method to short spatiotemporal scales, an isotope flux (δ-flux) needs to be resolved. Few have attempted to measure this δ-flux as the required instrumentation only became available in recent years. In our presentation we will discuss observations made during the LIAISE 2021 field campaign using an EC system, Picarro L-2130i H2O isotope analyser, and Aerodyne TILDAS-CS CO2 isotope analyser. This campaign took place in the summer of 2021 in the heavily irrigated Ebro River basin near Lleida, Spain embedded in a semi-arid region.

We will present procedures to estimate and scrutinize the central δ-flux variable. To this end we calculated co-spectra of the relevant signals and compared their frequency dependent contributions. One relevant finding is that mole fractions and isotope ratios measured with the same instrument can be offset in time by more than a minute, thereby impacting the resulting δ-fluxes. Additionally, we found asymmetric signal loss between net ecosystem fluxes and δ-fluxes. We will show that such effects impact flux partitioning severely and indicate how they can be tackled using physically sound corrections. Only when such corrections and verifications are made, ecosystem flux partitioning can be applied to validate conceptual land-atmosphere exchange models. Such models will calculate the diurnal variability of CO2 and H2O isotopologue concentrations, and link local to regional scales, all with the purpose of better constraining current and future exchange fluxes.