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Carbon dioxide and water vapour balance of different management regimes in an olive orchard in SE Spain using conventional and lower-cost eddy covariance measurements

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Conservation agricultural practices, such as maintaining spontaneous weed cover in tree alleys, are a useful measure to reduce soil erosion, improve soil fertility and increase the uptake of CO_2 by tree plantations. Particularly, when weeds were allowed to grow in olive tree orchards, CO_2 uptake was significantly higher as compared to when the weeds were removed, either mechanically or by using pesticides. The eddy covariance (EC) technique is frequently employed to quantify ecosystem-atmosphere exchanges of trace gases and energy, as it provides non-invasive, continuous and direct measurements of atmospheric components (e.g. CO_2) and energy flux densities.

One of the main hindrances in EC studies is the lack of spatial replication. At heterogeneous sites, such as olive groves, variability caused by different patches of vegetation, land cover or irregular orography, can be a significant source of uncertainty, as measured gas or energy balances are only representative of the footprint area of the station, which is not uniformly distributed over the vegetation or land cover types. In recent years, there have been developments of lower-cost EC (LC-EC) setups that open the way to improve the spatial representativeness of EC measurements and therefore gaining more information about the heterogeneity of ecosystems and how it influences flux densities.

In this study we present a year of measurements for two different treatments (weed-free and weed-covered) in an irrigated olive grove in SE Spain, performed with conventional EC setups, with above and below-canopy EC stations. Besides, we present the current state of development of an alternative LC-EC setup.

The newer LC-EC setup is based on previous published versions of similar systems, and consists of a combination of two sensors to measure CO_2 and H_2O molar densities, integrated with an ultrasonic anemometer. With the reference to above and below-canopy conventional EC setups, three replicates of the LC-EC setup will be installed at different olive grove management systems: traditional, intensive, and super-intensive orchards. The first objective is to validate the newer setups as a tool to potentially increase the number of replicates in EC studies, by performing a

thorough setup-to-setup comparison. The second objective is to compare how the different treatments affect year-round CO_2, water vapour and energy balance and, therefore, to establish which managements are more beneficial in the context of climate change adaptation and mitigation.