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Water Footprint of a Super-intensive Olive Grove Under Mediterranean Climate using Ground-based Evapotranspiration Measurements and Remote Sensing

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The water footprint of a crop is the volume of water that is necessary to produce it, therefore relating crop water requirements and yield. The components of water footprint, blue, green and grey water footprints, refer to the volumes of respectively, surface and groundwater, rainfall, and water required to assimilate pollution, that are used to produce the crop yield. Determining blue and green water footprints is generally achieved using estimates of evapotranspiration obtained with a crop coefficient approach and of a water use ratio. In the present study we have used evapotranspiration measurements to estimate the water footprint of a super-intensive olive grove in southern Portugal (cv. Arbequina, drip irrigated, 1975 trees ha-1), during 2011. The crop water requirements were measured using a heat dissipation sap flow technique, to determine transpiration and using the eddy covariance method that allowed the direct measurement of evapotranspiration, applied to non-flat terrain conditions. This technique was used for a short period, from end of July till the end of August, while the sap flow measurements were performed from May to December, hence allowing the extension of the data series; for other periods estimates were used. Evapotranspiration measured directly with the eddy covariance method was in average close to 3 mm d-1 and the ratio of evapotranspiration to reference evapotranspiration approached 0.6 for the same period. Plants were under a moderate water stress, as confirmed with predawn leaf water potential measurements.

The water footprint of the olive crop under study was lower than the water footprint simulations reported in literature. A possible reason relates to the density of plantation, yield and irrigation crops management. The irrigated olive grove under study had a high yield, which compensates for a high water consumption, leading to a water footprint lower than the ones of rainfed or less dense groves. Furthermore, as evapotranspiration measurements were used to calculate water footprint instead of the common procedure (using evapotranspiration estimates), this might have also introduced some differences.

The potential of using remote sensing techniques for the assessment of water footprint of crops has been discussed in recent literature. It can provide estimates of actual evapotranspiration, of precipitation, of surface runoff and of irrigation needs when associated with modelling. In this study we further compare the water footprint estimates using in situ evapotranspiration measurements and water footprint estimates using remote sensing techniques. A comparison with the irrigation records for this particular olive orchard will be used to validate the approaches.