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Partitioning of evapotranspiration into soil evaporation and plant transpiration of a drip-irrigated crop: combining various approaches.

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This paper combines several independent methods to estimate the evapotranspiration (ET), the plant transpiration (T) and the soil evaporation (E) of two drip-irrigated wheat fields in central Morocco. Specifically, ET is estimated from eddy covariance, lysimetry and FAO dual crop coefficient modeling, T is estimated from sap flow, lysimetry and FAO modeling, and E is estimated from lysimetry and FAO modeling. The objective is three-fold: 1) to quantify the partitioning ratio (T/ET) at the daily/field scale, 2) to propose a methodology for quantifying the systematic and random uncertainties in the partitioning ratio, and 3) to assess the consistency and develop synergies between various partition measurement methods. The FAO dual source model is first calibrated using reference measurements. Then, all measurements are compared to the fluxes simulated by the calibrated FAO model in two cases: i) uncorrected daily model output and ii) daily model output corrected by subtracting the simulated to measured flux over a 7-day sliding period. The first case allows the determination of systematic errors for FAO model and/or each measurement technique. The second case allows the evaluation of relative random uncertainties in the various independent measurement techniques. The study period was between 100 and 150 days after sowing when most measurements were available. The partitioning ratio increases from about 0.50 to 0.85 during the growth stage and rapidly drops towards 0 during wheat senescence. The FAO model estimates ET accurately, but it systematically overestimates T and underestimates E. For the weighing lysimeters, despite the small surface sensed, the partitioning ratio is evaluated more precisely (19% error) with lysimetry than with the other systems (any combination of eddy covariance, lysimetry and sap flow measurements). Increasing the number of sap flow sensors is likely to reduce the observed variability in T measurements, but nevertheless systematic errors are observed during water-stress and senescence periods. The daily T/ET ratio is found to be significantly correlated ($R>0.7$) with the 5-cm soil moisture. This study suggests that combining different independent measurement techniques could help both quantify and reduce uncertainties in the T/ET ratio estimates.