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Agricultural water use, crop water footprints and irrigation strategies in the seasonally dry Guanacaste region in Costa Rica

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Agriculture is the main productive sector and a major water-consuming sector in the seasonally-dry Guanacaste region of north-western Costa Rica. Agriculture in the region is intensifying at the same time that seasonal water scarcity is increasing. The climate of this region is characterized by a prolonged dry season from December to March, followed by a bimodal wet season from April to November. The wet season has historically experienced periodic oscillations in rainfall timing and amounts resulting from variations of several large-scale climatic features (El Nin˜o Southern Oscillation, the Pacific Decadal Oscillation, the Atlantic Multidecadal Oscillation and the North Atlantic Oscillation). However, global circulation models now project more recurrent variations in total annual rainfall, changes in rainfall temporal distribution, and increased temperatures in this region. This may result in a lengthening of the dry season and an increase in water scarcity and water-related conflicts as water resources are already limited and disputed in this area. In fact, this region has just undergone a four-year drought over the 2012-2015 period, which has intensified water related conflicts and put agricultural production at risk. In turn, the recent drought has also increased awareness of the local communities regarding the regional threat of water scarcity and the need of a regional water planning. The overall goal of this research is to generate data to characterize water use by the agricultural sector in this region and asses its sustainability in the regional context. Towards this goal, eddy-covariance flux towers were deployed on two extensive farms growing regionally-representative crops (melon/rice rotation and sugarcane) to evaluate, monitor and quantify water use in large-scale farms. The two identically instrumented stations provide continuous measurements of evapotranspiration and CO_2 fluxes, and are equipped with additional instrumentation to monitor micrometeorological variables, vegetative status, and soil conditions. In this presentation, we present measured crop water footprints (total crop water consumption as blue and green water), crop water use efficiencies (water used per unit of agricultural production), and crop physiological status (PRI and NDVI index) under drought conditions (2015) and under average rainfall conditions (2016). We will use these data to evaluate the resilience to drought of these crops, which is crucial for the economy of the region. We will also evaluate the impact of agricultural water use for the local water balance and implications of irrigation practices for catchment-scale hydrological processes. Finally, we will explore the feasibility and potential of using CROPWAT 8.0 modelling software to generate estimates of crops water footprint for regional water planning decision-making and farm irrigation planning. The implications of these findings will be discussed in the context of the regional socio-hydrological system that is facing a likely increase in water scarcity due to climate change and demand intensification.