ASSESSMENT OF IRRIGATION EFFICIENCIES OF AN AGRICULTURAL VALLEY WITH AN OVEREXPLOITED AQUIFER USING REMOTE SENSING AND METEOROLOGICAL DATA

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Northern Mexico is characterized by a semiarid climate, where limited precipitation restricts crop production. Therefore, crops need efficient irrigation techniques. Agriculture is a high water consumption activity that in order to become more sustainable, demands knowledge of irrigation efficiencies at the regional scale. Furthermore, northwestern Mexico has been shown to experience widespread groundwater stress levels. (Gleeson et al., 2012; CONAGUA 2014) with some of the more overexploited aquifers where groundwater extraction far exceeds recharge (CONAGUA 2015).

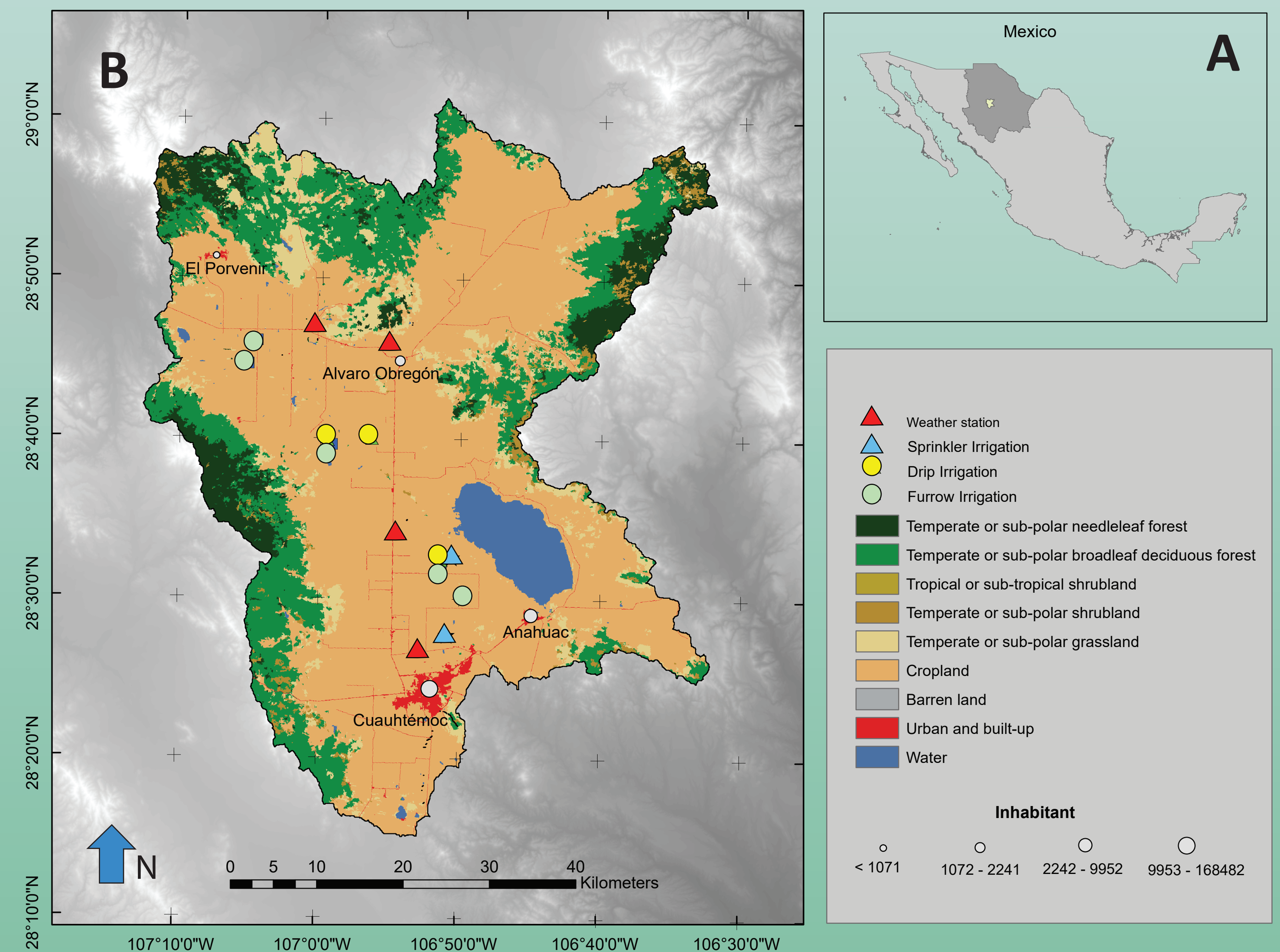

Figure 1. A) Macro-localization of the study area; B) Bustillos Lake basin, showing the experimental locations where different irrigation systems were measured, the land cover and the population centers.

The study site is located in an agricultural valley in northern Mexico in an area of corn fields with approximately 47,000 ha under irrigation that lies on top of an overexploited aquifer with a sustained declining water table (averaging 2m/year of drawdown) and sustained increases in average water well depths (Figure 2).

Using Landsat 8 imagery from the METRIC-EEFLUX site for the period between April 30 (emergence season) to Nov 24 (harvest season) during the 2017 agricultural cycle, the Crop coefficient (Kc), the reference Evapotranspiration (ET0) and the actual Evapotranspiration (Eta) were obtained. Daily values of ETa in between the 16 day Landsat images interval, were obtained using Kc derived from an empirical relation with a vegetation index (NDVI) and ET0 calculated using Penmann-Montheit fed with meteorological data from weather stations in the vicinity of the area.

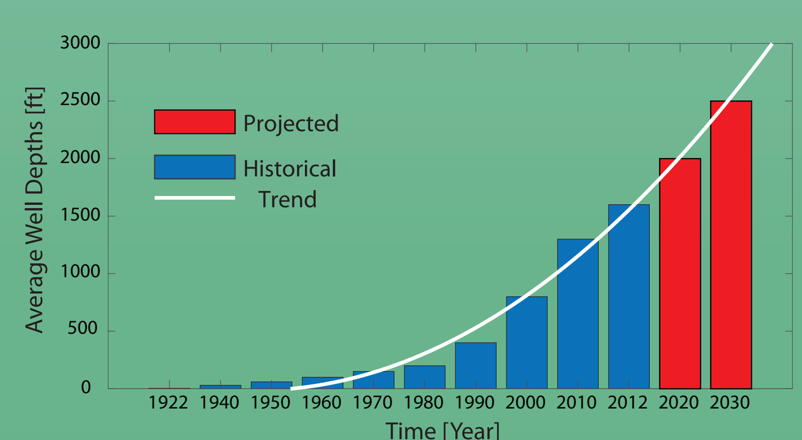

Figure 2. Historical and projected average water well depths in the Bustillos Lake basin.

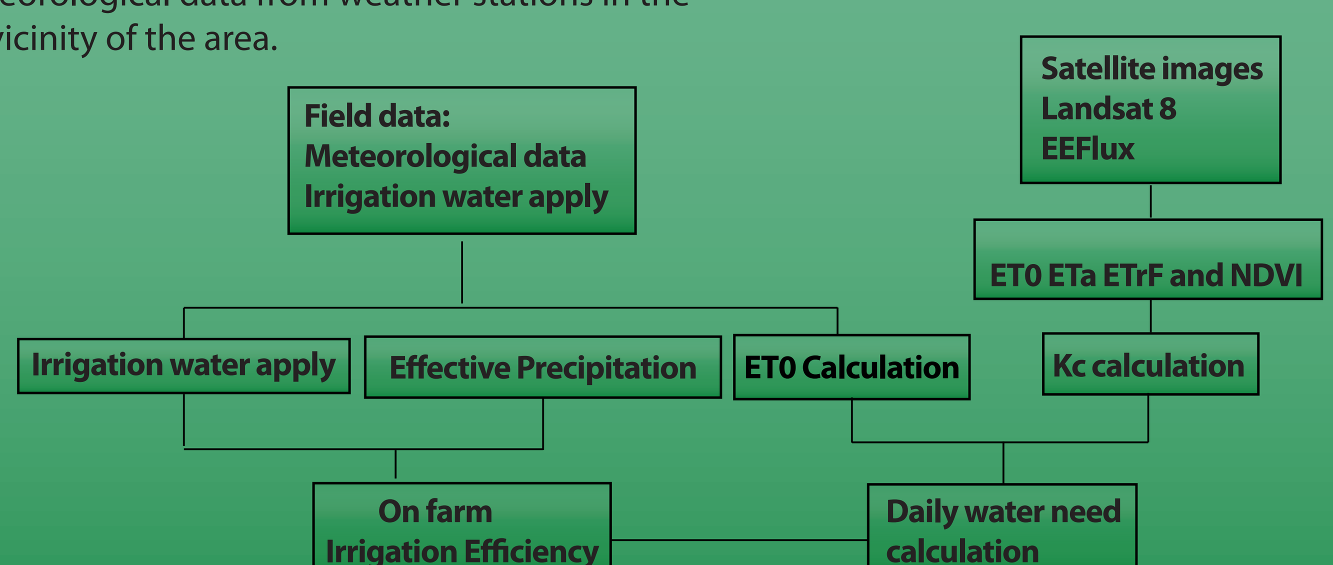

Figure 3. Diagram of flux to assessmet the irrigation effciency using remote sensing and meteorological data

Figure 4. Irrigation systems in the study area. A) Corresponds to furrow irrigation; B) show the subsurface drip, and C) shows one of the sprinkler irrigation systems

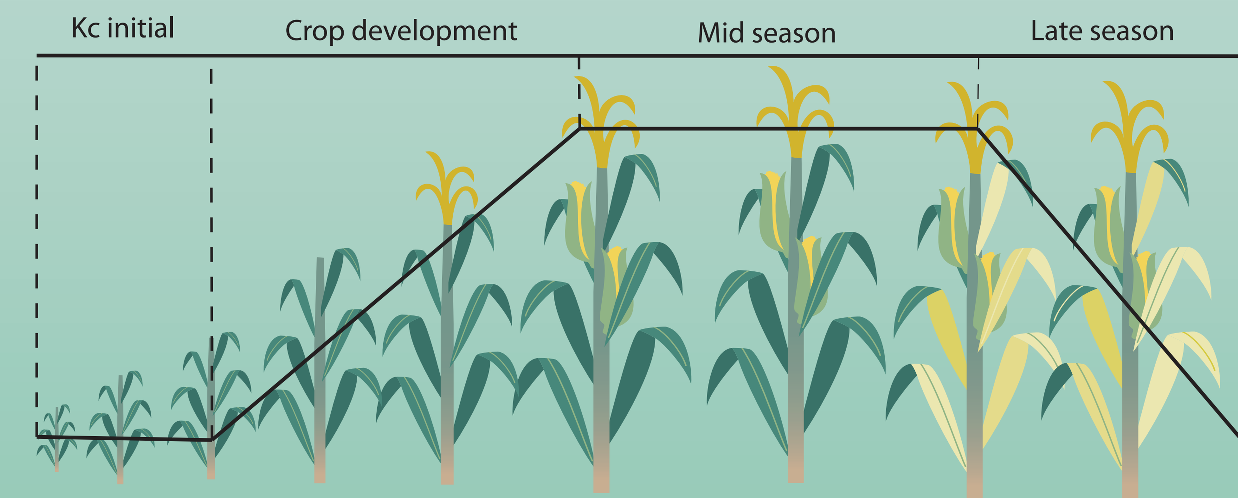

Figure 5. Hypothetic diagram of the crop coefficiente (Kc) to different growing stages

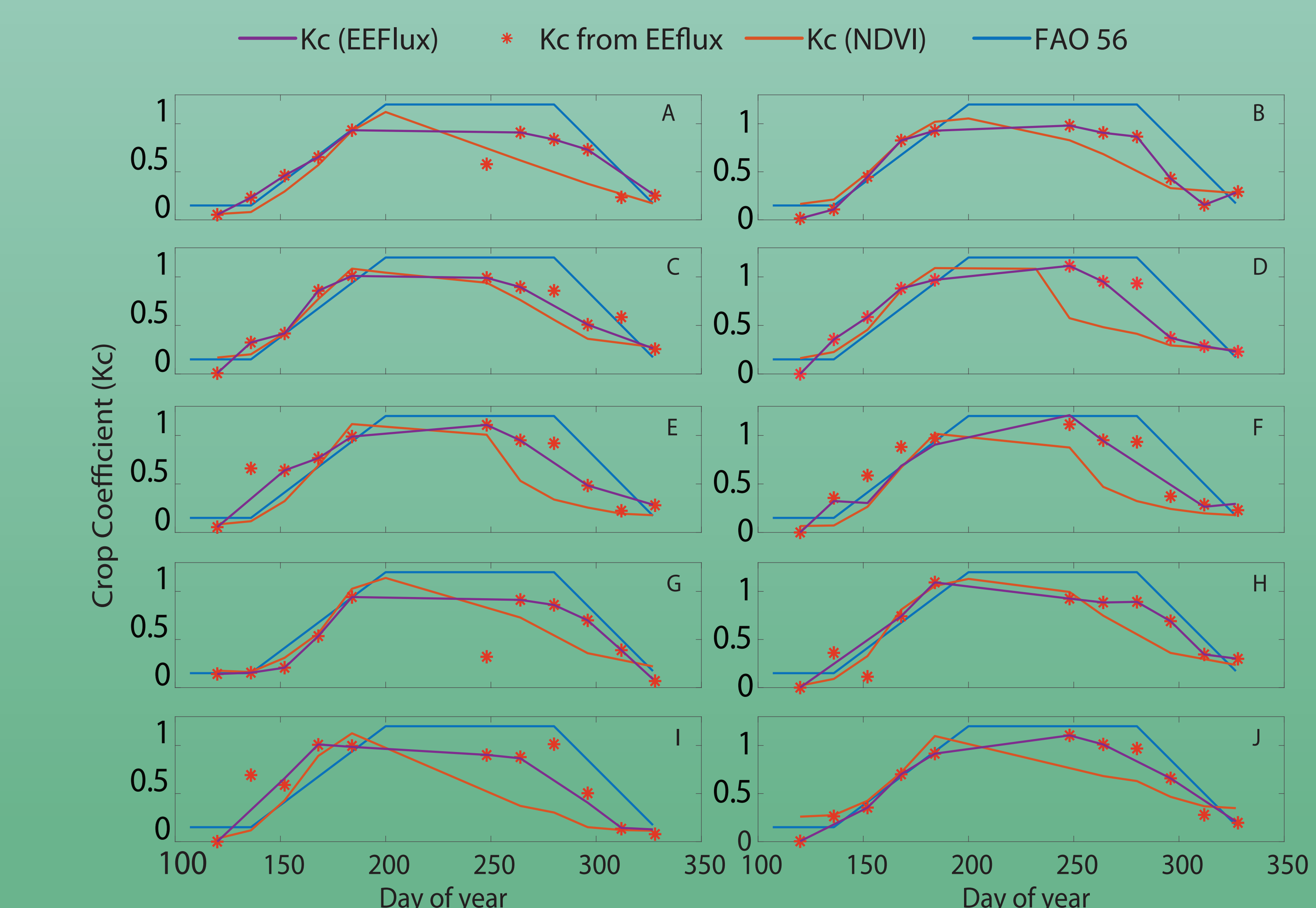

Figure 6. Comparison between the hipotetic curve from FAO 56 and computing of the curve with NDVI data and make curve fron Kc from Landsat

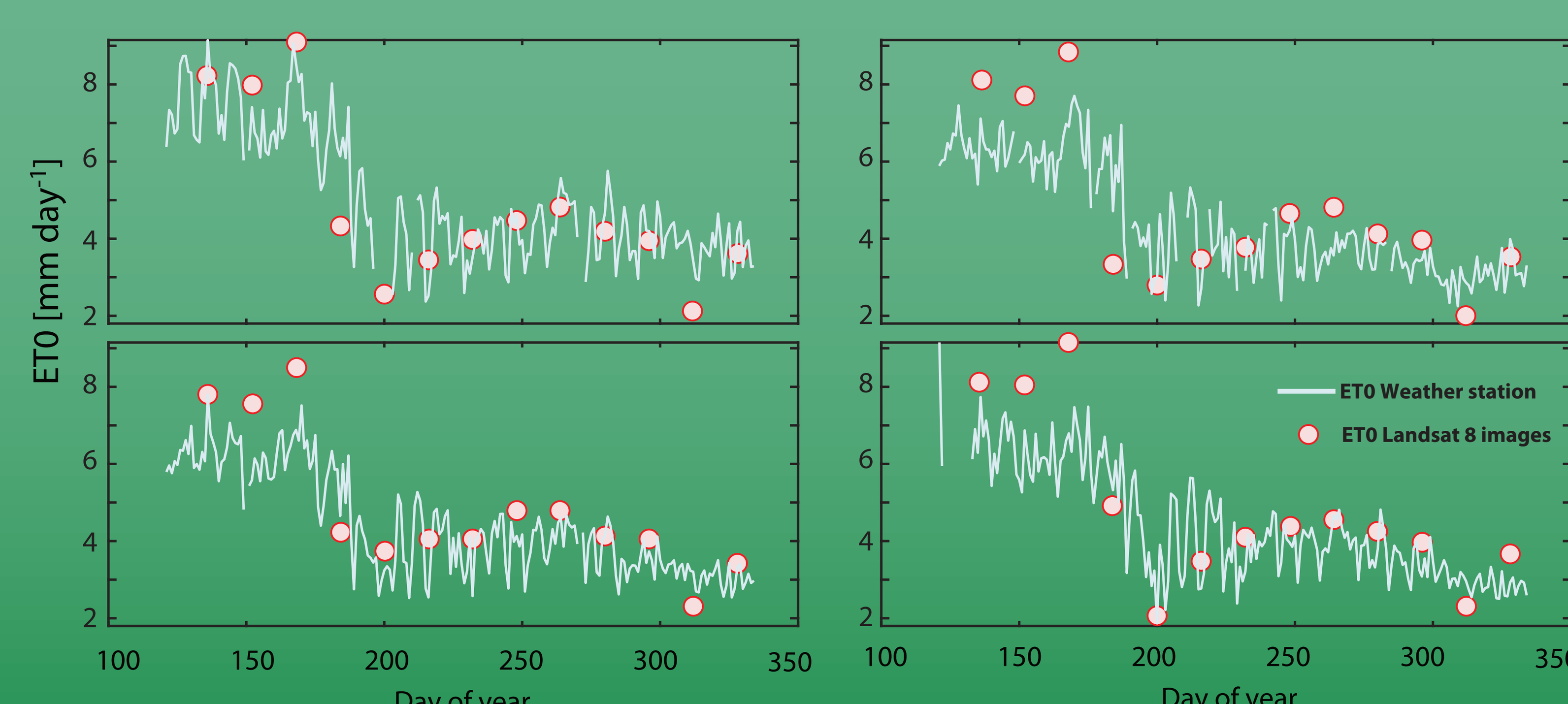

Figure 7. Behavior of the ET0 from weather stations compare to ET0 come from Landsat 8 images

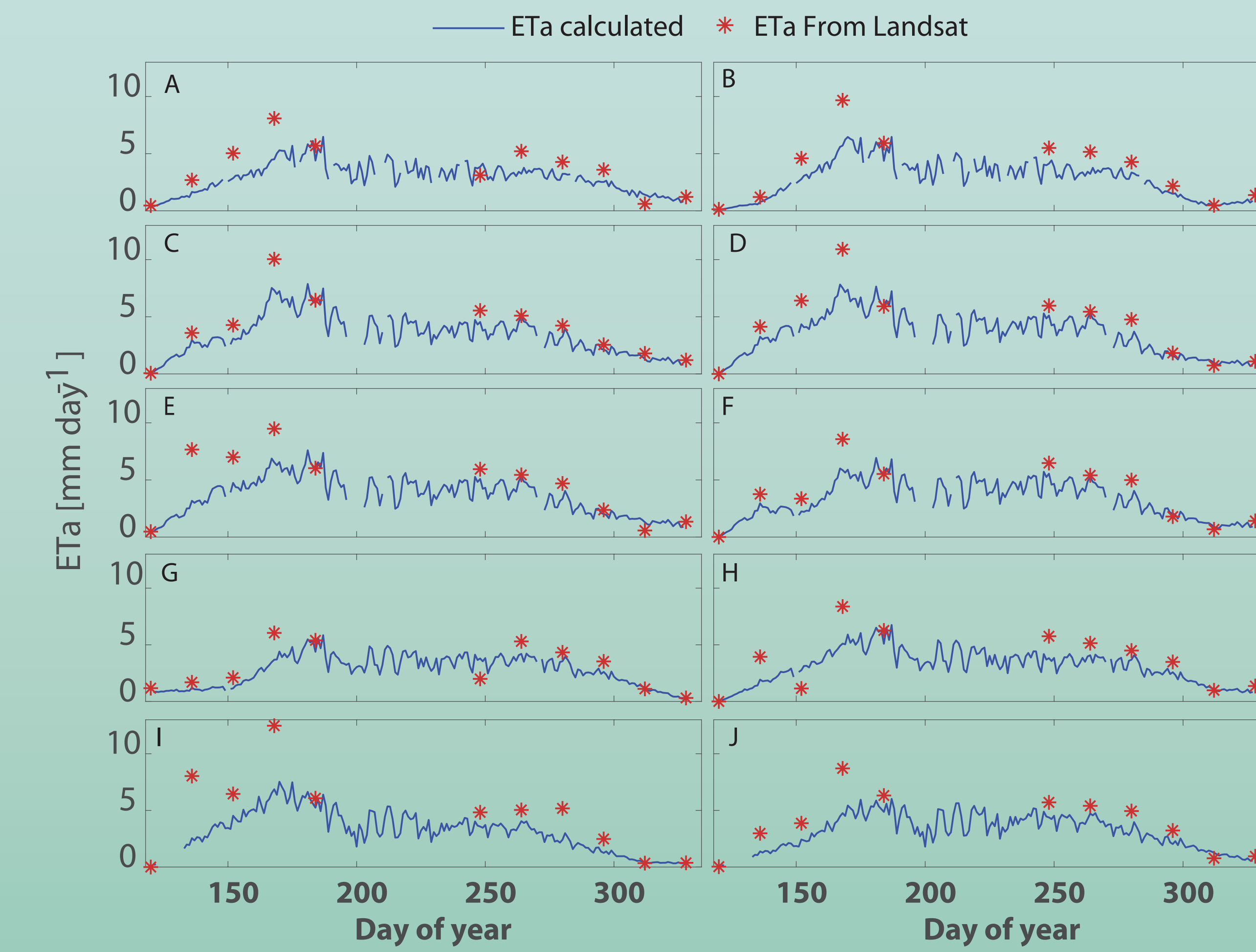

Figure 8. Comparison between the calculated ETa and ETa come from Landsat 8

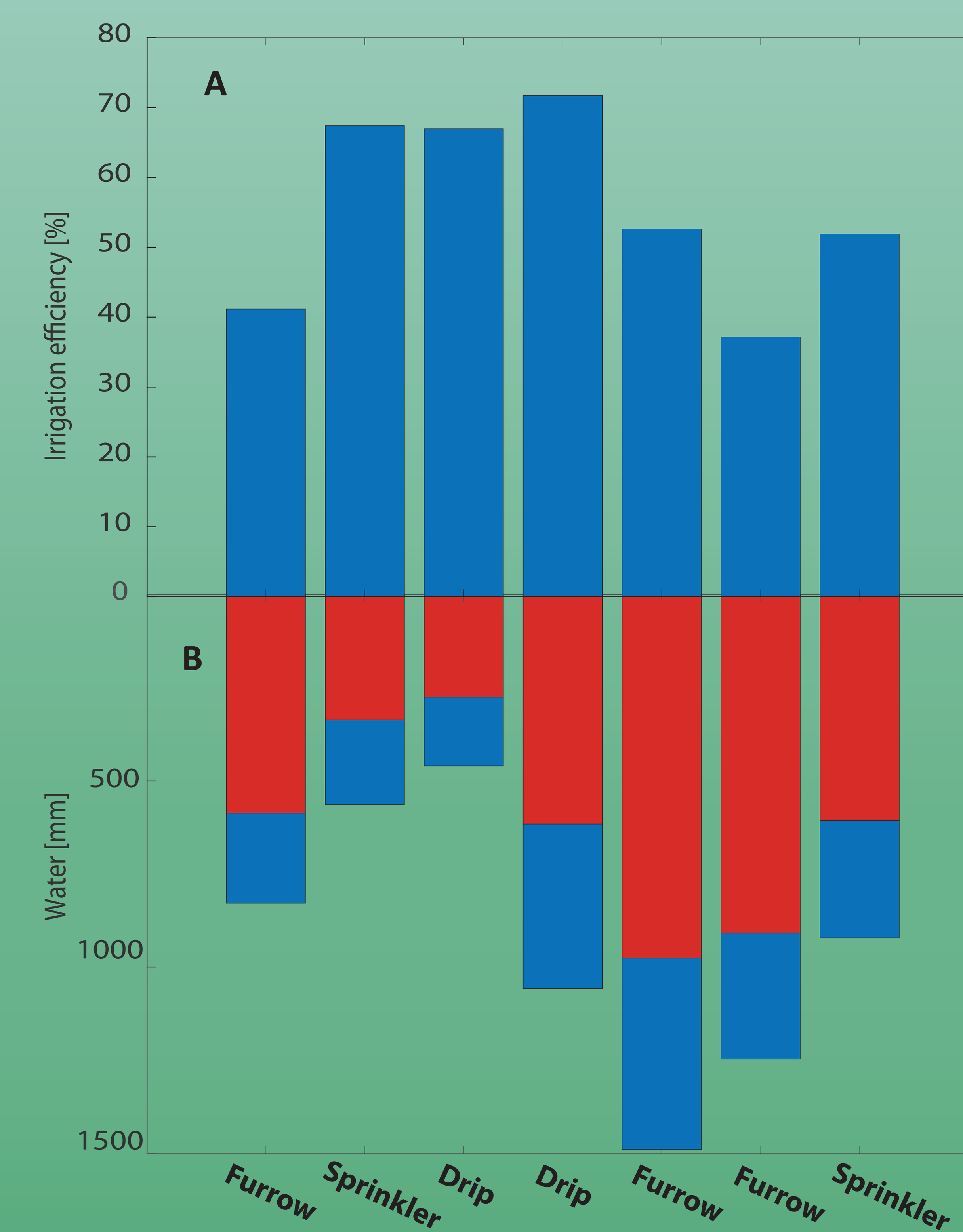

Figure 9. A) Irrigation efficiency in different systems; B) water requirement by plant in blue, and water applied by farmer in red.

Acknowledgments

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