*From the Abstract*

The expansion of perennials to nearly half the irrigated landscape in California has shifted the cropping from mostly annuals, which can be fallowed during drought, to one of more and more orchards and vineyards and their hardened irrigation demand, which especially stresses groundwater resources during droughts.

*From the Intro*

Soils are able to temporarily store a volume of water equal to their total pore space, commonly 40-60% of the soil’s total volume. But since the larger pores rapidly drain due to gravity, only some part of the total soil porosity is effectively storing water between storms. The soil’s field capacity is the water content at which the larger soil pores have been drained by gravity but is available to uptake by roots or evaporation at the surface. At the other end of the spectrum, the water held in the smallest soil pores is not plant available, because the suction required to extract water from these pores is more than what crop roots can typically exert. This volume of unavailable soil held water is called the wilting point.The difference between field capacity and wilting pointis called the plant available water.

*From the Methods*

313,573 polygons were successfully modeled. Of these polygons, there were 106,998 unique combinations of soil major component, climate, and crop.

This simplifying model assumption likely has the effect of producing conservative estimates of plant available water for most soils, since any water content between field capacity and saturation becomes instantaneously unavailable as a loss to deep percolation.

This function submits a SQL query to the Soil Data Access website and returns the query as a dataframe for each level of the database

Thus, assuming still mostly ‘green’, transpiring fields, this results in occasional to frequent winter crop water stress, depending on location.

Grape’s footmultiple ecoregions: (a) the Cascades; (b) Central California Foothills and Coastal Mountains ecoregion units; (c) Coast Range; (d) Eastern Cascades Slopes and Foothills; (e) Klamath Mountains/California High North Coast Range; (6) Sierra Nevada; (7) Southern California Mountains; and (8) Southern California/Northern Baja Coast

and the (3) Intermountain region, which included multiple ecoregions: (a) the Cascades; (b) Eastern Cascades Slopes and Foothills; (c) Klamath Mountains/California High North Coast Range; (d) Sierra Nevada; (e) Northern Basin and Range; and (f) Central Basin and Range.

Of these, there were 94,868 unique combinations of soil map unit, crop, and climate, which expanded to 106,998 combinations at the major soil component level (Figure 3).

*From Results*

For annual accuracy in quantifying green water, all soil storage supplied ET must come from that preceding winter’s or in-season rainfall. In 3.5% of simulations in all scenario years, the irrigation water applied is greater than the growing season ET for a given year. This means that the green water resource is calculated as negative for that year. Annual accuracy is diminished by interannual ΔS.

This begs the question as to whether cover crops could make use of this evaporated water and improve soil surface conditions without negatively affecting green water availability to perennial crops.

This provides a useful target for root stock breeders looking to increase green water utilization.

While decreased deep percolation, especially early in the growing season when fertilizer applications are common, would be expected to reduce non-point source pollution, lack of natural deep percolation could eventually lead to problematic soil salinity unless leaching by irrigation water is practiced. This is especially true where the irrigation water is saline. In short, management for green water can be at odds with management for soil salinity, especially in the drier climates such as the Tulare (X% of landscape but Y% of green water resource).

(from Table 3 description): …in terms of 13 year cumulative green water volume (2005-2017), the percentage of crop water demand met by green water, and the average annual availability as a depth over a region.

*From Discussion*

On average, 1.9 km3 green water yr-1 is available for 1.46 million hectares of perennial crops in the moderate scenario with the 80th percentile on the landscape at 195 mm green water availability yr-1. Even in the shallowest soil reservoir scenario considered, 1.3 km3 green water yr-1 is still available on average.

Besides their wetter climate, the main reason that the highest proportion of growing season ET is met by green water in wine grapes is due to assumed intentional crop water stress to increase crop quality at the expense of some yield.

Third, there is a “fudge factor” built into irrigation management with the distribution uniformity coefficient (0 < DU < 1.), which quantifies the uniformity in irrigation management and, for example, a DU of 0.7 means that in order to get 1” to the driest quarter of the land covered by the irrigation system, then 1 / 0.7 = 1.43” need to be applied through the system. This means substantial leaching for three-quarters of the field, on average.

..along with an improved network of precipitation gauges and some required input from farmers