Agricultural Irrigation Induced Evaporative Water Loss in a Temperate Climate Study Site: a Stable Isotope Approach

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Abstract

Worldwide, significant agricultural activities take place in temperate climate zones In regions where groundwater is used for irrigation, water losses take place due to evaporation. Previous studies demonstrated the utility of stable oxygen and hydrogen isotopes in estimating evaporative water loss experienced during return flow back to an aquifer. Unlike arid regions where the other studies took place, this study examined the region around Kalamazoo, Michigan, the United States, which experiences a more temperate climate.. Irrigation in the Kalamazoo area primarily uses center-pivot systems supplied by wells, unlike flood irrigation in previous study areas. Water samples were taken periodically from wells close to center-pivot irrigation systems. Water losses due to evaporation were estimated using stable oxygen and hydrogen isotopes, which are effective tracers for water. This approach was possible in the Kalamazoo area since the distribution of oxygen and hydrogen isotopes in local precipitation, which is the source of groundwater recharge, is known based on years of measurements. The link between agriculture and meteorology is thus clear. Isotope analyses during the irrigation season suggest water loss due to evaporation is in the range of 9.1% and 14.3%. This is less than what was estimated by previous studies in arid climate zones. Evaporative water loss was greater at wells near cornfields than at wells that supplied other crop types. There was little expected correlation between the groundwater's isotope ratio values and the change in chloride concentration. This is likely due to an external input of chloride from road salt used in winter months.

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Figure 1

Figure 2

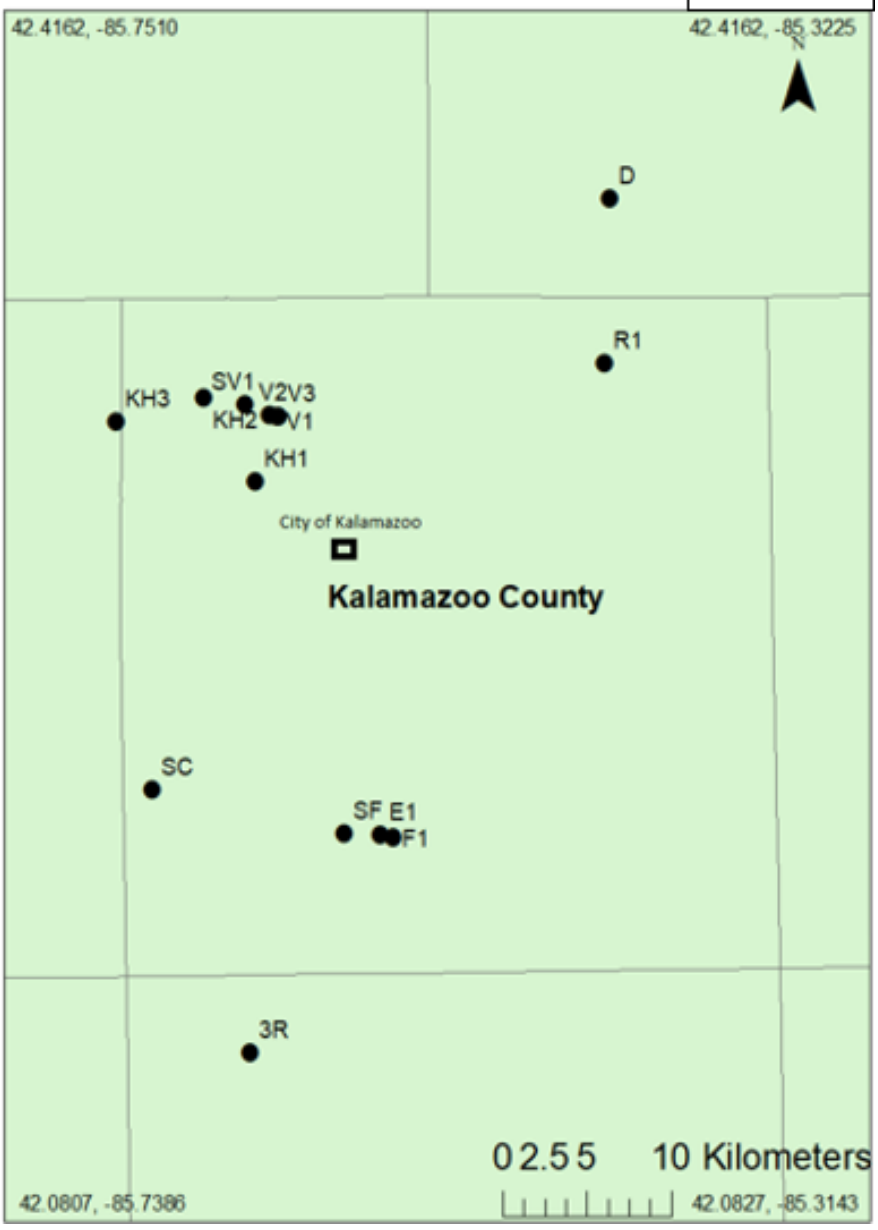

Figure 3

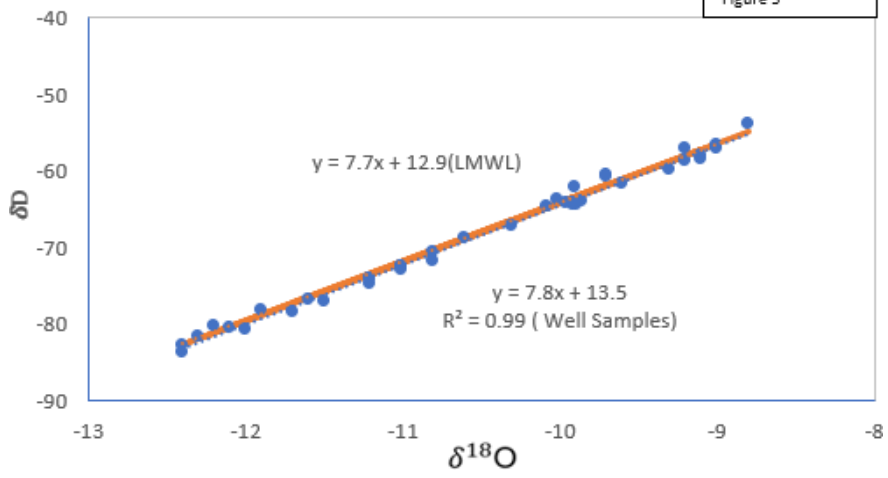

Figure 4