Analyzing the Effects of High Water Tables on Evapotranspiration From Uncultivated Land in Colorado's Lower Arkansas River Valley

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Abstract. The Lower Arkansas River Valley in Southeastern Colorado is an important agricultural region in Colorado. More than a century of intensive irrigation has raised the water table of the region causing several agroecological problems including water logging, soil salinization, and leaching of selenium into waterways. These issues could be addressed in part through improving irrigation practices, lining irrigation canals, and other strategies that lower the water table. A lower water table may increase crop productivity in some areas, and it is expected to reduce the ground water gradient that drives return flows, along with dissolved and mobilized salt and selenium loads, back to the river. A lower water table is also likely to reduce non-beneficial evapotranspiration (ET) from naturally-vegetated, fallow, and retired fields. Various studies in the literature suggest that a lower water table tends to produce lower ET rates, but a quantitative analysis is lacking for conditions that are representative of the uncultivated lands in the Arkansas River Valley. The primary goal of this project is to determine the relationship between ET and ground water depth as well as other site properties for uncultivated regions in the Arkansas Valley. Two field sites were selected for detailed study. One site is a retired farm field near the Arkansas River that has a shallow water table due to nearby irrigation. The other site is a naturally-vegetated area at the edge of the alluvial valley that has a shallow water table due to its proximity to an irrigation canal. Both sites are dominated by natural grasses and forbs. Tamarisk and trees were avoided for this study. ET was calculated at a 30 m resolution from Landsat satellite imagery using the Remote Sensing of Evapotranspiration (ReSET) energy balance method. This method also produces estimates of the Normalized Difference Vegetation Ratio (NDVI), which is a measure of vegetation greenness, at the same resolution. Water table depths were measured with a total of 58 monitoring wells divided between the two sites. Other variables were measured in the field including gravimetric soil moisture at 1 ft, 2 ft, 3 ft, and 4 ft depths, ground water salinity, and soil salinity. Water balance analyses indicate that groundwater upflux contributes between 65% and 70% of the total ET during the growing season at these sites. Clear relationships between ET and water table depth at one of the two sites also suggest that ET rates drop with lower water tables. Further study is needed to put firm values on the water savings that might be achievable for the region if the water table was lowered.