

Improving evapotranspiration estimates in the Lower Arkansas River Valley using ArcGIS Spatial Analyst

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Abstract. Regional-scale ground water and mass transport models have been developed and calibrated for the Lower Arkansas River Valley to assist in determining the areal extent and severity of waterlogging and salinization, as well as in exploring the potential benefits from improved water management and infrastructure strategies. Together, the modeled regions constitute an area of 105,600 ha (261,000 acres), or roughly half of the irrigated lands between Pueblo, Colorado and the Colorado-Kansas border. Due to the large areal footprint of the modeled regions, evapotranspiration (ET) is a significant component of the governing mass-balance equations. ET is among the many inputs required by MODFLOW, the selected ground water flow modeling platform, and is one of the more difficult parameters to accurately predict.

A methodology is described for calculating spatially-distributed estimates of reference evapotranspiration (ET_o) using meteorological data from all weather stations in the river valley, including from the National Weather Service and Colorado Climate Center. These data were used to generate a 1-km resolution raster by spatial interpolation for each climatic parameter required by the Food and Agriculture Organization (FAO) Penman-Monteith (P-M) equation for calculating ET_o. Once rasters for each climatic variable were generated, an FAO P-M ET_o raster was calculated using ArcGIS Spatial Analyst™. Spatial Analyst™ was then used to determine ET_o for each field polygon within the study region. Next, ET_o was paired with corresponding crop type information (derived from algorithms performed on satellite imagery) for each field polygon in order to calculate actual evapotranspiration (ET_c). The methodology is being evaluated by comparison to ET_c values computed from energy balance analysis of satellite images. Other factors that influence ET in the Arkansas River Valley, such as soil water salinity and soil water content also are being considered in on-going research.

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