Assessment and management of saline irrigation-return flows in areas affected by tile drain networks

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Abstract. The Lower Arkansas River Valley (LARV) is a productive agricultural region in southeastern Colorado that has experienced a decline in crop yield due to irrigation-induced salinization and waterlogging caused by poor drainage, excessive irrigation and canal seepage. High water tables produce large hydraulic gradients which expedite the transport of dissolved salts and minerals (such as selenium (Se)) via baseflow to tributaries of the Arkansas River compounding the issues downstream. The acceleration of Se transport to waterbodies is of particular concern because the presence of Se can change from causing no harm to reproductive failure in fish and waterfowl with an increase of only a few μg/L. The goal of the study is to analyze the effect of a subsurface drainage network on the storage, movement, and fate of salts and Se and the impact it has on return flows and solute loading to the Arkansas River and to construct a solute fate and transport groundwater / subsurface drainage model using MODFLOW and the conduit flow processes (CFP) package. By coupling data gathered from measuring and estimating the amount of water entering and leaving the system via rain, irrigation, subsurface drainage and tailwater flow, with water quality data from shallow and deep monitoring wells, applied water, subsurface drainage and tailwater, we will estimate a mass-balance of salts and Se in the system. This data will provide insight to the effects of subsurface drainage on the storage, movement and fate of salts and Se within the root zone as well as near the shale bedrock. The results of this study will be used to assess management strategies to avoid yield loss and limit salt and Se loading to streams.