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Using landscape-scale evapotranspiration estimates to explain groundwater dynamics at Uranium Mill Tailings Radiation Control Act (UMTRCA) sites in the arid southwestern United States

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Because groundwater recharge is generally low, arid and semiarid environments have been considered well suited for long-term isolation of hazardous materials (e.g., radioactive waste). In these dry regions, water lost (transpired) by plants and evaporation from the soil surface (collectively termed evapotranspiration; ET) is usually the primary discharge term in the water balance. Therefore, vegetation can potentially be used as a tool to hydraulically control and naturally attenuate groundwater contamination plumes at waste disposal sites. We used remote sensing-based algorithms to estimate landscape-scale ET of the 3,513 hectares Groundwater Modeling Domain (GMD) at the Tuba City, AZ UMTRCA site from 2000-2012. Assuming the difference between precipitation (PPT) and ET would result in a net recharge (PPT > ET) or discharge of shallow groundwater (PPT < ET), our ET model predicted that 0.17 million cubic meters per year of groundwater contributed to surface flows (PPT not lost as ET) in a down gradient stream (Moenkopi Wash), which was supported by streamflow measurements at the upstream and downstream boundaries of the GMD. Our results demonstrate that (1) land use practices that enhance ET can be part of an overall remediation strategy and (2) locally calibrated remote sensing ET algorithms can accurately estimate ET at such sites, which can be used to inform local groundwater modeling efforts. In addition to our work in Tuba City, we are using other cutting-edge remote sensing technologies to characterize vegetation and explain groundwater dynamics at other UMTRCA sites.