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TI: Comparison of Different Approaches for Estimating Recharge in the High Plains Aquifer, Texas
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AB: Recharge is a critical issue for evaluation of groundwater resources and for assessment of groundwater vulnerability to contamination. We compared a variety of approaches to estimate recharge in the High Plains Aquifer in Texas, including soil physics, environmental tracers, and numerical modeling. The different approaches complement each other and provide information over varying space and time scales. Environmental tracers such as tritium and chloride in groundwater provide spatially and temporally integrated estimates of groundwater recharge. Previous estimates of recharge based on groundwater 3H concentrations in the southeastern part of the High Plains aquifer resulted in recharge estimates of 13 to 80 mm/yr. The average groundwater Cl concentration in non-irrigated regions was 19 mg/L that resulted in an average recharge rate of 7 mm/yr based on annual precipitation of 452 mm/yr and Cl input of 0.3 mg/L (about 3 times Cl concentration in precipitation). The average groundwater Cl concentration in irrigated regions (15.5 mg/L) was lower than that in non-irrigated regions. The Cl data are insufficient to constrain recharge rates beneath irrigated regions. Soil physics and environmental tracer data in the unsaturated zone provide more detailed information on spatial variability in recharge. Deep penetration of bomb pulse 3H, Cl flushing, low calcium carbonate, and high water potentials indicate that playas focus recharge. Water fluxes estimated from 3H profiles in playas were up to 120 mm/yr. In contrast, Cl bulges, calcic soils, low water potentials, and upward water potential gradients indicate negligible recharge in non-irrigated, interplaya settings. The bulge shaped Cl profiles in interplaya settings indicate that water fluxes were higher during the Pleistocene (up to 5 mm/yr) and that Cl has been accumulating during the Holocene. Numerical simulations of nonisothermal liquid and vapor flow using the HYDRUS-1D code indicate that the water potential and Cl profiles can be reproduced by downward flux during the Pleistocene followed by an order of magnitude reduction in downward flux, zero flux, or upward flux during the Holocene. Information on recharge from this study is extremely valuable in predicting groundwater resources during the next 50 yr and for delineating aquifer regions that are particularly susceptible to contamination.